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Finance and Trade in Africa

Macroeconomic Response in the World Economy Context

Alemayehu Geda

Finance and Trade in Africa

International Finance and Development Series

Published in association with the Institute of Social Studies

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ISS
Institute of Social Studies

First published 2002 by
PALGRAVE MACMILLAN
Houndmills, Basingstoke, Hampshire RG21 6XS and
175 Fifth Avenue, New York, N. Y. 10010
Companies and representatives throughout the world

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ISBN 0–333–97722–X

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources.

A catalogue record for this book is available from the British Library.

Library of Congress Cataloging–in–Publication Data
Alemayehu Geda Fole.
Finance and trade in Africa: macroeconomic response in the world economy context / Alemayehu Geda.
p. cm. — (International finance and development series)
Includes bibliographical references and index.
ISBN 0–333–97722–X (cloth)
1. Africa—Economic conditions. 2. International finance–Econometric models. 3. International trade—Econometric models. 4. Economic policy—Econometric models—Evaluation. I. Title. II. Series.

HC800 .A694 2002
339'.096—dc21

2001055685

10 9 8 7 6 5 4 3 2 1
11 10 09 08 07 06 05 04 03 02

Printed and bound in Great Britain by
Antony Rowe Ltd, Chippenham and Eastbourne

for Selamawit Asfaw

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List of Acronyms and Abbreviations

2SLS	Two Stage Least Square
3SLSI	Three Stage Least Square Iterative
3SLS	Three Stage Least Square
A	Africa
AAF-SAP	African Alternative Framework to Structural Adjustment Programs
AAU	Addis Ababa University
ACP	European Union Designated 'Africa Carribean and Pacific' States
ADI	World Bank, African Development Indicators
AERC	African Economic Research Consortium
AFRIMOD	Africa within a North-South Framework: A Neostructuralist Global Econometric Model
BANK-GEM	World Bank's Global Economic model
CAR	The Central African Republic
CEMA	Council for Mutual Economic Assistance
CES	Constant Elasticity of Substitution
CGE	Computable General Equilibrium Model
CPI	Consumer Price Index
CSAE	Centre for the Study of African Economies, University of Oxford
DAC	Development Assistance Committee of the OECD
DRLC	Debt Relief Laffer Curve
EC	European Community
ECA	Economic Commission for Africa
ECLAC	Economic Commission for Latin American and the Caribbean
ECM	Error Correction Model
EDT	Total External Debt Stock
EEC	European Economic Community
ESA	East and Southern Africa
ESAF	Enhanced Structural Adjustment Facility

ESPLA	Inter-American Development Bank's Economic and Social Progress in Latin America dataset
EU	European Union
EWTM	IMF Research Department's Expanded World Trade Model
FOB	Free on Board
CIF	Cost Insurance Freight
FDI	Foreign Direct Investment
FIML	Full-Information Maximum Likelihood
GDP	Gross Domestic Product
GFS	IMF's Government Financial Statistics
GK	Goldstein and Khan model
GNP	Gross National Product
GS	Henderey's General to Specific methodology
HIPC	Highly Indebted Poor Countries
IDS	Institute for Development Studies, Sussex University
IMF	International Monetary Fund
INTERLINK	OECD Model [International Linkages Model]
ISS	Institute of Social Studies, The Hague
IV	Instrumental Variables
LDC	Least Developed Countries
LIBOR	London Inter Bank Rate
LM	Money Market
LSE	The London School of Economics and Political Science
MNE	Multinational Enterprises
MSG2	McKibbin and Sachs Global Model, version 2
MULTIMOD	Multicountry Econometric Model (of the IMF)
N	North
NA	North Africa
NIESR	National Institute of Economic and Social Research, London
N-S	North/South
OAU	Organization of African Unity
ODA	Overseas Development Aid/Assistance
OECD	Organization for Economic Cooperation and Development
OLI	Ownership-specific Location and Internalisation
OLS	Ordinary Least Squares
OPEC	Organization of Petroleum Exporting Countries
OT	Other South (Excluding Africa)
QEH	Queen Elizabeth House, University of Oxford
RER	Real Exchange Rate
RW	Rest of the World
S	South

SAF	Structural Adjustment Facility
SAM	Social Accounting Matrix
SAP	Structural Adjustment Programs
SDM	System Dynamics Models
SEPM	Spatial Equilibrium and Programming Models
SITC	UN Standard International Trade Classification
SNA	System of National Accounts
SOAS	School of Oriental and African Studies, University of London
SSA	Sub-Saharan Africa
STAC	A Structuralist North-South Trade Model
ToT	External Terms of Trade
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UN-ECA	United Nations Economic Commission for Africa
USSR	Union of Soviet Socialist Republics
WAM	World Accounting Matrices
WCA	West And Central Africa
WWI	First World War
WWII	Second World War

Series Editor's Preface

At the start of a new millennium and after almost half a century of independence, the African economy seems trapped in a low-level disequilibrium. This not only condemns millions of people to a life of poverty but also blocks the process by which human and material capital can be accumulated. Many of Africa's economic problems are to be found within her own state and civil society, but it is too easy – and too convenient for the rest of the world – to attribute all economic problems to 'governance'. The fact is that Africa is an integral part of the world economy, open to financial and trade shocks and without the means to protect itself effectively against these shocks.

There are 53 countries in Africa, which accounts for 12 per cent of the world population. Yet, according to IMF estimates, the region generates only 3.3 per cent of world GDP at 1998 purchasing power parity and 1.8 per cent of world exports of goods and services. By comparison, Italy alone accounts for 3.4 per cent of world output and 5.7 per cent of world trade. This apparent marginalization is, of course, asymmetric. Although the world may not 'need' Africa in an economic sense, what happens in the world economy does have profound effects on Africa through commodity prices, interest rates, foreign investment flows, migrant remittances and aid budgets. African policymakers – and indeed ordinary Africans – are well aware of this asymmetry but seem powerless to affect it, or even to reframe the agenda of international debate.

Indeed, the prevailing orthodoxy in Washington and Brussels tends to be that this is an out-of-date socialist view, based on discredited 'dependency' theories, originating in the independence struggle. The importance of the world economy to Africa is not denied, of course, but national governments are enjoined to adjust to 'economic reality' and 'market discipline' in order to stimulate exports and promote foreign investment. The danger that the efforts of individual countries trying to adjust will lead to a 'race to the bottom' in labour standards, environmental safeguards and tax concessions is ignored; as is the 'fallacy of composition' inherent in the small-country assumption, leading to the overexpansion of commodity supplies and declining prices.

The problem is thus one of economic *perception* as well as one of economic *reality*. What has been missing, perhaps, is a modern view of the world economy from an African standpoint. Alemayehu Geda is perhaps uniquely qualified to undertake this task, since, possibly alone among young African economists, he possesses the technical skills to see beyond the platitudes of the 'North-South' debate. Thus, he examines external economic relations as a variable, rather than as a given. Hence, domestic economic events become endogenous to the model rather than simply at the behest of policy makers. This shows, on the one hand, how limited the options really are for domestic policymakers (especially if they act individually and only for short periods) and, on the one hand, the crucial importance of changing international arrangements – particularly trade and investment rules rather than aid.

In this book, Alemayehu Geda constructs a rigorous model of the world economy. This is based on earlier work by The Hague based 'Finance and Development' research group on global economic accounting and modelling. Some of this work is reported in two previous volumes in this series: Rob Vos' *Debt and Adjustment in the World Economy* (1994) and Joke Luttik's *Accounting for the World Economy* (1998). These set the foundations of how the world economy can be modelled, in a tractable fashion that allows the effect of trade and investment flows upon macroeconomic balances in any one developing region to be identified. In this way, the global framework required to analyse the full effect of aid and other capital flows from 'North' to 'South', as well as the effect of northern macroeconomic policies on the 'South' can be set up in such a way as to be compatible with the variables used in the analysis of structural adjustment.

The book opens with an outline of the historical origins of African debt and external finance problems, arguing that the debt problem results from the structure of its trade, in general, and commodity trade in particular. That the twin effects of low income elasticities and low price elasticities in northern markets have lead to declining terms of trade and high price volatility is generally agreed. The issue, then, seems to be why Africa has not switched to other export products – manufactures, services or processed raw materials – which offer better growth prospects. However, such a switch requires capital (infrastructure and plant) and skills (or 'human capital') which Africa does not currently possess. Debt and aid have both been used in an effort to overcome this constraint – but to no avail. The book then moves on to examine what existing economic theory has to say about this issue, providing a useful survey of theories of international finance, primary commodity trade models, and macroeconomic frameworks coming from an African perspective. In particular, the incisive analysis of macromodels currently being used in Africa is valuable for the insight it provides into import compression, fiscal response and 'Dutch disease' from the point of view of a domestic 'consumer' rather than an international 'producer' of knowledge. Indeed, in this book, Alemayehu Geda provides the basis for a textbook for advanced African students of economics that would take them beyond the one-country technical and dependency political perspectives.

The empirical part of the book explores the patterns of capital flows to the region and their relationship to foreign exchange earnings from commodities, where the declining terms of trade are not balanced by aid or debt flows in the short run, while in the long run these latter lead to unsustainable liability positions. Fiscal response to these external shocks and the consequences for the real exchange rate are then analysed, closing the circle, so to speak, as we return to the chronic trade deficit. On the basis of these data and the theoretical framework discussed above, Alemayehu Geda builds a simulation model of the region, which is a *tour de force,* not only in technical terms, but also as an alternative interpretation of reality. This empirical work demonstrates what should be the conventional wisdom but unfortunately is usually overlooked: that investment is the key to the problem and its possible solution.

What lessons does this book hold for the economic future of Africa? The author is too modest to put forward strong policy recommendations himself, although his main conclusions do have serious policy implications. Firstly, his view that the debt problem in Africa is essentially a commodity problem is amply confirmed. In part, this implies that the HIPC process led by the UK and the World Bank – which, while limited in scope to bilateral debt, and thus hardly reducing the bulk of the debt which is now multilateral, at least indicates a political commitment to act – will have little lasting effect unless export capacity and prices are raised. Secondly, his findings on the mixed effects of aid on growth – both through the 'Dutch disease' effect of overvalued currencies on exports, and through the diversion of public investment away from production – imply that (a) more aid should be channelled towards small export farmers, so as to promote exports and reduce poverty; and (b) that aid should be accompanied by expansionary policies in order to keep the exchange rate competitive.

Thirdly, his conclusion that Africa is highly vulnerable to changes in world interest rates – due not to capital market effects but rather to their impact on commodity prices resulting from the activities of speculators – implies that action can only be taken at an international level as part of the construction of the new 'global financial architecture'. Fourthly, his finding that fiscal deficits are largely exogenously determined by aid flows has important implications in terms of the need for donors to co-ordinate their actions in order to ensure macroeconomic sustainability, rather than leaving this task to the IMF.

These various findings imply that trade relations will need to be improved. The question, then, is how? Improved access to northern markets for processed primary commodities, and, in particular, the replacement of the Lome system with improved access to the European market, would be a first and important step. Commodity price stabilization schemes are currently out of favour, and would require the full co-operation of the major importing transnational corporations in order to work at all. However, this is a problem of price volatility around the trend, as well as the declining trend itself. Reducing this volatility would benefit both importers and exporters and thus should not be impossible to achieve through a properly administered buffer stock system. The market mechanism alone cannot achieve this result, since hedging ranges are so short, so this would have to be a form of public intervention. However, the long-term downward direction of the terms of trade is difficult. It wouldn't matter so much if volume was increasing fast enough to raise the income terms of trade (as is happening with labour-intensive manufactures), but this is not, in fact, the case. The market for tropical commodities is oligopsonistic and riddled with restrictive practices – examples being sugar and cotton in the US, bananas and coffee in Europe as well as minerals. Therefore, a producer's cartel may be the only theoretically viable solution. However, in spite of the recent success of OPEC in driving up oil prices, Africa is unlikely to be able to organize such a cartel, in view of the worldwide competition in those commodities, which it supplies.

In fact, Africa needs to change the mix (or at the very least upgrade the quality) of its primary export products, with the continent unlikely to able to compete within the foreseeable future. This requires investment, and investment not so much by foreign companies (which is in fact already fairly high as a proportion of the total by international standards) but by domestic investors such as firms, flight capital and households. More than savings, risk is the main problem here, since there is plenty of capital held overseas and also plenty of liquidity within the banking system. However, this cannot be undertaken by each African country in isolation, but rather requires an international agreement on investment rules and stabilisation of commodity prices. In other words, the *orderly* insertion of Africa into the global market.

Valpy FitzGerald
Oxford and The Hague

Acknowledgements

This study would not have been possible but for the assistance of a number of people. My heartfelt thanks go to my PhD study advisors Prof. E.V.K. FitzGerald, formerly of the Institute of Social Studies (ISS), The Hague, and now of University of Oxford, and to Prof. Rob Vos at ISS. I have learned a great deal from both. Indeed, without wishing to implicate either men with any responsibility, I have reached a point where their ideas, and those of mine, have become so intermingled that it becomes difficult to say which are theirs, and which mine. In addition to providing academic supervision, both men lent me invaluable support when my continued presence in the Netherlands, both financial and legal, was in jeopardy.

I also owe special thanks to a number of other staff members of the ISS. Firstly, to Prof. Marc Wuyts who not only taught me the importance of careful reading of data, and methodological rigour in general, but also helped me to support myself when I was in need of such help. I have benefited greatly from my frequent visits to his office, particularly when writing Chapter 4. I would also like to thank Dr Howard White who read the entire first draft of this book and gave me many constructive comments. His insight has been of great value. I have also learned a great deal from Dr Karel Jansen, who was particularly supportive at the initial stages of my work. Niek de Jong helped me to familiarise myself with the data of the ISS 'World Accounting Matrix' and provided invaluable assistance with many related issues. I have also benefited from the useful comments of Prof. John Weeks and Prof. Paul Mosley.

Dr Susan Harton (Canada), Dr Abebayehu Tegene (Washington) and the participants of the internet discussion group 'H-Africa' also deserve special thanks. George Mavrota, Alfred Maizels and Ann Roche of the Finance and Trade Policy Research Centre, Queen Elizabeth

House (QEH), University of Oxford, deserve special appreciation. (The Centre, which was effectively my second school, is directed by Prof. FitzGerald.) I have also benefited from discussions with T. Palaskas at QEH and P. Sarkar. Thanks are also due to the staff of the Food Research Unit, University of Oxford, the libraries of The London School of Economics (LSE), Institute for Development Studies (IDS), Sussex, and School of Oriental and African Studies (SOAS), as well as to D. Evans at IDS. Ato Desalegne Rahamato and Dr Abdulahamid Bedri at The Institute of Development Research, Addis Ababa University (AAU), together with my friend Kasahun Berhanu at PSIR, AAU, facilitated my fieldwork stay in Addis. My undergraduate instructors, Dr Taye Mengiste and the late Ato Mekonnen Tadesse of The Department of Economics, AAU, helped me in many ways. I would also like to thank Dr Befekadu, the late Dr Eshetu and Dr Dejene of The Department of Economics at AAU for their encouragement. Prof. O. Teriba and Dr C.T. Mwalwanda, both at the Economic Commission for Africa (ECA), the Library of ECA, Dr Henock Kifle and the Research Department of The African Development Bank, and Uri Dadush, T.G. Srivasan and M. Brahmbhtt at The International Economic Analysis and Prospects Division of the World Bank have all been helpful during the course of my study. My stay in Washington was made comfortable thanks to Rob and family, as well as Gigi, Lencha and their family. Thanks are also due to my colleague, Elias Kedir, for his help in updating part of the data upon which this study is based.

Many thanks to my colleagues at ISS and to Harm Zebregs at Erasmus University, Rotterdam. My dear friends Alex, Ashesh, Mona, Daniel, Kalpana, Karen, Maha and Phil deserve special thanks. Without the values we shared, life away from home would have been much more difficult. From them I learned to stand for the under-class. Alex, with whom I shared a room, and discussed economics, for over half a decade, deserves special mention. I would also like to thank my friend Wangu, who read the first chapter and gave me valuable comments, as well as my Ethiopian friends and colleagues Daniel H., Yeshitela G.M., Awed J., Menbere T., Meron B., Hayat A., Alemayehu S. and Getachewu Y. who lent me encouragement of various kinds. My lifelong friends Thomas, Daniel and Endrias deserve special mention. I have been cherished to enjoy their unreserved love and care since our high school days at Gelawdious, nearly a decade and a half ago.

I would also like to thank the staff of various ISS departments for their help. In the Student Office, Ank van de Berg, Miss Nijhof and Marien, Jeff, Ton and Henry in the Computer Department, Dita Walenkamp and Els van der Weele in the PhD Secretariat, Joy Misa, Paula Bownas and Gary Debus in the Publications Department, Martin Blok in the Welfare Office, John and Martin in the financial office, and A. Voorvelt at ECD all deserve special thanks. My heartfelt thanks go to Mike Warner, who did an excellent job of editing this book. I would also like to extend my gratitude to the Netherlands Ministry of Development and Co-operation and the African Economic Research Consortium (AERC) for financing this study, through their generous grant. Special thanks are also due to J.C. Fine, Prof. W. Lyakurwa and Prof. B. Ndulu of AERC. (However, views expressed in the book are solely my own and do not reflect the views of these institutions.)

During my stay in the Netherlands, I was fortunate enough to become friends with Dr Gebru Mersha. He was a teacher, a father and a friend. I would also like to thank Abera A., Argawi B., Melse W.A., Emmanuel T. and Eskedar in The Hague and Nebiat in Arnhem, all of whom helped me in various ways. My family, W/o Bruke, Ato Ababu and the entire extended family have all been very supportive. And, last but surely not least, I owe a great debt to Selam, who has been a source of inspiration throughout. Her useful comments, love and care have been instrumental in bringing this work to a successful conclusion.

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Addis Ababa

1 Introduction

1.1 Introduction and Overview

Notwithstanding the recent optimism about African economies, the performance of these economies since the time of political 'independence' can only be described as dismal. There has been a secular deterioration in their terms of trade (particularly from the mid-1970s); the level of external debt has grown enormously, leading to near insolvency; dependency on foreign aid has grown at an alarming rate (and this has been exacerbated by stagnation in exports); and, finally, levels of investment have been extremely low. Partly as a result of the latter, physical and social infrastructures have deteriorated rapidly. Political instability, frequent wars, and natural disasters have further aggravated this situation. The major question to be asked then is 'why?'

In this book an attempt to address only one part of this question – the impact of the external sector – will be made. Specifically I will focus on understanding the major causes of Africa's external finance and debt problem. It will be argued that Africa's external finance problem is a consequence of the structure of its trade in the world economy (and, in particular, its position as a commodity producer). It will also be argued, that this is compounded by the adverse effect of the macroeconomic policies adopted by 'Northern' (industrialized/ developed) countries. The purpose of this book, therefore, is to underline the existence of an economic structure, primarily built in the colonial era, which continues to shape the external economic conditions of the African continent today. Thus, it will be argued that any analysis of the external finance problem of Africa, as well as policy proposals based on such an analysis, will be incomplete if this fails to take account of such issues. The book addresses these issues using historical information, and employing both partial and general equilibrium analyses. The following are some of the major findings of the study.

First, with regard to capital flows to Africa, these are found to depend on the relative (to other 'South') position of Africa, in terms of the economic, political and strategic self-interest of donors. Humanitarian considerations are not found to explain aid flows.

Second, with regard to trade, the study shows that there is a clear difference between UNCTAD's world commodity prices and the regional export prices constructed in the context of this study. Hence, previous studies, using the former set of prices, could have biased elasticities. In order to examine determinants of exports of primary commodities, three competing models of export supply are applied to three regions of Africa for four commodity categories. Although the result is mixed, the model based on a real exchange rate is found to be comparatively the best one. This model underscores the importance of both relative prices and capital formation indicators. However, relative prices are found to affect capacity utilization but not capacity creation.

Third, two macroeconomic effects of external finance are examined, namely, fiscal response and 'Dutch disease' effects. With respect to fiscal response, the result of the empirical analysis is mixed. However, the following major points may be stated. Firstly, the impact of capital inflows on taxes varies, depending on the type of capital inflows, nature of taxes and region. In general, bilateral flows are found to have a negative impact on direct taxes. Capital inflows, in general, are also found to have a strong positive impact on current government expenditure in all regions. Capital inflows to Africa, generally, were disbursed conditional on deficit reduction. However, these inflows have an inherent tendency of aggravating the deficit and, consequently, may result in governments drifting away from sustainable self-financing behaviour. The study also shows that there is evidence of the 'Dutch disease' effect in all regions. Interestingly, in almost all cases, government spending on the non-traded sector is found to have a statistically significant negative elasticity. Thus, insofar as part of this spending is financed by foreign inflows, the 'Dutch disease' effect may be observed indirectly. This is entirely plausible since most capital flows to Africa are directed to the public sector.

The last important sets of findings are derived using the global model developed in the book. From simulation of different policies and external shocks, the following major results are obtained. Firstly, the effect of aid on Africa depends on the manner of its financing in the 'North'. Compared to budget financing, deficit financing of aid is found to have an adverse effect on commodity prices and, hence, export revenue. If bond/deficit financing is deemed the preferred means of financing, there may emerge asymmetric relations in policy choice between the 'South' and the 'North'. Secondly, the exact effects of this policy will vary, depending on the specific dynamics of each commodity. Thus, depending on the composition of exports, different regions may experience different effects, for the same policy shock. Thirdly, unlike some global models, where aid leads to a rise in South's GDP (e.g., MULTIMOD, see Jamshidi 1989: 38), the impact of such aid in Africa is not only found to vary across regions but also to be generally negligible. The latter is the result of both the degree of disaggregation and the inclusion of the macroeconomic effect of aid in the model developed within this book. Thus, although aid might initially result in a rise in the level of imports, and hence output, the macroeconomic ('Dutch disease' and 'fiscal response') and terms of trade effects of such aid work against this initial positive impact, resulting in no noticeable effect on output. Finally, the study shows that debt cancellation is not a panacea to the African debt problem, since these problems are intricately linked with trade problems. It is also shown that its impact can vary drastically between regions. However, debt cancellation may alleviate the pressure on the fiscal balance of governments, both by reducing the expenditure burden and by providing positive signals to private lenders.

The remainder of this chapter is concerned with providing a solid conceptual background to the various questions and findings noted above. In section 1.2 the external finance problems of Africa are described. The section concludes by highlighting a number of economic implications of the debt problem for Africa. Section 1.3 describes how the debt issue has been examined during the course of a recent policy debate about African economic problems in general. Section 1.4 examines how the structure of African economies may usefully be seen as a legacy of its colonial history. Section 1.5 highlights a number of important methodological issues. Finally, section 1.6 sets out the organization of the remainder of this book.

Table 1.1 Major debt indicators for Africa (in billions of US dollars, unless otherwise stated)

	1971	1975	1980	1985	1990	1991	1992
Total external debt stock (EDT)							
East and Southern Africa (ESA)	4.9	11.4	28.3	55.4	85.2	88.8	91.1
North Africa (NA)	5.1	12.9	51.3	75.0	93.0	90.9	88.7
West and Central Africa (WCA)	3.9	8.2	32.2	51.7	91.7	94.2	90.9
Sub-Saharan Africa	8.8	19.7	60.8	107.1	176.9	183.4	182.7
All Africa	13.9	32.6	112.1	182.1	269.8	274.2	271.4
Long-term external debt (total, All Africa)	11.9	27.2	84.6	140.1	227.7	231.7	227.2
Multilateral (DOD)							
East and Southern Africa	0.5	1.4	4.0	8.9	18.9	20.7	21.5
North Africa	0.2	0.6	4.1	7.2	12.4	13.8	14.2
West and Central Africa	0.5	1.2	3.6	7.8	19.4	20.9	21.7
Sub-Saharan Africa	1.0	2.6	7.6	16.7	38.2	41.6	43.2
All Africa	1.2	3.2	11.7	23.9	50.6	55.4	57.4
Bilateral							
East and Southern Africa	2.6	5.0	11.1	23.7	36.6	37.3	37.2
North Africa	3.0	6.0	17.5	31.9	36.6	37.8	38.2
West and Central Africa	2.0	3.2	6.9	10.5	33.9	36.7	37.1
Sub-Saharan Africa	4.6	8.3	18.1	34.2	70.5	74.0	74.4
All Africa	7.6	14.3	35.6	66.1	107.2	111.7	112.6
Private creditors (DOD)							
East and Southern Africa	1.1	2.6	5.4	8.6	13.3	13.3	13.0
North Africa	1.2	4.8	21.0	23.8	34.5	30.8	29.0
West and Central Africa	0.7	2.3	10.8	17.6	22.1	20.2	14.5
Sub-Saharan Africa	1.9	4.9	16.3	26.3	35.4	33.9	28.2
All Africa	3.0	9.7	37.3	50.1	69.9	64.7	57.2
Interest & principal arrears (% of total external debt)							
East and Southern Africa	0.3	3.6	10.3	16.4	21.1	25.2	28.4
North Africa	1.5	0.2	0.9	6.9	6.3	0.9	0.3
West and Central Africa	2.8	3.9	1.6	3.1	9.6	10.3	14.1
Sub-Saharan Africa	1.4	3.7	5.6	10.0	15.2	17.5	21.2
All Africa	1.4	2.3	3.5	8.7	12.1	12.0	14.4

(Continued)

Table 1.1 (Continued)

	1993	1994	1995	1996	1997	1998
Total external debt stock (EDT)						
East and Southern Africa (ESA)	93.4	101.4	106.0	104.0	103.2	107.3
North Africa (NA)	86.7	94.1	99.6	98.0	92.2	94.4
West and Central Africa (WCA)	94.7	98.2	103.9	101.7	94.5	98.1
Sub-Saharan Africa	194.8	221.3	235.4	231.8	223.1	230.1
All Africa	281.5	315.4	335.0	329.9	315.3	324.5
Long-term external debt (total, All Africa)	234.0	253.0	266.9	260.9	249.2	256.3
Multilateral (DOD)						
East and Southern Africa	23.4	25.9	27.7	28.0	28.0	29.8
North Africa	15.4	17.0	18.4	18.2	17.2	18.5
West and Central Africa	22.8	25.3	27.1	26.7	25.6	27.3
Sub-Saharan Africa	46.1	51.2	54.7	54.7	53.6	57.0
All Africa	61.4	68.2	73.0	72.9	70.7	75.6
Bilateral						
East and Southern Africa	36.8	39.2	40.0	39.5	38.2	39.8
North Africa	38.1	44.4	49.8	50.7	48.0	49.1
West and Central Africa	37.0	40.4	42.8	41.2	38.7	40.7
Sub-Saharan Africa	73.8	79.6	82.7	80.7	77.0	80.5
All Africa	111.9	124.0	132.6	131.4	125.0	129.7
Private creditors (DOD)						
East and Southern Africa	13.0	12.9	13.5	12.6	12.6	12.3
North Africa	27.3	26.1	24.5	21.5	18.7	17.6
West and Central Africa	14.6	13.9	13.4	12.2	10.6	10.6
Sub-Saharan Africa	33.4	34.6	36.8	35.1	34.7	33.6
All Africa	60.7	60.8	61.3	56.6	53.4	51.1
Interest & principal arrears (% of total external debt)						
East and Southern Africa	32.5	34.0	36.7	35.0	34.2	35.4
North Africa	0.3	0.3	0.4	0.5	0.5	0.5
West and Central Africa	19.2	19.5	21.9	23.8	22.7	25.6
Sub-Saharan Africa	25.0	24.2	26.3	26.2	25.5	27.5
All Africa	17.4	17.1	18.6	18.6	18.2	19.6

Source: World Bank *Global Development Finance* (2000).

Table 1.2 *Major debt indicators for Africa (in billions of US dollars, unless otherwise stated)*

	1971	1975	1980	1985	1990	1991	1992
Net transfer on debt							
East and Southern Africa	1.09	2.19	2.48	2.49	2.07	0.80	2.45
North Africa	0.54	4.68	2.25	-0.06	-5.64	-3.39	-5.71
West and Central Africa	0.40	1.12	4.01	-1.89	-0.27	-2.22	-2.02
Sub-Saharan Africa	1.50	3.31	6.56	0.55	1.78	-1.18	0.74
All Africa	2.04	7.99	8.81	0.49	-3.86	-4.57	-4.98
Aggregate net transfer							
East and Southern Africa	1.08	2.30	4.18	5.37	7.62	7.57	7.55
North Africa	0.46	5.19	2.95	2.60	3.08	0.54	-0.75
West and Central Africa	0.29	1.14	1.16	-1.28	2.32	1.80	1.49
Sub-Saharan Africa	1.43	3.41	5.11	4.44	9.23	8.97	8.83
All Africa	1.90	8.60	8.06	7.04	12.31	9.51	8.08
Technical co-operation grants (as % of total grants)							
East and Southern Africa	61.81	36.39	36.77	32.06	24.31	25.61	26.44
North Africa	38.70	16.33	58.53	39.71	20.31	22.50	31.49
West and Central Africa	51.54	46.90	54.37	36.61	30.04	31.78	35.62
Sub-Saharan Africa	61.36	49.23	42.60	35.52	29.76	31.79	32.91
All Africa	50.03	32.78	50.57	37.61	25.04	27.14	32.20
Debt (EDT)/GNP (%)(simple arithmetic mean, based on countries that have relevant data)							
East and Southern Africa	19.87	23.12	44.32	77.66	99.45	94.71	115.66
North Africa	29.33	31.56	57.07	84.27	71.98	75.11	68.30
West and Central Africa	21.35	27.61	59.61	106.68	121.16	127.89	147.63
Sub-Saharan Africa	14.55	15.52	23.45	56.37	63.01	63.68	62.91
All Africa	21.94	23.54	40.26	70.32	67.50	69.39	65.61
Debt service ratio (%)(simple arithmetic mean, based on countries that have relevant data)							
East and Southern Africa	8.54	9.63	14.23	21.89	20.87	21.73	18.79
North Africa	21.77	8.52	22.27	30.24	32.96	34.58	37.21
West and Central Africa	5.28	6.88	13.16	22.08	19.29	18.12	15.83
Sub-Saharan Africa	..	..	7.20	17.58	12.92	12.46	12.28
All Africa	..	..	14.73	23.91	22.94	23.52	24.74

(Continued)

Table 1.2 (Continued)

	1993	1994	1995	1996	1997	1998
Net transfer on debt						
East and Southern Africa	0.84	-0.04	0.47	-0.45	1.65	-1.32
North Africa	-5.85	-2.80	-3.33	-3.58	-4.86	-5.97
West and Central Africa	0.83	-2.80	-0.57	-1.33	0.31	-3.28
Sub-Saharan Africa	2.53	5.48	2.01	-2.57	0.15	-6.48
All Africa	-3.32	2.68	-1.32	-6.15	-4.71	-12.45
Aggregate net transfer						
East and Southern Africa	6.46	5.66	5.76	3.77	5.37	4.13
North Africa	-1.80	0.39	-1.54	-0.23	0.29	-2.20
West and Central Africa	4.19	5.45	3.05	2.77	2.52	1.95
Sub-Saharan Africa	10.21	11.75	15.36	8.66	13.33	6.68
All Africa	8.41	12.14	13.81	8.43	13.61	4.48
Technical co-operation grants (as % of total grants)						
East and Southern Africa	28.94	24.26	29.06	33.98	31.25	24.94
North Africa	52.21	38.85	51.19	40.04	43.32	33.25
West and Central Africa	37.18	26.81	32.06	30.01	32.53	28.86
Sub-Saharan Africa	33.86	28.45	30.70	32.69	31.30	27.82
All Africa	43.04	33.65	40.94	36.36	37.31	30.53
Debt (EDT)/GNP (%) (simple arithmetic mean, based on countries that have relevant data)						
East and Southern Africa	116.12	141.51	133.18	114.93	103.40	111.55
North Africa	67.02	69.68	68.75	61.36	58.15	55.81
West and Central Africa	167.20	158.63	145.95	146.27	163.02	
Sub-Saharan Africa	70.99	82.57	77.57	73.82	67.74	72.32
All Africa	69.00	76.13	73.16	67.59	62.94	64.07
Debt service ratio (%)(simple arithmetic mean, based on countries that have relevant data)						
East and Southern Africa	17.55	14.86	21.26	15.26	12.39	15.49
North Africa	36.49	29.86	24.48	21.15	20.10	22.38
West and Central Africa	14.52	21.12	18.98	18.39	15.92	17.08
Sub-Saharan Africa	9.20	14.57	15.29	14.22	14.72	14.68
All Africa	22.84	22.21	19.88	17.69	17.41	18.53

Source: Based on World Bank *Global Development Finance* (2000). Net transfer = Loan disbursements less amortization and interest payment [as defined in World Debt Tables] Aggregate net transfer = Aggregate net resource flows (Loan disbursements less amortization) plus official grants (non-technical) and foreign direct investment (FDI) less interest payment and FDI profit [as defined in World Debt Tables].

1.2 BACKGROUND TO AFRICAN DEBT AND MACRO POLICY DEBATES

1.2.1 Background to African Debt

African economic problems can be seen as a complex of interrelated factors of an internal and external nature. As noted in section 1.1, this study focuses on the latter. The external finance problem – and the debt crisis in particular – represents one of the major problems facing African nations today. As can be seen from Table 1.1, the total external debt of Africa has risen nearly 25-fold from a relatively low level of US$13.9 billion, in 1971, to over $300 billion in 1998. The major component of this burden comprises outstanding long-term debt. During the late 1970s, and early 1980s, IMF credits were increasingly used, with 'Structural Adjustment' and 'Enhanced Structural Adjustment' facilities comprising an ever-important component of flows to Africa.

Changes in the structure of African debt can also be described in terms of creditor patterns. From Table 1.1, it can be seen that bilateral debt comprises the largest component of Africa's total debt. This is followed by multilateral debt, with private inflows showing a decline. Generally, it may be observed that a larger share of official debt is now disbursed on concessional terms. Finally, it is interesting to note that the debt problem is being aggravated by capitalization of interest and principal arrears, which constitute nearly a quarter of the external debt burden.

Although the share of African debt as a proportion of the total debt of developing countries is low, the relative debt burden borne by African nations remains high. As can be seen from Table 1.2, the debt to GNP and debt service ratios rose from 22 per cent and around 9 per cent, respectively, in 1971, reaching a high of 67 per cent and 23 per cent during the late 1980s. In 1998, the last year for which we have data, these ratios stood at 64 per cent and 18 per cent, respectively.[1] Africa's burden of debt may also be assessed by examining net transfers to the sub-regions. Thus, if we exclude grants and net foreign direct investment inflows from Table 1.2, it can be seen that net transfers since 1990 have, in fact, flowed *from* Africa to the developed nations. Further, it is noteworthy that the level of such transfers has increased, from US$ 3.86 billion in 1985 to nearly US$ 12.45 billion in 1998. Finally, it is worth pointing out that in the 1990s nearly 35 per cent of grants to Africa, in fact went to 'technical experts' coming from the North.

In summary, the last three decades have witnessed an unprecedented increase in the level of African debt. This debt is characterized by its predominant long-term character, the growing importance of debt owed to bilateral and multilateral creditors, a trend away from concessionality to nonconcessionality and an increase in the importance of interest and principal arrears (usually capitalized through the Paris and London clubs) as a component of long-term debt. Indicators of the debt burden also indicate that African debt is extremely heavy compared to the capacity of the African economies, and, in particular their export sectors. Moreover, most African nations have been subjected to net financial outflows in the period since the mid-1980s. The performance of these economies, coupled with a mounting debt burden, surely indicates that African countries are incapable of simultaneously servicing their debt and attaining a reasonable level of economic growth, let alone addressing issues of poverty alleviation.

The actual size of indebtedness does not usually represent an economic problem in itself, since this debt may usually be mitigated by rescheduling and similar short-term arrangements. However, the size of accumulated debt, relative to capacity level, and subsequent impacts on the economy, do represent a serious problem for African nations. In this respect, three interrelated implications of the debt problem deserve mention. First, servicing of the external debt erodes foreign exchange reserves, which might otherwise be available for purchase of imports. This has led to the 'import compression problem', in which a shortage of foreign exchange adversely affects levels of public and private sector investments. The import compression problem represents one of the major macroeconomic issues facing Africa today. Second, the accumulation of a debt stock results in a 'debt overhang' problem, which tends to undermine the confidence of private investors, both foreign and domestic. A decline in levels of private investment as a share of GDP, from the late 1970s onwards, may partly be attributed to this factor. Finally, servicing of debt is placing an enormous fiscal pressure on many African nations. Such pressure has had an adverse effect on public investment. This finding is reflected in a reduction in the share of public investment in GDP from late 1970s onwards. Naturally, a reduction in levels of public investment will tend to have negative consequences for physical and social infrastructure. To sum up, the debt issue is a crucial element of the overall economic crisis facing Africa. How, then, has this crisis come about? The following sections will briefly summarize some of the general arguments surrounding this issue.

1.2.2 Africa's Economic Crisis: What Caused It?

There are three sets of contending explanations for Africa's economic crisis. The first is set out in World Bank (1981) – also known as 'the Berg Report' – and a number of subsequent World Bank publications. An alternative explanation for Africa's economic problems, associated with the United Nations' 'Economic Commission for Africa' (ECA) is outlined in *African Alternative Framework to Structural Adjustment Programmes,* AAF-SAP (ECA 1989a). Finally, there exists a third view, which is less clearly associated with any particular institution and largely held by academics of a Marxist orientation. This latter position is often offered as a critique to the other two explanations. Although the scope of all three sets of explanations is general, encompassing every aspects of the African economic crisis, we focus mainly on how problems in the external sector of the economy are explained. Nevertheless, by referring to this wider debate, we aim to locate the problems and the role of the external sector in a wider context.

The World Bank's *Agenda for Action* (1981) argues that Africa's problems relate to underdeveloped human resources, political fragility, problems of restructuring colonial institutions, inheritance of poorly shaped economies, climate, geography and population growth. Set in the context of these problems, disappointing performance of the external sector is, perhaps, a little more understandable. The Bank argues that, in spite of external shocks, associated particularly with a rise in oil prices in the periods 1973–74 and 1978–80 and a decline in world demand for primary commodities, the balance of payments problems experienced by most African nations since the 1970s cannot generally be attributed to a deterioration in terms of trade.[2] With the exception of mineral exporters, it is suggested that terms of trade for most African nations have, in fact, either been favourable or neutral.[3]

The main cause of the balance of payments problem, according to the Bank, has been a decline in the volume of exports. The decline in terms of trade faced by African nations is attributed to three factors. Firstly, structural changes in the composition of world trade, with trade in commodities growing at a slower rate than that of manufactures, has resulted in a decline in the African share of total world trade. Secondly, drought and civil strife has negatively affected Africa's supply capacity. And thirdly, trade restrictions and agricultural subsidy policies of industrial countries represent a barrier to African trade.[4] The Bank goes on to argue that the failure of Africa's export sector may be explained in terms of three *main* factors. Firstly, government policy has tended to be biased against agricultural and export production. Secondly, increased consumption associated with rapid population growth has placed a burden on resources, which might otherwise have been used by the export sector. And, thirdly, inflexibilities in African economies are seen as representing an obstacle to diversification. The Bank's insistence that policy failure represents the main explanation for Africa's economic crisis, and consequent emphasis on the need for reforms, has continued with the publication of its long-term perspective study (World Bank 1989). Moreover, as recently as 1994, the Bank continues to argue that orthodox macroeconomic management represents the road to economic recovery in Africa and, hence, that more adjustment, not less, is required (World Bank 1994). This assertion has been the subject of various criticisms, coming from a host of different angles (see *inter alia* Adam 1995, Mosley et al. 1995, Lall 1995).[5]

A number of other analysts have arrived at conclusions, in line with those of the Bank. Van Arkadie (1986), while sympathetic to the problems posed by external shocks, argues that stagnating or falling output has had an important impact on export earnings. On the latter point the World Bank (1989) argues, rather vigorously, that declining export volumes, rather than declining prices, account for Africa's poor export revenue. Grier and Tullock's (1989) analysis supports this view. Based on their survey of empirical studies into the causes of the African economic crisis, Elbadawi et al. (1992), also found domestic policies to be important. White (1996b), citing the case of Zambia, argues that economic decline following Zambia's independence may largely be attributed to economic mismanagement. Using a simple pooled multiple regression equation for 33 African countries, Ghura (1993) also found significant support for the Bank/IMF viewpoint. Easterly and Levine (1996) suggest political instability, low levels of schooling, deterioration in infrastructure, as well as policy failures as representing possible causes of Africa's growth problems. They conclude, however, that policy improvements alone are likely to boost growth substantially (see also Collier & Gunning 1999 for a similar argument). Although the above survey is not exhaustive, the aforementioned works would tend to lend strong support to the Bank/Fund's viewpoint. The logical conclusion to be drawn from this survey, therefore, is that the remedy to Africa's economic problems is to implement structural adjustment programmes (SAPs).

In contrast, the ECA (1989a) prefers to explain Africa's problems in terms of deficiencies in basic economic and social infrastructure (especially physical capital), research capability, technological know-how and human resource development, compounded by problems of socio-political organization. The ECA sees inflation, balance of payments deficit, a rising debt burden and instability of exports as resulting from a lack of structural transformation, unfavourable physical and socio-political environment, as well as an excessive outward orientation and dependence. The ECA study suggests that weaknesses in Africa's productive base, the predominant subsistence and exchange nature of the economy and its openness (to international trade and finance) have all conspired to perpetuate the external dependence of the continent. Hence, one of the striking features of the African economy is the dominance of the external sector. This has the effect of rendering African countries quite vulnerable to exogenous shocks.[6] Consequently, according to the ECA viewpoint, perceiving African problems in terms of internal and external balance problems and seeking a solution within that framework (most notably, through the implementation of structural adjustment programmes) implies not only the wrong diagnosis but also the wrong treatment. The ECA study argues that '...both on theoretical and empirical grounds, the conventional SAPs are inadequate in addressing the real causes of economic, financial and social problems facing African countries that are of a structural nature' (ECA 1989a: 25).

Based on this alternative diagnosis, and the major objectives of the '*Lagos Plan of Action*' (OAU 1981), the ECA formulated an African alternative framework to the Bank/Fund's policy recommendations. The ECA framework focuses on three dynamically interrelated aspects, which need to be taken into account. First, *the operative forces* (political, economic, scientific and technological, environmental, cultural and sociological),[7] second *the available resources* (human and natural resources, domestic saving and external financial resources) and third *the needs to be catered for* (i.e., focusing on vital goods and services as opposed to luxuries and semi-luxuries). The adoption of this general framework would allow the different categories of operative force to influence not only the level and structure of what is produced but also the distribution of wealth. Moreover, these forces may then influence the nature of needs to be catered for and the degree of their satisfaction. At a concrete level this is envisaged as taking a number of policy directions. Firstly, improving production capacity and productivity, mobilization and efficient use of resources, human resource development, strengthening the scientific and technological base and vertical and horizontal diversification. Secondly, improving the level and distribution of income, adopting a pragmatic balance between the public and private sectors, putting in place 'enabling conditions' for sustainable development (particularly economic incentives and political stability), shifting of (non-productive) resources, and improving income distribution among various groups. And, finally, focusing on the required needs, particularly in relation to food self-sufficiency, reducing import dependence, re-alignment of consumption and production patterns and managing of debt and debt servicing.

Just as many have argued in favour of the Bank/IMF view, so too, many analysts have come out in support of the ECA's position. Thus, various studies have emphasized Africa's extreme dependence on primary commodity exports (see Ngwenya & Bugembe 1987, Fantu 1992, Adedeji 1993). Siting this discussion in a broader historical context, these studies have highlighted the impact of colonialism in establishing the rules by which Africa might participate in the world economy. According to these rules, African nations produced raw materials and agricultural goods for Europe's industries. Further, it is argued that this pattern of trade has changed very little since the time of political 'independence' (Fantu 1992: 497–500, Adedeji 1993: 45). Indeed, Stefanski (1990) argues that, understood in the context of direct continuum with the colonial experience, Africa's economy still depends on external factors to a much greater degree than any other developing region. As a result of this dependence, Africa's economic crisis is seen as being intricately interconnected with external factors such as falling terms of trade, declining demand for African exports and related external shocks (Stefanski 1990: 68–77, Adedeji 1993: 45). Collier (1991) also argues that abrupt external shocks (be they negative or positive) have represented important causes of the poor long-term economic performance of Africa.[8] Ali (1984) has touched on another dimension of the problem. He argues that, for most African nations, the mitigation of their problems depends not only on the characteristics of the commodities they export (and specifically their elasticities) but also on the presence or absence of the necessary market staying power. Wheeler (1984) has made an exploratory econometric analysis of the sources of stagnation and suggests that 'environmental' factors (especially terms of trade and international conditions of demand) have had a greater impact on growth than policy variables. Indeed, based on Ghura's (1993) recent econometric analysis, world interest rates represent a further significant variable, which should be added to Wheeler's list of adverse 'environmental' factors.[9]

The negative impact of dependence on exports of primary commodities is reflected in three interdependent phenomena. Firstly, a decline in prices faced by exporters ('terms of trade'). Secondly, instability of export earnings. And, thirdly an absolute decline in levels of demand and supply. Attempts to compensate for a deterioration in the exchange rate facing exporters, by increasing supply, have resulted in a further decline in prices (Fantu 1992: 502, Stefanski 1990, Stein 1977). Stein (1977) examined export trends in East Africa (Uganda, Kenya and Tanzania) in order to determine the causes of the divergence of each country's export growth from that of the world. He found that unfavourable commodity composition,[10] as opposed to the favourable/ unfavourable nature of its market and increased competitiveness went a long way in accounting for this divergence. Because African countries depend on a few commodities, whose prices swing cyclically and may decline over time, these countries face export-earning instability. Naturally, such instability adversely affects their economies. However, Fosu (1991) examining the evidence for sub-Saharan Africa, argues that export instability *per se* is less important than fluctuation in capital formation (capital instability) in affecting economic growth. Yet, as his own work shows, in sub-Saharan Africa, high export instability may render export proceeds a relatively unreliable source for funding for investment projects (Fosu 1991: 74–75). This usually forces countries to depend on external finance (discussed, at length, in section 1.3).

The third view differs from the other two in its understanding of what crisis means in the African context. For these analysts crisis '...has a connotation of systemic breakdown, but more generally it can refer to a moment or a specific time period in the history of a system at which various developments of a negative character combine to generate a serious threat to its survival' (Lawrence 1986: 2). Sutcliffe (1986), for instance, argues that the African crisis represents the continuation of a complex process of polarization trends. It emanates from Africa's economic dependence. For him, the African crisis is best understood in terms of the combined result of long-term secular effects of imperialism suddenly aggravated by the impact of the world capitalist crisis. Thus, according to these viewpoints, Africa's problems are best understood as resulting from long-term underdevelopment, following dependency theory,[11] and short-term vulnerability, following international aspects of crisis theory (Amin 1974a, 1974b; Ake 1981, cited in Ofuatey-Kadjoe 1991; Sutcliffe 1986: 19–20; Harris 1986: 93; Onimode 1988: 13; Moyo et al. 1992: 210). In general, these writers are against the view that there is a 'norm' from which African countries are in a temporary deviation, with associated implications that these countries may return to that norm given a particular adjustment measure (Harris 1986: 84). Harris (1986) and Mamdani (1994) for instance, argue that the IMF and Bank's ultimate objective is not to correct distortions in a free market international system, but to construct such a system (Harris 1986: 88). In so doing, these institutions may undermine any attempt to create an independent, integrated and self-sustained (African) economy (Mamdani 1994: 129).

While there are areas where the first two approaches both converge and diverge, the third explanation for Africa's economic crisis stands firmly in opposition to both. Thus, the core of the disagreement between the bank and ECA views centres on 'the role of the market' mechanism[12] (Oskawe, quoted in Asante 1991: 179). While the Bank believes in the market mechanism as representing the fundamental instrument of resource allocation and income distribution, the ECA questions this viewpoint. Thus, while the bank focuses mainly on financial balances, the ECA considers a much broader transformation as an enabling condition for the former. While the Bank emphasizes the export sector, the ECA strategy advocates selectivity (see also Asante 1991: 180). While the Bank expresses concern about anti-export bias and population policy, the ECA prefers to emphasize the need to ensure total structural transformation and food self-sufficiency. While the Bank places more emphasis on short-term policies than on Africa's long-term needs, the ECA strategy, as defined in the Lagos plan of action, stresses the importance of also addressing issues of long-term transformation, alongside these short-term policies.[13] However, these institutions do agree on some major issues, such as the need for human resource development, improving the efficiency of parastatals, and sound debt management. The ECA analysis is quite comprehensive in addressing the causes of the crisis and in suggesting not only short-run solutions but also a framework for long-term transformations.[14] Thus, the analysis of the external sector of Africa, adopted in this study, will be conducted within this broader context. Within this perspective, it is not difficult to show that the African debt crisis has developed as part of the broader external economic problem of the continent.

The literature on the origins of the African debt crisis lists a number of factors as its cause. The oil price shocks of 1973–74 and 1978–79, the expansion of the Eurodollar, a rise in public expenditure by African governments following increases in commodity prices during the early 1970s, recession in the industrialized nations and subsequent fall in commodity prices, as well as rises in real world interest rate are all mentioned as major factors. Surprisingly, almost all of this literature focuses on the post-independence period, with a greater part of the analysis contained therein relating to the 1970s, 1980s and 1990s. The main argument set out in this book is that we need to extend this analysis to the pre-independence period if we are adequately to explain the current debt crisis, as well as propose possible solutions for its resolution. From this point of departure, the following section traces the historical formation of an African economic structure incapable of handling the current debt crisis.

1.3 THE HISTORICAL ORIGIN OF AFRICA'S ECONOMIC LINKAGE WITH THE NORTH

Following Amin (1972), African economic history may be classified into: (i) the 'pre-mercantilist period' (from pre-history to the beginning of the 17th century); (ii) the 'mercantilist period'[15] (from the 17th century to 1800), characterized by the operation of the slave-trade; (iii) the 'third period' (from 1800 to 1880) characterized by attempts to set up a European dependent African economy; and finally, (iv) the 'period of colonization' in which the dependent African economy became fully established (Amin 1972: 106). This section will not pretend to discuss the details of Amin's periodization. Rather, after briefly reviewing the economic history of the other periods, it will focus mainly on the colonial period, during which time the economic structure African countries inherited at the time of independence became established.

1.3.1 Pre-colonial Trade in Africa

African interactions with the rest of the world, and especially Europe, date back many centuries, before culminating in full-fledged colonization in the latter part of the 19th century.[16] During the first part of this period, Africa had autonomy in its linkages with the rest of the world[17] (Amin 1972: 107–10). However, during the 16th century, African trade centres moved from the savannah hinterland to the coast, in reaction to changes in European trade, which shifted increasingly from the Mediterranean to the Atlantic (Hopkins 1973: 87).

Various studies have documented how pre-colonial Africa was characterized by production of diversified agricultural products (see, for instance, Rodney 1972: 257). The internal trade of the continent was distinguished by regional complementarities, with a broad natural resource base. Thus, a dense and integrated network was set in place, dominated by African traders, which included, *inter alia*, trade among herdsmen and crop farmers, supply of exports and distribution of imports. This was dominated by trade in salt, West African 'spices', perfumes, resins and kola nuts, of which the latter was the most important (Amin 1972: 117, Hopkins 1973: 51–86; Neumark 1977: 128–30, Vansina 1977: 237–48, Austen 1987: 36). Brooks' account of the economic conditions prevailing in this period provides an impressive insight into African trade at the time (Brooks 1993). Specifically, one is struck by: (a) the extent of local and long distance trade; (b) the range of goods traded; and, (c) the degree of processing of commodities (for instance in textile manufacturing, dyeing and metal working), particularly in West Africa. According to his account, the major commodities traded among West Africans in pre-colonial times include salt, iron, gold, kola, and malaguetta pepper and cotton textile. Of these, kola and malaguetta pepper were important, not only in West Africa, but also in the trans-Saharan trade. Indeed, this trade was so extensive that Europeans were able to obtain malaguetta pepper at inflated prices from Maghreb[18] middlemen from at least the 14th century onwards (Brooks 1993: 51–121). Moreover, in this period, Europeans were able to purchase cloth from Morocco, Mauritania, Senegambia, Ivory Coast, Benin, Yorubaland and Loango for resale elsewhere (Rodney 1972: 113, Hopkins 1973: 48). (It is curious to note that, in a geographic and economic sense, North Africa was connected, rather than separated, by the Sahara to other parts of Africa.)[19] It is also worth noting that the quality of many of these processed goods was quite comparable with products originating in other parts of the world. For instance the level of manufacturing of textiles in pre-colonial West Africa was so sophisticated that these textiles were not only traded in West, North and Central Africa but also in the European market (see Hopkins 1973: 48 for details). Moreover, none of the goods brought by Europeans supplied any of the basic or unfulfilled needs of African societies. Indeed, similar commodities and/or substitutes were obtainable through West African commercial networks. Specifically, African artisans of the time manufactured high-quality iron, cotton, textiles, beers, wines and liquors (Brooks 1993: 56). Austin argues that this trade, sometimes referred to as the 'Sudanic economy', represents 'an ideal African development pattern: continuous and pervasive regional growth with a minimum of dependence upon foreign partners for provision of critical goods and services' (Austen 1987: 48). However, this autonomy in traditional industries was to be undermined by subsequent events (Koncazcki 1990: 24).

The early development pattern of Africa varies between regions. In contrast to West Africa, East and Southern Africa (ESA) were characterized by a well-established economic interaction with the Arabian and Asian countries, long before the arrival of the Europeans. More specifically, this part of Africa supplied a range of products, such as gold, copper, grain, millet and coconut to the Middle East and Indian Ocean economies. There also existed a dynamic caravan trade and commercial plantations long before the onset of European colonial rule. According to Austen, the towns in this part of Africa degenerated into little more than entrepôts for raw material exports and manufactured imports, rendering them dependent on the external economy (Austen 1987: 67–74). However, as documented by Kjekshus, during the mid-19th century, prior to the onset of the colonial period, the interior of what is now mainland Tanzania carried an estimated 4.5 million head of cattle. Indeed, the entire coastal region also supported a rich agricultural and pastoral economy (quoted in Leys 1996: 111). Further, Nzula et al. (1979)[20] argued that the region was characterized by peasant production, which was mainly a natural and closed economy, with a substantial number of people leading a nomadic existence (Nzula et al. 1979: 38). The existence of an independent and autonomous economy, dating back to antiquity, is also well documented in Ethiopian history.[21] Amin also notes that the African societies of the pre-colonial period developed autonomously (Amin 1972: 107–8). Thus, one may reasonably conclude that, although its economy was not as complex as that of West Africa, nevertheless, that the ESA region had some degree of autonomy in its economic activity, and, hence, was not as dependent on the export of commodities, particularly to Europe.

To sum up, there would appear to be a long history of integrated and autonomous economic activity in most regions of Africa with local and long-distance trade playing a linking role. This is not an attempt to paint a 'golden past' for Africa. Rather, it is meant to underline the fact that Africa had a healthy and fairly independent economic system, before colonialism intervened to force a structural interaction with Europe.

1.3.2 The Formation of a Commodity-exporting and External Finance-constrained Economy

The period leading up to the industrial revolution, and the 16th and 17th centuries, in particular, witnessed the beginning of the shaping of the African economy by European demand. A clear example is the pressing demand for gold coin in Europe, and the subsequent search for gold in West and Central Africa (WCA).[22] Indeed, demand for labour, required in the American gold search, was instrumental in the formation of the European slave trade (Rodney 1972: 86–87). Thus, the shaping of the African economy by Europe began, even before the onset of the formal colonial period.

With the onset of the industrial revolution in Europe, Africa lost its remaining autonomy and was reduced to being a supplier of slave labour for the plantations of America (Amin 1972: 107–10). The European slave trade, and the so-called 'triangular trade', both of which are beyond the scope of this book, are widely discussed issues in the economic history of Africa. Any resistance to the slave trade was silenced, not only by the co-opting of local chiefs, but also by sheer force. Such use of force has been documented in what is now Angola, Guinea and various other parts of the continent (Rodney 1972: 90–91, see also Bernstein et al. 1992 for a brief summary of the triangular trade). Moreover, this era witnessed a widespread expansion of European control. This expansion was undertaken with the dual aims of: (a) incorporating new areas under primary crop production, using African land and labour (which were priced below world market prices); and, (b) increasing the level of production of existing primary commodities. On the import side, cheaper and purer iron bars, and implements such as knives and hoes were made available, displacing some of the previous economic activities undertaken by local blacksmiths. This had knock-on effects in terms of a reduction in levels of iron smelting and even a decline in the mining of iron-ore (Wallerstein 1976: 34–36, Baran 1957: 141–43).[23]

Within the ESA region, cloves grown in Zanzibar and Pemb islands, for export to the Asian and European markets, were the first cash crops successfully produced prior to European colonialism. Mainland estates, dominated initially by Arab and Asian traders, were involved in externally-oriented production through sales of copra, sesame seed and oil-yielding materials, for which France was the principal market (Munro 1976: 55). Following colonization, peasant cash-cropping developed in East Africa. However, unlike the WCA region, this was mainly as a consequence of a combination of political injunction and regulation. Such imposition from above was usually resisted, the Maji-Maji uprising, in today's Tanzania, being a case in point. In other instances cash cropping simply failed to take hold, as in the case of a cotton scheme proposed for Nyanza province, Kenya (Munro 1976: 116). However, in spite of these initial setbacks, eventually the colonial powers were successful in implementing their policy of introducing cash cropping to the region.

As described above, there existed a reasonable degree of trade linkage with Europe in the pre-colonial period. Leaving aside the slave trade, the main feature of this trade was the export of primary commodities by African nations to Europe. Thus, even before the onset of the colonial era, the seeds of Africa's subsequent role (as a supplier of raw materials and foodstuffs for Europe, and a market for European manufactures) as well as its dependence on external finance had already been sown.[24] Or, to take a slightly different perspective, a move from the production of primary products to processing of these products (by Africans and in Africa) was interrupted. This represents the first pre-designed attempt to articulate African economic activity to the requirements of the outside world. This development was vigorously followed up upon during the colonial period as a consequence of: (i) the so-called *imperial self-sufficiency in raw materials* scheme; (ii) the impact of the First and Second World Wars; and, (iii) financing requirements for the creation of public utilities designed to serve (i) and (ii).

The imperial self-sufficiency scheme

As noted above, the export structure associated with colonialism did not arise by accident. Rather, it was preceded by various experiments to produce agricultural products demanded by the developing European industries. A French experiment to produce crops similar to those produced in America, the establishments of plantations in Senegal, during the 1820s, British experiments with 'model farms' in Niger, during the 1840s and cotton experiments[25] in Senegal, Nigeria and the Gold Coast (Ghana) all represent cases in point (Hopkins 1973: 137). In Germany, Bismarck, initially reluctant to create a colonial empire, was persuaded by German commercial interests that overseas territories could provide raw materials for German industries, as well as markets for their products (Longmire 1990: 202). This growing demand for raw materials, the search for a market for finished products from Europe, inter-European competition, and a number of other factors conspired to form the basis upon which colonialism was to evolve.[26]

During the colonial period, one of the main phenomena, which strengthened primary commodity exports from European colonies in Africa, was the so-called 'imperial self-sufficiency' scheme. Thus, British, French and Belgian textile industries sought to obtain cotton from Africa, and invested accordingly. A similar scheme was also developed for tobacco. This was administered both by colonial governments and by some European-based companies (Munro 1976: 128–37) and resulted in an expansion in colonial trade. With the onset of colonialism, the centre of African trade shifted from the hinterland to the coast, and the composition of this trade also changed in response to the demands of the increasing external orientation of the economy (Amin 1972: 117). For example, expansion in the production of palm products and groundnuts in Africa was directly linked with increased demand for inputs required in soap and candle factories, lubricants (particularly for the railways) and European economic growth in general (Hopkins 1973: 129).

At the same time, the processing of such primary products in Africa, except in white settler colonies was actively discouraged. Indeed, this was the case even when factories were owned by Europeans. For example, in Senegal, the proportion of groundnuts, which could be processed, prior to their export to France, was strictly controlled (Fieldhouse 1986: 48, Fyfe quoted in Wallerstein 1976: 36, Onimode 1988: 177). In Angola the Portuguese prevented the operation of flour mills, with the country exporting wheat to Portugal and importing wheat flour back (Koncazcki 1977: 81). According to Austen, the fact that colonial governments, (with the possible exception of the Union of South Africa), saw themselves primarily as representatives of the 'mother' (colonial) country, which was benefiting from the existing pattern of trade, explains why they pursued policies which were directly and indirectly designed to block efforts at local industrialization (Austen 1987: 133).

In order to achieve these dual objectives, of inducing the colonies to be suppliers of inputs, and markets for manufactured goods, various methods of coercion were employed. Africans were forced, by superior firepower, to abandon small-scale manufacturing industries and trade with rival European nations (Dickson 1977: 142). At the same time, large European firms were encouraged to concentrate on growing and trading in agricultural products. This was easily achieved for a variety of reasons. Specifically, African peasants moved into cash cropping: (a) to ensure access to European goods, to which they had become accustomed, in a limited way, in the pre-colonial era; (b) to earn cash, which was required to pay various taxes; and, finally: (c) as a result of force.[27] In other cases, Africans were simply exterminated to pave the way for settlers.[28] In other parts of Africa Europeans directly controlled the production of commodities such as cotton, sugarcane and tobacco. (Amin 1972: 112–13). Indeed, in areas such as British East Africa the law required that farmers grow a minimum acreage of cash crops. However, these peasants were not wholly dependent on cash crop production. Rather, they also produced food for own consumption, this being in the interests of the big firms, since it enabled them to pay only minimal wages, which did not have to cover maintenance of the labourer and his family (Rodney 1972: 172). Nevertheless, the colonial authorities ensured that the extent of such food production was not large enough to ensure self-sufficiency. For instance, in British Guinea it was a criminal offence to grow rice (at a time when it was imported from India and Burma) because it was feared that rice growing would lead to the diversion of labour from the sugar plantations (Frankel 1977: 236). Thus, in this manner, Africa's economic role, basically as a producer of primary commodities, continued to be shaped to serve Europe's industrial and commercial interests.

The First and Second World Wars (W.W.I and II)

The impact of the First World War on African colonies was devastating. Although trade was disrupted during the period, nevertheless African colonies were forced to supply commodities to finance the war. The end of the war was followed by a surge in major commodity prices and hence high export earnings for the African colonies (Munro 1976: 119–23). Similarly, The Second World War also resulted in an increased demand for primary commodities, and especially those with military strategic importance such as vegetable oils, metals and industrial diamonds (ibid.: 170, Burdette 1990: 84.). This had the effect of reinforcing the commodity producing and exporting role of the European colonies in Africa. In addition to the direct effects of the war, the post-war reconstruction of Europe, rising levels of European incomes and removal of restrictions on consumer demand and commodity stockpiling, engendered by the outbreak of the Korean war in 1950, resulted in the price of African exports surging to unprecedented heights (Munro 1976: 177). Thus, when war erupted or was expected to erupt in the colonizing countries, commodity production and exports by African colonies was boosted by non-price mechanisms. Further, the end of the war was usually also followed by a commodity price boom and associated increase in the level of the commodity exported, this time through the operation of the price mechanism. In the process, the specialization of European colonies in Africa as producers and exporters of primary commodities became firmly established.

Financing public utilities and commodity exports

In general, in the pre-1929 international financial order, which was dominated by government bonds (i.e., portfolio investment), Asian and African colonies had little choice in relation to the nature of their involvement in international financial systems. Political considerations were at the heart of regulating access to capital markets (Bacha & Alejandro 1982: 2–3). Besides, such inflows to Africa were generally negligible (UN 1949: 26–28). Capital inflows from W.W.II onwards increasingly came in the form of foreign direct investment (FDI). There was a moderate flow of such capital from the United States and Britain to Africa. However, such investment that did come (especially that originating in the United States, which was the largest supplier) was concentrated mainly in South Africa, Egypt and Liberia, the latter relating to the introduction of a shipping line by the United States (UN 1954: 15–16). In almost all cases, the investment went into plantations and mineral extraction (UN 1949: 32–33).

The colonial period also witnessed a flow of loans and grants from European centres to the African colonies. In almost all cases, these funds were spent on public infrastructure development such as railways and roads to link ports to export production sites, and, to a lesser extent, on schools and health facilities. This was undertaken with the aim of developing the primary commodity exporting capacity of the colonies (see UN 1954: 32–33). In some circumstances the colonial powers were also motivated by military-strategic considerations. It is estimated that, from the mid-1940s to 1960, only 15–20 per cent of such inflows were allocated for social and production sectors, while the rest went into infrastructural development (Munro 1976: 183). The nature of these financial flows to the colonies also differs before and after W.W.II. In general, it can be said that the pre-W.W.II flows came mainly in loan form, while the post-W.W.II flows, and especially those from France, increasingly incorporated a grant element (see also Austen 1987: 197–202 for details). However, the repayment of this debt by colonial administrators created serious difficulties.

These financial difficulties were exacerbated by instability in the world commodity market and the vulnerability of the African colonies to this. Indeed, various analogies may be drawn between the current debt crisis and the situation in this period. For instance, after the great depression (1929–32), African exports declined by about 42 per cent. The depression also resulted in contraction of credit flowing to the colonies. These events led to a serious incapacity to service debt owed to the 'mother' (colonizing) country. Since colonies were not in a position to default on these debts, there was effectively no way out for them. This had repercussions for every African economy, with widespread bank failures, retrenchment programmes in colonial administrations and liquidation of businesses (see Munro 1976: 150-53 for details).

Setting in place a vicious cycle, the financial difficulties being experienced by colonial governments forced the colonies to vigorously follow a policy of producing export commodities, at the expense of other alternatives (Munro 1976: 155, Austen 1987: 127). Peasant cropping, with its attractive minimum cost for colonial governors, was chosen as a convenient vehicle to address this problem. This, the so-called 'peasant path' to financial solvency, became a universal phenomenon throughout the colonies, and especially in the present-day WCA. It was attained by forced involvement of ordinary peasants in the primary commodity export sector. Indeed, this coercion was sometimes so harsh that the ordinary peasants were paid not in cash, but in bills of credit to the administration's head tax (Munro 1976: 156). In the British colonies of East Africa a similar emphasis to the 'peasant path' was also followed (ibid.: 156–57).

In summary, through the process discussed above, the foundations for the existing economic structure of African countries were laid during the colonial period. This was achieved through two channels. Firstly, by directly contributing to the expansion of an enclave of primary commodity-exporting economies. And, secondly, by bringing about a situation of indebtedness, it further accentuated the importance of these activities as sources of foreign exchange required for settling of this debt. Although this general pattern was applied throughout the African colonies, some variations existed across the regions. The following section addresses this issue.

1.3.3 The Three Macro Regions of Colonial Africa: The Amin-Nzula Category

Although colonialism shaped the production structure in a similar way across Africa, nevertheless one may observe certain variations in this general pattern between different macro regions. Leaving aside North Africa, Nzula et al. (1979)[29] and Amin (1972) divide the continent into three distinct regions, based on their colonial structure. Firstly, *Africa of the labour reserves* (Nzula et al. 1979 label this 'East and Southern Africa'); secondly, *Africa of the colonial economy* (Nzula et al. 1979 label this the region 'British and French West Africa'); and, thirdly, *Africa of the concession-owning companies* (Nzula et al. 1979 label this 'Belgian Congo and French Equatorial Africa'). The fundamental distinction between these regions is derived from the manner in which the colonial powers settled the 'land question' (Nzula et al. 1979: 36).

In West Africa, commodity production did not take a plantation form. Besides, until quite recently the mineral wealth of the region remained largely untapped (Amin 1972: 115). The amount of African peasant land expropriated was also negligible (Nzula et al. 1979). However, in spite of this, the control and growth of the commodity sector was governed by European interests, while land remained in the hands of small peasants. The mechanisms for this control were as much political as economic (Amin 1972: 115). Hopkins lists a number of reasons why plantation-based production never became fully established in West Africa. Firstly, some traders were opposed to plantations for fear that they might compete with the export sector for scarce capital. (Such objections were voiced, for example, by businessmen such as Lever and Verdier.) Secondly, a few plantations, which were established, failed because of lack of capital and ignorance about tropical conditions. The third, and perhaps most important, reason why plantations failed to became fully established in West Africa was that small African peasants had already succeeded in forming an export economy by their own efforts. Moreover, establishing plantations would have created conflicts with traditional land rights. Indeed, some crops, such as groundnuts, would not have been suited to plantation agriculture (Hopkins 1973: 213–14). Finally, it is worth pointing out that it was not necessary to develop formal plantation agriculture, since it was possible to influence the nature of production and control the export supply of peasants through monopolistic trading practices, customs restrictions, fiscal controls and appropriate credit arrangements (Nzula et al. 1979: 38).[30]

In much of today's Central Africa, and part of Southern Africa, concessionaire companies, usually supported by their European state, dominated the entire economic structure through their involvement in mining, fishing, public works and communication, and even taxation (see Seleti 1990: 40). In these regions, the indigenous population were reduced to semi-slavery, and exploited by open and non-economic forms of coercion on the plantations and mines (Nzula et al. 1979: 37, Austen 1987: 140–42). The establishment of such concessionaire companies was further facilitated by the indigenous population fleeing and seeking refuge in the more inaccessible parts of the region. Discouraged by this population exodus, the colonial authorities encouraged adventurer companies to 'try to get something out of the region' (Amin 1972: 117). The activities of these companies were organized in line with demand in the 'mother country'. One example of this was the demand for raw materials required in the European war effort. Thus, the mining companies, in co-operation with colonial officials, designed and determined the nature of their enclave activity to meet the increased demand for copper and other base metals required by the European war industries (Burdette 1990: 84).

In Southern and Eastern Africa both systems referred to above were intricately interwoven with a number of specific features (Nzula et al. 1979: 36). In this region the extraction of mineral and settler agriculture was accompanied by the creation, often by force, of a small, and often insufficient, reserve of labour comprising land-owning peasants and the urban unemployed. This was undertaken with the labour demands of mineral extraction and settler agriculture firmly in mind (Amin 1972: 114, Nzula et al. 1979: 37). This labour was further supplemented by interregional migration. Other economic instruments, such as taxation, were also used to create reserve labour for European plantations and mining (Seleti 1990: 34, Koncazcki 1977: 82). The reduction of the cost of labour in such regions to mere subsistence levels rendered the exports of the colonies competitive, in comparison to similar goods produced in Europe. Clearly, the formulation of such a structure was 'as much political as economic'[31] (Amin 1972: 115, Seleti 1990: 47). However, since the focus of this book is on the economic, we do not go further into such political considerations here. Rather, we would simply observe that, during this period, an economic structure was set in place, characterized by the export of primary commodities.

By the end of the colonial period, what had been achieved in all these macro regions was the creation of a commodity-exporting economy and virtual monopoly of African trade (both import and export) by Europe (see Hopkins 1973: 174). The commodity export-led strategy was vigorously followed during this period. As a result, not only did production for overseas markets expand at a high rate, but also several new items (especially foodstuffs) began to appear on the import list (Hopkins 1973: 178). In some cases, European business interests were so pervasive that they created a protected market, on which to dump their manufactured goods.[32] Summarizing the stylized facts in the colonial period, Koncazcki described the economic pattern of what is called 'matured' colonialism[33] as having three distinct components. Firstly, both imports (which were mainly manufactured goods), and exports (mainly raw materials), were fixed with the 'mother' country. Secondly, capital investment in the colony was determined by the trading interest of the 'mother' country, and concentrated in exporting enclaves. Finally, a supply of cheap labour was ensured through a variety of mechanisms (legal, monopolistic employment and through other economic instruments; Koncazcki 1977: 75–76). Indeed, it is worth noting that this pattern has not changed fundamentally, even today.

Another important characteristic of this period relates to technological change. For example, if one focuses on cotton production, during the colonial era, Africa '...was concentrating almost entirely on export of raw cotton and the import of manufactured cotton cloth. This remarkable reversal [compared to the pre-colonial period] is tied to technological advance in Europe and to stagnation of technology in Africa owing to the very trade with Europe' (Rodney 1972: 113). Colonialism further exacerbated this situation. Thus, as Amin notes, when we speak of the exchange of agricultural products against imported manufacture (i.e., the terms of trade), 'the concept is much richer: it describes analytically the exchange of agricultural commodities provided by a peripheral society shaped in this [colonial] way against the product of a central capitalist industry (imported or produced on the spot by European enterprises)' (Amin 1972: 115).

To sum up, it has been shown that African nations were in possession of an integrated and autonomous economic structure prior to their intensive interactions with Europeans during the colonial period. It is hard to speculate what the future of such a structure might have been, in the absence of colonialism. However, it goes without saying that it would not have been what it is now, since clearly the present is the result of specific historical process. More specifically, historical interaction with today's developed countries has shaped the structure of the economic activity of African nations, particularly in the areas of international trade and finance. Indeed, economic domination, accompanied by colonization, has further cemented this structure. Thus, given such historical process it is not surprising to find that almost all African nations had become exporters of a limited range of primary products, and importers of manufactured goods, by the time of independence, in the 1960s.[34] This was further accompanied by a demand for external finance, when export earnings were not sufficient to finance the level of public expenditures required for maintaining and expanding the commodity-exporting economy. This structure has not changed in any meaningful way in the post-colonial era. Thus, when one examines the financial problems of Africa (which I am arguing relate to its role as a primary commodity exporter) one is, compelled to conclude that these problems are a direct outcome of historical process.

1.4 Some Notes on Methodology

Methodological discussions in economics are usually problematic. Mainstream economists, usually follow the Popperian approach (the theory–hypothesis–critical test/evidence–falsification or corroboration chain) (see Blaug 1992). However, it could be argued that this approach is more relevant for physics than it is for economics. Thus, some of the problems a researcher in developing countries might face while following the Popperian approach include the possibility of excluding rival explanations *ex-hypothesis* as well as the difficulty of obtaining 'evidence' or 'facts'. Moreover, as noted by Feyerabend (1975), a method, which adheres to a binding principle, stands in contradiction to the history of research/science. Indeed, openness in research, and Feyerabend's principle of 'anything goes', may be defended under all circumstance. However, as Dutt (1990) notes, the problem, which Feyerabend does not address, is how a researcher may become versed in all the relevant theories pertaining to a particular problem. Dutt's answer to this question is, 'by specializing in areas or problems' (Dutt 1990: 6). And, one might add, by explicit recognition of the fact that the researcher is dealing with an aspect of a problem which is presumed to fit the overall structure, not as a jigsaw puzzle, but as an integral part of it. This implies an obvious trade-off between depth (in the sense of deeply focusing on the particular) and breadth (which entails focusing on the overall picture).

The approach adopted in this study departs from the Popperian one in favour of a realist approach. It is our view that the adoption of such an approach represents a much more fruitful avenue of research in developing countries. This methodological framework is informed by the works of Lipton (1991), Mukhrjee and Wuyts (1991), Wuyts (1992a, 1992b) and Lawson (1989). The overall framework adopted in this study is Lipton's 'inference to the best explanation' (contrastive inference), which looks for residual differences in similar histories of facts and foils as a fruitful method for determining a likely cause (Lipton 1991: 78). This approach entails testing competing hypotheses in the process of research.

At a practical level, this general approach is narrowed down to a more refined one proposed by Mukhrjee and Wuyts (1991) in which a *working hypothesis*, is confronted with the evidence and various rival explanations. Wuyts (1992b) argues 'the best way to test an idea (wrapped up as a hypothesis) is not merely to confront it with its own evidence, but to compare it with rival explanations. It then becomes easier to detect which explanation has more loose ends or will need to resort to *ad hoc* justifications to cope with criticism' (Wuyts 1992b: 4). Once a working hypothesis has been arrived at, the dialogue between data and alternative explanations may best be handled by exploratory data analysis, which comprises graphical display, techniques of diagnostic analysis and transformation of data (Mukherjee & Wuyts 1991: 1). This does not imply that theory has no role to play. Rather, that theory is important 'as a guide to pose interesting questions which we shall explore with data' (Wuyts 1992a: 2).

The generation of working hypotheses, and the subsequent examination of these, may be pursued along Kaldorian lines (Lawson 1989, Lawson et al. 1996). In this realist approach to economic analysis, the researcher is free to start from 'stylized' facts – broader tendencies ignoring individual details – and to construct a working hypothesis, which fits with these facts. The final stage of the analysis entails subjecting the entities postulated at the modelling or explanatory stage to further scrutiny (Lawson 1989).

Building on this methodological background, the study is divided into three main sections. In the first of these, a theoretical literature study, in line with the research problem, will be undertaken. This will help to shape alternative theoretical explanations, in order that the questions and problems posed might be more clearly defined. In Part II (comprising Chapters 4 and 5) the dialogue between the data and alternative explanations will be explored. At this stage in the analysis, the researcher is faced with the practical problem of being open to all conceivable explanations for a particular phenomenon. Thus, economists might differ on their view on a particular economic phenomenon (Dutt 1990: 6). Based on this line of thinking, the underlying view adopted in this study is that the African economy has its own peculiarity. Moreover, it is suggested that different institutions and agents, both in the North and South have different behavioural rules by which they operate. This, in turn, affects the functioning of the economy. Since such structures are explicitly incorporated into this study, the book may be seen as lying within the structural macroeconomics school (see, for example, Taylor 1983 & 1991, FitzGerald & Vos 1989, FitzGerald 1993). Thus, the amalgamation of the view of an economy with the 'inference to best explanation' leads one to work under a specific paradigm à la

Khun. The wider context of 'inference to best explanation' is not lost, however, because, as research progresses, the view about the economy, and judgement about theories, follows a dynamic process of learning. Once the empirical exploration is conducted within the framework of this background, the final step is to depict the stylized facts, which emerge from the dialogue between data and theory, using modelling techniques. This is undertaken in Part III, which comprises the last two chapters of this study.

1.5 ORGANIZATION OF THE BOOK

As set out above, this book is organized in three main sections. Part I, comprising the current chapter and Chapter 2, explores some background issues and reviews a number of relevant theories. Part II, which comprises Chapters 4 and 5, presents an empirical analysis of the major issues and theories explored in Part I. In Part III (Chapters 6 and 7) these empirical issues are brought together within a North-South modelling framework. Chapter 7, in particular, is devoted to an analysis of external shocks and policies, using the model developed in Chapter 6. Finally, Chapter 8 highlights some of the major policy implications arising from this study.

In this introductory chapter, I have argued that Africa's external finance problem is the result of the structure of its trade in the context of the world economy, in general, and its place as a commodity producer in particular. I have also argued that this is compounded by the adverse effects of macroeconomic policies adopted by the Northern (industrialized) nations. The major purpose of this background discussion is to underline the existence of an economic structure, primarily built in the colonial era, which continues to shape the external economic conditions of African nations today. This discussion sets the ground for subsequent chapters, which will examine the questions posed from both a theoretical and empirical perspective.

Chapter 2 is devoted to an in-depth analysis of the key theoretical explanations for the external finance problems of Africa. This analysis is carried across financial instruments which comprise the external finance to Africa (FDI and official and private flows). The theoretical discussion presented in this chapter is used to specify the model developed in the book. The chapter will also attempt to identify theories, which may be used to explain the linkage between Africa's trade and finance problems. Cognizant of the importance of the primary commodity trade in Africa, the chapter attempts to identify theories to explain the functioning of the commodity market, in general, and terms of trade, in particular. The chapter also reviews the literature relating to commodity modelling strategies, with the aim that this might inform the commodity modelling exercise undertaken in this book.

Chapter 3 focuses on theoretical issues relating to African macroeconomics. In this chapter, a cursory look at existing African macro models is undertaken. Major theoretical issues in African macroeconomics, such as import compression, 'the fiscal response' and 'Dutch disease' effects are discussed. The chapter also describes the accounting framework, which is used to organize the macro database of the 21 sample countries, used in the study.

Chapter 4, which begins the empirical analysis section of the book, focuses on the determinants of foreign exchange supply to Africa. The chapter addresses two broad themes. Firstly, capital flows to Africa are examined. The chapter then moves on to examine other sources of foreign exchange, and, in particular, earnings from commodity exports. An attempt to understand the determinants of African export supply is conducted by locating these exports in the context of the world commodity market.

Chapter 5 examines some macroeconomic ramifications of the foreign exchange earnings discussed in Chapter 4. This is undertaken by extending the discussion presented in Chapter 2 to take account of a number of theoretical and empirical issues. Again, the chapter covers two broad themes. Firstly, the 'fiscal response' to external finance is examined, and an alternative framework for analysing the relevant issues is set out. Secondly, the 'Dutch disease' effect of such flows is described. The results obtained in this analysis feed into the global model developed in Chapter 6.

Chapter 6 represents a synthesis of the preceding chapters. Specifically, the theoretical discussion and empirical analysis set out in these chapters is formalized in a North-South economic model. The chapter begins by examining the analytical framework developed by Dutt (1990) with the aim of developing a taxonomy of the major global models currently in use. By critically examining existing models, the framework lays the foundation for the model developed in this book. The main focus of the model, which is based, among others, on Taylor (1981) Darity and FitzGerald (1982) and Vos (1994), is an elaborated modelling of Africa using a Kalecki-Lewis set-up. Most of the model's parameters are econometrically estimated for the three African sub-regions, and for the North. In Chapter 7, this model is applied in the analysis of various policy issues and external shocks. Finally, Chapter 8 summarizes the major implications arising from the policy and external shock simulation undertaken in Chapter 7.

2 Trade, Finance and Development in a Global Context

2.1 INTRODUCTION

In Chapter 1, the external finance problems of Africa were discussed. This chapter will focus on providing a theoretical perspective to this analysis. More specifically, the chapter will attempt to identify key analytical elements, which may be used to explain Africa's external finance problems. With this objective in mind, the theoretical determinants of capital flows to Africa, and the 'South', in general, will be identified. The major systemic explanations found to be relevant in explaining Africa's external finance problems will form the basis of attempts to develop a formal model. The development of such a model will be set out in subsequent chapters. The general approach chosen will be to examine the issue of Africa's external finance problems across different financial instruments, each of which is assumed to have its own specific features. With these broad objectives in mind, the remainder of this chapter is organized as follows. In section 2.2, international finance theories, which may have relevance for the modelling of Africa, within a North-South framework will be discussed. Section 2.2.1 will examine the determinants of foreign direct investment (FDI) with a view to arriving at an explanation for such flows, which might have relevance for Africa. Section 2.2.2 focuses on theories of bank lending and their relevance for Africa. Section 2.2.3 examines the theoretical underpinnings of official capital flows, which are becoming increasingly important in Africa. In section 2.3, relevant trade theories and models are explored. Finally, section 2.4 highlights some major strands of the literature, which underpin the modelling work set out in subsequent chapters.

2.2 Finance Theories, North-South Modelling and the African Context

2.2.1 Foreign Direct Investment

Foreign direct investment does not comprise a major component of external finance flows to low-income countries of Africa. Nevertheless, this section will briefly examine various theories on the determinants of foreign direct investment, in the hope that this may help to explain why this type of investment has not been important in that continent. The early neoclassical approach, summarized in an article by MacDougall (1960), hypothesized that capital flows across countries are governed by differential rates of return (within the neoclassical market setting).[1] It is argued that such capital inflows are welfare-enhancing[2] to both parties engaged in the capital movement. The MacDougall model assumes perfect competition, risk free capital movement, mobility in factors of production and no risk of default. The portfolio approach to FDI, presented in reaction to The MacDougall model emphasizes not only return differential, but also risk (Iversen 1935 and Tobin 1958, both cited in Agarwal 1980). This is strengthened by a theory which emphasizes the positive relationship between FDI and output (sales in host country) along the lines of Jorgenson's (1963) model (see Agarwal 1980).

A major criticism of these theories relates to the question of perfection in markets. Hymer (1960, published in 1976) and Kindleberger (1969) argue that, if foreign firms were able to compete and succeed in the host country, then they must be in possession of a specific and transferable competitive advantage, both over local firms, and other potential entrants into the local market. This analysis also focuses on the micro foundations of FDI, by moving from a simple capital movement/ portfolio theory to a broader production and industrial organizational theory.

Indeed, this school of thought has formed the basis for a whole strand of the literature. According to this line of thinking, some advantages of the competitive foreign firm include cheaper sources of financing, the use of brand names and patent rights, technological, marketing and managerial skills, economies of scale, and entry and exit barriers (Kindleberger 1969, Agarwal 1980).

A related micro-based theory of FDI has also emerged with the development of the Vernon's product cycle theory (Vernon 1966). The product cycle theory represents an advance on previous theories, in that it incorporates an analysis of oligopoly and strategic market considerations. Based on Vernon's theory of 'product cycle', and the existence of 'new' and 'old' goods, Krugman (1979a) further develops this theoretical avenue for explaining FDI flows. Specifically, he extends the analysis to a North-South framework with innovation (in the 'North') and technology transfer (to the 'South') representing its crucial aspects. Krugman notes that technological progress raises the marginal product of capital and provides an incentive for foreign direct investment. On the other hand, this process may be reversed through technology transfer (Krugman 1979a: 263–65). Mainstream trade theories usually underlie this type of analysis. Indeed, recent theories of trade, such as that of the 'economies of specialization' which emphasizes the existence of intra-industry (as well as intra-firm) trade, also provides scope for analysis of FDI (see, for instance, Ocampo's survey, 1986: 152–55).

Notwithstanding Vernon's contribution, a second wave of refinements to the neoclassical capital movement/portfolio theory of FDI, building upon Hymer's original contribution came with the emergence of explanations based on the ideas of 'international firm' and 'industrial organization'. The fact that decision making about FDI takes place within the context of oligopolistic firm structures – and that such investment includes a package of other inputs, such as intermediate imports and capital flows – has led to the development of alternative explanations grounded in the theory of industrial organization (see Agarwal 1980, Helleiner 1989: 1452, Dunning 1993). In this approach, as set out by Hymer, foreign firms are seen as having an advantage over local ones. The foreign firms pursuit of FDI is explained by the theory of internalization. This is characterized by the desire to minimize transaction costs, à la Coase (1937), to tackle risk and uncertainty, increase control and market power, achieve economies of scale, and ensure advantageous transfer pricing (Hymer 1976, Buckley & Casson 1976). In this approach, oligopoly power is seen as mitigating, rather than creating, market imperfection (Helleiner 1989). The recent works of Dunning (1993), which he terms the 'eclectic paradigm', represents a culmination of this trend towards a refinement of theories of FDI. Without departing much from the Heckscher-Ohlin-Samuelson theory of trade, in explaining spatial distribution of multinational firms, Dunning's paradigm summarizes this strand of theory under an 'ownership-specific, location and internalisation' (OLI) framework (see Dunning

1993). Helleiner notes that 'this "eclectic" theory of direct investment ... drawing on firm-specific attributes, location advantages and internalisation advantages – is widely accepted' (Helleiner 1989: 1253). There also exists an international trade version of FDI determination (termed the macro approach) which is associated with the works of Kojima (Kojima 1982). The Kojima model argues that FDI may be explained by the 'comparative disadvantage' of industry within the investing countries. According to Kojima's theory, this may be mitigated by investing in foreign industry, which may be able to achieve comparative advantage in the production of a particular product and potentially, even export back to the home country. Naturally, this type of FDI will also have the effect of increasing trade volumes (Kojima 1982).

Another strand of literature, which is often overlooked in mainstream analysis, are Marxist theories of FDI determination. Citing historical and other empirical evidence from Britain and the United States, Baran and Sweezy (1966) argue that FDI represents an outlet for investment-seeking surplus, resulting from stagnation in the centres of capitalism. Indeed, according to Marxist theories, FDI also represents a mechanism for extracting surplus from underdeveloped areas (Baran & Sweezy 1966: 110–11). Thus, Magdoff (1992) argues that the 1970s and 1980s exhibited a slow down in economic activity – itself an inherent feature of capitalism, according to Marxist theory – and that this slow down spurred capital to seek and create new profit opportunities. Thus, the speeded-up flow of direct investment from one country to another is itself seen as a reaction to stagnation in the capitalist centres (Magdoff 1992: 9–13).[3] According to Magdoff, the 1980s witnessed world FDI growing at an average annual rate of 29 per cent, and the pattern of such investment increasingly switching to finance and insurance, real estate, advertising and the media (as opposed to the traditional sectors of manufacturing and raw material extraction).[4] In spite of such changing patterns, Magdoff sees stagnation in the centre and the search for profit as representing the main reasons for FDI.

In sum, the theory of determinants of FDI covers a range of explanations: the pure capital movement, product cycle, industrial organization, the stagnation thesis as well as other political considerations. In the African context, the pure capital theory does not work since the assumptions simply do not hold. Neither is Krugman's hypothesis workable, since it is more relevant to countries with a good industrial base and infrastructure. As discussed in Chapter 1, the deterioration in terms of trade, combined with the debt crisis, will greatly undermine the relevance of this theory, in the African context. The most probable theoretical explanation seems to be found in the Marxist version, as well as 'industrial organization' and 'the international firm' (the 'eclectic') explanations. The Marxist version focuses primarily on the consequence of FDI, which is not the prime focus of our empirical study. Besides, its stagnation thesis may not fully explain FDI destination as much as its source and might also be inferred from the industrial organization and international firm-based theories. On the other hand, the concentration of multinational corporations in the mining sector of most African countries and, to a good degree, the importance of the colonial history in determining their spatial pattern might be taken as lending support to the importance of the 'eclectic' approach. This theoretical insight will be used in identifying the determinants of FDI in the empirical analysis and construction of the model undertaken in Chapters 4 and 6.

2.2.2 Theories of Bank Lending and Optimal Borrowing

Bank lending also represents an important source of finance for Africa. There are a number of systemic explanations for such lending. These include static/dynamic capital movement theories (MacDougall 1960, Bardhan 1967), the portfolio theory of capital movement (see Williamson 1983: 182–92, Solink 1974) and theories of credit rationing (see Sachs 1984 and Stiglitz & Weiss 1981; for an empirical study of credit rationing, see Feder & Uy 1985 and Lee 1993). All of these are essentially microeconomic explanations, tailored to a neoclassical framework. The first explains how capital is allocated across countries and generations in order to equate return differentials, with the aim of achieving optimal borrowing. The second approach adopts a portfolio choice methodology, owing to the emphasis it places on the evaluation of risk and uncertainty. However, the portfolio theory is essentially governed by the same motives as the first approach. The credit-rationing theory builds on both of the above approaches, but also incorporates a constraint based on market imperfection. A common problem in applying these approaches is their implicit belief in the workings of a competitive market, albeit with some reservations in the case of the credit-rationing theory. A further weakness is the assumption that theories based on micro behaviour may readily be carried over to the macro/international level. This theoretical underpinning greatly limits the relevance of these approaches for countries in Africa where risk, uncertainty and instability all represent significant factors, which need to be taken into account. Neither is it reasonable to assume that fully developed financial markets are available in all African countries. Indeed, most African countries are sovereign borrowers. In the following section, therefore, we will examine a number of alternative theories, which seek to explain borrowing in Africa.

2.2.3 Models of Sovereign Lending and the Institutional Response

The important distinction between lending domestically and lending to other sovereign countries has led to the emergence of a number of theories, which are summarized in this sub-section. At the heart of all of these stands the issue of how the risk of default issue is dealt with. More specifically, theorists seek to explain why creditors continue to lend to countries which do not have collateral and, hence, where risk of default is a real possibility. One of the first explanations for this phenomenon was set out in a model developed by Eaton and Gersovitz (1981). They argued that private creditors could take a number of retaliatory actions, such as exclusion from future borrowing, in order to penalize defaulting debtors by rationally anticipating the inherently dishonest nature of such debtors. For the debtor, the major cost of default is the possibility of endangering future borrowing which might be required to smooth the variability (and growth) in its income (Eaton & Gersovitz 1981).

According to some authors such as Cooper and Sachs (1985), countries' capacity to borrow, and pay their international debt is likely to depend on the nature of their crisis. This may take three general forms. Firstly, they may become insolvent, and so, incapable of servicing their debt in the long run. Secondly, they may become illiquid, and so not have cash on hand to pay outstanding debt obligations. Or, thirdly, they may be insouciant, that is, unwilling to pay, being conscious of the fact that there are economic gains to be had by repudiating debt (Smith & Cuddington 1985: 21–26, Eaton & Taylor 1986: 217–20). Cooper and Sachs (1985) also raise the possibility that, if debtors should become illiquid, but not insolvent, that this may lead to rescheduling or moratorium mainly as a consequence of panic and failure of individual banks to co-ordinate their actions.

Building on this last suggestion, Sachs (1984) attempts to develop a simple model of debt-repayment feasibility. Thus, he argues that, for debtor nations to be able to repay their debts, requires that their indebtedness at any particular time should not exceed the 'national productive wealth' (defined as the discounted value of GDP net of investment). In other words, that debtor nations should not become insolvent (Sachs 1984: 6–7; see also Smith & Cuddington 1985). In Sachs' model, optimal borrowing is arrived at by maximizing consumption, subject to a production function, capital stock, level of consumption and the maximum possible debt (Sachs 1984: 6–8).[5] Sachs also analyses the possibility of default and considers this to depend on the benefit and costs of repudiation. Thus, the borrower is considered to be a rational economic agent who will default when the cost of default is comparable to the level of relief from debt that would be obtained by defaulting. Sachs also notes attempts to diversify this risk (especially by American banks) as well as the formation of syndicated banks to tackle such problems. Indeed, he argues that a borrower confronted with problems of liquidity (as opposed to insolvency) can more easily and safely be provided with additional loans by syndicated, than individual banks. Syndication may also help to avoid the 'free rider' problem, in which an individual lender may demand full repayment at the time that other lenders reschedule (Sachs 1984: 33). Similar arguments have also been developed in an earlier work of Cline (1983).

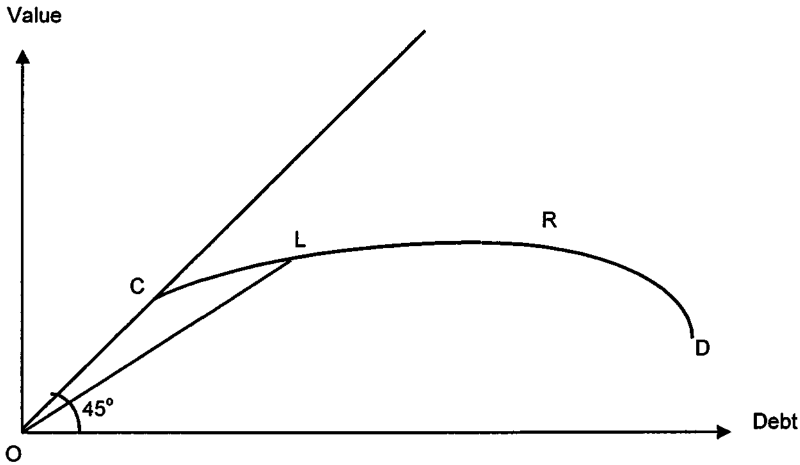
The first major weakness in both Cline's (1983) projection model and Sachs' (1984) approach is that they consider debtor countries as representing rational atomistic agents in a perfect market setting, capable of assessing the benefits and costs of repudiation. However, in practice, the structure of capital markets, combined with trade sanctions, denies any such choice to debtors. Thus, Bulow and Rogoff (1989) have developed a model, which explicitly addresses this issue. They argue that, although collateral is insignificant and limited (except possibly in aircraft financing), debtors' desire to maintain a good reputation, taken alongside lenders capacity to impose sanctions that will impede trade and financial market transactions, together represent effective incentives to ensure repayment. Of these, the latter is likely to be the more important. Moreover, as Bulow and Rogoff point out, previous models invoke penalties without exploiting the possibility of negotiation. However, such negotiation *is* possible and bargaining-theoretic approaches may be applied in explaining these (Bulow & Rogoff 1989). The second weakness of the Sachs- and Cline-type models is that, by focusing primarily on the individual lenders' perspective, they downplay the potential impact of efforts towards syndication. Some obvious examples of the potential effects of syndication include mark-up pricing, commissions, and, market segmentation. Another extreme example is where borrowers are forced by such syndicated lenders to accept a policy, such as structural adjustment programmes, in line with the objectives of these lenders.

It should be noted that the earlier theories are essentially neoclassical since they assume the existence of optimizing agents, acting in a competitive capital market with the possibility of imperfection (as in the case of credit rationing). One problem with these theories is that the neoclassical assumptions clearly do not apply in a situation characterized by 'sovereign borrowers' and syndicated lenders. Hence, the importance of such 'concerted' lending is emphasized in the works of Cline (1983) and Sachs (1984). However, it is not reasonable to assume that the institutional response to the debt crisis evolved from the atomistic actions of borrowers and creditors making decisions based on a marginal assessment of risks and returns within a neoclassical market setting. Rather, the importance of analysing the institutional response to the debt problem is increasingly being recognized.

In Folkerts-Landau's (1985) view, it is precisely the problem of 'sovereign risk'[6] and the simplicity of tackling this through syndicated international bank lending which has led to a shift in the nature of development finance. Thus, from the use of bond finance and direct investment, common in the 1920s and 1930s (and to which the above theories relate), international bank lending became increasingly important during the 1970s and 1980s (see also Bacha & Alejandro 1982, Kletzer 1984, Sachs & Cohen 1984 cited in Eaton & Taylor 1986). Folkerts-Landau proposes two explanations for this phenomenon. Firstly, 'financial authorities were perceived as being increasingly willing to protect the deposit liabilities of their large money-centre banks'. Secondly, international banking proved to be effective in tackling the risk of lending to sovereign borrowers by taking collective action such as limiting access to capital markets. This led to restructuring of debt, through rescheduling and stabilization programmes (Folkerts-Landau 1985: 317–18).[7] As part of a logical effort to address the issue of competitive market failure, Folkerts-Landau argues for an institutional evolution of banks, who are seen as moving 'away from pricing to offset the expected risk of outright default to a new system where rates on syndicated international credits reflect only the (lower) expected cost of rescheduling'. This has resulted in a lowering, and reduction in the variability, of interest rates on loans, even compared with those of the well-developed domestic financial markets of the North (Folkerts-Landau 1985: 332). Folkerts-Landau's approach is rooted in treating the bank as a firm, rather than simply as an investor, as is the case in portfolio theory. Thus, the bank, acting in its capacity as firm, is seen as pursuing a strategy, which entails more than one goal. These include, *inter alia*, market share, stability, as well as a host of goals other than profit maximization (see Vos 1994). A related explanation is the concept of 'loan pushing and revulsion'. The essence of this argument is that commercial banks lent to LDCs in a syndicated fashion, in reaction to a weakening in demand for loans from sources in the developed world. However, as loan levels built up, and perceived risk grew, banks began to feel pressure to retreat from this type of lending. The preferred tactic adopted in such a situation was usually a shortening in the maturation period on loans (see Eaton & Taylor 1986: 239–41).[8]

Finally, the late 1980s and early 1990s witnessed the inability of debtors to pay back their debt and consequent debt overhang problems. This led to a number of theoretical advances relating specifically to the development of efficient, usually market-based, methods of debt forgiveness (see Cline 1995, Cohen 1994). This is well summarized by the *debt Laffer curve,* associated with Krugman (1989; see Diagram 2.1). On this, the vertical axis measures the expected payment and the horizontal axis the nominal value of the country's debt. The relationship between the two is depicted by the curve CD. At lower levels, nominal debt may be expected to be fully repaid (OC equals the 45°-line). The ray OL gives the ratio of expected to nominal debt. Assuming risk and transaction costs away, this ray gives an idea of the secondary-market price of debt. A movement away from C is associated with a declining secondary-market price: The curve DRLC, the *debt relief Laffer curve,* shows that, in a similar way that government tax rate reduction might increase the total level of tax revenue collected, so too creditors may increase expected payment by forgiving part of a country's debt. This type of incentive effect usually becomes significant when the debt is very large, such as beyond point *R*, in Diagram 2.1.

Diagram 2.1 The debt relief Laffer curve (Krugman 1989: 264)



To sum up, we have noted that the assumptions, upon which the static/dynamic and portfolio theories of capital movement are based, ignore both the institutional framework, within which the market operates, and the evolution of institutions, which market problems give rise to. Folkerts-Landau's approach and the 'loan pushing' theories are just some of the attempts to address these issues. As the empirical analysis on credit rationing also shows, as far as African economies are concerned, the capital market is clearly a segmented one. This segmentation of the capital market, and resulting credit rationing, gives a powerful insight into how African economies are positioned within the global financial market (see Vos 1994). Such institutional development can also shape the nature of official capital flows, influencing, for example whether these are likely to take bilateral, multilateral or some other form. Such flows, which have different institutional features, are particularly important for Africa. Therefore, the next section will examine the theoretical underpinnings of these flows.

2.2.4 Official Capital Flows

Official capital flows – comprising bilateral, multilateral, concessional and non-concessional loans, and foreign grants – represent an important component of financial flows to African countries. The basic questions which we set out to answer in this chapter are 'what determines official capital flows to the South?' and 'why such flows?' The search for an answer to these questions leads one to different, sometimes conflicting, theoretical explanations. Thus, one school of thought maintains that capital flows are determined by the *economic and geo-political* interests of donors. Indeed, this suggestion finds support in a number of studies (see, for example, Mikesell 1968, OECD 1985, Mosley 1985, Ruttan 1992, McGillivray & White 1993). Another major explanation for these aid flows relates to humanitarian or developmental considerations (studies supporting this viewpoint include Streeten 1976, cited in Gasper 1992; Riddell 1987; and the 'aid as a public good' literature of Mosley 1985, Dudley & Montmarquette 1976 and Frey 1984).[9]

A number of studies investigate one or both of these explanations empirically. Indeed, Beenstock (1980), Mosley (1985) and White and McGillivray (1992, 1993) have gone so far as to portray these empirically-based studies as representing a distinct approach, devoid of theory. However, I prefer to view these simply as empirical manifestations of the first two theoretical explanations.

These three strands of the literature will now be discussed, and an attempt to relate this discussion to Africa's economic conditions, as discussed in the previous chapter, will be made. I begin by examining the literature, which sets out to explain capital flows to Africa in terms of *economic and geo-political considerations,* before moving on to examine *aid as public goods* as well as *empirical explanations* for such flows.

2.2.4.1 Economic and geo-political factors

Here, again, we are seeking to answer the basic question 'why such flows?' However, we will also examine the interrelated issue of how these flows are distributed among countries. It could be argued that this issue is simply an empirical manifestation of the first question. Hence, creating a dichotomy between these, as White and McGillivray (1993), and others, have done, may be analytically problematic (unless this is considered as simply representing a problem of 'operationalizing' within a quantitative studies framework).

In an attempt to answer the first of the above questions, Ruttan (1992) examines the philosophical underpinnings of foreign aid. Ruttan maintains that there are two arguments for such aid. Firstly, 'economic and strategic self-interest', and, secondly 'ethical[10] responsibility' of donors. According to the author, the former entails an inherent contradiction since 'self-interest' goals may usually be achieved at a cost to the recipient country. As far as the 'ethical argument is concerned', Ruttan maintains that 'in a society of free people the concept of social or distributive justice has no meaning'. Stated differently, 'justice is a function of the rules or processes that govern individual and group behaviour and not of the outcome generated by the rules'. Citing Bansfled (1963), Ruttan notes that the extreme argument can be 'our [the North's] political philosophy does not give our government any right to do good for foreigners' (Ruttan 1992: 219). However, Ruttan questions the validity of the ethical argument when writing 'I would personally prefer strong behavioural foundation on which to rest conviction about moral responsibility for assistance to poor countries' (ibid.: 220). Notwithstanding Ruttan's doubts, the ethical or moral argument, as set out by Streeten (1976), is founded on a belief: (a) that there exists a 'brotherhood of men' *[sic]*; (b) that the poor are not fully responsible for their poverty; and, (c) that the rich are partly responsible for this poverty. Opeskin (1996), Riddell (1987) have also pursued a moral case for inter-governmental foreign aid (see also Gasper 1992: 6–8).

According to the OECD's (1985) explanation, its aid in 1950s was governed by strategic consideration (*vis-à-vis* the USSR). During the 1960s, the level of aid declined, due to economic problems in donor countries. In the 1970s and 1980s, the oil crisis brought new demand and supply into the market. However, in general, OECD countries maintained aid flows, in line with the long-run political and economic interests of the industrialized countries, and the general humanitarian leanings of Western civilization (OECD 1985:13–14). Hence, the exact geographic distribution of such aid is governed by the bilateral donors' perceptions of these driving forces.

Mosley et al. (1987) summarize the argument by identifying three 'universal' reasons for aid. Firstly, aid may have a *redistributive* function, being motivated by a sense of responsibility for the poor. Secondly, aid may have an *allocative* function, given perceived imperfections in capital markets. And, finally, aid may have a *stabilization* function, being disbursed with the aim of augmenting world aggregate demand and reducing unemployment. Further, at what Mosley et al. terms a 'particular' level, bilateral aid may be used to buy political support and increase exports from the donor country (Mosley et al. 1987: 12). However, this approach has been criticized since the weight attached to Mosley et al.'s 'universal' reasons are very controversial and, thus, give rise to a number of empirical questions, which we discuss below. It can also be argued that Mosley et al.'s 'particular' reasons are incomplete, since they ignore syndicated efforts to achieve those bilateral motives, which are increasingly being made 'universal' among donors. It is worth noting that Mosley et al.'s (1987) work is recent enough that it could have taken account of such developments.[11]

Magdoff (1969, 1992) argues that capital flows from the North to South are best understood as part of the historical development of capitalism, which he sees as born in the process of creating a world market. Hence, growth in the core industrialized countries was associated with a centuries-long spread in the sphere of influence of these countries, through conquest and economic penetration. (According to this viewpoint, the drive for accumulation and control of raw materials is believed to push business beyond political boundaries.) He observes that growth of industrial production has slowed from decade to decade (between 1960 and 1990), and that this has spurred capital to seek and create new profit opportunities. Thus, for Magdoff, it is within this general context that flows of capital are best understood (Magdoff 1992: 45–50). With regard to the specific issue of aid, for Magdoff, this is simply an instrument of control to ensure the political, economic and military interests of the donor nations (Magdoff 1969: 117).

This broad theoretical/philosophical discussion is manifested in specific cases. Thus, Miksell (1968) attempts to explain official capital flows by examining these from the US and European perspective. For the former, such flows represent an instrument of foreign policy as well as a mechanism for securing national security, particularly in the context of the cold war. Capital flows were also used to obtain economic benefit, particularly through the use of export credits and the promotion of direct foreign investment. However, Miksell questions whether these flows are best explained by business, national interest or humanitarian[12] motives. For Europe, these flows are seen as a continuation of the colonial/dependency relationship (Miksell 1968: 1–14).

2.2.4.2 Aid as a public good

The other attempt to explain the underlying reasons for aid is articulated around the theory of 'aid as public good'. Mosley (1985) distinguishes between studies, which attempt to explain aid in terms of the theory of public goods, and those, which adopt an empirical approach, without attempting to apply explanatory theory. Vos (1994) terms the latter a 'descriptive and empiricist approach' and the former as 'theoretical approaches' (Vos 1994). Mosley's approach is to treat foreign aid as a public good in an imperfect market with ignorant consumers (namely, donor country taxpayers). Citizens are assumed to have a demand for this public good and they are able to adjust their actual consumption to the desired level not simply through the market but also through political action. However, it is worth pointing out that both governments and electors may be ignorant about the end product of aid, and, indeed that voter's demand for aid could be altruistic. These facts effectively allow Mosley to exclude the 'price' of aid (in the form of donor country taxes) from his aid demand equation. This leaves the relative level of donor's income, together with the quality of aid (the degree of concessionality), as determining factors. Supply is seen as being determined by the previous year's budget, which is marginally influenced by the treasury and a reflection of the state of domestic economy. White and McGillivray (1992) have termed this the administrative/incremental approach. Other factors seen as influencing supply are the relative performance of other donor countries (a sort of 'bandwagon effect') as well as an adjustment parameter between supply, as determined by the above factors and the electorates demand for such aid.

Based on this empirical approach, Mosley concludes that, past disbursements, as well as other countries' disbursements, represent significant determinants of aid supply. On the other hand, international aid is found to be mildly responsive to the state of the donor nation's domestic economy. This last result leads Mosley to conclude 'either that my original hypothesis about the public demand for aid was wrong or simply that the government of that country has not chosen to respond to public demand'. However, there are three basic problems with this approach. Firstly, there is no reason to expect that electors in the North will act effectively in support of increased aid flows by voting, where aid represents a negligible issue in the overall political process. Secondly, factors posited as influencing supply, are likely to explain only the marginal effect and not the central cause. Thirdly, and perhaps related to the second point, one can hypothesize that the demand-side finding (aid's insensitivity to the economic conditions in the donor country) might be attributed to the view that aid is a necessity (not a luxury) to the donor. It might also be taken as showing that, in general, the assumption of no difference between the objective of the consumers (electors) and the government of countries in the North is too weak to theorize upon.

Dudley and Montmaquette (1976) adopt a similar approach to that, later adopted by Mosley, in that they see aid as a public good, consumed indirectly by donors, or, alternatively, donated with the expectation of receiving something, intangible and difficult to quantify, in return. Thus, based on this line of thinking, it could be argued that donors' supply is determined by their own demand. The authors attempted to model supply at two levels: with and without administrative costs. In the latter model the probability of grant is related to the income and population size of the recipient. The empirical conclusion of the model is that granting aid is a decreasing function of recipient per capita income, as well as economic, political and 'bandwagon' (relative to other donor) considerations. Frey (1984) also attempted to explain aid flows, by considering these as a public good, even though his empirical evidence suggests that aid is not a public good from which all nations benefit. Frey's approach differs slightly from the others, in that he combines the concept of aid as a public good with the use of game theory. In his approach the recipient country is characterized as maximizing aid, or maintaining its independence, in a situation where donors are seen as competing with each other. Frey's main conclusion is that such interaction is quite complex, and hence that 'the behaviour of each actor has to be identified before any conclusion can be drawn' (Frey 1984: 95).

2.2.4.3 Empirical studies

A further branch of the literature comprises empirical studies which seek to answer the question 'why aid?' In one of the earliest studies, McKinley and Little (1979) develop a 'recipient need and donor interest model' which sets out to examine the 'humanitarian' versus 'national (donor) security' explanations for aid flows. According to this 'recipient need model', aid should be allocated in proportion to the economic and welfare needs of the recipient, otherwise, such aid is simply fulfilling the donor's interests, either as a commitment, or as leverage strategy. After discussing, at length, how these propositions might be operationalized, McKinley and Little conclude that the recipient need argument is likely to be a secondary one. However, while this paper focuses on bilateral issues, syndicated efforts are more widely followed today by international and regional organizations, in their effort to realize donor interests. In this study, we do not examine this phenomenon. However, we would refer the interested reader to Anyadike-Danes and Anyadike-Danes (1992) review of evidence relating to European Community (EC) aid to the African Caribbean and Pacific (ACP) region. They conclude that such aid is strongly associated with the pre-Lome association.

However, most econometric studies of recipient need models are not so robust. Having surveyed such models, White and McGillivray (1993) note that the separate estimation of recipient need/donor interest models suffers from specification error due to the omission of relevant variables, which are usually not orthogonal, (i.e., correlated with all included variables). This, they suggest, leads to OLS estimates with bias. They argue that this problem is inherent in the very methodology of this approach. White and McGillivray illustrate how different results may be obtained if one allows for correction of such specification errors (White & McGillivray 1993: 36–41). To this, one might add the observation that such time series studies might as well suffer from spurious regression.

In his study, which sets out to explain what determines total aid volumes, Beenstock (1980) starts from the assumption that political factors affect the geographical distribution and not the total volume of aid. He points out that, whatever the objective of aid, its volume is constrained by GNP (or GNP per capita), the balance of payment, levels of unemployment and the size of net budget surplus of the donor state. At a statistical level, all signs are as expected and, with the exception of the budget term, all are significant at a 5 per cent significance level (Beenstock 1980: 142). Using a time trend, Beenstock also tested whether there was a tendency for ODA to increase over time. He concludes that that there is a positive trend. Although Beenstock's analysis focuses on the supply side of the issue, this analysis does not explain the central reason for aid. Further, it is quite difficult to envisage a situation where politics is used solely in allocation, and not also in the determination of total supply.

Finally, this section will conclude by summarizing the findings of a recent survey of the literature on allocation of aid, undertaken by White and McGillivray (1992, 1993). White and McGillivray adopt two broad classification schemes: firstly, *descriptive measures,* which are evaluative in their nature, while measuring donor performance (White & McGillivray 1992: 1); and secondly, *explanatory studies* which trace their origin to political-economy theories, and base their explanation on 'political, strategic, commercial and (albeit often begrudgingly) humanitarian motives[13] (White & McGillivray 1993: 2). These surveys raise a number of important issues, which are useful at various stages in the subsequent analysis. They conclude by maintaining that models should approximate the actual practice of aid determination process. Perhaps more importantly, these surveys also highlight how aid allocation is the outcome of a bureaucratic decision-making process, economic, political and other relations between the donor and the recipient (White & McGillivray 1993: 68). This line of thought will be re-examined in subsequent sections of this book, in which issues of empirical analysis will be addressed.

2.2.5 Conclusion

To sum up, this section has attempted to examine a number of systemic explanations for the determinants of capital flows, with the aim of understanding the external finance problems of Africa. This analysis has been carried across three categories of capital flows, namely FDI, bank lending and official flows, each of which has its own peculiar features. A number of implications of each of these types of capital flow for the rest of this study may briefly be outlined.

Firstly, looking at FDI, it is noteworthy that the level of this type of capital flow to African countries is extremely low. This may broadly be attributed to low levels of infrastructure, poorly developed markets and absence of a skilled workforce in many African countries. (Indeed, for similar reasons, levels of portfolio investment in most African countries are also insignificant.) Since such factors are implicitly assumed to be similar in many of the earlier capital movement and technology-based FDI theories, their relevance to Africa is likely to be limited. However, an eclectic approach could be important in demonstrating empirically why levels of FDI to Africa are so low. Indeed, such an exercise is undertaken in Chapter 4, and the results of this analysis are used to construct the model developed in Chapter 6.

Bank lending in Africa largely falls under the 'sovereign lending' category. This is particularly the case since most loans are either public, or publicly guaranteed. However, for Africa, accessing this market may not always be straightforward. The empirical evidence also supports the segmented nature, and prevalence of credit rationing in this market, as far as Africa is concerned. Thus, the segmented capital market and credit-rationing framework gives an important insight into the analysis of bank lending to Africa. Indeed, this insight is used in building the international banking sub-block of the model developed in Chapter 6.

Nonetheless, whatever the nature of lending, the sustainability of debt, as discussed in Chapter 1, requires a reduction in vulnerability in the export market, as well as sustained investment, especially in infrastructure. These fundamental problems are not addressed, and in fact are aggravated, by the policy of stabilization and structural adjustment being implemented in Africa. In the recent past, these polices have also led to an increase in the importance of official flows, often on concessional terms. If one is to fully understand how these policies operate, therefore, one not only needs to understand their impact (as discussed in Chapter 5), but also the determinants of such official flows. Indeed, this information will prove extremely useful in attempting to model the patterns of such official flows. Again, based on the literature discussed above, the economic, strategic and political self-interest and developmental considerations arguments could give us an important handle on this type of flows. Hence, in combination with the empirical analysis discussed in Chapter 4, this insight will be used in building the official capital flow sub-block of the model developed in Chapter 6.

To sum up, although the discussion, so far, has been helpful in sharpening our understanding of the financial side of the external finance problems of Africa, as argued in Chapter 1, this only represents one side of the inquiry. Rather a more fundamental issue is the impact of trade on the external finance problem of the continent. In the next section, therefore, we will attempt to give a theoretical underpinning to this issue.

2.3 INTERNATIONAL TRADE THEORIES AND THEIR RELEVANCE IN MODELLING AFRICA

2.3.1 A Brief Overview of Trade Theories and their Implications for Africa

In the African context, the implications of the classical trade theories (Smith 1776, Ricardo 1817) relate to Africa's role as specialist producers of primary commodities. The rigidity of the classical school's assumptions, particularly in relation to the structure of costs, led to the evolution of the neoclassical (or orthodox) trade theories developed at the turn of this century (Heckscher 1919, Ohlin 1933, Stopler & Samuelson 1941, Samuelson 1948). The emphasis on factor endowment differentials as the source of trade in these theories, in turn strengthened the policy implications of the classical theories about Africa, and in particular the continent's role as a specialist producer of primary commodities and tropical products.

By late 1950s and 1960s, the importance of technology in explaining world trade patterns led to the emergence of trade theories based on technological gaps (see Posner 1961, Hufbauer 1966 and Vernon 1966). These theories – for instance, the approach advocated by Vernon – helped in the development of a North-South model based on the importance of technology and innovation (see Krugman 1979a). Although coming from a slightly different perspective, Emmanuel had also put forward a similar proposition, in the early 1970s. Both Emmanuel and Krugman questioned the factor mobility assumptions of traditional trade theories. However, they differ in that, while the former focuses on labour, the latter is more concerned with technology. In both cases, however, the South is placed in a relatively disadvantageous position. In general, technology gap models within a North-South perspective require a high level of infrastructure, with cheap, semi-skilled labour, and are based mainly on trade in manufactured goods. However, such a structure may apply only to a fraction of the countries in the South, and is certainly not relevant for Africa (see also Stewart 1984: 92).

The apparent failure of the above theories in explaining the evolving trade patterns, especially among developed countries, has led to the development of other theories based on imperfect competition and scale economies. Partly inspired by the technological gap models of the 1960s (see, for instance, Posner 1961: 329), as well as dynamic and industrial organization theory, which their exposition implied, writers such as Krugman (1979b, 1980, 1981), Dixit and Norman (1980), Lancaster (1980), Helpman (1981), Ethier (1982), Lall (1973) and Helleiner (1981) have developed what might be called the 'new'[14] trade theories.

According to Krugman's excellent summary, there are at least two distinct features of these theories which distinguish them from the traditional ones (Krugman 1992). Firstly, the importance of *increasing returns/scale economies* as a cause of trade; and secondly, the need to model international markets as *imperfectly competitive*. Two distinctive features are usually emphasized here: firstly, 'intra-industry' trade[15] (see Balassa 1967; Kravis 1971; Grubel 1970; Dixit & Stiglitz 1977; Krugman 1979b, 1980, 1981; Dixit & Norman 1980; Lancaster 1980; Ethier 1982; Falvey 1981; Helpman 1981); and secondly, 'intra-firm' trade (see, among others, Lall 1973, Helleiner 1981). In the former case, economies of scale, and trade in differentiated products are emphasized. The latter, on the other hand, emphasizes the importance of transfer pricing in the operation of multinational enterprises (MNEs), the irrelevance of the nation state as a unit of analysis as well as the importance of joint profit maximization by all the subsidiaries of such enterprises.

What, then, are the implications of these theories in the African context? According to Stewart (1984), the new trade theories are designed primarily to explain trade patterns in the North, in which there exists a great deal of preference similarity (see Linder 1961). When these theories are observed, within a North-South perspective, the South is generally found to have a comparative disadvantage, since it does not have the market size (with appropriate income) to exploit economies of scale. Moreover, attempts to move into larger markets would entail a transportation cost, which would further accentuate this disadvantage. Apart from this fact, owing to income differential, the combination of characteristics of preferred consumer and producer goods differs between the two regions. This implies lower welfare for the South, since it has no alternative but to consume Northern products. Besides, free trade at the initial stages, under such a set-up, effectively eliminates local production in the South. The logical implication of this theory is that South-South trade should take place (Stewart 1984). However, Stewart warns that further evaluation is required, in order to determine whether South-South trade is best seen as a substitute for, or a complement to, North-South trade.

Based on his analysis of intra-firm trade, Lall (1973) notes that the welfare impact of such trade has resulted from a bargaining process between MNEs and the South. The existence of intra-firm trade acts 'as a powerful bargaining counter in the MNEs' favour, enabling it to conceal from the government a crucial item of information' (Lall 1973: 190). Similarly, Helleiner (1981) stresses that transfer pricing by MNEs adversely affects gains by the South through tax evasion, transfers, and legitimate share of profit of joint domestic owners. In terms of the structure of Southern economies, he argues that intra-firm trade has the effect of creating an enclave sector and ill-formed import substitution industries in the South. This also affects the direction of volumes of trade towards the interest areas of the MNEs, at the expense, say, of regional integration (Heleiner 1981: 14–15). In a nutshell, he concludes that the intra-firm framework implies that the future expansion of the South's trade could be managed as part of the long-term investment planning of MNEs, in order to minimize possible later disruption or surprises (Helleiner 1981: 65). To sum up, the relevance of the 'new' trade theories in explaining trade between North and South, as opposed to North-North trade, is highly limited. This implies that a search is needed for other systemic explanations, which might help to explain North-South trade, in general, and trade in primary commodities in particular. This is undertaken in the following section.

2.3.2 Non-orthodox Models and Trade in Primary Commodities

In parallel with the above theories, a critical (non-orthodox) school has provided an alternative analysis about the gains from trade. Analysts from this school have focused particularly on North-South trade. This is discussed in the next two sub-sections. Since primary commodities represent the most important component of the South's trade, in general, and Africa's trade, in particular, in this section we will briefly survey a number of issues relating to the modelling of primary commodities. This focus on modelling stands in line with the general objective of this book, which is to develop a formal model for this market and integrate this into a global macro framework. Such an approach helps in the analysis of external shocks, and is also useful in terms of setting policy options within a wider framework.

2.3.2.1 Unequal exchange

The distinction between the structuralist school and Emmanuel's unequal exchange theory is a blurred one. This is particularly the case in relation to terms of trade. Although, chronologically speaking, the ideas of Prebisch and Singer precede those of Emmanuel, for various reasons we begin by examining the unequal exchange theory. Firstly, the unequal exchange theory sets a general framework for a discussion of deterioration in terms of trade. Secondly, the alternative, structuralist school's view was still being debated as recently as the 1990s. And, finally, such non-chronological ordering is helpful, in terms of linking the discussion to current issues concerning primary commodity production and trade by African countries.

Emmanuel's (1972) unequal exchange theory is informed by an attempt to understand why there has been a secular deterioration in the terms of trade in primary commodities produced by developing countries. More specifically, the theory questions whether this results from the fact that these commodities originate from poor countries (Emmanuel 1972: xxx).[16] Bacha (1978) and Ocampo (1986) beautifully summarized the main argument of the unequal exchange theory using a few equations. Thus, if we let w_i be the real wage in country i in terms of Southern commodity, q average productivity of labour, P price, and employ the Ricardian assumption of capital as wage fund, on which a uniform international average rate of profit r is made, owing to capital mobility, then the equilibrium price is given by:

$$P = (1 + r)\, w_N / q_N \qquad [1a]$$

$$1 = (1 + r)\, w_S / q_S \qquad [1b]$$

Under these conditions, the barter (P) and factoral (f) terms of trade are given by:

$$P = (w_N / w_S) / (q_N / q_S) \qquad [2]$$

$$f = w_N / w_S \qquad [3]$$

Emmanuel maintains that 'it [is] clear that inequality of wages as such, all other things being equal, is alone the cause of inequality of exchange' (Emmanuel 1972).[17] Gibson (1980) labels this casual association of relative wages and the barter terms of trade the 'Fundamental Theorem of Unequal Exchange' (cited in Ocampo 1986: 132). However, the unequal exchange theory has been severely criticized from a host of different angles (see, for instance, Bettelheim 1972, Amin 1974a & 1974b, Mack 1974, Kay 1975, Sau 1978 and Johnstone 1980).

2.3.2.2 The structuralist school and the Prebisch-Singer hypothesis

The discussion about terms of trade has taken concrete form in the works of the 'structuralist' economists of the Economic Commission for Latin American and the Caribbean, ECLAC (Prebisch 1950 reprinted 1962, and Singer 1950).[18] Having highlighted the enclave nature of export sectors, and the role of industry within a protected domestic market as a dynamic force for growth, Singer goes on to argue against specialization in the export of primary commodities. This stands in contradiction to traditional trade theories. The main reasons he gives for this are twofold. Firstly, that it removes the secondary and cumulative effects of investment, since such investment usually comes in the form of foreign capital, which is not reinvested. And, secondly, that it diverts investment in developing countries to areas where the scope for technical progress is limited and worsening terms of trade prevail (Singer 1950: 477).

For Singer and Prebisch, the root cause of the terms of trade deterioration is the fact that the increase in productivity of manufactures in the North raises the income of producers, as opposed to lowering prices, which would have benefited consumers. On the other hand, productivity improvements in primary commodity production, benefits consumers through lower prices. Thus, developed countries benefit, both as consequence of higher income and lower prices, while no such benefits are reaped by the developing countries. In Kaleckian or Hicksian terms, the essential point is that the North sells in an oligopolist fix-price market, while the South operates within a flexi-price one. This results in a logical asymmetry in favour of the former (see Spraos 1983 for a critical review of this). The demand elasticity for food, and negative impact of technical progress on raw material demand further aggravates the problem (Singer 1950: 478–79, Prebisch 1962: 4–6).

In addition to the elasticity argument noted above, Singer and Prebisch have also emphasized the adverse impact of cyclical commodity prices. Singer argues that the developing countries could face a dilemma in that they could fail 'to industrialize in boom because things are as good as they are, and [they fail] to industrialize in a slump because things are as bad as they are' (Singer 1950: 482). Similarly, Prebisch explains how the business cycles, which arise from imbalance between aggregate demand and supply in the centre, could pass to the primary producers of the periphery, and so result in ups and downs in prices. Thus, Prebisch argues that rising profits are bound in with economic upswing in the center. This has the effect of curtailing excess demand by increasing prices, with the opposite effect taking place in a downswing. Thus, as prices rise, profits are transferred to the South, since prices of primary commodities tend to rise more sharply than those of finished goods. However, the prices of primary products 'fall more in downswing, so that in the course of the cycles the gap between prices of the two [finished and primary] is progressively widened'. The main reason which Prebisch gives for this fact being the downward inflexibility of wages, for organizational reasons, as well as profit, arising from profit earners prominent role in production in the North.[19] Demonstrating the deterioration in terms of trade of the South using price-index data, Prebisch maintains a similar view to that of Singer (Prebisch 1962: 5–7).

Patnaik (1996) notes that the disadvantage of specializing in primary commodity exports is usually assessed based on an analysis of demand side or market structure. However, he argues that the problem can also be seen from the supply side. Thus, Patnaik constructs a model in Kaleckian line of supply-constrained agriculture as well as a demand-constrained manufacturing sector. Under such a framework, exports may be seen in terms of external demand for primary commodities and a source of finance for the import of manufactured goods. Such trade, even assuming the small country assumption, non-diminishing returns, and a balanced trade, entails a decline in demand for the domestic manufacturing sector and, hence, output and employment, for a given level of real wages, or, indeed, vice-versa. This de-industrialization will affect agriculture retrogressively, and this, in turn, affects the manufacturing sector in the familiar Kaleckian way of bringing about a shortage of wage goods.[20]

2.3.2.3 The Prebisch-Singer hypothesis and empirical evidence

The hypothesis of a secular deterioration in the terms of trade of primary commodities *vis-à-vis* manufactured goods, termed the *Prebisch-Singer hypothesis*,[21] has generated a number of empirical studies. The debate relating to these studies is summarized in Sarkar (1986). Based on this review, Sarkar basically concludes that the Prebisch-Singer hypothesis is valid (Sarkar 1986).[22] Similarly, debates about the quality of data problem would appear to be resolved[23] following reconstruction of the 'G-Y series' data, upon which recent work has been based, by Grilli and Yang themselves (Grilli & Yang 1988). Indeed, based on this reconstruction, Grilli and Yang confirm the validity of the Prebisch-Singer hypothesis, although at a smaller magnitude than originally claimed by Prebisch (1962).[24]

Recently, with developments in time-series econometrics, there has been renewed interest to re-examine the Prebisch-Singer hypothesis. Thus, Cuddington and Urzua (1989) and Cuddington (1992) have re-examined the hypothesis using modern time series econometric techniques. More specifically, they have questioning the earlier trend stationary approach, conducted without a formal stationarity test. Claiming to find non-stationarity in the G-Y series, they concluded that 'secular decline' in the price of primary commodities should not be interpreted as a 'stylized fact'. However, neither of these studies challenges the underlying theory, nor, indeed the statistical validity of this theory. In re-examining Cuddington and Urzua's work, Ardeni and Wright (1992) highlight three methodological problems. Firstly, Ardeni and Wright question the use of a simple correlogram of the series as a guide for their specification. Secondly, they note that Cuddington and Urzua ignored the low power of the Dickey-Fuller test, in the case of closer alternatives. And, thirdly, they highlight a number of problems relating to the use of the dummy. Perhaps more importantly, they also cast doubt over the non-stationarity assumption of the series upon which Cuddington and Urzua's analysis is based. However, use of a structural time series approach to overcome the above problems would appear to lend support to the validity of the hypothesis (Ardeni & Wright 1992). Helg (1990) also reports on attempts to apply the new time series analysis to the reconstructed G-Y series. Sarkar (1992) and Sapsford and Balasubramanyam (1994) have also critically reviewed recent empirical debates and conclude that the Prebisch-Singer hypothesis is still valid. Indeed, Sarkar (1992) and Reinhart and Wickham (1994) note that the deterioration is not simply the effect of a temporary shock but a rather a deterministic one. Thus, Sarkar (1992) concludes, 'the secular decline of the terms of trade of primary commodities is not a myth but a reality'.

2.3.3 Quantitative Models of Trade in Primary Commodities

The preoccupation of the structuralist school with trade in primary commodities, and, in particular, the empirical studies discussed in the previous section, underscore the importance of understanding the functioning of commodity markets. This is hardly surprising, since (as discussed in Chapter 1), for many countries in Africa the role of commodities is central. An insight into such markets may be obtained from a discussion of both theoretical and practical modelling of commodities. With this objective in mind, this section will examine the underlying theory behind commodity modelling, and present some recent examples of commodity models.

2.3.3.1 Structure of theoretical primary commodity models

Based on the works of, *inter alia*, Labys and Pollak (1984), Labys (1978), Behrman (1978), Adams (1978) and Guvenen et al. (1991), three broad classes of commodity models may be identified: firstly, *econometric* models (which include 'market' models, 'process' models and 'system dynamics and optimization' models); secondly, *spatial equilibrium and programming* models; and finally, *input-output* models. We begin by examining econometric models, before moving on to describe the other two broad classes of models.

(a) Econometric models

Perhaps the most basic econometric model is the 'market' model. This model describes a competitive market, in which the demand for, and the supply of, commodities, including inventories, interact. Equilibrium is arrived at through price clearing. The approach is based fundamentally on an assumption of perfect competition (Labys & Pollak 1984, Labys 1978, Behrman 1978, Adams 1978). An important subset of market models are 'process' models. The focus of these is on supply and demand within a particular industry, rather than across markets. In the process model, the demand for a commodity is a derived demand from the product within the production process (see Labys & Pollak 1984, Labys 1978). Thus, it could be argued that process models focus mainly on demand for a particular commodity.

In sharp contrast, system dynamics models (SDMs) focus mainly on the supply side of the commodity in question. In SDMs, adjustment of actual levels of inventory, production and consumption of a commodity, towards a desired level is central. In these models, the level of stock adjusts to the differences between rates of production and consumption. Such stock is usually given as a certain proportion of expected consumption. The latter, in turn, is determined as a certain proportion of the desired stock. This formulation, termed 'relative stock coverage', provides a mechanism for the determination of prices for the particular commodity in question. This price, in turn, will determine the desired level of production capacity, which forms the basis for actual production, usually through an adaptive expectation scheme (see Labys & Pollak 1984: 61–63 for formal treatment).

The third important type of econometric model are 'optimization' models. In contrast to the other varieties of model, optimization models focus on the structure of markets. This has the effect of shifting the emphasis away from perfect competition towards an oligopolistic market structure. This, when taken in combination with the assumptions underlying the economics of exhaustible resources, will tend to imply a backward-sloping supply curve. Such models are usually employed in the analysis of cartel behaviour and are given in an optimization equation which maximizes the sum of discounted profits, with the aim of picking the price trajectory of the commodity in question (Labys & Pollak 1984, Behrman 1978).

(b) Spatial equilibrium and programming models (SEPMs)

'Spatial equilibrium and programming models' represent a further branch of commodity modelling, widely cited in the literature. The major objective of such models is to determine the spatial flows of demand and supply, as well as to identify equilibrium conditions, by explicitly considering the configuration of transport networks. These are usually formulated as a mathematical program with the aim of maximizing sectoral/regional revenues or minimizing costs. In other words, the model operates in such a way that transportation costs are minimized, with commodities left free to transfer between markets until demand equals supply in every spatially-separated market (Labys & Pollak 1984). Depending on the degree of complexity, such models may take either a linear, quadratic, recursive or mixed form. The solution for the objective function of the model, given its particular constraint, is arrived at using mathematical programming techniques, such as Simplex.

(c) Input-output models

Input-output models are based on Leontief's pioneering work on inter-industry relations. Although these are not commodity-market models, as such, nevertheless they may be used to study how the demand and supply of commodities relates to inter-industry structure and macro-economic variables at a national economy level (Labys 1978, Labys & Pollak 1984). Though static, the technical coefficients specified in input-output models can help to determine the demand and supply for a commodity. It is worth pointing out, however, that the input-output model is a demand-driven model, such that it may not always be helpful in explaining supply determination. Moreover, since technical progress is a central feature of commodity markets, the fact that this model is static, represents its major weakness.

To sum up, the basic methodologies outlined above form the basis for most commodity models. However, the above description represents an enormous simplification upon reality, since, in practice, modellers may use a mixed bag of overlapping methodologies. However, this description is sufficient to give an idea of the underlying theory upon which most commodity modelling work is based. Further, based on this description, one might conclude that recent developments in commodity modelling have been promising (see Guvenen et al. 1991). In general, most commodity modelling and non-linear programming now takes account of risk and uncertainty, intertemporal linkages and adjustment processes. Most of these also attempt to capture the structure of the market, especially market imperfections, address issues of data quality, incorporating new techniques for estimation, particularly in relation to time series data and, finally, link in with other macro and policy models (Guvenen et al. 1991). These theoretical discussions, combined with an overview of some recent models, are used to arrive at the approach employed in Chapters 4 to 6.

2.3.3.2 A brief overview of recent commodity models of 'the South'

Having set out some background on the methodology of modelling, this section will examine some recent commodity models that emphasize North-South trade in primary commodities. The intention is not so much to exhaustively examine all recent models, but rather to focus on those modelling approaches, widely cited in the literature, and deemed relevant in informing the commodity modelling pursued later in this book. We examine six such approaches here, beginning with a model developed by Bond (1987).

(a) M.E. Bond (1987) and Goldstein & Khan (1978)

Bond's (1987) work follows Goldstein and Khan (1978). I have used her work because it is relatively recent and also representative of other work, using this approach. In Bond's model, the demand for primary commodities depends on a number of factors. Specifically, economic activity within the industrial countries, the price and composition of commodities, the geographical location of the exporting nation, and, finally, the trade and agricultural policies pursued by industrial countries. Supply, on the other hand, is seen as depending on weather conditions, factor endowment (together with investment), relative prices, technology, domestic market characteristics and population growth.

The author emphasizes the need to specify demand and supply equations for different commodity groups as well as regions of the developing world. Thus, five commodity groups are identified for the study, namely, food, beverages and tobacco, agricultural raw materials, minerals and energy. These classifications of commodity supply and demand equations are set out for Africa, Asia, the Middle East, Europe and the Western hemisphere. Adjustment in export demand to changing market conditions is assumed to occur within a period of one year, while supply is allowed to have delayed adjustment possibilities, due to production lag. The four major commodity groups, with the exception of energy, are modelled as follows.

<u>Export demand</u>

The world demand for exports of commodity k from developing country region R is specified in log-linear form as follows,

$$\ln XD_R^K = a_0 + a_1 \ln\left(\frac{PX_R^K}{PW^k}\right) + a_2 \ln YW \qquad [1]$$

where: $XD^K{}_R$ is the quantity of exports of commodity k demanded from region R, $PX^K{}_R$ the export price of commodity X from region R, PW^K the average price of commodity K in the international markets and YW the real income in importing countries.

It is noted that, owing to the logarithmic specification, a_1 is the (relative) elasticity of world demand for region R's export of the k^{th} commodity with respect to the divergence between region R's export price of the k^{th} commodity and the average world price. a_2 is the income elasticity of demand. The former is expected to be negative while the latter positive. It is implicitly assumed that there is no, or constant, elasticity of substitution.

Export supply

The supply of exports of commodity k from region R ($XS^K{}_R$) is specified as a log-linear function of the current and lagged ratios of the export price of commodity k ($PX^K{}_R$) to domestic price level in the producing countries in region R (P_R), multiplied by the exchange rate of currencies of the producing countries, i.e., US$ per unit of local currency (E_R), an index of productive capacity in region R (Y_R), supply shocks (SS_R) and trend value, t:

$$\ln XS_R^K =$$

$$\beta_0 + \beta_1 \ln\left(\frac{PX_R^K}{P_R E_R}\right) + \beta_2 \ln\left(\frac{PX_{R-1}^K}{P_{R-1} E_{R-1}}\right) + \beta_3 \ln \overline{Y}_R + \beta_4 \ln SS_R + \beta_5 t \qquad [2]$$

This equation allows for a positive relationship between supply and export price, relative to domestic price. It also allows for the operation of a lag supply response.[25] Normalizing this equation for the price of exports in region R yields the following equation, which together with equation [1] can be estimated simultaneously to obtain the estimates of the structural parameters.

$$\ln PX_R^K = b_0 + b_1 XS_R^K + b_2 \ln P_R E_R + b_3 \ln\left(\frac{PX_{R-1}^K}{P_{R-1} E_{r-1}}\right)$$
$$+ b_4 \ln \overline{Y}_R + b_5 \ln SS_R + b_6 t \qquad [3]$$

Finally, the equations for energy exports are treated differently. This follows two steps, first the world demand for energy is specified assuming that the supply is exogenously fixed ($XS^{en}{}_W = XS^{en}{}_W$ bar). Then the world demand for energy ($XD^{en}{}_W$) is allocated across exporting developing regions with reference to trend term. The world demand is taken as a function of energy price (PW^{en}) relative to world price (PW) and world income (YW) as,

$$\ln XD_W^{en} = \alpha_0 + \alpha_1 \ln\left(\frac{PW^{en}}{PW}\right) + \alpha_2 \ln YW \qquad [4]$$

World energy demand is allocated using the region's share in the world energy market and a trend variable given by,

$$XD_R^{en} = w_R XD_w^{en} e^t \qquad [5]$$

By substituting equation [4] into [5], the demand for energy exports from region R is given by,

$$\ln XD_R^{en} = \alpha_0 + \alpha_1 \ln\left(\frac{PW^{en}}{PW}\right) + \alpha_2 \ln YW + \alpha_3 t \qquad [6]$$

Equation [6], combined with the fixed regional supply of energy (arising from the oligopolistic pricing practices of OPEC member states), determines the estimating equation. The author undertakes empirical investigation based on the set of equations specified above.

<u>Some notes on the initial model</u>

The original model set out by Goldstein and Khan (1978) is divided into two parts: firstly, an 'equilibrium' model, in which no lag is assumed, and adjustment is deemed as taking place instantaneously; and secondly, a 'disequilibrium' model, in which the above assumption is relaxed. In Bond's work, discussed above, the first of these models is employed.[26] I will now discuss the disequilibrium model, in order that these two approaches may be brought into perspective.

In order to introduce the disequilibrium mechanism Goldstein and Khan (1978) use the method adopted by Taylor and Houthakker (1970, cited in Goldstein & Khan 1978). Thus, they assume that exports (X) adjust to the difference between demand for exports in period t and the actual flow in the previous period, which is given as,

$$\Delta \ln X_t = \gamma \ (\ln X_t^d - \ln X_{t-1}) \qquad [A]$$

where: γ is the coefficient of adjustment, d demand, t time and Δ denotes change. By substituting equation [1] into [A] we can obtain an equation for estimating exports (minor symbolic difference between the two papers is ignored; I have used symbols as reported in the earlier model of Goldstein & Khan 1978):

$$\ln X_t = c_0 + c_1 \ln\left(\frac{PX}{PXW}\right) + c_2 \ln YW_t + c_3 \ln X_{t-1} \qquad [B]$$

where: $c_0 = \gamma a_0 \quad c_1 = \gamma a_1 \quad c_2 = \gamma a_2 \quad c_3 = 1-\gamma$

The mean time lag in the adjustment of exports is equal to γ^{-1} and may be calculated from parameters of equation [B] as $(1-c_3)^{-1}$. Since the quantity of exports is specified as adjusting to excess demand, the price of exports adjusts to conditions of excess supply:

$$\Delta \ln PX_t = \lambda(\ln X_t - \ln X_t^s), \;\; \lambda > 0 \qquad [C]$$

Substituting equation [2], taking note of the footnote remark under equation [2], into equation [C] and solving for PX_t we get

$$\ln PX_t = d_0 + d_1 \ln X_t + d_2 \ln P_t + d_3 Y_t^* + d_4 \ln PX_{t-1} \qquad [D]$$

where:

$$d_0 = \frac{-\lambda\beta_0}{1+\lambda\beta_1} \quad d_1 = \frac{\lambda}{1+\lambda\beta_1} \quad d_2 = \frac{\lambda\beta_1}{1+\lambda\beta_1}$$

$$d_3 = \frac{-\lambda\beta_2}{1+\lambda\beta_1} \quad d_4 = \frac{1}{1+\lambda\beta_1}$$

The reduced form equations obtained from equations [B] and [D] are:

$$\ln X_t = \frac{c_0 + c_1 d_0}{D'} - \frac{c_1}{D'} \ln PXW + \frac{c_2}{D'} \ln YW + \frac{c_1 d_3}{D'} Y_t^* \qquad [E]$$

$$+ \frac{c_1 d_2}{D'} \ln P_t + \frac{d_4}{D'} \ln PX_{t-1} + \frac{c_3}{D'} \ln X_{t-1}$$

$$\ln PX = \frac{d_0 + d_1 d_0}{D'} - \frac{c_1 d_1}{D'} \ln PXW_t + \frac{c_2 d_1}{D'} \ln YW_t \qquad [F]$$

$$+ \frac{d_3}{D'} Y_t^* + \frac{d_2}{D'} \ln P_t + \frac{d_4}{D'} \ln PX_{t-1} + \frac{c_3 d_1}{D'} \ln X_{t-1}$$

where $D' = 1 - c_1 d_1$.

After developing these two forms of the model – taking an equilibrium and disequilibrium form – the reduced equations are then estimated using the 'Full-Information Maximum Likelihood' (FIML) approach (see Chapter 6 for further details).

Bond (1987) and Goldstein & Khan's (1978) models are interesting in that they recognize the importance of various factors in modelling trade in primary commodities. The author's emphasis on the use of functions specified by product type and region, and the method of solving this, simultaneously, are both worth noting. Moreover, Goldstein and Khan's distinction between equilibrium and disequilibrium models is its strength. However, when it comes to applying this model, they fail to specify all the factors that were previously mentioned as likely to affect the market. Indeed, even the suggested classification between products is not reflected in the fully specified model, except in the case of energy. More importantly, the trade sector in their model is seen as an enclave, which does not affect, and is not affected by the other sectors of the economy. This problem is addressed in this book.

(b) Ke-Young Chu and T.K. Morrison (1986)

Previously, Chu and Morrison had analysed the demand-side factors underlying the short-run fluctuation of non-oil primary commodity prices (see Chu & Morrison 1984).[27] In the study summarized below (i.e., Chu & Morrison 1986), a model with a medium-term framework, in which supply-price dynamics[28] plays a significant role is specified. Moreover, the role of supply shocks in the short-run fluctuation of commodity prices was also underscored.

The authors developed their model following a moderately-sized survey of the literature on supply-price dynamics. We discuss this survey, in detail, in Chapter 4. In developing this model, they show how the simple 'cobweb theorem' of Ezekiel (1938) has evolved into Nerlove's (1958) model (Chu & Morrison 1986: 140–44). Chu and Morrison begin by making a number of assumptions. World non-oil primary commodity markets are assumed to be price clearing. Supplies are considered to be based on profit maximization, and thus are affected by supply shocks. Demand is assumed to depend on world economic activity and relative price of commodities. Supply may change as a result either of changes in medium- and long-run supply or in short- and medium-term utilization.

Supply determination

Thus, in Chu and Morrison's model, production is specified, in the short run, as a function of prices, supply shocks and potential production, as follows:

$$q_t^s = u_t + qc_t \qquad [1]$$

$$u_t = \alpha_0 + \alpha_1\, rps_t + \alpha_2 rps_{t-1} - \alpha_3 SS_t \qquad [2]$$

$$rps_t = p_t + es_t - ps_t \qquad [3]$$

where, in logarithms,

$q^s{}_t$ = world production of a commodity
u_t = utilization of potential production
qc_t = potential production
p_t = output price (the international price of a commodity, in US$)
es_t = exchange rates (relative to US$) of the currencies of exporting countries
ps_t = domestic price levels in exporting countries
rps_t = real price of commodities, as defined in equation [3], approximated by output to domestic price
ss_t = supply shocks (resulting, say, from weather conditions in food production and approximated by stochastic error term).

The first equation defines world production of the commodity. The second specifies the utilization ratio, as a function of a distributed lag of real output prices faced by producers and as a consequence of supply shocks. And finally, the third equation defines real prices faced by producers. The change in potential production (supply) is specified as a function of average excess profits in recent years.

$$\Delta qct = \beta_0 + \beta_1^{k-1}\sum_{1}^{k} erps_{t-1} \qquad [4]$$

$$erps = rps_t - \overline{rps} \qquad [5]$$

where: *rps* (bar) is the long-run average of rps_t, $erps_t$ is the excess profit and *k* is a parameter (k>0).

Equations [4] and [5] specify the change in potential production as a function of the average excess profits. (In other words, the average real price faced by producers in excess of their long-run average in recent years.) Average excess profit, as defined in equation [5], may cause an increase in potential production (as given in equation 4) either through expansion of production or entry of new firms. This increase in potential production may result from excess profits arising from the distant past, for example, in the case of the maturation of newly planted perennial crops. Alternatively, such excess profits may have arisen in the immediate past, as in the case of the reactivation of existing trees. Based on the above, the entire system of equations for *change* is given as

<u>Supply</u>

$$\Delta q_t^s = \Delta u_i + \delta qc_t \qquad [1a]$$

$$\Delta u_t = \alpha_0 + \alpha_1 \Delta rps_t + \alpha_2 \Delta rps_{t-1} - \alpha_3 SS_t \qquad [2a]$$

$$\Delta rps_t = \Delta p_t + \Delta es_t - \Delta ps_t \qquad [3a]$$

$$\Delta qc_t = \beta_0 + \beta_1 k^{-1} \sum_{i=1}^{k} erps_{t-i} \qquad [4]$$

$$erps = rps - \overline{rps} \qquad [5]$$

<u>Demand</u>

$$\Delta q_t^d = \gamma_0 - \gamma_1 \Delta rpd_t + \gamma_2 \Delta y_t \qquad [6]$$

$$\Delta rpd_t = \Delta p_t + \Delta ed_t - \Delta pd_t \qquad [7]$$

Equilibrium condition

$$\Delta q_t^s = \Delta q_t^d \qquad [8]$$

where:

q_t^d = quantity demanded

ed_t = exchange rates of importing countries (in relation to the US$)

y_t = industrial production (economic activity) in importing countries

pd_t = domestic price of importing countries; *r* stands for real.

Equations [6] and [7] are a simplified form of the demand equation given in Chu and Morrison (1984).

The above system of equations explains both the short-run and medium-term fluctuation in prices. It also captures the dynamic interaction between supply and price, over a number of years, where prices affect potential production. With potential production taken as exogenous, equations [1a] to [3a] and [6] to [8] capture the short-run determination of prices. Using this general approach, the authors modify the basic model, using relevant assumptions in relation to the different commodity groups selected. For instance, lagged prices are assumed to play a strong role in determining the supply function for food, while prices of industrial raw materials are seen as being determined mostly by shifts in demand. The study concludes that potential production responds to medium-term fluctuation in prices, while the utilization rate responds to short-run fluctuations. Industrial production and exchange rate fluctuations are also found to have been major factors underlying commodity price fluctuations, since the early 1970s.

The strength of this model lies in its attempt to explicitly capture supply price dynamics for primary commodity exports. It also brings into the picture the role of exchange rates, in affecting primary commodity markets. At a specification level, the nature of each primary commodity also plays a role. Although not explicitly an objective of this modelling exercise, the impact of this sector on the rest of the economy, and vice versa, is relatively neglected. Such an approach is tantamount to setting the function of the utilization rate (say equation 2a) and insulating it from the repercussions of, say, financial flows.

(c) *Ramanujam and Vines (1990): A structural rational expectation model*

This model is applied to four commodity groups, namely, food, beverage, agricultural raw materials and metals.[29] Unlike the previous models, this and Hwa's (1985) model emphasize the importance of commodity stockholding. Indeed, it is this aspect of the model, which serves as justification for their inclusion in this review.

Ramanujam and Vines (1990) have developed supply, demand and price equations incorporating stockholding identities. Their model assumes that commodity stockholders who are seen as having forward-looking – rational or model-consistent – expectations willingly hold stocks. The assumption in relation to forward-looking expectations is justified on the grounds that speculators are assumed to equate the risk-adjusted yields on commodities and on financial assets. Indeed, the theoretical model, based on the works of Adams and Behrman (1976) and Labys (1978),[30] also assumes that there is an instantaneous market clearing. This may be formally specified by the following set of equations:

Supply

$$Q_t = Q_t\left(P_t\,,\ \sum_{i=1}^{t} P_{t-i}\,,\ Y\right) \qquad [1]$$

where supply is assumed to be a function of current price P_t, (lagged) series of past prices, due to costs of adjusting output, as well as other exogenous variables, Y.

Demand

$$C_t = C_t\left(P_t\,,\ \sum_{i=1}^{m} P_{t-m}\,,\ X\right) \qquad [2]$$

where demand is assumed to be a function of current price P_t, a short series of past prices, due to habit, persistent, and other exogenous variables, X.

Price

$$P_t = P_t\left(P^e_{t+1_t}, f(H_t), Z_t\right) \qquad [3]$$

The price equation is an inverted stock demand function. It is a function of expected price (p^e_{t+1},t)[31] and either the change in stock or the level of stock (*H*) together with other exogenous variables (*Z*) particularly the interest rate.

Stock identity

$$H_t = H_{t-1} + Q_t - C_t \qquad [4]$$

The vectors of exogenous variables *X*, *Y* and *Z* vary between the four different commodity categories. The price variable is taken as the real price of the commodity group, with the deflator being the unit value of manufactured exports. All the variables, except for the interest rate (which is used as a proxy for the opportunity cost of holding stocks), as well as the trend term, are expressed as a natural logarithm. The estimation is predominantly by OLS, and in some cases, also by IV (instrumental variables).

The four supply equations are estimated after tests about stationary and co-integration have been made (see pp. 511–12). Thus, for 'food', estimates are based on current price, five-year lagged price, lagged stock and price of fertilizer (as representing cost of production). For 'beverage', short-term price effect (with a two-year lag) and long-term gestation period price effect (with 4 to 8-year lag combined price), price of fertilizer and lagged stock holding are all used as explanatory variables. For 'agricultural raw materials' both current and lagged (5-year) prices are used, since this category also covers perennial crops. In relation to 'processing costs', lagged oil prices are used. Stock holdings are also used in this model, but found not to be significant. The 'metals and minerals' supply function is estimated using current and lagged (4–8 years) prices, as well as the difference between the current and the average price, in order to reflect the cost of extraction, which increases according to the amount extracted. Finally, stock holding and interest rates have been used, with the aim of reflecting capital cost.

The authors found it difficult to distinguish between demand by households, for direct consumption, and demand by firms, for further processing. Hence, the demand function for each commodity group is postulated to be a composite one. Demand is assumed to be directly related to income (taken as the weighted real GDP of the industrial countries) and inversely related to prices. Prices of substitutes are not considered. For food, lagged prices with a weighted exchange rate between OECD currencies and US dollars were also considered. Finally, price is estimated using an equation derived from models with costs, including handling costs such as storage, as well as interest rates (representing the opportunity cost of holding financial assets) adjusting to the commodity holding structure. The model is closed by estimating the stock identity using a logarithmic form (equation 4) in order that this might be comparable with the other equations of the model, which are also in logarithmic form. The full model, using the single equation estimations, may then be solved using a forward-looking model.

By estimating the model using different groups of primary commodities within a forward-looking market, this model brings a new insight into the modelling of commodities. The strength of this model is its effort to make each of commodity groups' specifications unique by allowing for variation in the exogenous factor, as well as through the incorporation of lags. In common with most models, the model assumes instantaneous market clearing. Moreover, in defining the real price it is not clear why the current price is deflated by unit value of manufactured exports. Further, it could be argued that the use of rough proxies (such as cost of fertilizer, for food and beverage, and cost of oil, for raw materials) rather than the actual cost of imported inputs as intermediate costs may not accurately describe the situation of, for example, smallholder producers in Africa. Similarly, on the demand side, although there is scope to disaggregate existing data, in fact, no attempts have been made to undertake such an exercise. Thus, the stock holding equation, which describes a crucial relationship within the model, doesn't actually provide information on who holds such stocks, and how the data has been generated. And, in spite of the authors' finding that the series are non-stationary, most estimations are in fact, undertaken in the traditional way, without any discussion as to whether these are derived from a co-integration vector or an ECM model. Finally, as with previous models this model does not connect the commodity market with the rest of the economy.

(d) E. Hwa (1985)

Hwa's model is a further variant on recent models having a disequilibrium structure. The model is based on two broad assumptions: firstly, that quantity adjustments may be relatively 'sticky', as a consequence of supply lag, and, hence, that the adjustment mechanism lies in price; secondly, as a disequilibrium model, it assumes away instantaneous market clearing. However, the modelling begins from an equilibrium model of storable primary commodities given by

$$c_t = f_1(p, xc_t) + u_t \quad [1]$$

$$q_t = f_2(p_t, xq_t) + v_t \quad [2]$$

$$hd_t = f_3(p_t, xh_t) = w_t \quad [3]$$

$$h_t = h_{t-1} + q_t - c_t - x_t \quad [4]$$

$$hd_t = h_t \quad [5]$$

The first three equations describe consumption (c), production (q) and stock demand (hd), respectively. These are postulated to be a function of real price (p) and other relevant predetermined values (xc, xq, xh). The fourth equation describes stock supply (h), in which x represents intervention by a buffer stock agency or national government. The last equation is an equilibrium (stock demand and supply) condition.

Within the model, in order to explicitly consider price adjustments, a disequilibrium condition in price and quantity is introduced. Thus, if functions f_i, i=1,2,3 are linear, the following relation will hold true,

$$P_t^e - Pt = (f_1' + f_2' + f_3')^{-1}(hd_t - h_t) \quad [6]$$

$P^e{}_t$ is the equilibrium price that can be derived from [5], the f_i's are the partial derivative (with respect to price) of c, q and hd, respectively. This equation shows that the actual (observed) price is not equal to the equilibrium price, unless the market is in equilibrium. (The same can be said about stock demand and supply.) The important question is how equilibrium may be attained from such an initial disequilibrium condition. Although, theoretically, this may be attained through price and quantity adjustment, the latter is perceived not to hold in the short run. Thus, Hwa assumes that prices will gradually adjust towards their equilibrium value. This is approximated by a distributed lag function [$T(L)$] in which L is a lag operator.

$$p_t = \omega(L) p_t^e \quad [7]$$

Believing that equation [6], rather than [5], is, in general, the one that holds and inserting [7] into [6], yields the following dynamic price equation:

$$P_t = \phi\left[\frac{1}{\omega(L)} - 1\right]^{-1}(hd_t - h_t) \qquad [8]$$

where: $\phi = (f_1'+f_2'+f_3')^{-1}(hd_t - h_t), \quad \phi > 0$

Hwa admits that there can be as many dynamic price equations as there are hypotheses about the distributed lag function. In his study two hypotheses which can be handled with annual data are discussed. The first [9a] is a geometric lag hypothesis, which implies a monotonic increasing or decreasing path towards the equilibrium price. The second [9b] implies oscillations around the equilibrium price.

$$\omega(L) = \frac{1-\lambda}{1-\lambda L}, \qquad 0 < \lambda < 1 \qquad [9a]$$

$$\omega(L) = \frac{1-\lambda_1-\lambda_2}{1-\lambda_1 L - \lambda_2 L^2}, \qquad [9b]$$

$$\lambda_1 + \lambda_2 < 1, \quad \lambda_2 - \lambda_1 < 1 \ - \ -1 < \lambda_2 < 1$$

Substituting [9a] and [9b] into [8], respectively, yields,

$$Dp_t = \frac{\phi(1-\lambda)}{\lambda}(hd_t - h_t) \qquad [10a]$$

$$Dp_t = \frac{\lambda 2}{\lambda_1+\lambda_2} DP_{t-1} + \frac{\phi\,(1-\lambda_1-\lambda_2)}{\lambda}(hd_t - h_t) \qquad [10b]$$

where: $Dp_t = P_t - P_{t-1}$

Both [10a] and [10b] show that price changes are a positive function of excess demand for stock. Note that the, λ's dictate both the size and speed of adjustment. (For instance, in [10a], if λ approaches 0, the price adjustment would be an instantaneous one, similar to the equilibrium system.)

In general, the competitive disequilibrium model consists of equations [1]–[4] and either [10a] or [10b]. In this model the voluntary accumulation of stocks $(hd_t - h_{t-1})$ is not the same as the actual accumulation of stock $(h_t - h_{t-1})$. The involuntary part being $(h_t - hd_t)$. This can be given as

$$h_t - h_{t-1} = (h_t - hd_t) + (hd_t - h_{t-1}) \qquad [11]$$

It is noted that the observed accumulation will be equal to voluntary accumulation of stock, only if the market is in equilibrium (i.e., $h_t - hd_t = 0$). Hwa states that, from an estimation point of view the demand for stock equation may be estimated by inserting [3] into either [10a] or [10b]. By estimating the demand for stock equation as a function of consumption (i.e., transaction demand for stocks), the expected price spread and interest costs and risk premium (i.e., speculative demand) and inserting this into [10a] and [10b], the price adjustment equations for a disequilibrium market may be estimated. For an equilibrium market, this demand equation may be directly estimated (see Hwa 1985: 309–11).

Finally, the models are estimated using OLS and IV methods, with annual data for six primary commodity groups. Following estimation, a dynamic simulation is undertaken using the full (simultaneous) model. It is reported that the model traces endogenous variables fairly well. Besides, when the model is 'shocked' (via exogenous variables) the commonly observed boom-and-bust-cycles are observed.

In keeping with Ramanujam and Vines model, the basic structure of this model is similar to that of Adams and Behrman (1976). However, the model represents a step forward in the modelling of primary commodities, since its focus is on disequilibrium structure. Moreover, the stock demand and supply function, which is a key relationship in the model, is specified realistically by taking into account a number of conditions of the financial market. More specifically, the speculative demand for stocks is assumed to be at a level where the expected price spread equals the storage cost plus the interest cost and risk premium. One weakness of the model is the use of identical specification for all commodity groups. Although the disequilibrium structure is realistic, eventually it will be price, rather than quantity, or indeed both, that will adjust. This effectively makes it a short-run model and so limits its generalizability. A further major weakness of the model is its failure to accommodate the role of supply factors in determining the equilibrium path. This is further aggravated by the structure of the model, in which supply effects are buried within stock demand[32] and supply balance, which are implicitly held constant. This has the consequence of allowing price to adjust, instead, as per equations [10a] and [10b]. Finally, as with most models, the repercussions on, and feedback from, the wider economy are not considered.

(e) CGE model of Dick et al. (1983)

This and subsequent models are based on a computable general equilibrium (CGE) framework, with export share matrices. This makes them somewhat different from those discussed above. Dick et al.'s (1983) model is designed to study the short-run impact of fluctuating primary commodity prices on three economies. As the authors point out, most commodity models suffer from 'casual empiricism' failing to explain the underlying casual mechanism (Dick et al. 1983: 405). This has led to the use of simpler econometric models, not only with the aim of overcoming such problems in the literature, but also to rule out the implicit assumption that instability in income is solely the result of export earnings instability. This approach is further developed to include sectoral and economy-wide effects.

Although sufficient allowance is made to accommodate the specificity of each country, the three countries in this study are modelled using a similar multisectoral general equilibrium approach. The use of a similar macro-modelling framework for all of the countries allows one to attribute the response to exogenous shocks to the specific nature of each country rather than to differences in model specification. The analytical framework adopted runs as follows. Producers are assumed to minimize the cost of producing a given activity level, subject to a production function[33] of a three-level, or nested, form. The average household is assumed to maximize its utility, subject to a function describing substitution prospects in consumption between imports and domestic products as well as an aggregate budget constraint. The solution to this constrained optimization results in a system of commodity-demand equations for production, capital creation and consumption, as well as a system of factor demand equations.

Government demand is linked to aggregate domestic consumption. Commodity export demand is linked to world demand facing a particular commodity and to world export price. A system of demand and supply equations ensures market-clearing equilibrium for domestic commodities, occupational labour, fixed capital and land. Finally, a host of miscellaneous identities and/or definitions are used. In a summarized form the model is framed as follows.

<u>Output</u> is given by:

$$Y = Y(F_1, F_2, F_3) \qquad [1]$$

Factor marginal product, for each of i factors

$$\frac{dY}{dF_i} = \frac{r_i}{P} \qquad [2\text{–}4]$$

Income

$$Y = ABS + B \qquad [5]$$

Trade balance

$$B = P^e X - P^m M \qquad [6]$$

Imports

$$M = \left(ABS, \frac{P^e}{P} \right) \qquad [7]$$

Exports

$$X = X\left(\frac{P^e}{P} \right) \qquad [8]$$

Numerior $P = 1$

where:
Y is the real output and F_i are aggregate factor inputs (1 = labour, 2 = capital and 3 = land).

Thus, based on the above, competitive behaviour implies [2]–[4], in which the marginal factor i (dY/dF_i) is equated to its real factor price (r_i is factor i's money price and P the price of output). Equation [5] shows national income identity, where ABS is real domestic absorption (aggregate real consumption, investment and government expenditure) and B the balance of trade. B is defined in equation [6] as the difference between foreign currency value of exports (P^eX) and imports (P^mM). Commodity import demand (M) in [7] is defined as a function of ABS and the domestic price level relative to the world price of imports. Finally, equation [8] specifies export demand.

The model is solved, first, by converting the equations to linear form by logarithmic differentiation. Since the number of variables (14) is greater than the number of equations (9), five variables are exogenously set, to close the system. These exogenous variables are selected to reflect the short-run nature of the model (F_2, capital; F_3, land; and the money price of labour, r_1) and by targeting domestic absorption (i.e., by making *ABS* exogenous and *B* endogenous) or vice versa (i.e., making *ABS* endogenous with targeted *B*). Based on this framework the authors proceed to investigate the impact of primary commodity *price* fluctuations as the only source of fluctuation in export earning. The conclusion arrived at, following a simulation exercise, is that the price shocks may be successfully isolated from affecting the relevant commodity sector by fixing domestic absorption. The problem with this option is that it requires a large sum of foreign exchange. The second conclusion is that a targeted balance of trade may be maintained, but that it requires a change in exchange rate to facilitate a switch in industrial composition. However, as the authors point out, since such adjustment takes time, compensatory financing schemes which extend the time required for restructuring, may be necessary.

This model is a good example of an attempt to relate the external market to the macroeconomic conditions of a particular country. Notwithstanding its merits, the model rests almost entirely on optimization solutions and instantaneous market adjustment, at the expense of differential pricing rules, the possibility of lagged responses and other modelling techniques. A further weakness of the model is a lack of specification plausibility, with government demand, for instance, being related only to total consumption, and with factor mobility within a competitive market assumed. Although the model attempts to explain the impact of fluctuating prices, nevertheless it fails to trace the source of that fluctuation. This fact would explain the authors' presumption that developing countries should adjust. Not surprisingly, the simulation results are identical to the IMF/World Bank policy proposals, in which price adjustments (such as devaluation) are emphasized, at the expense of structural problems related to cyclical markets, supply problems and market bottlenecks.

(f) G.B. Taplin (1973): A Model of World Trade

Taplin's model is one of the earlier models, which emphasizes a wider inter-country/region framework. It is based on a model developed by the Research Department of the International Monetary Fund, known as the 'Expanded World Trade Model (EWTM)', designed for short-term forecasting of trade flows and analysing economic policies. The version of the model surveyed below treats the world as being divided into 27 countries and regions, comprising 25 developed countries, the CEMA (former socialist countries) countries and the Rest of the World (RW). The RW comprises all of the less developed countries. The imports of each developed country are determined by an import function, which takes into account economic activity, relative prices and other relevant factors. As a consequence of lack of information, economic activity and exports are used to determine the imports of the CEMA region. RW's imports are a function of current and past foreign exchange receipts. Each country and region's exports are obtained by distributing forecast imports through an export share matrix.

Consistent sets of imports and exports are obtained using a programme for solving simultaneous non-linear equations by iteration. As with project LINK,[34] export share matrices stand at the heart of the system. Based on these points, two version of the model are presented. The first of these deals with total merchandise trade flows, and is termed the 'total trade model'. The second model divides imports into four commodity groups, which are used by Project LINK. Since the two versions of the model are essentially identical, the following discussion focuses on the total trade model, supplemented by comments on the commodity version, when necessary.

The total trade model

The model comprises a total of 84 equations (27 equations each for imports, exports and trade balance) given as,

$$M_i = f_i\,(X_i,\, Z_i) \qquad [1]$$

$$X_i = \sum_{j=1}^{27} a_{ij}\left(\frac{M_j}{\delta_j}\right) \qquad [2]$$

$$B_i = X_i - M_i \qquad [3]$$

In addition,[35] three world trade identities are given as

$$M_{28} = \sum_{i=1}^{27} M_i \qquad [4]$$

$$X_{28} = \sum_{j=1}^{27} X_i \quad [5]$$

$$B_{28} = X_{28} - M_{28} \quad [6]$$

where:

i,j {1…25 = the individual developed countries

26 = CMEA countries

27 = RW, the developing countries grouped together

28 = total world

M_i = total import of region i, c.i.f., in current prices in US$

X_i = total exports of region i, f.o.b. in current prices in US$

B_i = merchandise trade balance of region i

Z_i = explanatory factors other than exports, and assumed independent of exports, determining the imports of country i.

$_i$ = the f.o.b.-c.i.f. adjustment factor

a_{ij} = X_{ij}/E_iX_{ij}, the share of country i in the total of all countries' exports to market j.

If imports are quoted either in c.i.f. or f.o.b. the last equation should yield a value of zero. This result is essentially the same when imports are disaggregated into commodity groups. Given this system of equations, exports and trade balances may be obtained from a set of import forecasts (M_j), knowledge of the market share (a_{ij}) and the f.o.b.-c.i.f. adjustment factor ($_i$). Each of these factors are examined below.

Import equations

The specification of imports may vary depending on the nature of imports. Raw-material imports may be related to industrial activity, consumer imports to consumption demand, and capital imports to conditions of investment and return. In the absence of such a detailed account, the alternative is to use reduced form equations relating imports to exogenous variables. This procedure is relatively easy to compute and understand. However, such a procedure inevitably leads to a loss of knowledge on structural interactions as well as an inability to apply 'superior' statistical properties. In pursuit of simplicity, the import equation adopted in the Taplin's model is given by,

$$\frac{M}{P_M} = a_0\, WAE^{a_1} P^{a_2} \qquad [7]$$

where:

M	=	import value
P_M	=	import unit value index.
WAE	=	$0.5\, AE_t + 0.5\, AE_{t-1}$; average of autonomous expenditure.
AE	=	$G + I + X$; autonomous expenditure in constant prices defined as the sum of government expenditure, gross fixed capital formation and export of goods and services.
P	=	domestic price index divided by import unit value index.
a_1	=	elasticity with respect to WAE.
a_2	=	elasticity with respect to relative prices (P).

The use of autonomous expenditure as an activity indicator is justified on two grounds. First, the simultaneity problem that would arise because GNP includes imports could be avoided. Second, in a simple income determination model where GNP includes consumption, investment, exports less imports and autonomous components, such a functional relation would be expressed as a reduced form equation, since imports are related either to consumption, income or both. Consumption in turn is always considered as a function of income.[36] In EWTM, increases in demand for imports leads to an increase in demand for exports of the supplying countries. Increase in demand for a country's exports also leads to increases in that country's demand for imports through the income generation process.

Prices also play an important role in import demand determination. In order to account for substitution possibilities, relative prices (price ratios) are used. The role of prices is believed not to be simple. Thus, domestic prices are seen as related to import prices and demand for imports may affect the export prices of another region. Although the ideal solution is recognized to be the joint determination of export supplies and import demand, this is not applied, owing to lack of data.[37] The method used for estimating the import function is OLS on annual data.

<u>Export shares matrix</u>

Market shares (a_{ij}'s) may vary due to changes in relative prices, exogenous change in taste or other factors. For each year and each commodity there are 729 (27 times 27) shares which must add to one in any market. The author adopts a method developed by Armington (1969) in his study of demand functions for n goods from m suppliers to estimate the market share values (Taplin 1973: 190). Armington specifies the demand function of country j for the k^{th} type of good supplied by country (or group of countries) i after assuming (1) preference for one good is independent of the other and (2) that elasticity of substitution among suppliers is constant. This takes the form:

$$X_{ij}^{k} = b_{ij}^{\delta kj} X_{j}^{k} \left(\frac{P_{ij}^{k}}{\overline{P}_{j}^{k}} \right)^{-\delta kj} \qquad [8]$$

and,

$$P_{ij}^{k} X_{ij}^{k} = a_{ij}^{\delta kj} \left(\overline{P}_{j}^{k} X_{j}^{k} \right) \left(\frac{P_{ij}^{k}}{\overline{P}_{j}^{k}} \right)^{1-\delta kj} \qquad [9]$$

where:

X_j^k	=	quantity demanded	δ_{kj}	=	elasticity of substitution
P_{ij}^k	=	import price	$\overline{P}_j^k$	=	average price level

By dividing equation [8] by X_j and [9] by $P_j^k X_j^k$ we may obtain an expression for market share given as

$$\frac{X_{ij}^{k}}{X_{j}^{k}} = b_{ij}^{\delta kj} \left(\frac{P_{ij}^{k}}{\overline{P}_{j}^{k}} \right)^{-\delta kj} \qquad [10]$$

$$\frac{P_{ij}^{k} X_{ij}^{k}}{\overline{P}_{j}^{k} X_{j}^{k}} = b_{ij}^{\delta kj} \left(\frac{P_{ij}^{k}}{\overline{P}_{j}^{k}} \right)^{1-\delta kj} \qquad [11]$$

Assuming further that bilateral prices may be replaced by export unit-value indices for the exporting country, and that all imports are grouped together for the total trade model (or into the commodity categories), the model may help to handle share matrices. P_j^k was approximated by a linearly weighted average of export unit-value indices, with the previous year's share of country i in country j being the weight for the current period. Finally, constant market share instead of constant elasticity of substitution is assumed. The market share is given by,

$$\frac{X_{ij}^k}{\sum_i X_{ij}^k} = a_{ij}^k = A_{ij}^k \left(P_{ij}^k\right)^{-\delta kj} \qquad [12]$$

where: $P_{ij}^k = \dfrac{P_{ij}^k}{\overline{P}_j^k}$

$$\overline{P}_j^k = \sum_m a_{mj}^k{}_{,\,t-1} P_m^k \qquad [13]$$

Exports are in constant price (in volume) and all variables, except the weighting, are for the time period *t*. Thus the market share (a_{ij}) is based on volume flows. P_i^k is the export unit-value index of country *i* for commodity *k*. P_j^k (bar) is the average export unit-value index in market *j* obtained by weighting each supplying country's export unit-value index by that country's share in the previous period. The market share elasticity $\delta_i kj$, and *Aij* is a constant term.[38] For the purpose of modelling, a matrix of dimension 27 by 27 is constructed for total trade and each commodity group. The share matrices are computed by dividing the value of exports f.o.b. from country *i* to *j* of commodity *k* by all countries' exports of commodity *k* to *j*. Exports to the RW (the developing countries) are obtained as a residual, subtracting the exports to countries from 1 to 26, as well as to unallocated groupings (created to record miscellaneous trade), from total exports.

The f.o.b.-c.i.f. problem

Since exports by one country could be recorded as import c.i.f., and at f.o.b. by other, there could be a problem of consistency at total world trade level (for instance, USA, Canada and Australia record imports at f.o.b.). In the EWTM, the ratio of recorded imports of a country to the sum of all countries' exports to that country ($M_j/EX_{ij} = F_j$) were calculated and termed the 'f.o.b.-c.i.f. adjustment factor'. This reflects not only the f.o.b.-c.i.f. discrepancy, but also statistical errors, geographical factors, timing of shipment and other factors. Thus, caution should be exercised, in order to avoid systematic error, which may create biased market share figures. This share is used to correct (deflate) the total imports of each country, as is shown in equation [2].

Following the c.i.f.-f.o.b. correction, the final model contains 27 import equations, 27 export equations, 27 trade balance equations and 3 identities about total imports, exports and trade balance. The 84 equations have M_i, X_i, B_i, a_{ij} and F_j as endogenous variables. All price measures and Z_i's are exogenous. The model is then solved by iteration.

The strength of this model lies in its simplicity and limited data requirements. The f.o.b.-c.i.f. adjustment factor is also a useful innovation, which may be applied elsewhere. However, the simplicity of this model does not come without cost. As is usually the case, the focus of the model is on the industrialized countries, with the 'rest of the world' (i.e., the developing countries) being obtained as a residual. Although an attempt is made to immunize this residual from miscellaneous and statistical problems, there is no guarantee (within the model) that this will be successful. The import equation, which is the pillar of the model, suffers from huge aggregation problems and, thus, is highly simplified. Supply is totally neglected. Exports are not specified in their own right, but as derived from the import function, with all associated setbacks, which I pointed out earlier). Finally, as is usually the case, the external market is modelled as an enclave of the macro set-up of importing/exporting countries, precluding the possibility of analysing repercussion and feedback effects. This is an important criticism, since one of the objectives of this model is policy analysis.

To sum up, in this section I have examined some recent efforts to model trade in primary commodities. Since summary and comment for each of the surveyed models is given at the end of each section, we need not repeat them here. Naturally, surveying this type of model brings with it a host of difficulties, not least relating to the sheer number of models which have been developed. For instance, Labys (1978) provides a list of some 337 commodity models.[39] Notwithstanding such difficulties, I have summarized some basic features of the models using the synoptic table below (Table 2.1). Based on this survey, and the theoretical discussion that precedes it, the approach in this book (Chapters 4 and 6) is informed by:

- Explicit consideration of the short-, medium- and long-run impacts of demand and supply factors. Thus, the discussion about equilibrium and disequilibrium models in the works of Chu and Morisson (1986), Goldstein and Khan (1978) and Hwa (1985) will be used.

- The emphasis accorded to estimation across different commodities. In this regard the studies of Hwa (1985), Ramanujam and Vines (1990) and Bond (1987) are informative.
- The importance of focusing on factors, which affect the market owing to the macroeconomic interaction of the two economies (say North and South). The studies of Dick et al. (1983), Taplin (1973) and Bond (1987) represent good starting points, from which to proceed. However, these could be improved by placing the commodity market within a global macroeconomic framework.

Considering these points, short-, medium- and long-run supply, demand, stockholding and prices will be taken as the key relationships required in modelling African trade. As pointed out earlier in this chapter, a common weakness of these models is the lack of connection with macroeconomic balances and the neglect of their feedback effects (although we note that Dick et al. have attempted to take account of such effects). In this book, existing modelling works will be built upon by focusing, firstly, on the importance of macroeconomic interactions and placing the commodity model within a global macro framework, and, secondly, by emphasizing the supply side of commodity modelling and the impact of interest rate on the demand for commodities. The latter, in particular, will serve as an important mechanism for linking the commodity market with international finance and Northern macro policy.

2.4 CONCLUSION

This chapter, and particularly the last sub-section, has examined the interrelated questions of why countries trade with each other, and who gains from this trade. This has been set in a historical framework, with the discussion on these questions being traced back over the past two centuries. The main objective of this survey has been to find a systemic explanation to help illuminate the trade and external finance problems of Africa, as outlined in Chapter 1. The main conclusion of this survey has been that mainstream trade theories, from Ricardo to the present, serve to justify the specialization of African countries as producers of primary, and particularly tropical, commodities. However, as demonstrated in Chapter 1, this specialization represents precisely the root cause of Africa's financial problems.

This finding, in turn, justifies the search for other systemic explanations about African trade and finance problems. Thus, in this chapter it is shown that even the 'new' trade theories, including the technological gap models, are better suited to explaining North-North, than North-South trade. This effectively limits our choice to those theories, which focus on primary commodities and secular deterioration in terms of trade. These theories, informed by the structuralist economists of ECLAC, focus mainly on the structure of markets and on North-South interaction. This may be formally captured through a commodity modelling approach. Thus, the theoretical discussion and the overview of current models presented in this section will be used to inform the empirical analysis undertaken in subsequent chapters, and particularly Chapters 4 and 6. However, since the overall objective of this book is to examine the interaction of international finance, trade in primary commodities and Africa's place in the world economy from a macro perspective, we will now move on to examine some wider issues relating to the macroeconomics of Africa. This analysis, which will be set out in Chapter 3, will form the basis for the actual modelling work presented in subsequent chapters.

3 The Macroeconomics of Africa: Import Compression and External Finance

3.1 INTRODUCTION

This chapter will examine some of the main features which might usefully be included in a macro model for Africa. It is hoped that this discussion will help in formulating an actual prototype African macro model, which might form a working component of the North-South model developed in Chapter 6. Although the relevant African macroeconomic framework for this should broadly be similar to that outlined in Trap (1993), there are, nevertheless, a number of other specific features not properly dealt with in Trap (1993), which an African macroeconomic framework might usefully include. The first such feature is an 'import compression argument', as discussed in Ndulu (1986, 1991) and Rattsø (1992b). Two other features, which I will argue should also be incorporated into macro models of Africa, are the 'fiscal response to external finance' and 'Dutch disease' phenomena. Hence, an attempt will be made to integrate these features into the prototype African macro component of the North-South model developed in Chapter 6.

The discussion presented in this chapter will be organized as follows. In section 3.2, a number of published macro models of Africa will briefly be reviewed, with the aim of examining the main features emphasized in these models. In section 3.3, the import compression argument, as well as a number of other important theoretical issues relevant for the construction of an African macro model, will be discussed. Section 3.4 will outline the accounting framework, which will then be used to construct a consistent macro database for use in this study. Finally, section 3.5 will attempt to draw out a number of conclusions, based on the preceding discussion.

3.2 A CURSORY LOOK AT SOME MACRO MODELS OF AFRICA

As a recent survey by Harris (1985) shows, macro modelling in Africa is still in its infancy. Harris surveys most of the macro models of Africa which have been constructed by North American universities and international institutions, as well as published models of the African economy. He reports on a total of 184 macro models, 120 of which he evaluates further (see Diagram 3.1). Harris classifies the 184 models based on their underlying structure. Thus, models are categorized as (1) demand-driven Keynesian-type models; (2) supply-driven, general equilibrium with price adjusting to clear the market; (3) reduced form monetary-driven; and, (4) models based on consistency checking, without formal closure (see Diagram 3.2). Harris also applies a classification based on publication and sponsorship. Thus, models are grouped as: (1) Ph.D. dissertations, (2) university-based professional work, (3) international agency-sponsored, and (4) models developed by African governmental agencies (Diagram 3.3). Harris' data is summarized below.

Diagram 3.1 Number of African macro models (Harris 1985)

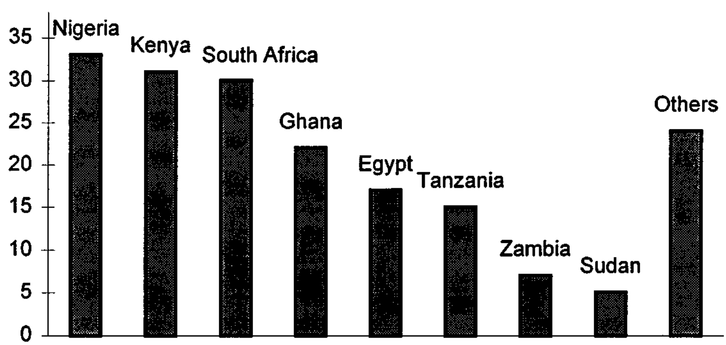


Diagram 3.2 Type or structure of African macro models (Harris 1985)

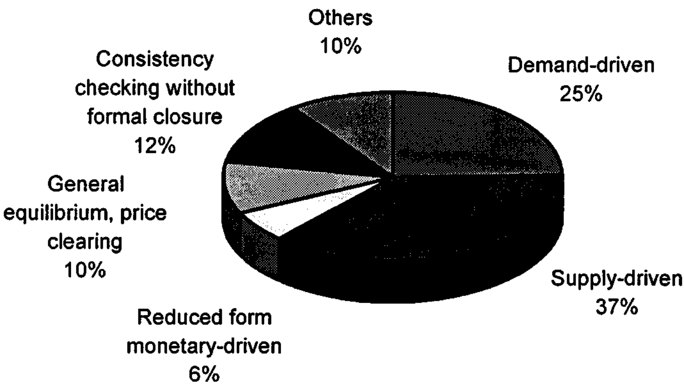
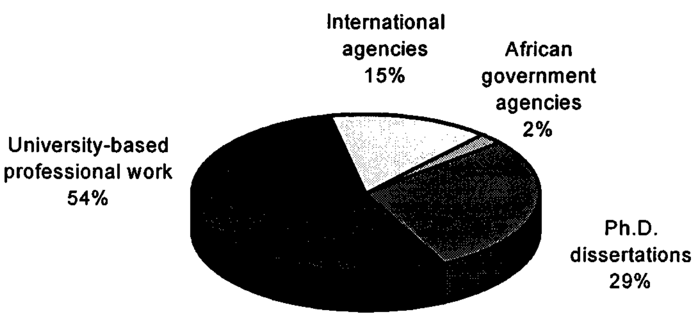


Diagram 3.3 African macro models by source (Harris 1985)



Naturally, these models emphasize different aspects of African economies. Thus, in order to understand how these work, a number of different types of African macroeconomic models are examined below. While some of these study the impact of foreign borrowing or, indeed, a sudden onset of oil or other mineral revenue on the economy, others focus more on fiscal conditions. However, in the discussion which follows, I will not primarily be concerned with the objectives of each model, although I am cognizant of the fact that this objective may shape the type of modelling undertaken. Rather, my own focus is on how these various approaches have been applied in building models of African economies. From this, I hope to be able to draw out some lessons, which may help in developing a prototype macroeconomic model for Africa.

I will begin by examining the work of Oshikoya (1989), who has developed a macro-sectoral model for *Nigeria,* with the aim of studying the impact of expanded domestic spending on externally-borrowed funds. His model is interesting in that it integrates a macroeconometric approach with an input-output analysis. This integration allows one to determine final demand from equations of economic behaviour, and to allocate this over sectoral production activities, by means of an input-output table. Oshikoya's model comprises five production sectors (bloc 1). Each sector's value added is determined by transformation of the input-output type production function and by linking final demand components with the sectoral value added. The residuals, in each of these equations are modelled by econometrically relating these, alongside others, to (lagged) capital stock, which is believed to show the capital constraint in such economies (and hence represent a supply factor in the long run). At the same time, this capital stock augments demand, in the short run. This bloc is related to the external sector, which basically takes foreign borrowing as exogenous (bloc 2), as well as to final demand, in which the components of final demand are estimated (bloc 3). A major strongpoint of this modelling approach is that it takes account of the impact of supply and demand. A further interesting feature of this model is that its production function is made realistic by the use of inter-industry coefficients. Although the structure of the lags does not follow the theoretical formulation, the estimation of the supply components of blocs 1 and 2 is its unique and insightful feature.

Olafin and Iyaniwura (1983) also report on a macroeconomic model of *Nigeria* developed by the University of Ibadan, Nigeria.[1] The model consists in 25 stochastic equations, of which 16 are exogenous and lagged endogenous, including output of petroleum and export of agricultural products, as well as four identities. GDP is decomposed into six sectors, which are then specified within the model. These are (1) agriculture, (2) mining and quarrying, (3) manufacturing and crafts, (4) transport and communication, (5) construction, and (6) services. Agriculture is taken as a function of exports of agricultural products, domestic consumption of food, non-food agricultural and other products, and investment in agriculture and mining sectors. Within the mining and quarrying sector, gross output is explained by output of crude petroleum, as well as by capital formation within the sector. Manufactured output is explained by urban population (taken as a proxy for demand) as well as investment in machinery and equipment (taken as a proxy for productive capacity). Export of petroleum is related to its output and to government revenue. The consumer price index (as a proxy for inflation) is related to money supply, government expenditure and the price of imports. Finally, money supply is related to the government deficit, government securities, rate of change and stock of reserves. These sets of equations are then closed using four identities given in the model. These identities sum up the GDP component, government revenue, total population (urban and rural) and total imports.

Pleskovi (1989) has also constructed a computable general equilibrium model for *Egypt*[2] with the objective of studying fiscal incidence in that country. Pleskovi's model is based on Harberger's (1962) model and a SAM framework. The extended version of Pleskovi's model includes a nine-sector input-output table. This model is a very simple one with a number of restrictive assumptions. These include perfect mobility of labour and capital, a closed economy, full employment, fixed technology and an elastic supply of factors. The SAM comprises seven accounts, with twelve rows and columns. For the purposes of the model, the economy is assumed to have two goods. On the supply side, net output is represented by a Cobb-Douglas production function, while gross output, including intermediate output, is represented by an input-output production function. The value-added relationships for each good are derived from the SAM. On the demand side, final demand is equated with consumption and intermediate demand. The income of urban and rural households is derived from their endowment of capital and labour, to which is added transfer income. Finally, expenditure (by activity) and prices (given by factory-get price plus tax) are defined by a set of equations derived from the SAM. The model leaves prices and output of the two goods, wages and returns to capital to be determined endogenously. Tax rates and allocation of tax revenue are assumed exogenous, while most parameters are taken from the SAM and assumed to be constant. The model is based on a number of heuristic assumptions about Egypt's economy. Thus, it deliberately avoids addressing issues of accumulation and, in fact, is very limited in its coverage of the economy in general. Nevertheless, the attempt to maintain consistency through use of a SAM, as well as its focus on tax (as both revenue and transfer) represent interesting features of this model.

Benjamin et al. (1989)[3] constructed a CGE model for *Cameroon,* which sets out to study the economic impacts of an oil boom. This model is an 11-sector version of a model of 'Dutch disease' in a developing economy. Its underlying mechanism may be grasped from the sector version, which is presented as the theoretical underpinning of the model. Thus, according to this version, the economy produces output, which is either domestically consumed or exported. Imports are assumed to be imperfect substitutes for domestic production, with consumers having constant elasticity of substitution (CES) over the two goods. Based on these assumptions, demand is taken as being determined by the relative price of these two goods. World price is also taken as exogenous (i.e., the small-country assumption). This is converted to the domestic price of imports through application of an exchange rate. Export demand is considered to be a downward-sloping schedule in terms of its domestic, relative to the world, market price. Finally, the system is closed by equating national income – augmented by inflows of foreign exchange – with total spending on domestic consumption and imports. Since this system generates five variables with four equations, foreign exchange inflow is assumed to be exogenous. However, the parameter of this variable is changed with the aim of simulating an oil boom, and thus examining how this affects other variables within the system. Within this broader framework, the authors assume that foreign savings are exogenous, that investment is determined by total savings, and that capital is fixed and sector-specific. This type of specification renders 'Dutch disease' type models, with different implications in developing countries, where, for example not all the traded sector may contract. However, the model has a number of obvious limitations. For instance, the small-country assumption is held for imports but, rather unrealistically, is left out when it comes to exports. It is also interesting to note the implications of the imperfect substitution of imports for domestic production assumption employed in this model.

Lipumba et al. (1988)[4] constructed a macro model for *Tanzania,* containing 89 equations, of which 32 are behavioural. The model, which is supply-constrained, sets out to study the role of capital formation in constraining economic activity in that country. In so doing, seven major blocs are defined: (1) GDP by sectors of production, (2) employment, (3) expenditure on GDP, (4) the government sector, (5) the monetary sector, (6) the external sector, and (7) prices and productivity. Exports and other foreign exchange earnings are taken as the major determinants of ability to afford inputs required by the non-agricultural sector. For each of the eight sectors which are defined, output is modelled using a production function, with capital and labour as arguments. In some of these sectors, intermediate input is also taken as a constraint. Employment is endogenously determined in two of the sectors, through real wage and sectoral output, while it is assumed to be exogenous on the others. Within the expenditure bloc, private consumption is related to disposable income, while capital formation is assumed to be an 'accelerator' type, which will depend on net inflow and availability of foreign exchange. These, in turn, are taken as determined by previous year's exports. Government deficits are specified as affecting the money supply, leaving interest rates as relatively unimportant within the monetary sector. Demand for money is seen as passively adapting to supply, which, in turn, affects price level. Tax revenue is related to the non-agricultural sector, private consumption as well as imports and exports.

Within this model, the external trade sector is one of the most elaborated. This serves to underscore the role of imports and exports in constraining supply. Five main agricultural export crops are endogenized. As far as exports are concerned, the small-country assumption is maintained. Finally, prices are taken as determined by import price levels, wages and labour productivity. Account is also given to the role of producer prices in affecting export crop production. In turn, these producer prices are seen as depending on world market prices, exchange rate, marketing margin and the non-food consumer price index. World market price is likely to be particularly important in influencing the price of perennial crops, while the prices of cotton and tobacco are likely to depend, to a considerable extent, on the non-food consumer price index. Weather dummies, as well as a time trend (which shows institutional changes), are also included within this model. Imports (which are subdivided into 'consumption', 'intermediate' and 'capital') are related to demand, consumption, GDP and capital formation. Foreign exchange availability, rather than prices, is considered as representing the most important constraint to imports. Finally, price deflators are related to labour productivity and import prices, with a built-in lag, with money supply also given a role in determining GDP deflator and CPI (Consumer Price Index).

This attempt to describe the Tanzanian economy represents the most elaborated model so far specified. Much attention is paid to depicting the role of imports in constraining supply (i.e., capacity utilization). The impact of external sectors is also basically modelled through its impact on imports and prices. Although not utilized in the model, a sort of 'Dutch disease' phenomenon is observed for some of these exports. However, no role is given to domestic capital formation, which represents a shortcoming of this model, since such considerations might have been useful in the search for policy options. Foreign finance is also considered in a general way and hence, this analysis is kept less detailed. However, different financial flows are recognized as having different impacts. In summary, overall this is a useful model, which captures most of the salient features of the Tanzanian economy.

Van Frausum and Sahn (1993) have constructed an econometric model of *Malawi*, which sets out to measure the effects of external shocks and policies in that country. The model is composed of five blocs with a number of stochastic equations and identities. The production bloc consists in equations that predict sectoral output. Agriculture is disaggregated into cash crop and maize production by smallholders and export crop production by the state. Due to lack of data on labour and cultivated land, output is related to relative prices, weather, as well as secular changes captured by the time trend. Industrial production is explained by imports of intermediate inputs, capital stock of equipment and infrastructure. Value added in construction is regressed onto gross fixed capital formation of the government and the private sectors.

A further bloc examined within this model relates to balance of payment (BOP). This bloc attempts to show how the current account problem is ultimately transformed into external debt. Imports of goods and non-factor services are determined by the availability of foreign exchange, net of foreign borrowing, debt service payment and other factor payments. This is then set, together with creditworthiness indicators, as a constraint on imports. Total external debt is modelled as the sum of lagged debt level as well as balance on current account. The model also examines the government finance bloc. Thus, government revenue is determined by imports and GDP, with official transfers taken as exogenous. Government debt service and interest payments on domestic borrowing are taken as a function of outstanding external and domestic debt, with a one-period lag. Government expenditure is derived as an identity defined by a financing constraint. The final bloc within the model examines the price and monetary sectors of the economy. With regard to prices, most essential prices are allowed to be determined endogenously. In relation to the monetary sector, this is examined in a simplified form. Thus, the advance from commercial banks is modelled as a function of foreign exchange availability, through the monetary base and real interest rates, with the advance to the private sector taken as residual, once the government's share has been removed.

In summary, this is a very detailed model, which makes a good attempt to depict the Malawian economy. Its strong points are its attempts to link the current account balance with the debt condition, as well as to separate export and non-export agricultural production. On the negative side, some of the assumptions upon which the model is based may be questionable. For instance, the model assumes that government expenditure is determined by a financial constraint. This assumption ignores the inelastic nature of government spending, as well as the inflation that such spending generates in most developing countries. Moreover, variation of investment across public and private institutions have not been properly addressed, although some attempt to take account of these has been undertaken for the construction sector.

Kayizzi-Mugerwa (1990) formulated a model with the aim of studying the impacts of copper prices on the economy of *Zambia*. The underlying theoretical formulation for this is the 'Dutch disease' literature, in which the spending effect and real exchange rate are given a key role. The economy is divided into tradable[5] and non-tradable sectors. The ratio of the price of tradables to non-tradables determines the real exchange rate. Within the model, government revenue is related to GDP, expenditure to government revenue, and both of these to their respective lagged value, this indicating lack of instant equilibrium. The real exchange rate is set to depend on price of copper, both through its impact on the non-traded sector, and by affecting the level of credit which, itself, affects demand. The rise in non-tradable prices is determined by excess demand for money, which itself is related to income and to relative prices. Real private consumption is related to real income as well as the stock of money in the preceding period. Real government expenditure, private consumption and relative prices determine the volume of imports. Finally, the model is closed using an income identity, as well as a definition of changes in the nominal money supply.[6]

In summary, the working of this model is clear and simple. Fiscal and trade disequilibria resulting from a change in copper price affects the domestic credit and volume of money. These, in turn, have an impact on non-traded prices, the real exchange rate and consumption, with the last two of these having a knock-on effect on import levels. The strength of this model is its attempt to describe the domestic sectoral adjustment process. Its weakness is that it overlooks the impact of the other aspects of the external sector. Moreover, the production structure of major sectors is also overlooked.

Berhanu (1994) has built a Kalecki-FitzGerald-inspired macroeconomic model of *Ethiopia*. The model is very small, having only six equations. In the first of these equations, the manufactured price is formulated, à la Kalecki, while, in the second equation, marketed surplus is formulated as a function of internal terms of trade. In the third equation, the total output of the manufacturing sector is assumed to equal the marketed surplus, non-food consumption of wage earners in the manufacturing and export sectors and the unsaved profit of capitalists. The remaining equations define total profits in the economy, the demand and supply of basic goods (including imported ones), the external balance, and, finally, investment (which is constrained by balance of payments).

The model assumes, *inter alia*, that the agricultural output market is not flexi-price, and that investment (not output) adjusts to the foreign exchange constraint. These assumptions neither follow the standard structuralist assumptions upon which the model is based, nor tally with the stylized facts in Ethiopia. Rather, peasants in that country had been marketing a good portion of their output in the flexi-price market, most industries were extremely import dependent, and import compression – with its adverse effect on capacity utilization and output – was the rule. Moreover, the ('socialist') state, as centre of accumulation, is not well integrated into the model. The model also contains a number of other limiting assumptions. Manufactured goods are assumed to be necessities within rural household consumption, the model abstracts from the debt problem and hence, balance of payments is essentially assumed to be a trade balance. These assumptions seriously limit the relevance of the model. Thus, if we assume that import compression takes place, then some of the arguments and conclusions set out in this model may no longer be sustained.

Notwithstanding such shortcomings, the model gives an interesting analysis of the distribution of income, process of accumulation/growth and the policy dilemma facing different actors. Its importance should also be seen in the context of a virtual absence of macro models for Ethiopia.[7] This analysis would have been more illuminating if mark-up pricing and its effect on accumulation had not been assumed to have a foreign exchange constraint. Indeed, it could be argued that this foreign exchange constraint, rather than the author's emphasis on the share of profit, should have been the focus of analysis, in relation to accumulation.

Davies et al. (1994) have also developed a CGE model for *Zimbabwe*. The model contains 25 supply-side equations. Five of these related to a fixed wage demand-determined labour market; eight equations specify income generation, saving and consumption; three define public sector accounting; and four define foreign exchange rationing. Finally, one equation is set as a closure that equates the 25 supply-side equations with total demand, while another ensures consistency by maintaining the investment-saving balance. Although these are the basic features, the fully specified model consists in 113 equations, all but one of which are independent, with the remaining equation dealing with the saving-investment balance.

One of the notable features of this model is the inclusion of an import compression aspect within a CGE model framework. The model identifies five sectors, each of which has a different adjustment mechanism. Thus, the agricultural sector will adjust through a flexi-price mechanism, services by way of a demand-determined one, construction through supply-demand adjustment, exportables derived as residual and, finally, importables through supply-demand adjustment. Imports are basically rationed among these sectors, with priority given to the exportable and construction sectors. The explicit inclusion of import compression and its linkage with food production (as shown in the counterfactual analysis) represent an interesting feature of this model. However, being a CGE model, it suffers from the use of parameters, which essentially show a 'snap-shot' picture of the economy. Moreover, exogeneity assumptions in relation to the agricultural sector, as well as similar assumptions in relation to investment and its impact on capital formation, could set a limit to the wider use of this model.[8]

Kwack (1989) also developed a prototype model for *Africa*, which is applied to different African countries. The model's underlying assumption is that the economy is 'small and open in the sense that activities and prices in the country are affected by conditions in world markets where its own influence is minimal' (Kwack 1989: 137). Thus, African countries are assumed to be 'price takers' in the international market. Within the model consumption is specified as a function of disposable income and inflation. Investment is basically an accelerator type (where change in output and lagged capital stock are arguments). This is augmented by the inclusion of a financial constraint (credit). A further aspect of the aggregate demand bloc comprises government expenditure and revenue. Thus, direct taxes are related to nominal income, and indirect taxes to nominal private consumption, nominal imports and exports. Finally, government consumption expenditure is considered as a policy variable.

On the supply side, GDP is assumed to equal the sum of value added in (1) agriculture, forestry and fishing; (2) mining and quarrying, and (3) manufacturing, utilities, construction and services. Output of mining and agricultural sectors are assumed to depend on world price relative to domestic cost and capital stock, while services and manufacturing outputs are assumed to depend on domestic demand.

Merchandise trade is disaggregated into four commodity groups. Imports are set as determined by relative prices, including tariffs and real income. On the other hand, real exports in manufacturing are specified as determined by foreign income and export prices relative to overseas price. Exports of primary commodities are assumed to depend on domestic supply, with producers of these exports assumed to be price takers. Exports and imports of services are assumed to depend on the level of exports and imports of goods as well as on overseas prices. It is also postulated that factor income payments depend on the US-based LIBOR (London Inter Bank Rate) interest rates as well as on outstanding net external assets. An attempt is also made to combine the monetary sector with balance of payments, by defining the demand for money as a function of real GNP and rate of inflation.

The prototype model explained above is estimated for ten African countries. As is explicitly acknowledged by the authors, the method suffers from simultaneous equation bias, since each equation is estimated using OLS. The author also notes theoretical and data limitations in modelling Africa. The former relates to such factors as the absence of financial markets and failure of the neo-classical production function, which may arise from natural disturbances, and other related causes. In relation to data quality, gaps in data, comparability across countries, underestimation of the subsistence sector, as well as lack of information as to the method of estimation of the acquired data, are all mentioned. However, in spite of these shortcomings, the author claimed that his model performed reasonably well. More generally, he stresses the importance of policy modelling in Africa.[9] Within this model, output in certain sectors, such as manufacturing, is assumed to be demand-determined. This assumption overlooks the stylized fact of import compression. Moreover, the model ignores the role of Northern demand as well as the commercial policies pursued by Northern nations, in affecting Africa's export sector. By emphasizing relative prices as determinants of imports, the model further undermines the importance of capacity to import, and hence capacity utilization, as well as creation.

Based on the above review, one might reasonably conclude that most of the published macro models of African nations developed in the past decade have been designed with the aim of studying the impact of external factors on the economy. Although a rigid classification would be difficult to justify, since overlapping objectives are common, the models reviewed nevertheless may broadly be grouped into those which:

(1) focus on the impact of foreign capital and foreign exchange earnings on major macro variables (Lipumba et al. 1988, Oshikoya 1989, Davies et al. 1994),

(2) stress the impact of oil revenue (Olafin & Iyaniwura 1983, Benjamin et al. 1989, Benjamin 1990),

(3) focus on the impact of external shocks in general (Lipumba et al. 1988, van Frausum & Sahn 1993, Kayizzi-Mugerwa 1990), and

(4) focus on domestic macroeconomic conditions and policy (Boutros-Ghali & Taylor 1980, Asmerom & Kocklaeuner 1985, Pleskovi 1989, Harton & McLaren 1989, Lemma 1993, Berhanu 1994, Decaluwé & Nsengiyumva 1994, Davies et al. 1994).

Based on the above review, a number of lessons may be drawn from these various efforts to depict African economies. Firstly, African macro models should focus more on the supply-constrained nature of the economy. This may be done by concentrating more on the role of both intermediate imports (in the short to medium term) and on capital formation (as representing a longer-run concern), as well as on their mechanism of financing. Secondly, sectoral adjustment (between traded and non-traded sectors) could represent an important focus for future efforts. And finally, the government fiscal posture and the monetary sector need to be linked and should be left open to the influence of external sector effects. In addition to these general lessons, a number of technical recommendations (for example on combining input-output analysis with econometrics) may be drawn from these models. These recommendations, taken alongside a number of theoretical issues which we examine in the following section, will form the basis for the construction of the prototype model for Africa detailed later in this book.

3.3 SOME BASIC ISSUES IN AFRICAN MACROECONOMICS

In this section a modest attempt is made to identify some salient features of macroeconomic theory as it relates to Africa. Trap (1993) provides an excellent assessment of the consistency of the macro framework advocated by the IMF and World Bank, as well as the theoretical underpinnings of the 'Stabilization' and 'Structural Adjustment Programs' sponsored by these institutions. However, notwithstanding his discussion on alternative macroeconomic theoretical frameworks, Trap does not actually go so far as to propose an alternative model for Africa.[10]

A further effort to understand how the African economy functions is associated with the economists of the Centre for the Study of African Economies (CSAE) at the University of Oxford. A number of studies undertaken by the CSAE have been helpful in highlighting which are likely to be the most productive channels through which policy might be propagated. Methodologically, these studies adopt a basic neoclassical approach, dealing with structural factors on only an *ad hoc* basis.[11] However, in common with the IMF and World Bank models, the African economic crisis is more often characterized as essentially a policy problem by CSAE economists. Thus, it is argued, those nations who achieved the best growth rates were those who were boldest in liberalizing (see Collier & Gunning 1999 for an excellent summary of the CSAE's thinking on this).[12]

Many of the models surveyed above, as well as those studies falling under the auspices of the African Economic Research Consortium

(AERC), have been undertaken individually, and hence, have not been organized into any kind of coherent framework. Indeed, it could be argued that the time for some degree of abstraction from these various models is long overdue. This would allow for the identification of salient features which might be included in an alternative economic model for Africa. Hence, in the remainder of this section exactly such an exercise will be undertaken. Issues highlighted in this discussion will then be empirically examined in the subsequent two chapters. Based on this analysis, a prototype economic model for Africa will be developed and applied in Chapter 6.

3.3.1 Import Compression

The balance of payment crisis discussed in Chapter 1 has brought about a policy response in most African countries. This response may be termed 'import compression' (Ndulu 1986, 1991; Rattsø 1994). The import compression model works as follows. The balance of payments crisis had set a limit on the level of imports. This, in turn, led to direct government control over the allocation of such imports. Given such constrained import capacity, governments were forced to set priorities between imports of intermediate goods and of investment goods. This sets in place a trade-off between capacity utilization and capacity expansion (Rattsø 1992b, Ndulu 1986, 1991). Understood in the context of the gap models of Bacha (1984) and its extension in Taylor (1991), the inclusion of intermediate imports as determinants of capacity utilization has the effect of relaxing the fixed import coefficient assumed in these models (Rattsø 1994: 36).

Rattsø's (1994) model is interesting in that it explicitly emphasizes the need to incorporate an import compression component into African macro models. However, its weakness is that it relies on the movement of real exchange rate and the assumed flexi price[13] structure in this protected, import-dependent sector. In fact, this pricing and market structure would appear to contradict the stylized fact of mark-up pricing in such sectors. Indeed, the fact that these sectors are protected by states or by their shear size in many African countries would appear to justify this assertion. Thus, incorporating this latter set of assumptions into Rattsø's (1994) model will result in a different set of conclusions.

Ndulu (1991) has extended his original contribution – which was based on Tanzania's experience (Ndulu 1986) – to a number of other African countries. Thus, as Ndulu notes, the process of growth entails not only the trade-off between current consumption and capacity growth, which was the focus of most labour surplus-based models, but also between capacity growth and capacity utilization, in an import-compressed situation (Ndulu 1991: 288). Ndulu argues that idleness of capacity in industry has resulted from structural bottlenecks as well as a mismatch between rate of expansion of capacity and the availability of operational resources (Ndulu 1986: 14). This, combined with a 'cost-plus' (i.e., mark-up) pricing system, implies that output growth in the short run will depend on capacity utilization, which in turn will depend on the composition of intermediate imports or, more generally, of total imports (Ndulu 1986: 15–19).

Import compression occurs either when domestic goods are imperfect substitutes for imported ones, or as a consequence of low import capacity of African countries. The latter will usually result from low levels of export earnings and foreign savings, which in turn will depend, *inter alia*, on external terms of trade, net foreign resource inflows, weather vagaries in economies dominated by rain-fed agriculture, and discovery and exhaustion of mineral resources. Hence, the possibility of exogeneity of growth in sub-Saharan Africa is likely to be a real one[14] (Ndulu 1991: 290). Ndulu further expands this framework to include the public sector in his analysis, along a three-gap line of thinking. Basing this analysis on empirical evidence of public sector crowding-in in Africa, Ndulu underlines the existence of a trade-off between growth, through public investment and inflation. The exact form that this takes will depend on whether this deficit is financed through borrowing or monetization (Ndulu 1991: 291–92).

The formalization of these ideas into a simple and elegant framework allows Ndulu to arrive at the important conclusion that 'in economies with excess capacity, the increase in net exports will not crowd out investment since domestic saving increases with the rise in capacity utilization'. He also notes that depreciation in the real exchange rate, together with a higher level of inflows and lower levels of debt servicing will play an important positive role in relieving the import compression problem. Similarly, such flows are also likely to ease the fiscal constraint to growth, both by raising tax revenue through growth of output and by reducing monetization (Ndulu 1991: 293–96).

Ndulu's analysis represents an important contribution to African macroeconomics. However, there are certain features within this analysis which could be elaborated upon and improved. For instance, within this model, the public sector deficit requirement is essentially just an accounting rule, or an 'identity'. However, if this is expanded to include behavioural rules, along the lines of the fiscal response literature, then some of these conclusions will need to be modified. Likewise, it could be argued that the impact of capital inflows on the trade and non-trade sector (i.e., the 'Dutch disease' effect), common in many African countries, should be explicitly modelled within such a macro framework. This addition is, in particular, important to accommodate the 'import compression argument' in the more liberalized context of the 1990s, where exchange rate increasingly became an important (adjusting) macro variable. The inclusion of these two related sets of concerns can only represent a positive development in relation to the macro modelling of African economies. Hence, the following section will outline how such considerations might be incorporated within a macro framework and this will be re-examined empirically in Chapter 5.

Arguably, a further shortcoming of Ndulu's framework is the modelling of inflation and the monetary sector using the 'Quantity Theory' of money. This implies that inflation is a purely monetary phenomenon. This is likely to have arisen because of the neglect of the non-export agricultural sector in Ndulu's formulation. Indeed, the linking of this sector to the import-compressed sector, along Kaleckian lines, is likely to have rendered a more fruitful analysis. This should be obvious in African economies where more than 50 per cent of the weight in the consumer price index (CPI) is constituted by the food category.

3.3.2 Macroeconomic Effects of External Finance

The modelling procedure pursued in the existing North-South models by and large fails to take account of the macroeconomic impact of external finance on the South. Nevertheless, theories of the macroeconomic impact of external finance, and especially of aid, which is particularly relevant in Africa, have grown in their own right. Such theories include the 'two-gap model', the 'Dutch disease' and the 'recipient fiscal response'. These are areas that have been studied in their own right, and hence have not been considered within a global framework or in a wider African macroeconomic framework.

The two-gap model (Chenery & Strout 1966) basically links a simple Harrod-Dommar growth model with flows of external assistance. The essential point of the model is that growth is constrained by skill supply, organizational ability, supply of domestic savings and the supply of imported commodities and services. The constraints to growth are examined in three phases. In phase I, growth is limited by the ability to invest and the savings gap determines capital inflows. Phase I ends when investment reaches the level adequate to sustain the target growth rate. In phase II, growth is set by the target set, and capital inflow is required to fill the saving gap. The tapering off of the capital inflow in this phase requires exports to grow faster than imports. However, this is found to be difficult for most LDCs and hence, a new set of restrictions, which is binding in this event, is introduced in phase III. Using this model the authors conclude that, although its impact varies in different phases, foreign economic assistance is generally productive, either in supplementing domestic savings or in relieving foreign exchange constraints.

The Chenery-Strout dual-gap approach has been criticized from a host of different angles. Griffin (1970),[15] Griffin and Enos (1970) and Papanek (1972) argue that aid will displace, rather than supplement, domestic savings. A further argument against the two-gap model is that it adopts an extreme disequilibrium framework, and hence, neglects relative price effects. These effects are explicitly covered in the 'Dutch disease' literature, which is becoming an important aspect of the discussion on the macroeconomic impact of aid. The argument is simple. Revenue is obtained from a booming sector. If part of this is spent on non-traded goods ('the spending effect'), this leads to a real appreciation, that is a rise in the relative price of non-tradables to tradables. This, in turn, draws resources out of the booming sector into the non-traded sector ('the resource movement effect') (Corden 1984, van Wijnbergen 1984). The growth effect of such a resource shift is considered to be negative, since traded sectors are characterized by 'learning by doing', dynamic externalities which have a higher and positive effect on growth (van Wijnbergen 1984, 1986a, 1986b; Edwards & van Wijnbergen 1986). The similarity between this and aid underscores the importance of the 'Dutch disease' approach in explaining the macroeconomic impact of external finance. Hence, in Chapter 5, I will return to examine this issue and its relevance in the African context. The empirical findings of Chapter 5 will then be employed in the North-South model developed in Chapter 6.

A further aspect of the macroeconomic impact of external finance which could usefully be considered within African macroeconomics is 'the recipients fiscal response' to foreign inflows. Critics of the two-gap model (Griffin 1970, Papanek 1972) have highlighted how foreign capital inflows may reduce government efforts to raise revenue, especially through taxation. This concern has been formalized by Heller (1975), in a model that assumes public sector decision-makers maximize a utility function. By maximizing this function, subject to the constraint that government expenditure should be equal to its revenue, he solves the model for a set of first order conditions that yield structural equations. The latter is estimated using data from a number of African countries. Mosley et al. (1987) have further extended this analysis by including aid's impact on growth of output as well as minor changes in the presentation of the public sector variables' specification. Chapter 5 will present an extensive treatment of the theoretical underpinnings of this literature, and will also attempt to set out an alternative means of thinking and estimation in relation to this. The results of this analysis will be incorporated into the model developed in Chapter 6.

To sum up, the macroeconomic impacts of external finance, and especially of the 'Dutch disease' and 'fiscal response', represents an important area of development within the literature. However, this has been a neglected aspect of North-South macroeconomic modelling, and also, to a certain extent, of macro modelling of Africa. Therefore, following an empirical examination of this issue in Chapter 5, I will explicitly incorporate this important literature within the specification of the North-South model developed in Chapter 6.

3.3.3 The Accounting Framework: An Overview

In this section I will not dwell upon the details of the relevant accounting framework for macroeconomic analysis in Africa. Harvey (1985), Trap (1993) and Lensink (1996) provide a good discussion of such accounting framework in African context. Rather, I will outline the procedure by which a consistent macro database might be built for 21 African countries selected for the purpose of this study, from three geographical regions: North Africa, West and Central Africa, and East and Southern Africa. This database, comprising panel data for the period 1970–90,[16] will form the basis for all the empirical analysis undertaken in this book. Sample selection is guided largely by the availability of data, as well as by the economic and demographic characteristics of African countries. Thus, one of the features of the global model developed in Chapter 6 is the use of econometrically estimated parameters in almost all sub-blocs of the model.[17] However, a major problem in constructing a macro database for each of the sample countries has been lack of consistency between the international data reporting systems of different institutions. In order to overcome this problem, I have used a data reconciliation procedure, which facilitates consistency in data reported by different international institutions. This procedure builds on earlier work discussed in Alemayehu et al. (1992) and FitzGerald (1993), and is formalized into a formal accounting framework, outlined below.

The accounting framework

Since the emergence of Keynes' macroeconomics in 1930s,[18] the Keynesian version of national income accounting has become the *de facto* accounting framework for macroeconomics. Thus, much of the data used in macroeconomic analysis today is theory- (and more specifically Keynesian theory-) laden. However, this is not a static phenomenon, with change and progress in theories having repercussions on data. Hence, the accounting framework relevant to open-economy macroeconomics has undergone a constant process of improvement, although its essential features remain unchanged. In the following discussion, I will outline the framework that has been adopted in constructing the sample database of this study, and detail the improvements made to this. Chapter 7 will outline how this effort might be extended, with the aim of improving the accounting framework of open-economy macroeconomics within a global context. The latter will define the accounting framework, which will be used in solving the model.

The cornerstone of an open-economy macroeconomics accounting framework is the identity that links the internal balance with the external balance. Thus, in relation to the United Nations System of National Accounts, this is the link between national accounts and the balance of payment. However, one problem which one might encounter in using such an accounting framework is the lack of institutionally disaggregated detailed data which could, to some degree, be resolved by resorting to various multinational data sources (see Alemayehu et al. 1992 for details on this).

A major macro problem in the case of Africa – and developing countries in general, for that matter – is how to finance this investment. This may be addressed by way of the accumulation balance, which may be defined as,

$$I = S + F \qquad [1]$$

where: I is gross domestic investment, S national savings and F net capital inflows. The latter is defined as the net change in assets and liability position of the country, and is equal to the deficit of the current account of the balance of payments (i.e., the external balance), which is given as,

$$F = M - X + N \qquad [2]$$

where: M and X are imports and exports of goods and non-factor services, respectively, and N is net factor payment and current transfer to abroad. Combining these, disaggregated into public (g) and private (p) sectors and rearranging [1] and [2] yields,

$$(I_g - S_g) + (I_p - S_p) = M - X + N = F_g + F_p \qquad [3]$$

This yields the basic identity which links the domestic investment and savings gap with the current account deficit or surplus, and hence the resulting capital inflow or outflow. Further disaggregation of each of the variables in [3] may then be carried out by consolidating the various multinational sources of data. For instance N and capital inflows may be disaggregated using the balance of payment (BOP) statistics and public savings and investment may be derived using government financial statistics (Alemayehu et al. 1992: 7–14).

In the reconciliation of data from different sources, the major adjustment lies in dealing with the discrepancy between the national accounts estimate for the net factor payment and current transfers from abroad ($S_n - S_d$), and that derived from the BOP statistics. Depending on what assumption one makes about the accuracy of national accounts data *vis-à-vis* the balance of payments, there are two options in dealing with this discrepancy. If one assumes that the N computed from national accounts is accurate, then this value can be imposed on the BOP statistics. The discrepancy on the BOP may then be accounted for in any variable deemed residual or assumed to be less accurately recorded. A database based on such an adjustment mechanism is reported in Alemayehu et al. (1992).

The second alternative is to assume that the net factor payment and current transfer computed from balance of payment is correct. In such a situation, the net factor payment and current transfer obtained from the balance of payments may be imposed upon domestic savings, in order to arrive at national savings. Assuming further that savings in the public sector are relatively accurately recorded, then private sector savings may be chosen to account for the discrepancy between the net factor payment and current transfer, as computed from national accounts and that of the balance of payment.[19] The choice between the two alternatives should depend on the nature of the analysis to be undertaken, as well as the relative faith one places in these two sources.

In relation to this study, the most relevant data is that relating to balance of payments. This is a logical consequence of the fact that the focus of this study is on international finance and trade. As a consequence, the adjustment is undertaken by imposing the net factor payment and current transfer obtained from the BOP (which is assumed to be correct) onto the national account data. Private saving is then taken to be the adjusting variable. This choice is based on two assumptions. Firstly, although, in principle, domestic saving may be set as an adjusting variable, in fact, it is more logical to choose national savings for this purpose, since the problem arises from net factor payment and current transfer, which is related more to national than to domestic savings. Secondly, among the components of the national savings, it is highly probable that public saving in Africa could be recorded more accurately than private ones. This is a consequence of the public sector's relative efficiency in data recording.

A further important dimension of the database is the disaggregation of trade and financial data. Firstly, a disaggregated stock of financial data is set out. That is, the stock data is disaggregated according to whether creditors are bilateral, multilateral, concessional, non-concessional or private (i.e., banks, portfolio and other commercial suppliers). Hence, instead of using direct flows reported in IMF balance of payments statistics, the flow counterpart is derived from the change in stocks. This allows consistency between the stock and the flow data. In relation to trade data, the total exports are disaggregated by the SITC classification chosen for the purpose of the study. Since this classification tallies with the one used by UNCTAD in its *Annual Commodity Yearbook,* this allows one not only to arrive at aggregated historic data by SITIC, but also to assign UNCTAD-based relevant prices for each SITIC classification. Consistency of total exports, between that reported in the national accounts and the disaggregated UNCTAD data, is maintained by introducing a category of 'other exports' as an adjusting variable. A similar approach may also be employed for imports.

3.4 CONCLUSION

Based on the above discussion, one might reasonably conclude that efforts to develop macroeconomic models for Africa have remained relatively unsophisticated. However, there have been a number of promising developments in depicting the actual macro dynamics of these countries. Further, based on the models examined in this chapter, it would appear that modellers have generally emphasized the supply-constrained nature of African economies as well as the vulnerability of these economies to external shocks, both positive and negative.

Indeed, this has taken a particular form in relation to the analysis of import compression and the resulting trade-off between capacity growth and utilization on the one hand, and inflation and growth on the other. However, this focus is at the expense of other related concerns, such as the macroeconomic impacts of external finance and, more specifically, the fiscal response and 'Dutch disease' effects. Moreover, it could be argued that the integration of this approach within a monetarist model for inflation would limit its realism. Hence, these and a number of other shortcomings of these approaches will be further examined in Chapter 5, and the findings of this analysis will be used to inform the prototype African model developed later in this book. However, before moving on to examine the impact of external finance, we begin by empirically examining some of its determinants.

4 Determinants of Foreign Exchange Supply

4.1 INTRODUCTION

In previous chapters we examined the trade and external finance problems of Africa from a historical and theoretical perspective. In this, and the subsequent chapter, I will attempt to investigate this issue empirically. The econometric results obtained in these two chapters will then be used in the construction of a North-South model, which will be detailed in Chapter 6. The empirical analysis which follows will be split between two chapters. In this chapter, some determinants of foreign exchange supply to African economies will be examined. In Chapter 5, a number of macroeconomic impacts of such flows will be noted.

The analysis contained in this chapter will be organized as follows. Section 4.2 will report some econometric results obtained using the 'eclectic' approach to FDI. This analysis will attempt to build upon the 'economic, strategic and political self-interest and developmental considerations' arguments for official flows, discussed in Chapter 2.[1] In section 4.3 the determinants of export supply will be examined, since exports represent the other main source of foreign exchange for Africa. (Again, this analysis will build upon the theoretical discussion presented in Chapter 2.) Section 4.4 will aim to further complement this analysis by placing the supply of commodities from Africa within a global commodity-market framework. Finally, section 4.5 will bring the chapter to a close, by attempting to draw out some conclusions, based on the preceding discussion.

4.2 DETERMINANTS OF FINANCIAL FLOWS TO AFRICA: ECONOMETRIC RESULTS

4.2.1 Determinants of Allocation of FDI to Africa

The level of FDI flows to African countries is extremely low. The existing flows are also concentrated within a small number of export enclaves, such as the mining sector. Although FDI does not represent an important financial flow to Africa, there has nevertheless been a tendency for such flows to increase in recent years (Kasekende et al. 1995, Fernandez-Arias & Montiel 1996). Indeed, by examining the pattern that this has taken in the recent past, we may be able to make useful inferences about the future of these flows. Thus, a simple model of FDI determination, based on the major features of the 'eclectic' approach, will now be formally estimated. This estimation is undertaken for the same three African regions, described in previous chapters, yielding the following final form for the estimated model:

$$FDI_A = \beta_0 + \beta_1 \frac{GDP_{ot}}{GDP_A} + \beta_2 \frac{Ming_{ot}}{Ming_A} + \beta_3 [FDI_A]_{t-1} + \beta_4 Dum_{SAP}$$

where: the subscript *ot* refers to Other South (World Bank definition of South Asia and Latin America) and *A* indicates the African region in question (East & Southern Africa [ESA], North Africa [NA] or West & Central Africa [WCA]).

The first argument (GDP ratio) is included, with the aim of showing the relative size of the market. The higher this ratio, the lower the relative size of African markets and hence, the lower the level of FDI flows to these markets. The second argument (Ming) gives the ratio of the value added of the mining sector. The lagged level of FDI aims to show the historical pattern of FDI flows (taking account, for example, of colonial influences). This is inferred from the error correction part in the Error Correction Model (ECM). Before arriving at this parsimonial form, I have experimented with similar ratios for imports, as representing an alternative indicator of market size, but have not found this to be statistically significant.

The ratios used as regressors are computed from their respective index (1990=100). The data is obtained from World Tables (1994, electronic) as well as the Inter-American Development Bank's 'Economic and Social Progress in Latin America (ESPLA)' (various years). All of the variables in each of the equations are found to be an $I(1)$ series using the ADF test at a 5 per cent significance level. A co-integration test is conducted for the ESA and WCA regions. The null hypothesis of no co-integration is rejected. Denoting the log of FDI by I, the log of the GDP ratio by Y, the log of the mining ratio by M, and the dummy by Dum_{SAP}, the result of the Error Correction Model (ECM) for the ESA and WCA regions, and the OLS for the NA region is given below.[2]

East and Southern Africa (ESA)

$$\Delta I = \underset{(1.9)^{+}}{0.73 Dum_{SAP}} - \underset{(-2.6)^{*}}{5.5\Delta Y} - \underset{(-0.9)}{1.24\Delta M} - \qquad [4.1\text{-}ESA]$$

$$\underset{(-4)^{*}}{0.99}(I_{t-1} + \underset{(-1.95)^{+}}{1.65 Y_{t-2}} + \underset{(-1.29)}{1.51 M_{t-2}})$$

R^2-adj = 0.45	Jarque-Bera 4.5^{+}
Reset 1.76(0.21)	LM 1.3(0.26)
BG=2.4(0.12)	Sample 1970-92

Notes:
Values in bracket are *t*-values, while for diagnostic test *P*-values are given (see Appendix 4.1).
* implies 1%. + 5% and ^10% level of significance.
LM is a hetroscedasticity test while BG is the Breuch-Godfery test for serial correlation.
The 5% (2 degrees of freedom) value for Jarque-Bera is 5.99.

North Africa (NA)

$$I = \underset{(-1.5)}{-0.656 Y_{t-1}} - \underset{(-1.8)^{\wedge}}{1.15 M_{t-1}} + \underset{(2.8)^{*}}{0.711 I_{t-1}} \qquad [4.2\text{-}NA]$$

R^2-adj = 0.61	Jarque-Bera 2.4^{+}
Reset 0.01(0.92)	LM 0.14(0.71)
BG = 0.09(0.77)	Sample 1970-92 (of which only 11 observations are used)

Other notes as given in equation [4.1-ESA].

West and Central Africa (WCA)

$$\Delta I = \underset{(0.98)}{1.08\Delta Y} - \underset{(-0.08)}{0.078\Delta M} - \qquad [4.3\text{-}WCA]$$

$$\underset{(-3.2)*}{0.816(I_{t-1}} + \underset{(-1.9)^{+}}{0.237Y_{t-2}} + \underset{(-0.29)}{0.107M_{t-2})}$$

R^2-adj = 0.31	Jarque-Bera 4.7^{+}
Reset 0.01(0.92)	LM 0.30 (0.60)
BG = 4(0.07)	Sample 1970–92

Other notes as given in equation [4.1-ESA].

However, these results throw up a number of problems, the major one relating to the absence of a sufficiently long time series, which severely limits the ECM model adopted. Nevertheless, the results remain better than might be arrived at through a simple OLS-based estimation. This is particularly the case since such OLS estimations might, in fact, be spurious, as can be inferred from the non-stationarity observed here.

For equations relating to the ESA region, we have experimented with a number of different estimations. Of these, the result given above is found to be relatively the best. Based on this equation, the GDP ratio for the ESA region failed to show a long-run relationship, using a standard co-integration analysis. However, if the GDP *per capita* figure is used instead, then such a relationship may be identified. A further important implication arising from this analysis of the ESA region is that adjustment towards equilibrium levels of FDI flow is instantaneous (99 per cent). This might be explained by the extreme enclave nature of FDI within this region, investment in mining representing a case in point. Finally, it is worth noting that only within this region is the structural adjustment dummy found to be important.

The estimation for the NA region is the most difficult and the least reliable. Firstly, the sample is very small, which limits the scope for use of a co-integration analysis. However, it is essential to undertake such an analysis, since the series are $I(1)$. Therefore, the estimation is based on a simple OLS, which may suffer from spurious regression unless the assumed, untested co-integration is true. This basically hinges upon an assumption that a long-term relationship would be identified if it were possible to run a co-integration test. In contrast to the other two regions

– where net FDI is found to be equivalent to FDI within the home country, coming in the form of credit – levels of FDI within the NA region are, in fact, found to be negative. This is entirely plausible, since the region is an oil exporter and consequently is in possession of resources which may be invested elsewhere. Hence, FDI within the home country (or credit) is used as a dependent variable. In contrast, the estimation for the WCA region is comparatively more sound. Nevertheless, the length of available time series remains short and so, at best, should be taken as representing only a medium-term approximation. The structural adjustment dummy is not found to be statistically significant, and hence is dropped from the estimation for this region.

In all cases, possible multicolinearity due to the correlation between mineral value added and GDP ratios are checked. It is found that, except within the NA region, the degree of multicolinearity is reasonably low, the simple correlation coefficient between the two being 0.34, 0.77 and 0.32 for ESA, NA and WCA, respectively. In general, the results summarized in this section suggest that relative market size, mining activity and the historical pattern of FDI together determine the flow of FDI to Africa, as well as its allocation among Southern nations. Although this is not a robust result, since such flows to Africa are extremely small, the limitations of the above equations may nevertheless be tolerated. In the following section, equations will be estimated for official aid, since this represents the most important type of capital flow to Africa.

4.2.2 Determinants of Allocation of Official Capital Flows to Africa

This section details some econometric results relating to the determinants of the allocation of official capital flows[3] to Africa. Data relating to such flows are generated by examining the change in the stock of such debt. This derivation has the advantage of making stocks and flows consistent. On the other hand, debt restructuring may entail overstatement of such flows by the amount of what are termed 'inferred flows'. These inferred flows – which are to be distinguished from cash flows – may result, say, from principal arrears. However, up to the mid-1980s, rescheduling of principal was negligible in most African countries.[4] To a degree, this overstatement may also be offset by debt forgiveness. The remaining data is obtained from the World Bank's World

Tables and World Debt Tables (1994, electronic) as well as from the Inter-American Development Bank's ESPLA dataset (various years).

A simple model of the determinants of allocation of official capital flows between Africa and the rest of the South (defined here, in keeping with the World Bank definition, as South Asia and Latin America) is given below. The specification is based on the theoretical discussion presented in Chapter 2. Thus, official flows to Africa are assumed to be determined by economic, political and strategic self-interest arguments, as well as by developmental and humanitarian considerations. Unlike other studies, these arguments are explicitly defined, in order to indicate Africa's position relative to other South regions. The estimation is then undertaken for the three regions in Africa, yielding the following final general form of the estimated model:

$$Fbm_A = \beta_0 + \beta_1 \frac{M_{ot}}{M_A} + \beta_2 \frac{PY_{ot}}{PY_A} + \beta_3 \frac{FDI_{ot}}{FDI_A} + \beta_4 \frac{DSR_{ot}}{DSR_A} + \beta_5 Dum_{SAP}$$

where: *Fbm* is bilateral and multilateral flows to Africa; *M* is import; *PY* per capita income; *FDI* is foreign direct investment; *DSR* is the debt service ratio and Dum_{SAP} is the structural adjustment dummy active since 1985. The subscripts *ot* and *A* are as defined before.

The import ratio (denoted below as *M*) and the FDI ratio (denoted below as *I*) are assumed to support the economic self-interest argument. The assumption behind the former argument is that most imports come from the North. Thus, aid inflows from the North are geared towards strengthening the export sector of the supplying countries. The FDI ratio is also used, based on the same line of thinking. The relative share of the mining sector in GDP of Africa (MIN_A) *vis-à-vis* other regions in the South (MIN_{OT}) is also used. This choice is made based on the assumption that most mining sectors in South are dominated by Northern companies, which are likely to shape the flow of resources from the 'mother' country. A related economic self-interest argument is the debt service ratio (denoted below as *D*), which may also indicate repayment capacity of borrowers. The dummy (Dum_{SAP}) shows the structural adjustment-related flows, which may also be interpreted as the political/strategic self-interest argument. This takes the value 1 if SAP policies are being applied in the country in question and zero if they are not. The developmental/humanitarian argument (denoted below as *PY*) is assumed to reflect the ratio of per-capita income in other regions in the South relative to that of Africa.[5] The *Fbm* is denoted by *F*. All parameters, except β_0, β_2 and β_4, are expected to be negative, since a higher ratio is the result of a higher relative value of the numerator. The latter is hypothesized to imply lower levels of flows to Africa.

As noted in Chapter 2, a further important feature of official capital flows to Africa relates to the fact that the budgetary considerations in the North will have an influence on such flows. Indeed, because proper evaluation of aid's impact from the donor's perspective is difficult, at least in the short run, the underlying determinants of budgetary allocation for the previous period may well influence the current budgetary process, with due consideration given to making corrections for previous mistakes. This is captured by the ECM model, which also tackles the non-stationarity problem of the series adopted.

In common with the FDI equations, the estimation which follows should, at best, be taken as a medium-term indicator, since the relevant time series (1970–92) is too short to undertake a fully fledged co-integration analysis. Nevertheless, this estimation is comparatively better than existing empirical studies, which are based either on a time-series estimation, without a formal test for non-stationarity (see the survey by McGillivray & White 1993), or on a cross-sectional analysis only (see Anyadike-Danes & Anyadike-Danes 1992). I have identified that most series are $I(1)$. This should cast doubt on simple OLS time-series studies. Through an examination of a simple correlation coefficient, the degree of multicolinearity is also found to be low for all estimations. Thus, following an exhaustive search process, the best estimated equations for the three regions which are the focus of this study are given below. These equations have also been tested for co-integration and a null hypothesis of no co-integration is rejected for all.

East and Southern Africa (ESA)

$$\begin{aligned}\Delta F = {} & \underset{(0.36)}{0.612\Delta M_{t-1}} - \underset{(-0.67)}{0.136\Delta I_{t-1}} - \\ & \underset{(-3.6)*}{0.89}(F_{t-1} + \underset{(-2.5)*}{2.138 M_{t-2}} + \underset{(-1.72)\wedge}{0.512 I_{t-2}} - \underset{(2.5)*}{1.972})\end{aligned} \qquad [4.4\text{-}ESA]$$

R^2-adj = 0.32 Jarque-Bera 0.3*
Reset 0.01(0.93) LM 0.26(0.62)
BG = 1.2(0.30) Sample 1970–92
Notes as defined under equation [4.1-ESA].

In the estimation for equation [4.4-ESA] I have experimented with the ratio of value added from the mining sector as well as a structural adjustment dummy. However, neither of these was found to be statistically significant, and so were excluded. The debt service ratio is also found to be highly correlated with the import ratio, having a simple correlation coefficient of -0.70. Hence, its inclusion would result in multicolinearity. However, this ratio has been omitted since an alternative equation to [4.4-ESA], using the debt service rather than the import ratio, performed comparatively less well, having a lower level of significance. Two other estimations, which separately use bilateral and multilateral flows as dependent variables, were also attempted. Signs remained unchanged from the aggregate form. However, the potency of the parameters decreased when we used bilateral flows and increased with multilateral flows. The estimation of [4.4-ESA], based on aggregate flows, yields an average value and hence, this estimation has been chosen.

In common with the FDI equation, the interpretation of this equation is relatively straightforward (see Appendix 4.1). Thus, if we take the first ECM, the 'long-run' co-integration relationship is given by,

$$F_t = 1.972 - 2.138M_{t-1} - 0.512I_{t-1}$$

89 per cent of any deviation from this long-run equilibrium in the previous period is made up for in the current period. The short-run coefficients are not found to be statistically significant. However, in the long run, the relative (to other South) level of imports and FDI flows within the ESA region determine the official flows to that region. Of these, the import ratio has relatively the more important influence. Moreover, within this region, humanitarian and structural adjustment related arguments are not found to be statistically significant. The statistical significance of the adjustment coefficient may, in all cases, be taken as showing the importance of the past budgetary practice of donors in influencing current allocations.

North Africa (NA)

$$F = 1.05 - \underset{(6.0)^*}{} 2.05M_{t-1} - 0.133D_{t-1} \qquad [4.5\text{-}NA]$$

$$(6.0)^* \quad (-5.9)^* \quad (-0.38)$$

R^2-adj = 0.64	Jarque-Bera 1.1
*Reset 0.86(0.37)	LM 0.14(0.71)
BG = 1.3(0.27)	Sample 1971–92

Notes as defined under equation [4.1-ESA].

The individual series within the NA region are found to be stationary. Hence, a simple OLS estimation is made. Per capita income and debt service ratios are found to be statistically insignificant. Indeed, a further estimation, using bilateral and multilateral flows, separately, yields a nearly identical result.

West and Central Africa (WCA)

$$\Delta F = 2.02Dum_{SAP} - 1.564\Delta M_{t-1} + 3.135\Delta PY_{t-1} -$$

$$(1.84)^\wedge \quad (-1.11) \quad (1.16)$$

$$[4.6\text{-}WCA]$$

$$0.86(F_{t-1} + 2.657M_{t-2} + 1.319PY_{t-2} - 2.591)$$

$$(1.9)^\wedge \quad (-2.1)^+ \quad (1.01) \quad (-1.01)$$

R^2-adj = 0.17	Jarque-Bera 3.2^
Reset 3.91(0.07)	LM 0.00(0.97)
BG = 4(0.07)	Sample 1972–92

Notes as defined under equation [4.1-ESA].

Within the WCA region the individual series are $I(1)$. The estimation [4.6-WCA] is undertaken once the null hypothesis of no co-integration has been rejected. The variables *I*, *YP* and *D* are found not to be statistically significant. Neither is the per-capita ratio found to be significant. Hence this ratio could be excluded from the estimation. However, since its *t*-value is closer to one, it is nevertheless included within the estimation. Neither does the separate use of bilateral and multilateral flows significantly change the result. In fact, the inclusion of these flows actually improves the RESET value, based on a specification test, to an acceptable level of around 30 per cent, although some serial correlation problems are exhibited. In general, equation [4.6-WCA], which summarizes aggregate official flows, is found to be preferable when all properties are taken into account.

To sum up, this section has reported on some econometric results relating to the determinants of the allocation of both FDI and official flows to Africa. Although the results of this analysis are not robust, because of the relatively short available time series, nevertheless they do provide a useful second-best indicator of the determinants of the allocation of flows. In any case, the use of this estimation, no matter how flawed, is preferable to using spurious results arising from existing studies. Besides, a regionally-based estimation for Africa is not available. In relation to the actual results of these estimations, these may be summed up as follows. Firstly, there exists a long-run equilibrium relationship between Africa's relative economic performance and flows of capital to that continent. Secondly, humanitarian and developmental considerations are found to be largely negligible in influencing such flows. This result would tend to lend support to the apparently obvious notion that capital flows are associated with the level of development, and particularly involvement in trade. Indeed, this remains true even when these flows chiefly comprise aid.

4.3 DETERMINANTS OF AFRICAN EXPORT SUPPLY

4.3.1 Introduction

Much of the analysis relating to the export problems faced by producers of primary commodities in developing countries would lead one to conclude that the problems faced by these producers are mainly price-related in nature. More specifically, overvaluation of the exchange rate and marketing board intervention are found to represent particular problems for these producers. Although the literature on commodity export supply functions begins by formulating structural equations which accommodate other factors, the reduced form of these equations, which is used for estimation purposes, is characterized only by explanatory variables for current or lagged (relative) prices. In this section, an attempt is made to underline the existence of other equally, or even more important, factors, which will influence the export of primary commodities. These factors will then be considered explicitly within the estimation. This is undertaken for two fundamental reasons. Firstly, exclusion of variables can only be interpreted as an omission, and hence, represents poor econometric practice. Secondly, such omission has the effect of depriving countries of policy handles other than price. Thus, the analysis which follows will first set about exploring price-focused estimations. Subsequent estimations will then be specified by adding other relevant explanatory variables, which are rare in the literature.

Thus, the discussion will be organized as follows. Section 4.3.2 will attempt to build upon the theoretical discussion presented in Chapter 2, by reviewing some literature relating to the supply of commodities. This discussion will be useful in developing the modelling approach set out later in this study. In section 4.3.3 a number of salient points relating to the nature of the data used in this study will be highlighted. Section 4.3.4 details the estimation of the aggregate export supply functions. Finally, in section 4.3.5 a number of conclusions, arising out of the preceding discussion, will be outlined.

4.3.2 The Literature

A number of studies have attempted to answer the question of what determines the supply of primary commodity exports. Broadly, a range of such factors has been identified. These include cost and accessibility of consumer goods, farm subsidies and taxes, research and extension, the existence and quality of road infrastructure as well as the availability of services such as marketing and credit (Binswanger 1992). Naturally, these various factors will not operate in isolation. Thus, the quality of road infrastructure is likely to affect the availability of services, while the availability of such services as credit[6] may constrain the effective demand for fertilizer. Agro-climatic conditions and considerations of human capital, such as rural population density and literacy rates, are also likely to represent important factors having an influence on the export supply of primary commodities. Further, these studies show that the short-run supply elasticities for primary commodities are generally low, simply because the basic factors of production (land, labour and capital) remain fixed in the short run. The latter constitute 70–85 per cent of the cost of agricultural production (Binswanger 1992: 151). Attempts to specify supply functions represent a logical outcome arising from this broad idea of supply-determining factors. However, most writers end up specifying supply equations in terms of relative prices. In general, these studies may be categorized under two themes. Firstly, *price-focused models,* which use prices of different complexity as explanatory factors, and secondly, *mixed (heterodox) factor-based models*.

Price-focused models

Price-focused supply models began from the simple 'cobweb theorem' of Ezekiel (1938), which states that output is determined by the level of price in the previous period. Over time, this basic theorem has been developed upon. Thus, Nerlove (1958) modifies the assumption relating to previous period prices. He maintains that producers are influenced by their perception of 'normal' price, which could be captured by the adaptive expectation scheme developed by Cagan (1956). In terms of the classification set out in Chapter 2, these fall under the category of econometric market models. However, this original formulation of a supply and price relationship has undergone numerous changes. Thus, a number of studies emphasize the distinction between the long-run (potential supply) and the short-run (a proportion of potential supply) responses (Wickens & Greenfield 1973, Chu & Morrison 1986). For instance, as outlined in Chapter 2, Chu and Morrison (1986) define the structural equations of supply as the sum of utilization of potential output (i.e., *the utilization rate approach*) and potential output (i.e., *the potential supply approach*). However, in the final form of this model, supply is specified (in reduced form) as a function of current and lagged prices, exchange rate and a supply shock indicator. Indeed, a similar approach is used in the earlier work of Wickens and Greenfield (1973). Such a classification is typically used for perennial crops and mineral extraction.

Other studies have focused on the optimization strategy of agents under a range of different assumptions. These strategies may be classified, according to whether they are based on: (1) maximization of average return per unit of cost (Gray 1914); (2) optimizing the amount of total deposit to be exploited, given first decreasing and then increasing cost structure over the expected life of the mine (Carlisle 1954: 3), maximizing the present value of discounted future net profit (Hotelling 1931); (4) optimizing expected profit under free competition, at both a firm and industry level (Herfindahl 1955); and finally, (5) relating higher short-term rate of extraction under uncertainty with a higher interest rate (Parish 1938). In terms of the theoretical classification set out in Chapter 2, these models fall broadly under the category of econometric optimization models. Again, this type of model is widely used in explaining mineral extraction.

Following Shu (1975) and Askari and Cummings (1976), supply response functions may be categorized according to whether they relate to annual crops, marketed surplus or perennial crops. For annual crops, six different models may be fitted: (1) a simple Koyck distribution lag or Nerlovian expectation model, (2) a complex Nerlovian expectation model, (3) a Koyck second-order lag model, (4) a Nerlovian adjustment model, (5) an expectations-adjustment model, and (6) the simple model (Shu 1975: 27). The Koyck model uses lagged prices (with a geometric lag assumption between these prices) as the only explanatory variable. In Nerlove this is replaced by expected prices. The complex form of the Nerlove model adds to this other expected values, such as expected yield. Koyck's second-order lag function uses a lagged dependent as a regressor, under the assumption of slow response due to institutional factors. Similarly, the Nerlovian adjustment model employs a lagged dependent variable by assuming that farmers adjust by learning from their past expectation mistakes. On the other hand, the simple model, which includes neither adjustment nor expectation variables, usually includes lagged price, lagged yield and trend variables to capture 'other' factors. Estimation is invariably undertaken using simple OLS. Indeed, the theoretical aspect of these models is ahead of the relevant estimation techniques, which accommodates their basic idea of adjustment to past disequilibrum (the relevance of the error correction model in this context is discussed below).

The first attempt to model supply response in perennial crops is Bateman's (1965) model of cocoa supply in Ghana. The model uses expected producer prices for cocoa and a competing crop, such as coffee. These prices are used since it is believed that they show expected profit as regressors. Other non-price factors are ignored completely. Within this model, the dependent variable is the additional acreage under the planted crop for each year in question (Shu 1975: 55–69, Askari & Cummings 1976: Ch. 7). Other models, such as those developed by Beherman, French[7] and Matthew (detailed in Shu 1975 and Askari & Cummings 1976), are fundamentally no different in terms of the explanatory variables used. A similar approach to Bateman's is to use the stock of trees rather than acreage under planted crops as the dependent variable. Differentiating such a specification yields equations similar to that of Bateman except for the fact that the explanatory variable, lagged planted trees, is replaced by lagged stock of planted trees.[8] The latter models, although fundamentally price-based, show a trend towards the inclusion of other factors in specifying the supply function. However, in general, price-focused models use functional forms, which either explicitly exclude non-price factors, or structural equations which include other non-price factors but which ultimately can be explained by price. The end result in both cases is a price-based estimation.

Mixed (heterodox) factor-based models

The Ady (1968) model, which was developed for perennial crops in Ghana, Nigeria and Uganda, represents an improvement on Bateman's model in that, in addition to price, it includes the existing acreage (i.e., the stock) of crop for the previous period. Another strand of supply function modelling which focuses on heterodox factors is what is known as the 'liquidity model'. This model includes farmers' incomes as an additional explanatory variable indicating his or her capacity to invest. However, in all other respects, this model is similar to Bateman's. Its basic feature is an attempt to relate investment to the difference between desired and actual level of capital. Wickens & Greenfield (1973), Palaskas (1986) and Chu & Morrison (1986) summarize such models by characterizing them as essentially being based on capital and investment behavior theory, as presented in the Nerlovian adjustment model.[9] Alternative forms of this theory arise in specifying the various factors, which determine the desired level of capital stock. These factors include capacity utilization (in capacity utilization theory), net output or returns to capital (based on a neo-classical approach), internal cash flow (in liquidity theory) and, finally, an expected profit-based approach. A different degree of emphasis is placed on each of these factors by different authors (Palaskas 1986: 16–18, Chu & Morrison 1986: 142–43, Wickens & Greenfield 1973). In some studies, supply is also considered as a function of expected price, expected opportunity cost, production costs, stock of output (trees, and specifically perennial), potential output of the industry and tax considerations (Kalaitzandonakes et al. 1992). In terms of our classification, set out in Chapter 2, such models represent a hybrid of process and market models. Finally, a further important explanatory variable, reported in the literature, is domestic demand (Pal 1992).

As discussed in Chapter 2, based on the original works of Goldstein and Khan (1978), Bond (1987) uses exchange rate, current and lagged price, an index of productivity, a vaguely defined supply shock factor and a time trend to estimate her model. These are far fewer than the supply factors mentioned in the text of her discussion, indicating either the difficulty of quantification or other data problems. In Ramanujam and Vines (1990), supply is specified as a function of current price, a lagged series of past prices, taking account of the cost of adjusting output, and exogenous factors to capture 'others'.[10] This general form is estimated for different commodity groups. Hwa (1985) emphasizes the understanding of the effect of supply and demand through stock demand and supply conditions. Palaskas and Gilbert (1990) have reviewed Haw's model and argue that storage disequilibrium is an implausible basis for a price adjustment theory. Firstly, as they note, correct specification/ estimation of Haw's model shows that the model performs poorly. Secondly, the model essentially relates price changes to the disturbance term within the stock demand equation, which, for them, represents the least important source of price variation (Palaskas & Gilbert 1990: 1424). However, Palaskas and Gilbert's review may be criticized in that it focuses almost exclusively on Haw's reduced form equation, while neglecting his main structural equations, in which supply and demand are allowed to vary.

Later developments in commodity supply modelling do not differ markedly from the principles set out in the above discussion. Thus, the emphasis remains on relative prices, expectations and types of equilibrium across different commodity groups.[11] In other words, it is hard to find well-elaborated supply functions. Indeed, a recent supply management study for tropical beverages (Maizels et al. 1992, 1993a, 1993b) essentially continues the tradition of using lagged prices and sometimes output. The study, which sets out to explain coffee, tea and cocoa supply management, uses a number of essential arguments to explain output. These include: (1) area harvested, which is believed to reflect maximum potential output; (2) a real producer price; (3) a lagged output, included to reflect relations between successive years; and, (4) a time trend in order to allow for trends in productivity. An important result in this study is that, in every case, area is correlated with output.[12] The authors also use acreage equations, which relate the area harvested to lagged prices, in order to arrive at a long-run investment equation.

Most of the other studies undertaken in relation to African exports have followed a similar approach, with supply response studied in terms of current and lagged prices. The finding for small African countries, particularly during the 1960s and 1970s, is that short-run elasticities are high for annual crops, while long-run elasticities are high for tree crops and minerals (Rwegasira 1984: 7–9). On the other hand, there has not been a great deal of recent work on aggregate commodity export functions. Indeed, a recent paper which assesses the export performance of sub-Saharan African countries calls for a disaggregated estimation of export supply functions, in order that light might be shed on factors influencing export volumes (Svedberg 1990: 32). However, work on specifying individual commodity supply function estimations is advancing (Gwyer 1971, Alibaruho 1974, Ghoshal 1974, Jones & Mutuura 1989, Eriksson 1993 and Dercon 1993 all represent good examples of such work)

The emphasis on supply in the above discussion need not imply that commodity models which explore the demand side – and hence its simultaneous determination – do not also exist. Indeed, such models not only avoid the simultaneous equation bias, which could arise from neglecting demand, but also challenge the small-country assumption, when constructed at a global level. Hence, this issue will be taken up again in section 4.4.

The link between supply theories and estimation technique: The relevance of the Error Correction Model (ECM)

Three features of the commodity supply theories discussed above may be linked to the ECM approach. These are: (1) the assumption that there exists a long-run relationship between the variables under study; (2) the hypothesis that this might have fairly distinct short- and long-run features, and (3) the assumed existence of some sort of in-built adjustment mechanism within this relationship. The first of these features would tend to suggest the need to run a co-integration test, since most series are $I(1)$. In relation to the second of these features, the literature does not come out clearly one way or another. Thus, some writers take the short/long run as being synonymous with short/long lags. However, such an approach fails dismally, particularly in relation to short gestation commodities such as food and agricultural raw materials. In contrast, other studies rightly emphasize that the short run should refer to mean utilization of potential capacity, and the long run to an increase in potential output. However, since few of these studies use a relevant estimation technique,[13] this type of study is not without its problems. The error correction model is a formal representation of dependent and independent variables, with explicit distinction being made between short-run variations (i.e., the immediate impact effect) and long-run aspects (associated with long-run level or a steady state relationship). Thus, it represents an appropriate technique for estimating supply functions based, as it is, on a distinction between the theory of potential, and utilization of potential, output. Moreover, since it explicitly includes an adjustment mechanism, an ECM approach will tend to incorporate the third feature of the theories reviewed above.

The theoretical model of this study

The above review provides insight into some important points in specifying export functions of primary commodities. Firstly, factors other than price are found to be important determinants of commodity supply. However, either lack of data or difficulty in quantifying this data, as well as having to focus on reduced forms, forces many researchers to use prices as the only explanatory variables. Secondly, a distinction across commodities, especially between annual and perennial crops, is essential in specifying supply functions. A third and relatively neglected point is the need to place the commodity market within a macro framework where the role of stockholding and the impact of macroeconomic variables is likely to be important.[14]

In this study, the export supply equation of a typical African economy is specified, in order to depict the behaviour of commodity producers, mediated through the government. We have further assumed that output of export commodities and exports respond to world prices in a broadly identical manner.[15] Although government intervention within the export sectors of most African countries is obvious, it is assumed that the impact of world price, and especially the degree to which this price *changes*, will send similar signals both to the public sector in its capacity as a producer, and to individual producers. However, it is worth noting that individual producers are also likely to surrender a proportion of their income to government.

The response to price and other supply factors is likely to take two forms. In the short run, increased capacity utilization is important. Thus, *short-run* parts of the argument would be based on the commodity model of Goldstein and Khan (1978), Chu and Morrison (1986) and Hwa (1985). Here, *(latent) capacity utilization theory* is the underlying hypothesis. In the long run, producers are assumed to respond through change in potential output, or, in other words, through capacity creation. *Expected profitability theory*, following Chu and Morrison (1986),[16] and other supply-inducing factors, such as capital formation and foreign inflow, are believed to explain this. However, foreign inflow may also result in 'Dutch disease' effects (see Chapter 5 for a discussion of this phenomenon). However, this remains largely an empirical question. Thus, I am essentially arguing that the different factors emphasized by different authors are basically complementary and hence, that these should explicitly be considered within any estimation. The lag structure will vary, depending on the nature of the commodity under consideration. For example, a longer lag structure should be used for beverages and minerals[17] than for annual crops.[18] This yields the following general theoretical model:

$$X_{si}^{ss} = a_0 + a_1\left(\frac{ep_s}{p_d}\right) + a_2\left(\frac{ep_s}{p_d}\right)_{t-1} + \qquad [1]$$

Capacity utilization

$$a_3\left[\left(\frac{ep_s}{p_d}\right)_{t-i} - k^{-1}\sum_{i=1}^{k}\left(\frac{ep_s}{p_d}\right)_{t-i}\right] +$$

Expected profit

$$a_4(\Delta K)_{t-i} + a_5 FF_{t-i}$$

Capital formation

where: X is export supply, e is exchange rate, P_s is the export price of South, P_d is the domestic price, FF is foreign inflow, ΔK is the capital formation indicator, the term in brackets [...] is the expected profit indicator, the deviation of current price from k years moving average.

The theoretical export supply function and the data

In this section, the theoretical commodity export function in equation [1] is adjusted to fit the available data. In our database, investment by commodity sector is not available. However, the reparametrization of this theoretical formulation renders this possible. The following sets of equations are used for this purpose. The distinction between the short-run *capacity utilization* theory, and the long-run *capital formation* argument will be maintained. To avoid the complex variables in equation [1], we designate the eP_s/P_d by P and the expected profit indicator by Π^{σ}. Maintaining ΔK and FF as they are, a shorter version of equation [1] may be written as,

$$X_{Ai}^{ss} = \alpha_0 + \alpha_1 P_t + \alpha_2 P_{t-i} + \alpha_3 \Pi^{\sigma} + \alpha_4 \Delta K + \alpha_5 FF \qquad [2]$$

Our capital formation data refers to gross fixed capital formation, both public and private, at a national level. To overcome the lack of sectoral disaggregation of this data, the capital stock is specified in terms of factors that affect its formation. The possible factors, about which we have access to data, include prices, an indicator of expected profit and instability of prices (Π^{σ}), supply of domestic credit (*DCR*), supply of fertilizer, government investment (I_g, indicator of infrastructure) and capital inflow (*FF*).[19] Of these, factor prices are omitted, since they are specified in the above equation. This omission might be taken as implying that the lagged price effect for the current and certain other periods is direct. In other words, that this does not occur through capital formation. However, since the indicator of expected profit and instability is computed from lagged prices the effect is indirectly captured. In relation to the expected profit indicator, the ideal approach would be to use a measure of direct profit. Nevertheless, such profit data is hard to come by. Its approximation as a deviation from three-year moving-average prices makes it similar to the price instability indicator. Hence, in specifying capital formation, it is included as one of the factors within the above equation. Its coefficient may then be interpreted both as a profit and price instability index. Thus, the capital stock may formally be given as,

$$\Delta K = \beta_0 + \beta_1 \Pi^{\sigma} + \beta_2 DCR + \beta_3 I_g + \beta_4 FF \qquad [3]$$

where: *DCR* is domestic credit, *FF* is capital inflow, I_g is government investment (*GDI*).

Equation [3] states that capital formation in the commodity sector is determined by prices, availability of domestic credit, public infrastructure provision and foreign inflow. Substitution of this capital formation equation into equation [2] yields the final adjusted equation for inclusion in the estimation,

$$X_{Ai}^{ss} = \phi_0 + \alpha_1 P_t + \alpha_2 P_{t-i} + \phi_1 '\Pi^{e} + \phi_2 DCR + \phi_3 I_g + \phi_4 ' FF \qquad [4]$$

where:

$$\phi_0 = \alpha_0 + \alpha_4\beta_0 \; ; \quad \phi_1 ' = \alpha_3 + \alpha_4\beta_1 \; ; \quad \phi_i = \alpha_4\beta_i \; ; \quad \phi_4 ' = \alpha_4\beta_4 + \alpha_5$$

At estimation stage, the linear formulation is transformed into a log-log form. This implies that the estimated coefficients are elasticities. However, specifically in relation to our own data, the expected profit indicator is found to be empirically problematic. In all cases, it is a stationary series and exhibits a very high correlation (usually greater than 0.80) with the price variables. Given the latter result, the former is entirely logical, since the moving average of profits is similar to a lagged price. Hence the series generated is nearly identical to the first difference of prices, which is stationary. This represents a serious multicolinearity problem and, therefore, may be interpreted as a serious shortcoming of previous studies. For this reason, in the estimation given below it is omitted from the functional form (see Appendix 4.2 for a discussion on these variable and estimation results). Finally, the foreign inflow variable (*FF*) might also result in a simultaneous equation bias[20] within one of the estimations, since it will affect the other capital formation indicators within the regression. However, this is likely not to represent a serious problem, since a very small proportion of foreign inflow is usually allocated to the primary sectors.

4.3.3 The Data

The relevant macro data used in this study is derived from a consistent macroeconomic database discussed in Chapter 3. Exports of commodities and price are compiled from the UNCTAD database (Annual Commodity Yearbook). However, certain changes are introduced, in order that this data may be adapted to the specificity of Africa.

1. Similar commodity categories are used for four commodity groups. These are:
   (a) Agricultural raw materials (excluding synthetic) SITIC 2-22-27-28-233-244-266-277
   (b) Tropical beverages SITIC 071.1+072+074.1
   (c) Minerals, ores and metals SITIC 27+28+68+522.56
   (d) Fuels SITIC 3.

2. The category *food* adopted in this study is slightly different from that used by UNCTAD. Thus, within the UNCTAD methodology, the category *all food* includes *food, tropical beverages, and vegetable oil seeds and oils.*[21] However, in this study *food* is defined simply as all food items with the exception of tropical beverages.

Prices (export prices)

For each of the commodities detailed above, UNCTAD provides a price series running from 1970 onwards. These price indices are computed using the total developing country exports of these commodities for the years 1984–86 as weights. However, since no index is provided for the category *food*, as defined within our study, we have generated such an index by summing together prices from the UNCTAD *vegetable oilseeds and oils* and *food* categories, and weighted their respective prices based on their share of total developing country commodity exports.

A further major change which we make to UNCTAD's price series relates to the weights used in the construction of this series. Such changes are likely to be necessary since the weighting used by UNCTAD may not be relevant for this study, in particular, and for Africa, in general. In other words, one might question whether the averaging method employed accurately reflects the world prices facing African economies. In order to answer this question the UNCTAD price is recalculated by weighting it by the level of each region's exports. This comparative analysis offers the following conclusions. Firstly, for Africa as a whole, the *food* price index is similar both in the UNCTAD study and in this study. For the NA region there was a difference between these two price series in 1970s and late 1980s. For the WCA region the UNCTAD series shows higher prices up to the early 1980s, at which time these prices fell into line with the price series used within the present study. For the ESA region, the UNCTAD series understates the regional indices. Secondly, for *tropical beverages* the UNCTAD price series is nearly identical with the regional price series computed in this study. Thirdly, for *agricultural raw materials* for Africa as a whole, the UNCTAD series overstates the actual price faced by African economies. This conclusion remains valid in relation to regional prices. Such overestimation is likely to be particularly great in relation to ESA countries. Fourthly, for *mineral, ores and metals* for the whole of Africa, the UNCTAD series overstates the actual price faced by African

Diagram 4.1 The modified and actual UNCTAD price series (WCA, 1985=100)

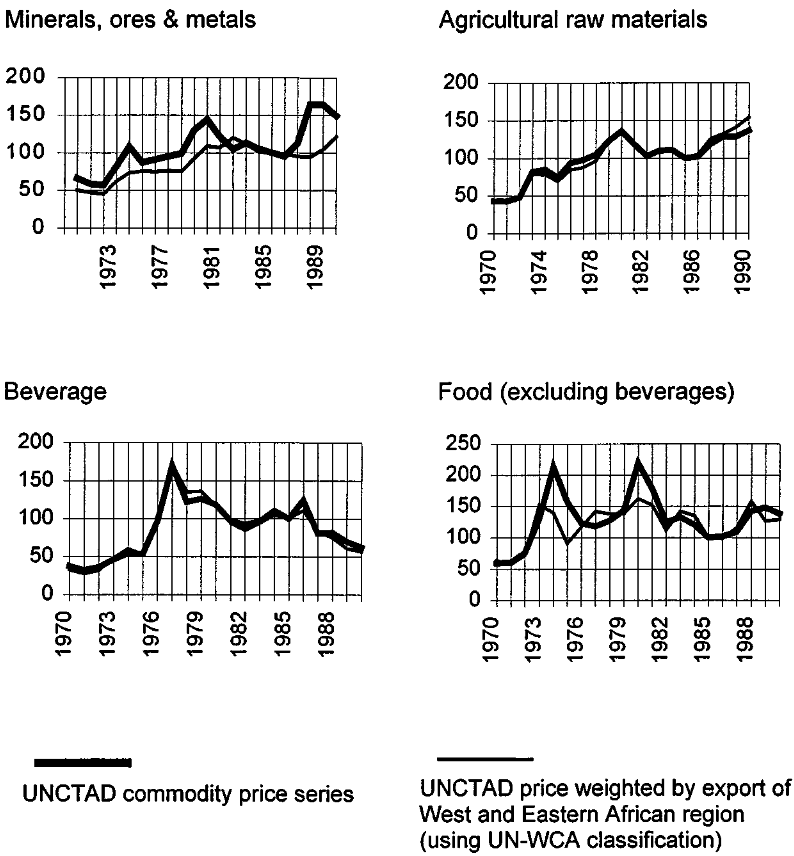


Diagram 4.2 The modified and actual UNCTAD price series (ESA, 1985=100)

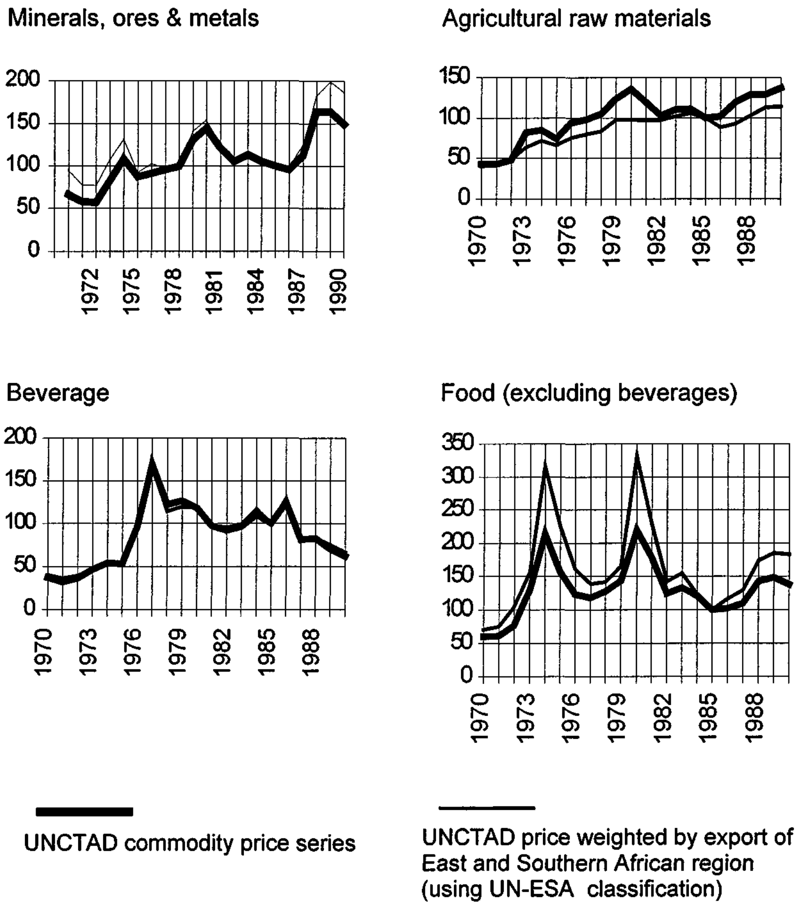
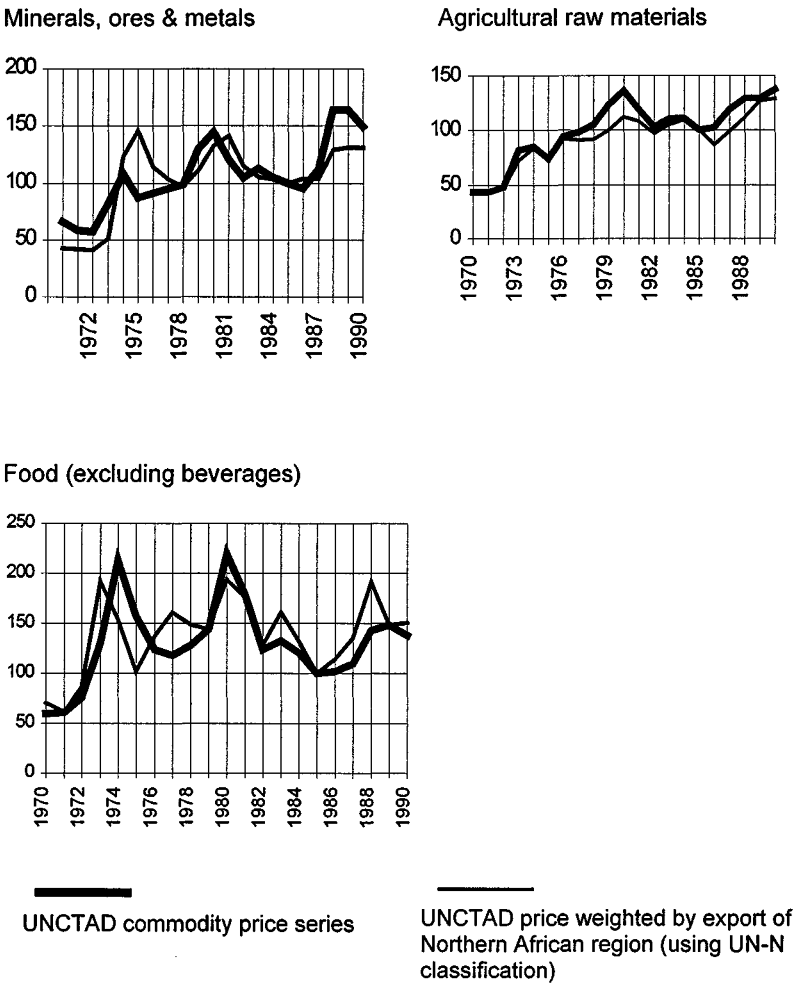


Diagram 4.3 The modified and actual UNCTAD price series (NA, 1985=100)



economies. With the exception of the 1980s, such overstatement is severe throughout the period. However, for the ESA region, this index understates the price faced during the early 1970s and late 1980s. Finally, a comparison of the African regional price series with the one generated using the sample countries of this study reveals that these are nearly identical for all commodities, with the exception of minerals, for all regions. Diagrams 4.1, 4.2 and 4.3 illustrate these conclusions for the three regions, which are the subject of this study.

This result has profound implications, not only in relation to previous studies in Africa, but also to other studies which use world prices to analyse the impact of such prices at a regional and country level. Obviously elasticities computed from such studies will be biased if there is a variation between the regional and world prices (as listed in UNCTAD or IFS series), even if these have an identical trend.

4.3.4 Estimation

4.3.4.1 Estimation approach

Obviously the econometric specification may differ from this general theoretical specification. Based on recent innovations in time series econometrics, the estimation is, in fact, carried out by formulating an Error Correction Model (ECM; see Appendix 4.1). The estimation is undertaken by pooling the data from the sample countries in each region, for the period 1970–90. However, in order to ensure that the series are not unduly mixed, when a lag structure is used, careful treatment of end points is adopted. A constant country dummy is used in all cases when such a dummy is found to be statistically significant. Moreover, sample sizes are adjusted by excluding a country or countries, when such data violates almost all the relevant diagnostic tests.[22] The choice of the variables is made after a search process that includes both diagnostic and co-integration tests. In all cases, the estimation is fully supported by the relevant diagnostic tests.

Preliminary estimations using current prices and capital formation indicators have shaped the approach followed in this section. That is, data has been allowed to inform theory, as per the approach advocated by Wuyts (1992a, 1992b). Such preliminary estimates reveal some interesting results. Firstly, short-run current price elasticities are generally positive, although not always statistically significant. For long gestation commodities, price is found mainly to affect capacity utilization.

Secondly, long-run current price elasticities are found to be both positive and negative.[23] In some cases these do not differ significantly from zero. Thirdly, capital formation variables are, in general, positive and significant. Fourthly, within the WCA region, 10 to 25 per cent of any disequilibrum in the previous period is made up for in the current period, for all commodity categories, with the exception of minerals. This may be interpreted as indicating a generally low level of adjustment to disequilibrum or shocks. However, standing at 62 per cent, the adjustment coefficient for the minerals category remains very high. Similar adjustment coefficients, except for minerals, are also obtained for the ESA region. Finally, for the countries of the NA region, the level of these coefficients remains quite high, indicating the likely capacity of these economies to cope with shocks.

The inverse relationship, between exports and long-run current prices is also worth examining further. This relationship may be observed for agricultural raw materials, in all regions, as well as for minerals within the NA region. Based on such an examination, at least two propositions in relation to export supply and price dynamics may reasonably be set out. The first such proposition is that domestic prices may not always be important and, hence, that relative price may be crucial. In the macro context, this implies that domestic prices might be affected by capital inflow. This, in turn, underscores the importance of macro variables in the determination of the supply of commodities, so long as they affect the level of domestic price. Thus, in line with the general focus of this study, this implies the possibility that a sort of 'Dutch disease' effect may occur. This will be discussed at length in the following chapter. However, it is worth noting here that if a 'Dutch disease' effect is present, that a real appreciation in domestic currency is possible. Thus, Tables 4.5, 4.10 and 4.15 summarize information relating specifically to this inflationary pressure. For this purpose, a one-period lag is assumed, with nominal export price, rather than the real exchange rate being used. The rationale for using the nominal export price is that the domestic price is assumed to be affected by foreign inflows.[24] The use of debt stock data within an ECM formulation allows one to observe the 'Dutch disease' impact in the short run, since the change in the debt stock may be taken as a flow. This specification also allows one to examine the debt overhang problem in the long run, as well as having the advantage that it explicitly focuses on the impact of foreign inflows.

Examining the relationship between exports and long-run prices yields a second major proposition in relation to African export supply and price dynamics: specifically, that the nature of demand for foreign exchange[25] within most African economies results in these countries seeking to maximize their total export revenue in a situation of declining prices, usually by increasing volume of exports.[26] Given these working propositions arising out of an exploratory data analysis, the aggregate commodity groupings for each region are then estimated in three stages. Firstly, current price and capital formation indicators are taken as regressors. The results of this estimation, we call *Model I.* Secondly, the current price is replaced by a commodity-specific real exchange rate (in other words, the ratio of the regional commodity price measured in domestic currency to the domestic price of that commodity). This we call *Model II.* Finally current prices,[27] a capital formation indicator and foreign capital inflow are used as regressors. This is *Model III.*

For all three models the current price data used is the current commodity price computed for each region. For perennial crops and minerals two sets of lagged prices are used. A one-period lag is assumed to affect capacity utilization while the five-year lag is assumed to affect capacity creation. As a consequence of the ECM approach adopted, both period lags have short- and long-run effects. Variables for consumption of fertilizer, investment and capital stock are used interchangeably[28] as indicators of capital formation. Thus, the final estimations are the result of exhaustive search processes using both Hendery's general to specific (GS) approach and relevant diagnostic tests. The actual estimation is undertaken using E-views and TSP. The results of this estimation are discussed in the following section.

4.3.4.2 Results

East and Southern Africa (ESA)

A sample comprising eight[29] of the countries of the region is used. Before this estimation is carried out, a test for unit root of the variables of the three models (I, II, III) is undertaken. The result shows that the series are non-stationary (Table 4.1) and that the variables for each model are co-integrated (Table 4.2). The results of this estimation, obtained after an exhaustive search, are reported in Tables 4.3–4.5. The major findings[30] of this estimation are detailed below.

Table 4.1 Unit root analysis: an ADF test at 1% Mackinnon critical value for East and Southern Africa

Logarithms of	Symbol Used	Level of Integration
Food real (at 1985 price)	LFOODR	I(1)
Agricultural raw materials real (at 1985 price)	LAGRMR	I(1)
Agricultural raw materials as proportion of GDP	LAGRMG	I(1)
Beverage real (at 1985 price)	LBEVR	I(1)
Beverage as proportion of GDP	LBEVG	I(1)
Minerals real (at 1985 price)	LMMR	I(1)
Minerals as proportion of GDP	LMMG	I(1)
Price of food, agricultural raw material, minerals, beverage of West & Central Africa sample	LPFESAs, LPAESAs, LPBESAs & LPMESAs	I(1)
Aggregate bilateral, multilateral, private inflows and grants respectively; aggregate inflows, aggregate excluding private flows; foreign direct investment, fertilizer consumption	LBILAD, LMULTD, LPRIVD, LGRANT, LBMPGFF, LBMGFF, LFDI, LFERTZ	I(1)
Capital stock as ratio of GDP, total, public, private	LKGDP, LKGVGDP, LKPGDP	I(1)
Domestic credit as ratio of GDP: total, private, respectively	LDCRTG, LDCRPG	I(1)
Government investment as proportion of GDP	LIGVGDP (at 10%)	I(0) border
Total, government and private investment as proportion of GDP	LIGDP, LIPGDP	I(1)
(Regional) real exchange rate for food, agricultural raw materials, minerals and beverages [(regional commodity price X nominal exchange rate)/GDP deflator]	LRERF, LRERA,LRERM & LRERB	I(1)

Table 4.2 Co-integration test for East and Southern Africa

Equation	Engel-Granger ADF statistics	Mackinnon critical value at 5%	Johansen likelihood ratio	Mackinnon critical value	
				5%	1%
Food					
Model I	-3.929	-3.795	87.21	29.68	35.65
Model II	-3.57	-3.489 **	38.20	29.68	35.65
Model III	-3.971	-3.862 **	121.68	47.21	54.46
Agricultural raw materials					
Model I	-4.147	-3.794	64.79	29.68	35.65
Model II	-4.176	-4.166	41.58	29.68	35.65
Model III	-3.769	-3.870 **	115.92	47.21	54.46
Beverages					
Model I	-3.879	-3.808	31.58	29.68	35.65
Model II	-3.769	-3.500 **	21.71	29.68	35.65
Model III	-3.903	-3.876 **	73.72	47.21	54.46
Minerals					
Model II	-3.274	-3.511 **	31.92	29.68	35.65

** [*] Mackinnon critical value at 10% [1%] level of significance.
The Johansen test used assumes linear deterministic trend in the data with intercept, no trend, in the test VAR (i.e., the co-integration equation, as a indicator of long-run equilibrium relation, has no trend).

Food: Within this region, the current price of food is found to have a strong and positive effect, in both the short and long run (for Model I) and in the long run (for Model III). Of these, the long-run effect is likely to be the stronger. When Model II is used, only the long-run relative price elasticity is found to be positive and significant. However, this remains significantly lower in magnitude than the elasticity for current prices. The results for all diagnostic tests are quite acceptable. A one-period lag is assumed for the impact of foreign inflows, using different foreign inflow indicators,[31] while three years is allowed for the impact of capital formation indicators to be felt. These results indicate that not all variables are statistically significant. The results may also be taken as suggesting the likelihood that 'Dutch disease' possibilities cannot be sustained, the existence of a positive impact of capital formation and generally confirming the positive impact of prices in the long run.

Agricultural raw materials: The estimation for this commodity group confirms that capital formation indicators have a strong and statistically significant positive impact, both in the short and long run. Current prices in the long run are found either to be statistically significant and negative (Model I) or statistically not significantly different from zero. This result would tend to confirm the second proposition relating to the supply price relationship, discussed in the previous section (estimation approach). However, short-run relative price is found to be positive and statistically significant. Again, a 'Dutch disease' effect cannot be suggested by the data.

1(c) Tropical beverages: Only in Model I are current prices (with the two types of lags) found to be positive and statistically significant. Relative price, which indicates capacity creation in Model II, is also found to be statistically significant in the long run. The capital formation indicator yields an ambiguous result, having a negative value in Model II and positive one in Model III. Using Model III, of all capital inflow categories, only multilateral flows are found to be co-integrated with the other regressors. The lag for capital inflows is set one period behind that of price and capital formation indicators in order to allow for inflationary pressure formation. Botswana and Zambia are excluded from the analysis, since we are not in possession of beverage export data for these countries. With diagnostic tests yielding quite good results, all but one of the variables are found to be statistically significant in the short run. The exception to this is the negative value of the variable for long-lag capital inflows, indicating the presence of a 'Dutch dis-

Table 4.3 Estimation with current prices for East and Southern Africa

Dependent→	Food		Agric. raw materials		Beverages		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LBEVR	t-values	LMMR	t-values
Short-run coefficients (elasticities)								
Constant	-2.4	-3.3***	4.16	3.0***				
ΔLP_1	0.29	2.06**	0.02	0.05	0.14	1.77*		
ΔLP_5					0.05	0.50		
ΔLIPGDP_1			0.16	1.77*				
ΔLIGVGDP_1	-0.21	-1.38						
ΔLKPGDP_5					0.03	0.25		
Long-run coefficients (elasticities)								
LP_2	5.03	4.45***	-1.38	-2.21**	0.54	3.26***		
LP_6					0.30	1.83*		
LIPGDP_2			0.44	1.91**				
LIGVGDP_2	-0.45	-0.69						
LKPGDP_6					0.14	0.74		
Dependent_1	-0.11	-1.87**	-0.43	-6.17***	-0.34	-3.79***		
Diagnostic test								
ECM adjusted R^2	0.18	n=108	0.34	n=85	0.09	n=90		
Level adjusted R^2	0.14		0.57		0.64			
Jarque-Bera	4.23**		0.4**		0.14**			
RESET(1)	5.6	Pr(0.02)	1.4	Pr(0.24)	0.01	Pr(0.91)		
Chow	1.4**		2.83***		2.77***			
Degree of multicollinearity+	Low		Very low		Very low			
Constant (country) dummy used			Botswana	-0.95	Ethiopia	0.59		
			Tanzania	1.88	Kenya	0.80		
					Madagascar	0.30		
					Tanzania	0.46		
					Uganda	0.64		

Table 4.4 Estimation with real exchange rate for East and Southern Africa

Dependent→	Food		Agric. raw materials		Beverages		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LBEVR	t-values	LMMR	t-values
Short-run coefficients (elasticities)								
Constant	0.84	2.85***	1.02	3.05***	1.84	3.47***	0.54	1.45
ΔLP_1	-0.02	-0.15	0.33	2.25***			0.10	0.48
ΔLP_5					0.08	1.18	-0.42	-1.7*
ΔLIPGDP_2			0.18	2.15**				
ΔLIGVGDP_2	-0.19	-1.08						
ΔLKPGDP_5							0.18	0.68
Long-run coefficients (elasticities)								
LP_2	0.13	1.6*	-0.18	-1.24	0.10	1.19	1.26	1.97**
LP_6					0.23	3.16***	-0.4	-0.64
LIPGDP_3			1.19	2.77***				
LIGVGDP_3	-0.42	-1.4						
LKPGDP_6					-0.27	-2.9***		
LIGVGDP_6							2.36	3.32***
Dependent_1	-0.34	-4.5***	-0.14	-3.43***	-0.50	-4.42***	-0.18	-3.03***
Diagnostic test								
ECM adjusted R^2	0.12	n=108	0.18	n=108	0.15	n=90	0.07	n=95
Level adjusted R^2	0.34		0.12		0.81		0.37	
Jarque-Bera	1.53**		2.85**		2.17		74	
RESET(1)	0.17	Pr(0.68)	0.46	Pr(0.50)	1.4	Pr(0.24)	0.07	pr(0.80)
Chow	1.8**		2.98***		2.3***		1.55**	
Degree of multicollinearity+	Low		Very low		Very low		Low	
Constant (country) dummy used	Zambia	-0.84	Botswana	-0.36	Ethiopis	0.77	Botswana	0.94
					Kenya	0.95	Kenya	0.52
					Madagascar	-0.64		
					Uganda	0.29		

Table 4.5 Estimation with capital inflow for East and Southern Africa

Dependent→	Food		Agric. raw materials		Beverages		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LBEVR	t-values	LMMR	t-values
Short-run coefficients (elasticities)								
Constant	-0.83	-0.71	1.04	0.81	-0.86	-1.01		
ΔLP_1	0.11	0.59	0.35	0.90	0.10	0.80		
ΔLP_5					0.08	0.76		
ΔLIPGDP_2			0.22	2.33***				
ΔLIGVGDP_3	-0.15	-0.75						
ΔLKPGDP_5					-0.10	-0.72		
ΔFF_2@	0.09	0.37	0.26	0.69	-0.17	-0.62		
ΔFF_6					-0.24	-1.83*		
Long-run coefficients (elasticities)								
LP_2	1.01	1.85**	-0.41	-0.23	0.37	1.02		
LP_6					0.22	0.92		
LIPGDP_3			1.16	2.96***				
LIGVGDP_4	0.07	0.24						
LKPGDP_6					0.58	5.28***		
FF_3@	0.22	1.51~	0.27	0.75	0.58	2.94***		
FF_7					-0.66	-3.4***		
Dependent_1	-0.30	-3.75***	-0.17	-3.33***	-0.37	-3.67***		
Diagnostic test								
ECM adjusted R^2	0.13	n=119	0.10	n=90	0.10	n=84		
Level adjusted R^2	0.25		0.14		0.68			
Jarque-Bera	7.13		1.86**		1.27**			
RESET(1)	0.13	Pr(0.72)	2.2	Pr(0.14)	0.01	Pr(0.94)		
Chow	0.60**		2.05***	Pr(0.01)	1.99***			
Degree of multicollinearity+	Low		Low		Very Low			
Constant (country) dummy used	Zambia	-0.95	Ethiopia	0.29	Madagascar	-0.26		
					Malawi	-0.32		

Notes to Tables 4.3–4.5:
The long-run coefficients and their t-values are using the Wickens and Breusch (1988) and Gurney (1989) approach. The long-run R2 is also taken from the same regression. _1, _2 ...etc. show one , two ...etc. periods lag; ~ weakly significant (closer to 10%)
* significant at 10% ; ** at 5% and *** at 1% and less. For all of the equations the F value (over all fit) is significantly different from zero.
The Jarque-Bera _2 statistics at 5% level of significance for 2 degrees of freedom is 5.99. ** indicates significance at this level or better. Note, however, that it is relevant for large sample and visual inspection is important (see Mukherjee et al. 1997).
Chow break test is carried by using two country data as one series (when there is insufficient data by each country)
+ For multicollinearity simple correlation between regressors around <35 is assumed very low , 35-55 low & 55-65 acceptable.
The error correction form, for instance, for the food equation above can be given by the following (See Appendix 4.1):

ΔLFOODR=0.29ΔLP_1-0.21ΔLIGVGDP_1-0.11(LFOODR-5.03LP_2+0.45LIGVGDP_2+21.82).

The long-run relationship being,

LFOODR=5.03LP_2-0.45LIGVGDP_2-21.82.

@ For food, bilateral debt is used (others are not co-integrated); for agr. raw material, the sum of all, except private inflows, is used.

Table 4.6 Unit root analysis: an ADF test at 1% Mackinnon critical value for North Africa

Logarithms of	Symbol Used	Level of Integration
Food real export of food (at 1985 price)	LFOODR	I(1)
Agricultural raw materials real (at 1985 price)	LAGRMR	I(1)
Minerals real (at 1985 price)	LMMR	I(1)
Price of food, agricultural raw materials and minerals of North Africa sample	LPFNAs, LPANAs, and LPMNAs	I(1)
Aggregate bilateral, multilateral, private inflows and grants respectively; aggregate, aggregate excluding private flows; foreign direct investment, fertilizer consumption	LBILATD, LMULTD, LPRIVD, LGRANTS, LBMPGFF, LBMGFF,LFDI,LFERTZ	I(1)
Capital stock as ratio of GDP, total, public, private	LKGDP, LKGVGDP,LKPGDP	I(1)*
Domestic credit as ratio of GDP: total, public and private respectively	LDCRTG, LDCRGVG, LDCRPG	I(1)
Investment as proportion of GDP: total, public and private respectively	LIGDP, LIGVG, LIPG	I(1)
(Regional) real exchange rate for food, agr. raw materials and minerals [(regional commodity price X nominal exchange rate)/GDP deflator)]	LRERF, LRERA, and LRERM	I(1)*

* For these variables the level of significance is 5%.

Table 4.7 Co-integration test for North Africa

Equation	Engel-Granger ADF statistics	Mackinnon critical value at 5%	Johansen likelihood ratio	Mackinnon critical value	
				5%	1%
Food					
Model I	-5.724	-4.533 *	63.11	29.68	35.65
Model II	-6.320	-4.532 *	39.8	29.68	35.65
Model III	-5.538	-4.975 *	68.27	47.21	54.46
Agricultural raw materials					
Model II	-3.075	-3.558 **	19.26	29.68	35.65
Model III	-3.386	-3.953 **	41.61	47.21	54.46
Minerals					
Model I	-3.073	-3.558 **	34.08	29.68	35.65
Model II	-3.138	-3.558 **	20.59	29.68	35.65
Model III	-4.721	-4.310	60.25	47.21	54.46

** [*] Mackinnon critical value at 10% [1%] level of significance.
The Johansen test used assumes linear deterministic trend in the data with intercept, no trend, in the test VAR (i.e., the co-integration equation, as a indicator of long run equilibrium relation, has no trend).

ease' effect. The foreign inflow variable shows a statistically significant negative sign, in the long run, indicating the presence of a debt overhang, with a positive sign for the long- and short-lag aspects, respectively.

1(d) Minerals, ores and metals: Of the equations described in this section, the one relating to minerals, ores and metals is the most difficult to estimate. The real level of mineral exports and its relative price are found not to be co-integrated with ten types of capital formation indicator. Further, the co-integration Dickey-Fuller statistics for these two variables with that of investment in the private sector is 3.3, compared to a Mackinnon critical value of 3.5, at a 10 per cent significance level. However, given the well-documented uncertainty of this test in borderline cases, the estimation is undertaken with some reservation. Nevertheless, the results of this test point to a statistically significant negative impact of the short-run relative price relevant for capacity creation. In the long run, the impact of the price affecting capacity utilization is found to be statistically significant and positive. The capital formation indicator is also found to have a statistically significant positive impact. Long-run prices show a negative coefficient, although not at a statistically significant level. Adjustment to disequilibrium is also found to be very low, with only 18 per cent of the past error being made up for in the current period.

The adjustment coefficient varies from model to model within this region, ranging from about 10 per cent up to around 50 per cent in the case of beverage. This may be taken as indicating a generally low level of adjustment to disequilibrium or shocks for all commodity categories, with the exception of beverages. This result stands in contradiction to the intuitive expectation that short gestation items will be likely to adjust faster.

North Africa (NA)

Since no data is available relating to Libya and Morocco, only three countries are chosen as a sample for the North Africa region. These are Algeria, Egypt and Tunisia. A similar estimation procedure is followed in relation to the NA region, as was applied to the ESA region. However, since none of the sample countries are exporters of beverages, we undertake only three sets of estimations, using the three relevant models. Unit rate tests indicate that the series are non-stationary, but that they are co-integrated within each model (see Tables 4.6 and 4.7 for details of this). Based on this analysis, the following observations may be made in relation to each commodity category.

2(a) Food: In general, the food function for the NA region suggests that current prices are not statistically significant in explaining exports of food, the only exception to this being the long-run value for Model III. Neither is the relative price effect satisfactory. However, the result does suggest a positive elasticity for short-run capital formation indicators within Model III. Indeed, the food equation in Model III would suggest that contrary to 'Dutch disease'/debt overhang hypothesis, capital inflows will have a positive and statistically significant impact, in the long run, and a positive but statistically insignificant impact in the short run.

2(b) Agricultural raw materials: Exports of agricultural raw materials are not found to be co-integrated with current prices and various capital formation indicators. Thus, the estimation is undertaken using Model II. This model indicates a positive elasticity for the real exchange rate, both in the short and long run. However, only the long-run elasticity is found to be statistically significant. The capital formation indicator is also found to have a positive elasticity in both the short and long run. However, only the short-run elasticity is found to be statistically significant. Based on Model III, a positive and statistically significant coefficient for the short- and long-run capital formation indicators may be identified. Capital inflows are found to have a statistically significant positive impact in the short run and a negative impact in the long run. However, caution should be exercised in the relation to these results, since the Chow value for Model III is high.

2(c) Minerals, ores and metals: With the exception of the capacity utilization indicator in Model I, long-run prices are found to have a negative and statistically significant value. This would tend to support the hypothesis that a lower price will trigger exports, under a revenue-maximizing regime. The long-run capital formation indicator also shows a positive and statistically significant value within Model I, having a statistically significant negative value in the short run. This would tend to corroborate the revenue maximization argument detailed above. Moving on to examine Model II, in which an estimation is undertaken using the real exchange rate, all of the coefficients, with the exception of the constant, are found to be statistically insignificant in the short run. However, in the long run, the price that is assumed to show capacity creation is found to have a positive and statistically significant value. In contrast, the price which indicates capacity utilization, while again positive, is not found to be statistically significant. Neither is the capital formation indicator found to be statistically significant within this model. However, when Model III is used, both of these types of prices are found to exhibit a negative and statistically significant result, in the long run. Long-run short-lag effects of capital inflows are also found to be positive and statistically significant, contrary to the 'Dutch disease' theory, while its long-run long-lag coefficient would tend to suggest a negative value. This result may be interpreted as showing that capital inflows are capable of ensuring capacity utilization but not capacity creation. (In fact, in the long run, 'Dutch disease' and debt overhang problems may be expected.)

In contrast to the two other regions, within the NA region, the adjustment coefficient is generally high. This would suggest that a good part of errors arising within the previous period may be made up for in the current period, which, in turn, points to a relatively higher capacity of the region to adjust to external shocks or, indeed, a deviation from the long-run equilibrium.

West and Central Africa (WCA) Region

A sample of ten countries has been selected from the WCA region, as defined in the UN-ECA (Economic Commission for Africa) data reporting system. These include Benin (Ben), Burkina-Faso (Bf), Cameroon (Cam), The Central African Republic (Car), Gabon (Gab), Ghana (Gha), Nigeria (Nig), Senegal (Sen), Sierra Leone (Ser), and Zaire/DR Congo (Zi). For this sample, four commodity export functions are estimated below. All variables used in the estimation are found to be non-stationary series. These variables are also integrated to the first order (Table 4.11). Thus, the estimation is carried out once a co-integration test has been undertaken for each of the three models. The results indicate that the variables in each equation are co-integrated, suggesting the existence of a long-run relationship between these (Table 4.12).

Table 4.8 Estimation with current prices for North Africa

Dependent→	**Food**		**Agric. raw materials**		**Minerals**	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LMMR	t-values
Short-run coefficients (elasticities)						
Constant	2.1	0.84			8.52	3.95***
ΔLP_1	-0.26	-0.59			0.21	0.59
ΔLP_5					-0.25	-0.93
ΔLIPGDP_1	0.54	0.86				
ΔLIGVGDP_5					-0.56	-2.24***
Long-run coefficients (elasticities)						
LP_2	0.35	0.96			-0.35	-0.70
LP_6					-0.91	-3.54***
LIPGDP_2	0.08	0.18				
LIGVGDP_6					1.14	5.05***
Dependent_1	-0.96	-6.23***			-0.71	-6.9***
Diagnostic test						
ECM adjusted R^2	0.47	n=57			0.60	n=45
Level adjusted R^2	0.41				0.60	
Jarque-Bera	273				1.5**	
RESET(1)	1.78	Pr(0.19)			1.1	Pr(0.30)
Chow	2.7***				2.03**	
Degree of multicollinearity+	Low				Low	
Constant (country) dummy	Tunisia	1.11			Egypt	0.48
used					Tunisia	-0.16

Notes for Tables 4.8 to 4.10: as given in Table 4.3.

Notes for Table 4.9: ++ The correlation coefficient between LIPG and LRERF = 0.82 (others are low).

Notes for Table 4.10: @ For agricultural raw material private debt with 1 period lag is used (since others flows are not co-integrated);
++ The correlation coefficient between LBMPGFF and LPMNASs =0.70 so is their difference; others are very low.

Table 4.9 Estimation with real prices for North Africa

Dependent→	Food		Agric. raw materials		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LMMR	t-values
Short-run coefficients (elasticities)						
Constant	4.88	4.4***	1.09	2.13**	2.55	4***
ΔLP_1	-0.52	-1.37	0.63	1.15	0.48	1.42
ΔLP_5					0.32	0.88
ΔLIPGDP_1	0.4	0.64				
ΔLDCRGVG_1			0.62	2.08**		
ΔLIGVGDP_5					-0.19	-0.61
Long-run coefficients (elasticities)						
LP_2	0.3	1.32	2.4	1.7*	0.64	1.38
LP_6					0.95	1.94**
LIPGDP_2	0.00	0.00				
LDCRGVG_2			0.56	1.44		
LIGVGDP_6					0.02	0.07
Dependent_1	-1.02	-7.1***	-0.22	-2.6***	-0.62	-5.9***
Diagnostic test						
ECM adjusted R^2	0.48	n=57	0.13	n=56	0.49	n=45
Level adjusted R^2	0.46		0.56		0.40	
Jarque-Bera	541		343		0.06**	
RESET(1)	0.34	Pr(56)	0.09	Pr(0.77)	0.28	pr(0.60)
Chow	3.5***		3.6~***		4.5	
Degree of multicollinearity+	High++		Low		Low	
Constant (country) dummy used	Algeria	-1.86	Algeria	-2.2	Algeria	-2.13

Table 4.10 Estimation with capital inflow for North Africa

Dependent→	Food		Agric. raw materials		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LMMR	t-values
Short-run coefficients (elasticities)						
Constant	-0.68	-0.23	-6.0	-3.1***	7.8	3.6***
ΔLP_1	0.05	0.09	0.61	1.12	0.40	1.24
ΔLP_5					-0.43	-1.36
ΔLIPGDP_1	1.14	1.56~				
ΔLIGDP_5					0.31	0.82
ΔLFERTZ_1			1.21	3.2***		
ΔFF_2@	0.98	1.35	0.68	2.19**	-0.39	-0.97
ΔFF_6					-0.05	-0.26
Long-run coefficients (elasticities)						
LP_2	0.90	2.21**	-0.4	-0.6	-1.02	-2.2**
LP_6					-1.28	-3.69***
LIPGDP_2	0.17	0.39				
LIGDP_6					0.25	0.66
LFERTZ_2			1.53	12***		
FF_3@	0.15	1.8*	-0.43	-2.4***	0.58	2.54***
FF_7					-0.02	-0.09
Dependent_1	-1.06	-6.6***	-0.60	-5.5***	-0.75	-4.92***
Diagnostic test						
ECM adjusted R^2	0.58	n=50	0.40	n=56	0.54	n=39
Level adjusted R^2			0.93		0.75	
Jarque-Bera	34		67		0.60**	
RESET(1)	0.49	Pr(0.48)	10.6	Pr(0)	0.06	Pr(0.88)
Chow	3.9~***		6.5		3.22**	
Degree of multicollinearity+	Low		Low		High++	
Constant (country) dummy used	Algeria	-1.53	Algeria	-2.24	Algeria	-0.68

Table 4.11 Unit root analysis: an ADF test at 1% Mackinnon critical value for West and Central Africa

Logarithms of	Symbol Used	Level of Integration
Food as proportion of GDP	LFOODG	I(1)
Food real (at 1985 price)	LFOODR	I(0)
Agricultural raw materials real (at 1985 price)	LAGRMR	I(1)
Agricultural raw materials as proportion of GDP	LAGRMG	I(1)
Beverage real (at 1985 price)	LBEVR	I(1)
Beverage as proportion of GDP	LBEVG	I(1)
Minerals real (at 1985 price)	LMMR	I(1)
Minerals as proportion of GDP	LMMG	I(1)
Price of food, agricultural raw material, minerals, beverage of West and Central Africa sample	LPFWCAs, LPAWCAs, LPBWCAs and LPMWCAs	I(1)
Aggregate bilateral, multilateral, private inflows and grants; same excluding private flows; foreign direct investment	LBMPGFF, LBMGFF, LFDI	I(1)
Total, government and private Investment as proportion of GDP	LIGNP, LIGGNP, LIPGNP	I(1)
(Regional) real exchange rate for food, agricultural raw materials, minerals and beverage [(regional commodity price X nominal exchange rate)/GDP deflator)]	LRERF, LRERA,LRERM and LRERB	I(1)

Table 4.12 Co-integration test for West and Central Africa

Equation	Engel-Granger ADF statistics	Mackinnon critical value at 5%	Johansen likelihood ratio	Mackinnon critical value 5%	Mackinnon critical value 1%
Food					
Model I	-6.534	-4.362 *	160.05	29.68	35.65
Model II	-6.810	-4.362 *	66.53	29.68	35.65
Model III	-6.612	-4.734 *	227.00	47.21	54.46
Agricultural raw materials					
Model I	-4.551	-4.362 *	71.35	29.68	35.65
Model II	-4.076	-3.783	27.14	29.68	35.65
Model III	-4.860	-4.502 @	94.4	47.21	54.46
Beverages					
Model I	-4.142	-3.795	58.41	29.68	35.65
Model II	-3.485	-3.491 **	29.58	29.68	35.65
Model III	-4.074	-3.867 **	83.25	47.21	54.46
Minerals					
Model I	-3.537	-3.485 **	69.32	29.68	35.65
Model II	-4.089	-3.790	109.34	47.21	54.46
Model III	-4.610	-4.163	60.31	47.21	54.46

@ is trend stationary, otherwise are not co-integrated.
** [*] Mackinnon critical value at 10% [1%] level of significance.
The Johansen test used assumes linear deterministic trend in the data with intercept, no trend, in the test VAR (i.e., the co-integration equation, as an indicator of long-run equilibrium relation, has no trend).

Notes for Tables 4.13-15: as given inTable 4.3. @ for beverages we used LDCRT (i.e. total domestic credit).
Notes for Table 4.15:
^ For minerals the foreign inflow used excludes private inflow since private investment is used as one of the repressors.
++ All other correlations are very low except that between LDCRT and LBMPGFF which is 0.79.

Tables 4.13–4.15 summarize the estimated results of the three models, for the four commodity categories within the WCA region. Based on these results, a number of observations can be made.

3(a) Food: It may be concluded that the aggregate food function exhibits a statistically significant positive coefficient for most variables[32] in all models, in both the short and long run. However, the possibility of the existence of a 'Dutch disease' phenomenon cannot be inferred from the coefficient for short-term inflows. However, a long-run debt overhang problem may be inferred from the statistically significant negative coefficient for Model III.

3(b) Agricultural raw materials: The results of this estimation suggest a positive short-run elasticity in Model I and statistically insignificant values in the remaining cases. However, relative prices are found to be positive and statistically significant. Capital formation is also found to have a positive and statistically significant long-run value, within Model I. Indeed, contrary to the hypothesis of 'Dutch disease' and debt overhang, capital inflows show positive and statistically significant values in both the short and long run.

3(c) Tropical beverages: In relation to beverages, the estimation results confirm that prices, whether current or real, determine capacity utilization in both the short and long run. On the other hand, prices are found to be relatively unimportant as a factor determining capacity creation. The results also show capital formation indicators as having a positive and statistically significant long-run impact within Model II, while exhibiting a negative impact in Model III. Finally, capital inflows are also found to have a statistically significant positive impact, in both the short and long run.

3(d) Minerals, ores and metals: This estimation confirms the importance of capital formation indicators in the long run (within Model I), as well as the positive impact of current prices on capacity utilization, again in the long run (within Models I and III). Model II shows real exchange rate as having a statistically significant positive and negative long-run impact on capacity creation and utilization, respectively. Finally, the results of Model III suggest the possibility of 'Dutch disease' and debt overhang problems within the sector.

Table 4.13 Estimation with current prices for West and Central Africa

Dependent→	Food		Agric. raw materials		Beverages		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LBEVR	t-values	LMMR	t-values
Short-run coefficients (elasticities)								
Constant	-0.68	-0.74	-0.85	-1.6*			-1	-0.32
ΔLP_1	0.46	3.0***	0.36	1.5~	0.37	2.44***	-0.60	-0.66
ΔLP_5					0.06	0.37	-0.38	-0.40
ΔLFRTZ_1	0.11	1.63*						
ΔLIPGNP_5@					-0.07	-0.60	0.49	1.18
ΔLKG_2			0.12	0.24				
Long-run coefficients (elasticities)								
LP_2	2.4	3.5***	-0.16	-0.35	0.84	2.5***	2.45	1.96**
LP_6					0.46	1.08	-0.73	-1.00
LFRTZ_2	-0.24	-1.06						
LIPGNP_6@					-0.01	-0.04	1.03	3.15***
LKG_3			1.02	5.6***				
Dependent_1	-0.20	-3.01***	-0.25	-4.27***	-0.25	-3.94***	-0.61	-4.9***
Diagnostic test								
ECM adjusted R^2	0.24	n=114	0.11	n=126	0.10	n=108	0.27	n=58
Level adjusted R^2	0.40		0.25		0.54		0.83	
Jarque-Bera	1.19**		0.06**		4.5**		5.3**	
RESET(1)	1.04	pr.(0.31)	0.07	pr.(0.79)	0.13	pr.(0.71)	0.04	pr.(0.83)
Chow	0.94**		1.93**		1.11**#		1.3**	
Degree of multicollinearity+	Acceptable		Acceptable		Low		Low	
Constant (country) dummy	Bf,	-0.65,	Gha,	-0.30	Ben,	-0.89	Ben,	-2.75
used	Cam,	-0.37,	Sen	-0.32	Car,	-0.62	Car	-1.93
	Car,	-0.88			Gab	-0.97		
	Nig,	-0.35			Sen,	-1.32		
	Zi	-0.81			Ser	-0.57		

Table 4.14 Estimation with real exchange rate for West and Central Africa

Dependent→	Food		Agric. raw materials		Beverages		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LBEVR	t-values	LMMR	t-values
Short-run coefficients (elasticities)								
Constant	-0.28	-0.72	0.04	0.10			0.13	0.14
ΔLP_1	0.27	2.19**	0.48	3.3***	0.18	1.96**	-0.12	-0.19
ΔLP_5					0.12	1.1	1.14	1.12
ΔLFRTZ_1	0.18	2.7***	0.01	0.26				
ΔLIPGNP_5@					-0.04	-0.31	0.28	0.50
Long-run coefficients (elasticities)								
LP_2	0.17	1.03	0.62	1.48~	0.50	2.32***	-2.52	-3.02***
LP_6					0.25	1.14	2.73	3.29***
LFRTZ_2	0.42	2.06**	0.03	0.21				
LIPGNP_6@					0.26	2.82***	-1.44	-1.39
Dependent_1	-0.15	-2.88***	-0.12	-2.85***	-0.26	-3.64***	-0.51	-4.28***
Diagnostic test								
ECM adjusted R^2	0.16	n=111	0.09	n=133	0.09	n=106	0.24	n=58
Level adjusted R^2	0.26		0.09		0.65		0.64	
Jarque-Bera	2.06**		0.05**		2.0**		3.29**	
RESET(1)	0.45	pr.(0.50)	0.48	pr.(0.50)	0.95	pr.(0.33)	0.01	pr.(0.91)
Chow	0.58**		1.3**		0.85**		0.87**	
Degree of multicollinearity+	Acceptable		Very low		Low		Very low	
Constant (country) dummy	Sen	0.33	Ben	-0.15	Car	-0.64	Ben	-2.55
used	Zi	-0.18	Sen	-0.23	Gab	-1.06	Car	-2.65
					Gha	0.25		
					Nig	0.76		
					Sen	-1.47		

Table 4.15 Estimation with capital inflow for West and Central Africa

Dependent→	Food		Agric. raw materials		Beverages		Minerals	
Regressors↓	LFOODR	t-values	LAGRMR	t-values	LBEVR	t-values	LMMR	t-values
Short-run coefficients (elasticities)								
Constant	-2.28	-2.07**	1.08	1.28	-1.29	-0.84	-3.84	-0.87
ΔLP_1	0.57	2.96***	0.35	1.26	0.37	1.55~	0.51	0.48
ΔLP_5					-0.03	-0.17	0.05	0.05
ΔLFRTZ_1	0.16	2.54***	0.03	0.58				
ΔLIPGNP_5@					-0.25	-1.96**	0.47	1.16
ΔFF_2^	0.04	0.65	0.21	2.55***	0.28	1.23	-0.88	-1.54~
ΔFF_6^					0.19	1.7*	-0.37	-0.75
Long-run coefficients (elasticities)								
LP_2	3.5	2.2***	-1.14	-1.45	1.35	1.42	4.0	1.96**
LP_6					0.05	0.09	0.23	0.18
LFRTZ_2	0.50	2.39***	0.00	0.02				
LIPGNP_6@					-0.86	-2.16**	0.58	0.82
FF_3^	-0.39	-1.63*	0.79	4.0***	0.62	1.57~	-0.55	-0.55
FF_7^					0.67	1.7*	-0.54	-0.67
Dependent_1	-0.14	-3.72***	-0.25	-3.93***	-0.24	-2.9***	-0.49	-4.16***
Diagnostic test								
ECM adjusted R^2	0.20	n=106	0.11	n=107	0.03	n=97	0.18	n=68
Level adjusted R^2	0.29		0.28		0.64		0.70	
Jarque-Bera	0.13**		0.04**		1.47**		3.5**	
RESET(1)	0.02	pr.(0.88)	0.38	pr.(0.54)	0.73	pr.(0.39)	1.06	pr.(0.31)
Chow	0.72**		1.3**		0.99**		1.25**	
Degree of multicollinearity+	Low		Low		High (0.79)++		Low	
Constant (country) dummy used	Sen	0.35	Ben Sen	-0.25 -0.47	Cam Gab Gha Nig Sen	0.5, -0.6 0.7, 0.5 0.84	Ben Car	-2.6 -2.4

In general, the estimation results for this region may be summarized as follows. For food and agricultural raw materials, both non-perennial and short gestation, 10–25 per cent of any disequilibrium in the previous period is made up for in the current period. However, in relation to beverages and minerals, this figure stands at the relatively higher levels of 25 per cent and 50–60 per cent, respectively. This result indicates a generally low level of adjustment to disequilibrium or shocks for the former, as well as a clear distinction between commodities that require a long and short gestation period. This stands in contradiction to the intuitively more appealing expectation that short gestation items are likely to adjust faster. (A possible explanation for this result is the importance of capacity utilization[33] in minerals and tree crops.)

4.3.5 Summing up

The results of the estimation are summarized in Table 4.16. I have reported only those values found to be statistically significant at a 10 per cent significance level or better. Within this table, the figures [1], [2] and [3] refer to estimations for Models I, II and III, respectively. In Model I, current price and capital formation indicators are used as regressors. In Model II, price is replaced by a commodity-specific regional real exchange rate. Finally, in Model III the basic estimation used for Model I is augmented by capital inflow indicators.

In this section, an attempt has been made to identify determinants of commodity export supply. This approach differs from previous studies in a number of important respects. Firstly, it emphasizes the role of other factors besides price in the determination of export supplies. Secondly, an error-correction model is used. And, thirdly it focuses exclusively on African countries.

Based on this analysis, a number of conclusions may be arrived at. Firstly, there would appear to be a clear distinction between short- and long-run elasticities. Hence, an ECM is likely to represent the relevant econometric technique in relation to commodity estimation. However, work in this area remains in its infancy. Secondly, estimation using relative prices (with a real exchange rate) yields largely satisfactory results. However, it is noted that the impact of relative prices is largely confined to capacity utilization and not to capacity creation. Thirdly, although capital formation indicators are neglected, within the literature, these are also found to have a positive and statistically significant impact, especially in the long run. As a result, specific parameters are ob-

Table 4.16 Summary table of elasticities: All Africa

	Current price		Relative prices		Capital formation		Foreign inflows	
	Short –run	Long-run	Short-run	Long-run	Short-run	Long- run	Short-run	Long-run
West and Central Africa (WCA)								
Food	0.46[1] 0.57[3]	2.4[1] 3.50[3]	0.27		0.11[1] 0.18[2] 0.16[3]	0.42[2] 0.50[3]		-0.39
Agr. raw materials	0.36[1]		0.48	0.62		1.02[1]	0.21	0.79
Beverage	0.37[1]* 0.37[3]*	0.84[1]*	0.18*	0.50*	-0.25[3]	0.26[2] -0.86[3]	0.19#	0.62* 0.67#
Minerals		2.45[3]*		-2.52* 2.73#		1.03[1]	-0.88*	
East and Southern Africa (ESA)								
Food	0.29[1]	5.02[1] 1.01 [3]		0.13				0.22
Agr. raw materials		-1.38[1]	0.33		0.18[1] 0.18[2] 0.22[3]	0.44[1] 1.19[2] 1.16[3]		
Beverage	0.14[1]*	0.54[1]* 0.30[1]# 0.77[3]#		0.12#		0.13[2] 0.58[3]	-0.24#	0.58* -0.66#
Minerals			-0.42#	1.27*		2.36[2]		
North Africa (NA)								
Food		0.90[3]			1.14[3]			0.15
Agr. raw materials				2.40	0.62[2] 1.21[3]	1.53[3]	0.68	-0.43
Minerals		-0.91[1] -1.02[3]* -1.28[3]#		0.95#	-0.56[1]	1.14[1]		0.58*

* = short lags (indicating capacity utilization) # = long lags (indicating capacity creation)

tained for each region and for different commodity categories. This has an important policy implication in that, in addition to giving us one more policy handle other than price with which to work, it also implies boosting levels of capital formation (both internal and with aid), rather than providing welfare aid. This is likely not only to raise the level of exports, but also to have a multiplier effect on output working its way through imports. This result has particular relevance in the African context.

An important variation across regions may also be observed. Thus, if we examine the regional variation across commodity categories, the following picture emerges. For *food,* the short-run current price elasticity is found to be highest for the WCA region. In the long run, both WCA and ESA regions have higher price elasticities than the NA region. The short-run impact of capital formation indicators on food is also found to be strong for the NA region. A negative debt overhang effect is observed for WCA, but not for the other regions. In relation to *agricultural raw materials,* the short-run price effect is stronger within the WCA region, while the long-run price effect is found to be negative for the ESA region. A similar short-run phenomenon is observed for relative prices. A long-run relative price effect is found to be strongest within the NA region, followed by the WCA region. Capital formation indicators are strongest within the NA region, followed by the ESA region. A debt overhang problem is found to be present within the NA region, but not the WCA region. In relation to *beverages*, current and relative price and capital formation effects are strongest in the WCA region, followed by the ESA region. 'Dutch disease' and debt stress effects are observed for the ESA region, but not for the WCA region. Finally, in relation to *minerals*, a long-run current price effect is found to be strongest for the WCA region, and negative for the NA region.

The impact of the arguments used in the regression also varies across regions. Thus, the relative price effect is negative for the short lag of the WCA region and the short-run, long lag, of the ESA region. Longer lag, capacity creation, long-run effects are found to be strongest for the WCA region, followed by the ESA and NA regions. The impact of capital formation indicators is found to be strongest for the ESA region and nearly equal for the other two regions. Evidence of a 'Dutch disease' effect is apparent only within the WCA region. Based on the above observations, one might reasonably conclude that the response of different commodity groups varies across regions. Indeed, giving due attention to such differences is likely to be very important in analysing the pattern of trade and finance in Africa. In relation to the impact of foreign inflows on exports, no firm conclusion may be arrived at, since the results obtained are mixed. The results are also mixed *vis-à-vis* the relationship between long-run current export price and the supply of exports, when the impact of foreign inflows is explicitly considered within the model specification. Since it is not possible to arrive at any firm conclusion based on these results, this would tend to suggest the need for further research on this relationship, both at a regional and country level.

Although most published studies focus on output, rather than on export supply, nevertheless we will now attempt to compare the results of these studies with our own findings. Using relative prices, Bond (1987) reports aggregate supply price elasticities for Africa of -1.28 for food, 0.70 for agricultural raw material, and -1.89 for minerals. (For other global regions she found lower elasticities.) She attributes the apparently perverse relationship for food to population growth, as well as to the very large gap between world price and producer price. In an earlier study (Bond 1983) she found an average aggregate price elasticity of 0.12, based on a coefficient of the logarithm of real prices, with the figure for individual countries ranging between 0.03 and 0.22. Binswanger (1992) maintains that price elasticities for sub-Saharan Africa are not lower than for other areas and, in general, that long-run elasticities are higher than short-run ones. Binswanger's results show elasticity values ranging from 0.05 to 0.15, with the exception of Senegal and Burkina Faso, for which the figures are 0.54 and 0.22, respectively. The cross-country result for this study stands at 0.06, long-run values fall in the range of 0.15 to 0.24 and no long-run elasticities were produced from the cross-country regression. Based on the results of his study of sisal in Tanzania, Gwyer (1971) found short-run price elasticity ranging from 0.24 to 0.29, with a long-run value of 0.48. For cotton in Uganda, Alibaruho (1974) found a short-run price elasticity ranging from 0.22 to 0.26 and a long-run value ranging from 0.44 to 0.66. Ghoshal (1974) found a one-period lag price elasticity of 1.16 to 1.71 in his study of rubber in Liberia. In their study of cotton in Kenya, Jones and Mutuura (1989) found short- and long-run elasticities of 1.33 and 1.71, respectively. Eriksson (1993) reviews a number of studies which examine supply price elasticity estimates for Tanzania. He reports elasticities falling in a range from 0.25 to 0.43 for perennials, 0.73[34] to 2.4 in the long run for cotton and a short-run value ranging from 1.5 to 2.3 for food crops. Also focusing on cotton in Tanzania, Dercon (1993) found that short-run elasticities for this crop ranged between 0.63 to 0.67. Ramanujam and Vines (1990) reported 'long-run' price[35] elasticities of 0.10 for food, 0.51 for beverages, 0.06 for agricultural raw materials and 0.33 for metals and minerals. The short-run price with no lag values stand at 0, 0.13, 0.08 and 0.31, respectively. Abebayehu (1990) estimated an export supply function for six African countries. His export price elasticity of supply is found to range from 0.50 to 1, if the exceptionally high value of 2.3 for Kenya is excluded.

Based on the above review, one might conclude that the findings detailed in this book stand in broad agreement with those of previous studies. More specifically, long-run price elasticities are generally found to be higher than short-run ones. However, the present study has an advantage over these other studies in that it explicitly clarifies what is meant by 'the long run' and 'the short run', using relevant estimation techniques. Moreover, the elasticity values generated in this study are stronger and more often positive than those arising out of previous studies. This may be attributed to the use of an error correction model and well-structured database with large degrees of freedom. Finally, since previous studies hardly touch upon other supply factors, a comparison with these studies in respect to such factors is not possible.

To sum up, the literature in relation to commodity export supply functions is characterized by explanatory variables that are either current or lagged relative prices. This study not only underlines the existence of other equally, or perhaps even more important factors, but also emphasizes the importance of their explicit incorporation within the estimation. Cross-sectional data for African countries is used for estimation purposes. Firstly, price-focused estimations are explored. Subsequent estimations are then undertaken by adding other relevant explanatory variables which may be rare within the literature. A number of important results are summarized in this section. Firstly, there is a clear difference between UNCTAD world prices and the regional price constructed for Africa. Hence previous work based on the former could have biased elasticities. Secondly, estimation using a real exchange rate resulted in statistically significant elasticity coefficients with a clear distinction between the long and short run. This underscores the importance of this particular specification as well as the use of an Error Correction Model (ECM) within this estimation. Thirdly, capital formation indicators are also found to be positive and statistically significant. Fourthly, the results of these estimations are found to vary across the three regions of Africa. And, finally, using the models detailed in this section, estimation with foreign inflow included yields mixed results both on the relationship between export prices and supply of exports and on the impact of aggregate foreign inflows.

4.4 AFRICAN EXPORTS IN A GLOBAL CONTEXT

4.4.1 Introduction

When data permits, one of the best ways of modelling a commodity market is to proceed along the lines outlined by Hwa (1985) and Ramanujam and Vines (1990). In these approaches, stock demand and supply is explicitly specified as a part of the system of consumption demand and supply equations, as set out in Chapter 2. The major problem in following this approach is a lack of commodity stock data, especially in relation to those disaggregated commodity categories used in this study. In order to overcome this problem, a simultaneous equation model of the demand for, and supply of, exports along the lines of Goldstein and Khan (1978), henceforth referred to as the GK model, is used as a starting point. Abebayehu's work on how this model may be applied to various African countries is also found to be useful, in this context (Abebayehu 1990). However, there are three main problems with the GK model. Firstly, the impact of stockholding is not explicitly incorporated within this model. Secondly, there is ambiguity in the use of a partial adjustment procedure in relation to the price equation of its disequilibrum model. And, thirdly, there may exist possible non-stationarity in relation to the series used for the estimation. I will return to examine some of these problems later in this study.

Most studies focusing on the export of commodities from developing countries take the individual national economy as their unit of analysis. Logically, such an approach will rest on the *small country assumption*. However, one of the major weaknesses of this approach is that it suffers from the *fallacy of composition* (Evans 1993) or the *adding-up* problem (Akiyama & Larson 1994). Thus, unless the modelling of exports for an individual country takes global effects into account, the results of such a modelling exercise may well be far from an accurate reflection on reality. The model proposed below attempts to resolve this problem by combining the global market of a commodity in question with the export market of the individual country or region. In this way the adding-up problem may explicitly be incorporated into the export function for individual or regional economies. In section 4.4.2 such a global model will be specified. Section 4.4.3 will be devoted to the estimation of the model. In this section some econometric problems of previous studies will be highlighted and a number of lessons drawn from this. Finally, section 4.4.4 will outline how this global model might be applied in relation to the macro supply situation in Africa.

4.4.2 The Global Commodity Model

The global demand for a commodity group i has two components. Firstly, a stock/inventory demand that is assumed to be determined by expected level of interest rate (i_w) and current prices. Agents in the North are assumed to hold commodities as part of their portfolio diversification scheme. The other part of aggregate demand is a consumption demand, be it industrial or otherwise. The latter is believed to be determined by the level of income in North (Y_N)[36] and by price of commodities (P_w) relative to an indicator of price for other trading partners (P_N). This aggregate demand may be specified as,

$$\ln X^{dd} = a_0 + a_1 \ln Y_N + a_2 \ln i_w + a_3 \ln\left(\frac{P_w}{P_N}\right) \qquad [1]$$

where: $a_1 > 0$; $a_2 < 0$ $a_3 < 0$

The supplies of exports are assumed to depend on price of commodities relative to domestic price in South (P_S), and on a productivity indicator taken to be the share of gross domestic investment in South (I_S) as percentage of the GDP in South (Y_S). This is given in equation [2],

$$\ln X^{ss} = b_0 + b_1 \ln\left(\frac{P_w}{P_s}\right)_{t-1} + b_2 \ln\left(\frac{I_s}{Y_s}\right)_{t-i} \qquad [2]$$

where: b_1 and $b_2 > 0$.

This supply equation differs from that of the GK model in two respects. Firstly, it uses lagged, as opposed to current, price levels. Secondly, a lagged investment to GDP ratio, rather than current GDP is used as a productivity indicator. We opt for the use of lagged price as a determinant of supply on the assumption that current supply is affected by price signals for the previous period. Similarly, the use of an investment ratio is likely to overcome the problem of taking GDP as a productivity indicator, in a situation where the export sector might grow, owing to previous period investment. This remains true even if the overall performance of the economy, as depicted by GDP, is poor.

Given these refinements, the equilibrium model may be arrived at by simultaneously estimating equations [1] and [2] under the assumption that they are in equilibrium,

$$X^{dd} = X^{ss} \qquad [3]$$

The disequilibrum model

A disequilibrium version of this model may be formulated by assuming a partial adjustment model, which is adapted from a similar earlier formulation within the export function, alongside the GK model (Houthakker & Taylor 1970). Thus, the change in exports are assumed to partially adjust to the gap between demand and actual flows in the previous period,

$$\Delta \ln X_t = \lambda \ (\ln X_t^{dd} - \ln X_{t-1}) \qquad [4]$$

where λ is the coefficient of adjustment and is defined as $0<\lambda<1$, and Δ is a first difference operator representing change. Equation [4] states that the quantity of export adjusts to the condition of excess demand and that there is some degree of stickiness in the supply conditions. Substitution of equation [1] into [4] yields the following equation for exports:

$$\ln X_t = \alpha_0 + \alpha_1 \ln Y_N + \alpha_2 \ln i_w + \alpha_3 \ln\left(\frac{P_w}{P_N}\right) + \alpha_4 \ln X_{t-1} \qquad [5]$$

where:

$$\alpha_0 = \alpha_0\lambda \quad \alpha_1 = a_1\lambda > 0 \quad \alpha_2 = a_2\lambda < 0 \quad \alpha_3 = a_3\lambda < 0 \quad \alpha_4 = 1-\lambda > 0$$

Normalizing equation [5] for world commodity price yields the estimating disequilibrum equation given by [5.1],

$$P_w = \beta_0 + \beta_1 Y_N + \beta_2 i_w + \beta_3 P_N + \beta_4 X_t + \beta_5 X_{t-1} \qquad [5.1]$$

where:

$$\beta_0 = \frac{-\alpha_0}{\alpha_3} \quad \beta_1 = \frac{-\alpha_1}{\alpha} > 0 \quad \beta_2 = \frac{-\alpha_2}{\alpha_3} < 0 \quad \beta_4 = -\frac{1}{\alpha_3} > 0 \quad \beta_5 = -\frac{\alpha_4}{\alpha_3} > 0$$

In the version of the GK model which is applied to a sample of African countries by Abebayehu, the disequilibrum price equation is formulated following a similar procedure to that of the supply equation (Abebayehu 1990). That is, the change in price of exports adjusts to excess supply in a similar partial adjustment manner.[37]

However, one of the major weaknesses of the GK model is the use of this type of partial adjustment model in relation to prices. If there is excess supply in the market, either the market clears for price or there must be some kind of non-price market clearing mechanism, such as a stock adjustment or, indeed, a related activity which might have the effect of neutralizing excess supply. Since a partial adjustment process in relation to prices is assumed within the GK model[38] the authors must have implicitly assumed that the excess supply, which is not taken care of by a movement in the level of prices, has somehow adjusted. However, Goldstein and Khan (1978) do not spell out what this mechanism might be. In contrast, since we have explicitly assumed the demand for stocks and inventory in the demand equation of our model, price will automatically clear that market. Thus, although the equation for export supply may follow a partial adjustment model, the price equation does not. As a result, our disequilibrum model is arrived at by simultaneously estimating equation [2] and equation [5], based on the equilibrium condition expressed in equation [3].

4.4.3 Estimation of the Model

4.4.3a Time series properties

A second major problem with the GK model, particularly as it is applied in Abebayehu (1990), is the assumption of stationarity. As can be inferred from Tables 4.17 and 4.18, all series, with the exception of real level of GDP in the North,[39] are found to be non-stationary. These series are also found to be $I(1)$. This finding casts serious doubt over the validity of most supply and demand commodity models since the findings of these models may be spurious.

Table 4.17 A unit root analysis of the world commodity model and ADF test

Series (all in logarithms)	No trend & inter-cept term	With trend & intercept term	With intercept alone
1966-1993			
Real export			
Agricultural raw materials	1.24	-1.88	-0.44
Beverage	1.57	-2.2	-0.43
Food	1.39	-2.53	-0.43
Minerals	0.35	-4.0	-3.46
World interest rate (3 months LIBOR rate)	-0.63	-2.34	-2.6
Real GDP in North	1.36	-3.45	-1.47
1960-1993			
World price			
Agricultural raw materials	1.05	-1.9	-1.02
Beverage	0.25	-0.80	-1.41
Food	0.55	-2.4	-1.8
Minerals	0.65	-3.34	-2.0
GDI to GDP ratio (South)	0.42	-2.6	-1.8

Table 4.18 Mackinnon critical values for the ADF test

No trend & intercept term		
1%	5%	10%
-2.64	-1.95	-1.62
With trend & intercept term		
1%	5%	10%
-4.27	-3.56	-3.21
With intercept alone		
1%	5%	10%
-3.65	-2.96	-2.62

There are two means by which this issue might be addressed. The first option is to conduct a co-integration analysis and apply an ECM model to this. However, the problem with this option is the limited size of the sample relating to the period 1960 (65) to 1993. Nevertheless, in spite of this shortcoming, our data is still relatively better than that used in pre-existing long-run estimations. The most recent study of Ramamujam and Vines (1990) also uses data from 1960–86 for only a limited set of commodities. The advantage of this option is that it, at least, highlights a medium-term relationship. The second option is to transform all data to an $I(0)$ series using the first difference values for this data.[40] The major shortcoming of this option is that information is lost in relation to the long-run (level) relationship. (Estimation results based on this approach are reported in Appendix 4.3.)

Table 4.19 Co-integration test for world commodity model

Equation	Engel-Granger ADF statistics	Mackinnon critical value at 5%	Johansen likelihood ratio	Mackinnon critical value	
				5%	1%
Food					
Demand	-5.91	-5.86[a]	67.50	68.52	76.07
Supply	-2.72	-4.14[b]	39.70	47.21	54.46
Demand			98.17[c]	87.31	96.58
Supply[d]			50.72[d]	39.89	45.58
Supply[e]			56.87[e]	53.12	60.16
Agricultural raw materials					
Demand	-3.36	-4.55[b]	84.42	68.52	76.07
Supply	-2.84	-4.14[b]	43.12	47.21	54.46
Beverage					
Demand	-4.24	-4.97[b]	83.12	68.52	76.07
Supply	-4.38	-4.13[b]	51.77	47.21	54.46
Minerals					
Demand	-7.01	-5.87[a]	92.60	68.52	76.07
Supply	-5.83	-5.39[a]	60.16	47.21	54.46

Notes:
[b] [[a]] are Mackinnon critical values at 10% [1%] level of significance (others at 5%). The Johansen test used assumes a linear deterministic trend in the data with intercept, no trend, in the test VAR (i.e., the co-integration equation (CE), as an indicator of long run equilibrium relation, has no trend).
[c] assumes linear deterministic trend in the data with intercept and trend in CE and no trend in test VAR.
[d] assumes no deterministic trend in the data with no intercept or trend in the CE or test VAR.
[e] assumes no deterministic trend in the data with intercept, no trend in CE and no intercept in test VAR.

Table 4.20 An ECM estimation result of the model

AGRICULTURAL RAW MATERIALS

Demand

$$\Delta X = -0.174\Delta P - 0.375\Delta Y_N - 0.145 i_{W_{t-1}} - 0.673(X_{t-1} + 0.708 P_{t-1} - 0.02 PY_{t-1} + 0.372 i_{W_{t-2}} - 5.504)$$

(-1.4) (-1.4) (-2.05)$^+$ (-3.5)* (-3.5)* (0.18) (-4.5)* (2.6)*

R^2-adj = 0.43 Jarque-Bera 1.05* Reset 0.83(0.37) LM 0.02(0.90) BG=2.6 (0.12) Sample 1968-93

TROPICAL BEVERAGE

Demand

$$\Delta X = -0.319\Delta P + 0.90\Delta Y_N - 0.003 i_{W_{t-1}} - 0.777(X_{t-1} + 0.250 P_{t-1} - 0.322 Y_{t-1} - 0.110 i_{W_{t-2}})$$

(-4.8)* (2.2)$^+$ (-0.04) (-3.2)* (-5.1)* (31.2)* (1.64) ~

R^2-adj = 0.50 Jarque-Bera 0.12* Reset 1.07(0.59) LM 0.30(0.59) BG=0.33 (0.57) Sample 1968-93

Supply

$$\Delta X = 0.003\Delta P_{t-2} - 0.146\Delta I_{t-5} - 0.590(X_{t-1} - 0.098 P_{t-3} + 0.580 I_{t-6} - 6.087)$$

(0.05) (0.362) (-3.0)* (-2.8)* (-0.95) (2.3)*

R^2-adj = 0.15 Jarque-Bera 1.12* Reset 1.46(0.24) LM 0.06(0.80) BG=1.45 (0.26) Sample 1967-93

FOOD

Demand

$$\Delta X = -0.915\Delta P - 0.356\Delta Y_N - 0.194 i_{W_{t-1}} - 0.389(X_{t-1} + 1.01 P_{t-1} - 0.583 PY_{t-1} + 0.049 i_{W_{t-2}} + 2.219)$$

(-14.0)* (-1.5) (-3.4)* (-2.3)* (-10.0)* (4.5)* (-0.5) (-1.13)

R^2-adj = 0.92 Jarque-Bera 0.61* Reset 0.05(0.83) LM 0.23(0.64) BG=5.7 (0.01) Sample 1968-93

Supply

$$\Delta X = -0.164\Delta P_{t-1} - 0.738\Delta I_{t-2} - 0.522(X_{t-1} - 0.247P_{t-2} + 0.246I_{t-3} - 4.707)$$

(-1.5) (-1.05) (-3.7)* (3.6)* (-0.23) (1.32)

R^2-adj = 0.30 Jarque-Bera 1.98* Reset 0.18(0.68) LM 8.0(0.01) BG=0.75 (0.49) Sample 1967-93

MINERALS

Demand

$$\Delta X = -0.312\Delta P + -0.424\Delta Y_N - 0.01 i_{W t-1} - 0.527(X_{t-1} + 0.646P_{t-1} - 0.396Y_{t-1} + 0.215 i_{W t-2})$$

(-2.8)* (1.8)^ (-0.14) (-2.65)* (-7.3)* (29.8)* (-2.5)*

R^2-adj = 0.42 Jarque-Bera 1.74* Reset 5.6 (0.03) LM 1.2 (0.28) BG=1.74 (0.42) Sample 1968-93

Supply

$$\Delta X = 0.073\Delta P_{t-1} + 0.487\Delta I_{t-5} - 0.797(X_{t-1} - 0.111P_{t-2} - 0.607I_{t-6} - 2.04)$$

(1.09) (1.8)^ (-4.4)* (-2.8)* (2.03)+ (2.1)+

R^2-adj = 0.45 Jarque-Bera 1.58* Reset 0.56 (0.47) LM 0.66 (0.43) BG=0.66 (0.42) Sample 1967-93

Values in bracket are t-values while for diagnostic test P-values (See Appendix 4.1). The sign difference between the t and the coefficients in the ECM term is because the t values refer to the long run coefficient. * implies 1%, + 5% and ^ 10% level of significant. LM is hetroschedasticity test while BG is the Breuch-Godfery test for serial correlation. The 5% (2 degrees of freedom) value for Jarque-Bera is 5.99.

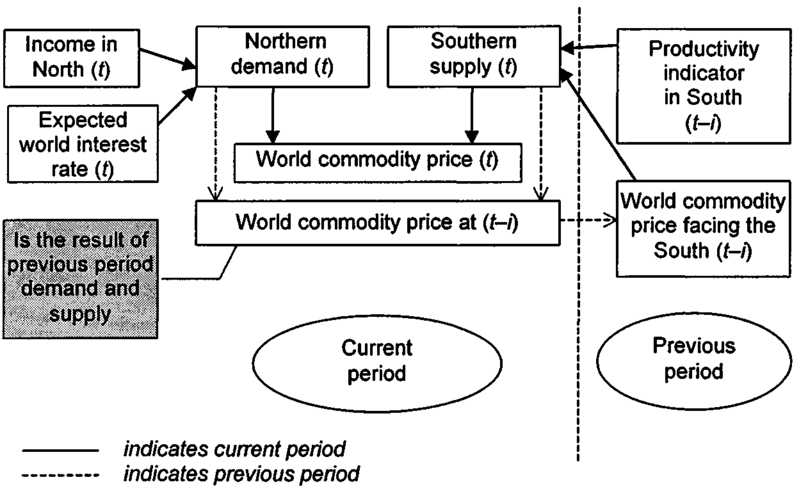
Although our data series are small,[41] we have nevertheless undertaken a co-integration analysis using the available data. The results for this are reported in Table 4.18. It is noteworthy that for two of the models,[42] the Engel-Granger test rejects the null hypothesis of co-integration while the Johansen test accepts this. This is mainly due to the limitations of the former test, in which a long-run co-integration regression is undertaken by taking the theoretically specified equation. Since the Johansen test, which is comparatively the better test, accepts all but one of these[43] estimations (albeit with some changes in assumptions with regard to the food equation), we accept the hypothesis of the existence of a long-run relationship. The ECM estimation which follows from this analysis is given in the following section.

4.4.3b The econometric model and estimation results

Table 4.20 shows the result of the ECM model fitted to data for the period running from 1960 to 1993. However, the export data relates only to the years between 1966 and 1993. Within this table, quantity of exports from South is denoted by X. Export figures for each commodity category relate to total exports from the South.[44] The price of each commodity group, which is derived from the UNCTAD world price, is denoted by P. Within the demand equation, the commodity price (P) is set relative to a general import unit price index of the North. The latter, following a similar approach to that adopted in the GK model, is taken as a proxy for the price of other trading partners. Within the supply equation, the commodity price (P) is set relative to domestic price in South (P_S). The investment to GDP ratio in South is denoted by I and the two periods moving average three months dollar-based LIBOR rate by i_w. The expected interest rate at time t is assumed to be formulated on the basis of knowledge acquired in the preceding two periods. A rudimentary procedure of expectation formation based on a moving average value for the previous two periods is assumed.[45] Northern (OECD) real GDP is denoted by Y_N. All variables are in logarithms. Hence, coefficients may also be read as elasticities.

Our ECM model has an edge over similar previous models because we are estimating the model for different commodity categories which had previously been aggregated into one single 'total export' category. Moreover, previous estimations (Goldstein & Khan 1978, Abebayehu 1990, Ramanujam & Vines 1990) do not formally address the issue of spurious regression. The result in Table 4.20 broadly provides the expected signs. The diagnostic test for all estimations is quite acceptable. However, compared to the supply equations, the demand model is quite robust.[46] In addition to the benefits associated with the use of an appropriate methodology, our model also provides additional insight into the impacts of interest rate on commodity demand. (An alternative estimation using a short-run argument is provided in Appendix 4.3.)

Diagram 4.4 The structure of the commodity sub-bloc



4.4.4 Locating African Commodity Trade in the Global Market

In this section, an attempt is made to combine the global commodity model formulated above with the export supply models specified in section 4.3. The combined model works at two levels. Firstly, the supply of exports from all South together with the demand for such exports from the North will determine the world price of commodities. Here the market is assumed to be a flexi-price one, with price determination following a Marshallian market period in the very short run. The current world price, which is determined from this market, is taken as the relevant information signal for African producers, who are assumed to respond accordingly in the coming period. The impact of this world price on African supply may be envisaged in both the short and the long run. The error correction formulation for African supply reflects these separate effects. These two sub-models relating to African supply and the global market are combined in Chapter 6. Diagram 4.4 sketches how the commodity sub-bloc of our North-South model works.

4.5 CONCLUSION

The main concern in this chapter has been to outline the determinants of foreign exchange supply to Africa. We noted that there are two basic sources of foreign exchange for Africa: namely, capital inflows (coming both as FDI and as aid) and export earnings. The flows of capital to Africa are found to depend on the relative (to Other South) position of Africa in terms of economic, political and strategic self-interest indicators. This finding will be used in building the allocation of capital flows section of the North-South Model developed in Chapter 6.

The second important source of foreign exchange for Africa is derived from the export of primary commodities. Three competing models of export supply for the three regions and four commodity categories are analysed. Although the results are mixed, the model based on the real exchange rate (Model II) is found to be comparatively the best. This model underlines the importance of both relative prices and capital formation indicators. However, in section 4.3 I have argued that the global commodity market does, in fact, influence the level of prices with which African exporters are faced. In order to address these issues, global demand and supply equations for Southern exports are specified and estimated. This allows one to locate African export supply within a global commodity market framework. This formulation is pursued in the commodity sub-bloc of the model developed in Chapter 6. However, before proceeding to undertake such an analysis, the macroeconomic impacts of capital inflows will first be examined empirically in the following chapter.

5 External Finance and the African Economy: A Macro Approach

5.1 INTRODUCTION

In the previous chapter, some determinants of the supply of external finance were discussed. Such flows have a number of macroeconomic implications that require careful management. Specifically, three such implications may be outlined. The first of these relates to the recipients' fiscal response in the face of such flows. Section 5.2 will discuss this issue in the context of the wider literature on recipients' fiscal response. The second and related impact of such flows relates to the upward pressure, which they place on the level of domestic prices, and the resulting appreciation of the real exchange rate. As discussed in Chapter 2, this falls within the 'Dutch disease' literature. Section 5.3 will examine this issue in relation to Africa. In section 5.4 the positive impacts of external finance will be examined. In most African economies this relates to the possibility that external finance offers to finance imports. The latter, in turn, will have a positive effect on investment and growth, by relieving the import compression situation discussed in Chapter 3. An econometric analysis focusing on this issue is given in section 5.4. Finally, section 5.5 brings the chapter to a close by highlighting a number of conclusions, arising out of the preceding discussion.

5.2 THE FISCAL RESPONSE TO EXTERNAL FINANCE

5.2.1 Introduction

There is a growing consensus that capital inflows – which, in Africa, predominantly come in the form of aid – will have serious macroeconomic ramifications. In this section, I will focus on one aspect of this impact, relating specifically to the recipients' fiscal response to such flows. Critics of Chenery and Strout's (1966) two-gap model have argued that foreign capital inflows, and aid in particular, may represent a useful substitute for savings (Griffin 1970, Griffin & Enos 1970, Weisskopf 1972). Indeed, these commentators note that a large fraction of such flows is likely to be used to increase consumption. Papanek (1972), on the other hand, argues that these critics have mistaken association for causation.[1] This 'aid-saving debate' has continued for nearly three decades.[2] In his original work, Griffin (1970) suggested different avenues through which a decline in savings might take place. The first such avenue could arise as a consequence of capital inflow's negative impact on government's efforts to levy or collect tax. Indeed, such inflows might even provide an incentive for governments to *reduce* tax. Similarly, these inflows might encourage governments to increase public consumption. The second avenue, suggested by Griffin, relates to the presumed negative effect of capital inflows on private savings and, finally, to its stimulating impact on consumption of importables and exportables (Griffin 1970: 106–7). The first avenue, taken together with the nature of public expenditure in recipient countries, has been articulated around what White (1992) terms the 'fiscal response' literature. This literature builds on the works of Heller (1975) and its extension by Mosley et al. (1987). This section also addresses this issue by focusing on two types of taxes which, in previous studies, are usually aggregated, as well as on government consumption expenditure.

Heller's original contribution is articulated in a model that assumes that public sector decision-makers maximize a utility function comprising public investment, public consumption[3] and borrowing from domestic sources (Heller 1975). By taking the variables as a deviation from their targeted values, the utility function is operationalized through a functional form that ensures diminishing marginal utility from each of the choice variables. The targets are further specified as a function of current and lagged values for a number of macroeconomic variables. These are imports, private investment, income and a social variable representing primary school enrolment. By maximizing this function, subject to the constraint that government expenditure should equal revenue (including foreign grants to the public sector and public foreign loans), Heller solves for the set of first-order equations that yield structural equations for the estimation. Using data from various African countries, the study highlights a number of broad findings. Firstly, the impact of foreign inflows (and especially those coming in grant form) on taxation levels is generally found to be negative. Secondly, foreign loans and other types of inflow are found to have an even greater negative impact on levels of domestic borrowing. Thirdly, inflows coming as grants are partially allocated to a consumption budget. Fourthly, foreign loans appear to lead both to an increase in total expenditure, and to the restructuring of the mode of domestic financing and pattern of public expenditure. (A full mathematical formulation of Heller's model is attached in Appendix 5.1.)

Mosley et al. (1987) have basically adapted and extended Heller's model by including aid's impact on growth of output and minor changes in the presentation of the public sector variable specification. Aid's impact on growth is considered by further specifying the target level of government investment. Thus, in Heller's original model, the target level of public investment is given as a function of lagged income and current private investment. Mosley and colleagues made two extensions to this model. Firstly, the private investment section of the model is further specified to include the price effects (a 'Dutch disease' type of relative price change) of aid inflows. Secondly, income is specified as being determined by a production function comprising public and private capital stocks and labour. Their finding, which is based on an OLS estimation, is that 'aid in the aggregate has no demonstrable effect on economic growth in the recipient countries'. This, they suggest, holds equally true both for the 1960s and the 1970s. Mosley and colleagues conclude that this may be due to the possibility of leakage into non-productive expenditure in the public sector as well as the transmission of negative price effects to the private sector.

One of the criticisms of Heller's model, which is addressed in the Mosley study, relates to the possible indirect positive impact of aid on taxes through its presumed positive impact on output (income). Other studies which adopt Heller's basic formulation have also been criticized along similar lines (McGillivray 1994, White 1994). Thus, White (1993) has attempted to reformulate Heller's model by explicitly considering these indirect effects. Closer examination of White's (1993) reformulation reveals that the new (demand-driven)[4] model is based extremely heavily on the assumed existence of a Keynesian closure. (In other words, the model assumes the existence of a demand-constrained developing economy.) This assumption is taken almost as axiomatic, and hence, various conclusions, including the possibility that aid may raise taxes are drawn, based on this. However, it could be argued that such an assumption cannot be sustained, in light of the substantial literature relating to the 'Dutch disease' effect. Further, the fact that most developing countries, particularly in Africa, are, in fact, supply-constrained,[5] would tend to throw further doubt on this assumption. Moreover, even if we accept as reasonable the incorporation of this supply argument, then its possible impact on income is likely to be felt only after a certain lag. Within an agricultural economy this lag may be as long as a year for annual crops, and longer for perennials. Consequently, the effect of the previous period level of capital inflow will already be incorporated within the *current* level of income. This fact stands as the main justification for using such variables in equations [1] and [2] below of the model used in this study.

However, in spite of the above reservations, empirical results supporting the Heller-Mosley studies have been documented for many countries (see White 1992: 194). Notwithstanding this fact, two recent empirical studies have produced quite different results. Thus, Gang and Khan (1991) tested the above model using country data for India and a three-stages least-square technique. They conclude that the results of this analysis may be taken as confirming Heller's findings that in the presence of aid, there exists a negative relationship between taxes and government investment. However, Gang and Khan reject Heller's other main finding that grants and loans by and large go towards financing consumption. Research undertaken by Pack and Pack (1990) has also produced results which would appear not to accord with those of the Heller-Mosley studies. Based on an econometric analysis of a four-equation model depicting the fiscal posture of the Indonesian economy,[6] they conclude that foreign aid actually stimulates total developmental public expenditure. Further, they note that nearly half of the revenue for such expenditure was raised by the Indonesian government from its own sources. However, the R^2 value reported, 0.99 per cent in almost all cases, leads one to question whether this result is free from spurious regression problems.[7]

To sum up, the recipient fiscal response literature holds that the government welfare (Mosley et al. 1987) or utility (Heller 1975) function may be maximized by narrowing the gap between the desired and actual performance of the government, subject to financing constraints, of which foreign inflows represents just one. One major shortcoming of this approach is the assumed existence of such a decision-making framework in the form of a public sector utility function. Even if one accepts this assumption à la Freidman (1953), nevertheless such a framework has a serious shortcoming, in that an additive assumption is included within the utility/welfare functions. Clearly such an assumption cannot hold if the arguments used in the utility/welfare functions are interdependent, as is the case in these functions.[8] A further shortcoming of this approach stems from the fact that expenditure and revenue equations are set as binding constraints, inasmuch as the approach implicitly assumes that the utility function is the adjusting variable. However, by incurring a deficit, the budget constraint itself could, in practice, also become the adjusting variable.

Thus, a number of major drawbacks may be identified in relation to the fiscal response literature. Firstly, the decision-making framework is not plausible, not only because it is inconsistent within its own framework[9] but also because decision-makers in most developing countries actually use a different framework, outlined below. Secondly, the econometric approach employed in these studies is extremely weak. Specifically, most series used in these studies have not been tested for the stationarity assumption. In fact, our own analysis of the series for various African economies reveals that these are not, in fact, stationary. Naturally, this would tend to imply that previous regression results reported in the literature might be spurious. Moreover, no diagnostic test is reported for these results. Indeed, for some of these cross-country studies, quite important tests, such as for parameter stability, have not been conducted. Thirdly, the tax variables used in the literature relate to aggregate taxes. Disaggregating taxes into different categories, such as direct and indirect, is likely to yield quite different results. Finally, the study relating to Africa as a whole not only is restricted in its sample size, but also fails to examine the variation across different African regions. The present study, therefore, represents an attempt to rectify these various shortcomings. Thus, in section 5.2.2 an alternative decision-making framework will be outlined and a relevant model and the equations used for the estimation will be specified. The model will focus on two types of taxes and government current expenditure. Section 5.2.3 will report on some of the estimated results and discuss their implications. Finally, section 5.2.4 will highlight a number of conclusions, based on the preceding discussion.

5.2.2 The Model

As has been argued above, the decision-making framework of utility maximization used in the fiscal response literature not only is inconsistent, but also does not reflect how decisions about financing are actually made in most African countries, in which foreign inflows are important. An alternative approach,[10] which tallies more closely with the stylized facts in relation to Africa, may be outlined as follows. Firstly, policy-makers will have a targeted level of expenditure, based on projected growth and social development objectives. These policy-makers are confronted with three costly means of financing this desired level of expenditure. The first alternative is to finance this through foreign capital inflows. However, such an option brings with it implicit costs, in the form of policy conditionality, as well as the accumulation of a burden of debt.[11] The second alternative is to finance this expenditure by raising revenue domestically. The implicit costs of this option arise from the institutional problems as well as political implications associated with having to levy taxes. Finally, if the desired level of expenditure cannot be financed through these two mechanisms, governments may be forced to resort to deficit financing or expenditure reduction to the extent that is tolerable. However, such an option is likely to have costly political implications in the form of inflation and possible social unrest.

The choice of these alternative mechanisms moves *recursively* from the first to the third, depending on the availability of foreign finance as well as the associated implicit political/developmental cost attached to each by policy-makers.[12] If, for geo-political or economic supply reasons, foreign inflows are made easily available, then this will represent the least-cost financing mechanism, since it simultaneously minimizes the political risk associated with deficit financing[13] and, at the same time, ensures the desired economic and social expenditure. However, such inflows might have the effect of discouraging domestic revenue collection, or even encouraging public expenditure,[14] sometimes in an undesired direction, as a consequence of fungibility. Furthermore, the composition of public expenditure also matters. Thus, if the foreign exchange demand component of the public expenditure is high, then government may be faced with its own foreign exchange constraint, à la Chenery and Strout (1966). This, in turn, will put further pressure on the use of foreign inflows. In this *recursive* approach to the financing of public expenditure, which instrument of financing should be used at a particular point in time is entirely an empirical question. More specifically, this choice will depend, to a great extent, on the availability and timing of foreign inflows and the associated valuation of different instruments of financing by policy-makers.

Such a decision-making framework has a simple and clear implication for empirical work. From the point of view of the government of a developing country, the supply of foreign inflows may be assumed to be exogenously determined. However, such inflows are likely to affect both tax revenue and government expenditure. Thus, an econometric model with a recursive structure, which simultaneously allows for adjustment to past disequilibrum is likely to represent a relevant estimation technique. This will allow individual equations (numbered [1] to [3] below) to be estimated using Ordinary Least Squares (OLS), after their formulation within an Error Correction Model (ECM). Following this approach, three sets of equations, derived from a simple model that attempts to capture the recipients fiscal response to foreign inflow are estimated using pooled time series and cross-country data (1970–90) for the three regions covered in this study. Thus, in the following section, a model will be outlined which attempts to depict the fiscal posture of a typical African economy. This model comprises three behavioural equations and one closure. Although the closure may be used for simulation purposes, nevertheless its inclusion does not have a direct bearing on the estimated equations. The scope of the model here is limited to examining the impact of foreign inflow on taxes and government current expenditure.

(i) Direct tax

Direct tax (T_d) is set as a function of economic activity (Q) and capital inflow (F). This function in log-log form is given by equation [1]. The log transformation is used throughout in order to exploit its dual advantages of correcting skewed distribution and tackling possible heteroscedasticity.

$$\ln T_d = \alpha_1 + \beta_{11} \ln Q + \beta_{12} \ln F \text{ or}$$

$$T_d = AQ^{\beta_{11}} F^{\beta_{12}} \text{ where: } \alpha_1 = \ln A \qquad [1]$$

where: $\beta_{11} > 0$; $\beta_{12} < 0$

By increasing the tax base, economic activity (Q) is believed to have a positive impact upon tax revenue. In the equations which are estimated below, the correlation coefficient between Q and F is checked to avoid possible multicolinearity. Only when such a correlation coefficient attains an acceptable value is the estimation carried. (Such a diagnostic check is also undertaken for equations [2] and [3] below.)

(ii) Indirect taxes

The level of indirect taxes in most African countries is closely related to external economic activity, and specifically to the level of exports (X) and imports (M). The level of these taxes is also directly related to private consumption expenditure (C_p), since such taxes are usually imposed on privately consumed commodities. Finally, foreign inflows are also allowed to affect this type of taxation. This is given formally by equation [2]:

$$\ln T_i = \alpha_2 + \beta_{21} \ln C_p + \beta_{22} \ln(X + M) + \beta_{23} \ln F \qquad [2]$$

where: $\beta_{21} > 0$; $\beta_{22} > 0$; $\beta_{23} < 0$

(iii) Government current expenditure

The level of current government expenditure (G) is assumed to be positively related to total revenue (T) and foreign inflows (F). It is also specified to be positively affected by external interest payments on both concessional (i_{w*}) and nonconcessional (i_w) loans. The final argument used in this function is a lagged value of the dependent variable. This is included in order to portray the persistence of previous patterns of expenditure. This is formally given in equation [3]:

$$\ln G = \alpha_1 + \beta_{31} \ln T + \beta_{32} \ln F + \beta_{33} \ln i_{w*} + \beta_{34} \ln i_w + \ln G_{t-1} \qquad [3]$$

where: $\beta_{3i} > 0$; for $i = 1...4$

These three behavioural equations [1]–[3] may be closed by a public deficit [DEF] equation. This equates the difference between government total expenditure (government current expenditure, G, and government investment, I_g) and total revenue (which is the sum of total tax revenue, $T_d + T_i$, other government revenue, T_o, borrowing from domestic banks Z_b, and resource transfer from the private sector, Z_p) with the total capital inflow. The last two items, Z_b and Z_p, are balancing items that could be derived by subtracting public saving, current revenue minus current expenditure, and foreign savings, F_g, of the government from public investment, I_g.[15] This closure is given as equation [4].[16]

$$Z = Z_b + Z_g = G + I_g - (T_d + T_i + T_O + F) \qquad [4]$$

5.2.3 Estimation Results

Data sources

Government current expenditure is obtained from IMF Government Financial Statistics (GFS) and indirect taxes from World Bank (World Tables 1994). Direct taxes are derived as the difference between total government current revenue (World Bank, World Tables or African Development Indicators, ADI, and IMF's GFS) and the sum of indirect taxes and other tax revenues as defined in the IMF's GFS. Finally, capital inflow is derived by taking the difference between current and preceding year's stock of bilateral, multilateral and private debt stock plus grants (World Bank, World Tables). Grants are taken from the IMF's Balance of Payment data tape (and relate to lines 39 and 40 of IMF's Balance of Payment, or BoP, Yearbook, dealing with inter-official transfers). Concessional interest payments are taken from World Debt Tables (World Bank) while non-concessional interest payments are derived by multiplying loans from commercial banks by the three months LIBOR rate. All flows are considered since all are capable of placing pressure on tax and current expenditure variables.

The classification of countries is based on that set out by the United Nations Economic Commission for Africa (UN-ECA).[17] As in the previous chapter, the data is based on eight countries within the ESA region, ten countries in the WCA region and three countries in the NA region. Each relevant variable is taken from a consistent macroeconomic database (1970–90) built along the lines discussed in Chapter 3.

Table 5.1a A unit root analysis of the fiscal response model: an ADF test

Series (all in logarithms)	No trend & intercept term			With trend & intercept term			With intercept alone		
	ESA	NA	WCA	ESA	NA	WCA	ESA	NA	WCA
Capital flows:									
Total	0.34	0.61	-0.68	-5.20	-2.10	-4.66	-5.20	-1.70	-4.54
Bilateral	-0.28	0.27	0.12	-4.70	-1.80	-4.09	-4.10	-1.80	-3.84
Grants	-1.00	-1.26	-1.33	-5.40	-3.55	-3.52	-5.20	-3.58	-3.54
Multilateral	-2.30	1.26	1.69	-2.90	-2.22	-3.44	-2.80	-2.27	-3.46
Private	-0.27	-0.10	0.20	-3.90	-5.20	-3.49	-4.10	-4.14	-3.32
Concessional interest rate	-1.20	0.06	-1.91	-4.30	-2.29	-3.87	-4.40	-2.19	-3.68
Direct taxes	0.90	0.67	0.62	-1.75	-2.80	-2.23	-1.65	-2.09	-2.19
Export plus imports	0.19	1.03	-0.07	-4.40	-1.97	-3.15	-4.50	-1.19	-3.01
Government expenditure	3.00	1.83	-0.09	-1.94	-3.59	-3.35	-2.40	-3.60	-3.45
Indirect taxes	-0.03	0.91	0.02	-3.80	-2.06	-3.61	-4.00	-0.98	-3.12
Non-concessional interest rate	-4.30	-1.46	-1.91	-5.00	-3.20	-3.87	-5.00	-1.91	-3.68
Private consumption	-1.14	1.31	-0.11	-3.30	-2.25	-3.13	-3.60	-1.09	-2.94

Table 5.1b Mackinnon critical values for the ADF test

No trend & no intercept term			With trend & intercept term			With intercept alone		
1%	5%	10%	1%	5%	10%	1%	5%	10%
-2.58	-1.94	-1.62	-4.04	-3.45	-3.15	-3.49	-2.89	-2.58

Table 5.1c Co-integration test for fiscal response model

Equation #	Engel-Granger ADF statistics	Mackinnon critical value at 5%	Johansen likelihood ratio	Mackinnon critical value 5%	Mackinnon critical value 1%
ESA					
Direct taxes	-1.082	-3.80	33.60	29.68	35.65
With bilateral	-1.32	-3.84	26.70 ++	24.31	29.75
Indirect taxes	-4.34	-4.19	81.40 +	53.12	60.16
Gov't expenditure	-1.82	-4.22	57.42	47.21	54.46
With grants			75.40 +	53.12	60.16
NA					
Direct taxes	-3.86	-3.63 **	32.83	29.68	35.65
With multilateral	-3.90	-3.63 **	28.96	29.68	35.65
Indirect taxes	-3.85	-3.64 **	40.80	29.68	35.65
With private flows	-3.74	-3.66 **	60.06	29.68	35.65
Gov't expenditure					
With multilateral	-3.90	-4.06	24.51 ++	24.31	29.75
WCA					
Direct taxes	-2.75	-3.54	43.60	29.68	35.65
With bilateral	-2.53	-3.59 **	51.50 ++ (+ also)	24.31	29.75
Indirect taxes	-2.39	-3.51 **	49.38	29.68	35.65
With private flows	-2.21	-3.58 **	34.93	29.68	35.65
With grants	-3.34	-3.49 **	35.86	29.68	35.65
Gov't expenditure	-2.04	-3.95 **	78.00 +	53.12	60.16

** [*] are Mackinnon critical value at 10% [1%] level of significance (others at 5%).
The Johansen test used assumes linear deterministic trend in the data with intercept, no trend, in the test VAR (i.e., the co-integration equation (CE), as an indicator of long-run equilibrium relation, has no trend).
+ assumes intercept but no trend in CE and no intercept in test VAR.
++ assumes no deterministic trend in the data with no intercept or trend in the CE or test VAR.
+++ assumes no deterministic trend in the data with intercept, no trend, in CE and no intercept in test VAR.
# The test is with aggregate flows (the sum of bilateral, multilateral, private and grants unless specified otherwise).

Results

Most econometric studies of the fiscal response literature fail either to report satisfactory diagnostic tests for their models or to test for the stationarity assumption. It is implicitly assumed either that the series are stationary or that they are co-integrated, without any formal investigation actually being undertaken. This casts doubt over the empirical results arising from studies based on such fiscal response models. In what follows, estimated results that correct for these deficiencies are reported. Tables 5.2–5.5 report results obtained from pooled time series (1970–90) and cross-country data for three regions of this study.

Prior to estimation, each series is tested for stationarity using the ADF unit root test. This is followed by a co-integration test between the hypothesized relationship using both the Engel-Granger (1987) and the Johansen (1988) methodologies. Only models that passed these tests are estimated and reported upon. The results of these tests suggest that a long-run relationship exists within our models (see Tables 5.1a–c). I have used Hendery's General to Specific (GS) methodology to arrive at parsimonious functional forms. Various diagnostic test results are also reported upon. Finally, since all the variables are again in logarithmic form, the coefficients obtained may also be interpreted as elasticities.

(i) Direct taxes

The estimation of direct taxes is pursued by first examining a second-order ECM equation. The second-order ECM for the ESA region is basically similar to its special case of first-order ECM, the only difference being that the short-run, one-period lagged value of GDP in second-order ECMs has a statistically significant elasticity coefficient of 0.47. Hence, the first-order ECM for the ESA region is reported in Table 5.2. Similarly, the second-order ECM for both the NA and WCA regions is nearly identical with the first-order ECM reported in Table 5.2. These results show that the restriction imposed in the second-order ECM is plausible.

As can be seen from Table 5.2, direct tax has a statistically significant positive elasticity with respect to GDP, especially in the long run. This elasticity is nearly identical in the ESA and NA regions, while relatively lower in WCA. The estimated equation is also characterized by the fact that adjustment to disequilibrium is very rapid in WCA, and successively slower in the NA and ESA regions. In general, the impact of total capital inflows is not found to be statistically different from zero. However, its short-run negative impact within the WCA region is significant at a 10 per cent level of significance, although with a low potency. Indeed, the long-run elasticity for the ESA region also suggests such a negative impact, at a 14 per cent level of significance. Notwithstanding its statistical insignificance, one notes a generally negative elasticity coefficient for direct taxes with respect to capital inflows. This clue leads one to investigate further the possible impact of different types of capital inflows.

Table 5.2 Direct taxes and capital inflows (coefficients are elasticities)

Region	Short run			Long run			Adj. R^2		Diagnostic check				Dummy
	Con	ΔQ	ΔF	$Q_{\_1}$	$F_{\_1}$	T_{d_1}	ECM	Level@	Chow	Reset	Jarque-Bera	Multc ++	
ESA	0	1.09	-0.04	0.77	-0.21	-0.40	0.27	0.49	1.7*	3.6	1.7*	Very low	(i)
(t-values)		4.7*	-0.89	9.0*	-1.5~	-4.0*		n=76		(0.06)			
WCA	1.05	0.27	-0.11	0.37	-0.07	-0.57	0.38	0.50	3.4*	0.48	7.3	Low	(ii)
(t-values)	0.81	0.54	-1.7^	1.6^	-0.58	-2.7*		n=36		(0.49)			
NA‖	0	0.40	-0.00	0.73	-0.04	-0.59	0.26	0.68	1.3*	91	6.26	Very low	(iii)
(t-values)		054	-0.12	6.2*	-0.23	-4.3*		n=40					

Notes:

1. Constant dummies used : (i) Uganda -1.1; Zambia 0.35 (ii) Cameroon 1.02; Gabon 1/37; Nigeria 2.1 and Burkina Faso 2.5 (iii) Algeria -2.15.
2. * Significant at 1% and better; + significant at 5% and ^ significant at 10%.
   ESA: East and Southern Africa, WCA: West and Central Africa, and NA: North Africa.
3. @ The long-run coefficients and their t-values are computed using the Wickens and Breusch (1988) and Gurney (1989) approach (see Appendix 4.1). The long-run (level) R^2 is obtained from this same regression. _1 shows one period lag. All variables are as defined in equations 1 to 3; n in the column shows sample size.
4. ++ For examining the degree of multicollinearity a simple correlation among regressors < 0.25 is considered Extremely Low (ELow), < 0.50 Very Low and < 0.60 Low (acceptable). (C) in this column indicates correction for multicolinearity of the general model by omitting the problem variable.
5. For the diagnostic tests, values in bracket are P-values.
6. ‖ For this region and in this table the F is the sum of bilateral and multilateral capital inflows only.

Similar to our discussion in Chapter 4, the ECM form of the models in Table 5.2 above may be given as follows (illustrated with ESA model):

$$\Delta T_d = -1.09\Delta Q - 0.04\Delta F - 40\,(T_{d-1} - 0.77Q_{-1} + 0.21F_{-1})$$

where the long-run equilibrium relation is given by $T_d = 0.77Q - 0.21F$.

Estimation of variation of elasticities across different financial instruments is undertaken by starting with a second-order ECM and working out towards a first-order ECM model, in search of parsimonious functional forms along the G-S approach. Only the bilateral inflow-based estimation for the ESA region is found to be important. This estimation is given below.

ESA with bilateral flows

$$\Delta Td = \underset{(-4.7)^*}{-0.64\Delta Td_{t-1}} + \underset{(2.4)^*}{0.89\Delta y_t} + \underset{(3.2)^*}{1.37\Delta y_{t-1}} - \underset{(-1.8)^\wedge}{0.10\Delta F_t} -$$

$$\underset{(-1.94)}{0.13\Delta F_{t-1}} \underset{+}{-} \underset{(-2.8)^*}{0.59}\,(Td_{t-2} - \underset{(14.0)^*}{0.77y_{t-2}} + \underset{(-3.3)^*}{0.3F_{t-2}}) -$$

$$\underset{(-3.4)^*}{1.8DUga} + \underset{(2.7)^*}{0.74DuZam} \qquad [5.2.1]$$

R^2-adj = 0.39	Jarque-Bera 4.8(0.79)
Reset 2.16(0.15)	LM 2.04(0.16)
R^2-level = 0.55	BG = 0.32(0.72)

Notes:

Values in bracket are *t*-values, while for diagnostic test *P*-values are given (see Appendix 4.1).

The sign difference between the t-values and the coefficients in the ECM term may be explained by the fact that the t-values refer to the long-run coefficient.

* implies 1%. + 5% and ^10% level of significance.

LM is a hetroscedasticity test while BG is the Breuch-Godfery test for serial correlation.

The 5% (2 degrees of freedom) value for Jarque-Bera is 5.99.

Table 5.3 Variation across financial instruments (coefficients are elasticities)

Region	Short run			Long run			Adj. R^2		Diagnostic check				Dummy
	Con	ΔQ	ΔF+	Q_1	F_1	Td_1	ECM	Level @	Chow	Reset	Jarque-Bera	Multc ++	
ESA		0.94	-0.13	0.75	-0.25	-0.52	0.30	0.60	2.8*	0.58	0.37*	Very low	(i)
(t-values)		3.3*	-2.7*	15*	-2.6*	-4.4*		n=67		(0.45)			
WCA	-1.7	1.4	-0.01	1.3	-0.22	-0.38	0.35	0.76	3.6*	0.49	3.8*	Very low	(ii)
(t-values)	-3.0*	3.0*	-0.17	10.0*	-1.8^	-4.4*		n=39		(0.49)			
NA		0.07	-0.15~	0.75	-0.08	-0.60	0.34	0.68	3.4*	4.1	36.0*	Very low	(iii)
(t-values)		0.09	-1.5	8.0*	-0.15	-4.4		n=39		(0.05)			

Notes:

1. Constant dummies used: (i) Uganda -1.4; Zambia 0.62; (ii) Burkina Faso =1.01; (iii) Algeria -2.15
2. Notes are as given under Table 5.2.
3. + The value of the F variable is bilateral flows for ESA and WCA, and multilateral flows for NA.

As can be seen from this estimation the diagnostic checks are quite acceptable with almost all values of coefficients being statistically significant. With a long-run elasticity of -0.30, these results clearly demonstrate that foreign inflows will have a negative impact in both the short and long run. For the other regions the second-order ECM does not differ from its first-order variant. Hence, only the latter is reported in Table 5.3.

Table 5.3 reports on the statistically significant results obtained by disaggregating capital inflows into the categories 'Bilateral', 'Multilateral', 'Grants' and 'Private inflows'. An exhaustive search process is undertaken before arriving at Table 5.3. For the ESA region estimation results are found to have statistically insignificant coefficients with all other capital inflow categories, with the exception of bilateral flows. A comparison with Table 5.2 indicates that, compared to aggregate flows, using bilateral flows within the estimation has a strong potency in the short run. For the WCA region both grants and multilateral flows are non-stationary series. Both failed a co-integration (Johansen 1988) test with GDP and direct taxes. However, the bilateral flow is found to be co-integrated with GDP and direct tax and also has a strong long-run elasticity, which was missing in the aggregate estimation for Table 5.2. The estimation for the NA region is less impressive in terms of its diagnostic test. However, the results of this test do suggest a short-run negative elasticity coefficient of direct tax with respect to multilateral flows. A model which included the other types of capital flows failed a co-integration test, and so could not be estimated.

2. Indirect taxes

Estimation of the indirect taxes equations is undertaken starting from a general specification of a second-order ECM. This general specification is similar to its first-order formulation for the ESA region. For the NA and WCA regions the second-order ECM performed best, and hence the results from this are reported below. The estimation of the second-order ECM for the WCA region, using the total inflow, bilateral and multilateral inflows, respectively, yields similar results to that obtained from the first-order ECM and, hence, only the first-order result is reported in Table 5.3. However, the parsimonious second-order ECM estimation using private inflows and grants, respectively, gave the best of the functional forms and so is reported below.

WCA with private flows

$$\Delta T_i = 0.28\Delta Ti_{t-1} + 0.60\Delta Cp_t + 0.27\Delta Cp_{t-1} -$$
$$\quad (-2.2)+ \qquad (4.4)^* \qquad (2.0)+$$

$$0.27\,(Ti_{t-2} - 1.03Cp_{t-2} + 0.12F_{t-2} + 2.41) + 0.49DGab$$
$$(-3.1)^* \qquad (9.7)^* \qquad (-1.94)^\wedge \quad (-3.4)^* \quad (4.3)^* \qquad [5.2.2]$$

R^2-adj = 0.37	Jarque-Bera 1.4(0.50)
Reset 0.90(0.35)	LM 0.08(0.78)
R^2-level = 0.67	BG = 0.91(0.41)

All variables are in natural logarithms. Notes as given in eq. [5.2.1].

WCA with grants

$$\Delta T_i = -0.08\Delta Ti_{t-1} + 0.68\Delta Cp_t + 0.09\Delta Cp_{t-1} + 0.01\Delta F_t + 0.07\Delta F_{t-1} -$$
$$\quad (-0.82) \qquad (8.2)^* \qquad (0.82) \qquad (0.13) \qquad (1.42)$$

$$0.24\,(Ti_{t-2} - 0.95Cp_{t-2} + 0.13F_{t-2} + 1.71) + 0.249DGab$$
$$(-3.7)^* \qquad (11.6)^* \qquad (-1.42) \quad (-3.3)^* \quad (3.1)^* \qquad [5.2.3]$$

R^2-adj = 0.43	Jarque-Bera 2.5(0.50)
Reset 0.00(0.99)	LM 9.4(0.00)
R^2-level = 0.64	BG = 3.2(0.04)

All variables are in natural logarithms. Notes as given in eq. [5.2.1].

These two equations show that both private inflows and grants have no short-run impact. However, both variables are found to have a statistically significant negative impact in the long term, this being greater in relation to private inflows than grants.

For the NA region, the second-order ECM is found to be the best specification. Two equations, identified in an exhaustive searching process, were found to be acceptable on statistical grounds and so are reported on below. The first of these uses total capital inflows, while the second uses private inflows to North Africa. Although both equations show strong negative elasticities with respect to capital inflows, the impact of private inflows is found to be important in the short run and to have a stronger impact in the long run. Given the relative importance of private inflows in North African countries this result is entirely plausible.

NA with total inflows

$$\Delta T_i = -0.36\Delta Ti_{t-1} + 1.1\Delta XM_t + 0.61\Delta XM_{t-1} - 0.03\Delta F_t -$$
$$\quad (-1.3) \qquad (8.2)^* \qquad (1.1) \qquad (-0.50)$$

$$0.07\Delta F_{t-1} - 0.80\,(Ti_{t-2} - 0.93XM_{t-2} + 0.24F_{t-2})$$
$$(-1.03) \qquad (-3.7)^* \qquad (26.4)^* \qquad (-7.2) \qquad [5.2.4]$$

R^2-adj = 0.27	Jarque-Bera 29(0.0)
Reset 0.08(0.76)	LM 2.4(0.13)
R^2-level = 0.90	BG = 1.04(0.37)

All variables are in natural logarithms.

NA with private inflows

$$\Delta T_i = -0.27\Delta Ti_{t-1} + 1.2\Delta XM_t + 0.52\Delta XM_{t-1} - 0.13\Delta F_t -$$
$$\quad (-0.94) \qquad (3.6)^* \qquad (1.2) \qquad (-3.0)^*$$

$$0.14\Delta F_{t-1} - 0.75\,(Ti_{t-2} - 0.94XM_{t-2} + 0.28F_{t-2})$$
$$(-3.0)^* \qquad (-3.7)^* \qquad (23.6)^* \qquad (-6.8)^* \qquad [5.2.5]$$

R^2-adj = 0.42	Jarque-Bera 5.8(0.05)	
Reset 1.2(0.30)	LM 2.4(0.14)	
R^2-level = 0.88	BG = 0.89(0.42)	n = 30

All variables are in logarithms. Notes as given in eq. [5.2.1].

The estimation for North Africa clearly demonstrates that the impact of capital inflows on the level of taxes varies across financial instruments. Within the NA region, both total and private inflows have a strong negative impact on indirect taxes in the long run. A percentage change in inflows to the region leads to 0.30 per cent decline in the level of indirect taxes in the long run. The remainder of the first-order ECM estimations for the ESA and WCA regions, using total inflows are reported in Table 5.4.

Table 5.4 *Indirect taxes and capital inflow (coefficients are elasticities)*

Region	Short run				Long run			
	Con	ΔC_p	ΔXM	ΔF	C_{p_1}	$XM_{\_1}$	$F_{\_1}$	T_{i_1}
ESA	-0.85	0.46	0.42	-0.01	0.63	0.73*	-0.03	-0.21
(t-values)	-3.0*	6.3*	5.4*	-0.75	5.2*	3.70*	-0.63	-3.40
WCA	0	0.64		0.02	0.64		0.05	-0.31
(t-values)		8.2*		1.6^	27.0*		1	–

Region	Adj. R^2		Diagnostic check				Dummy
	ECM	Level@	Chow	Reset	Jarque-Bera	Multc++	
ESA	0.67	0.84	1.7*	0.19	1.3*	Low	(i)
(t-values)		n=87		(0.67)			
WCA	0.55	0.72	1.14*	0.02	2.07*	Low	(ii)
(t-values)		n=87		(0.90)			

Notes: See Table 5.2

Constant dummies used:
(i) Kenya 0.14; Tanzania 0.24
(ii) Burkina Faso -0.14; Gabon 0.28; Senegal 0.19

Table 5.4 shows that indirect taxes are explained by the level of private consumption and external trade (comprising the sum of imports and exports) both in the short and long run. Within the WCA region, nearly half of past errors are made up for in the current period. The corresponding value for the NA region is much higher, as can be seen from the above estimations, while the value for the ESA region stands at less than half of that. This finding tallies with the stylized fact that the NA region has a relatively stronger and more flexible economy than either the WCA or ESA regions. However, in contrast to what one might expect, based on the prevailing theoretical orthodoxy, the elasticity coefficient of capital inflows does not differ statistically from zero, although it does show a negative sign, especially in the long run. This last result is further investigated by exploring the impact of different types of capital inflows on indirect taxes. For the ESA region the indirect tax equation (eq. 2) is estimated by separately using the financial categories for bilateral, multilateral and private flows as well as grants. The diagnostic test results for the four equations are all quite acceptable, and, in all cases, the elasticity coefficient with respect to each of these flows is not found to be statistically different from zero. For the NA and WCA regions, the impact of private inflows is found to be statistically significant, as shown by the second-order ECMs set out above.

In sum, the major lesson which may be drawn from this analysis is that an examination of the impact of capital inflows on taxes requires the disaggregation of these taxes into different components. Indeed, it would be tempting to conclude that if the foreign capital obtained is then spent on imports, this might have a positive impact on indirect taxes, which are largely levied on the external sector in most African countries. This, in turn, may offset the possible negative impact of these tax collection efforts on the rest of the economy.

3. Government current expenditure

The estimation for the ESA region using a second-order ECM yields identical results to that of its first-order variant for all financial instruments, with the exception of grants. Thus, this parsimonious functional form is chosen and reported on in Table 5.5. The second-order ECM, using grants, also highlights a significant positive impact of these grants in the short run. This is given below.

Table 5.5 *Government current expenditure and capital inflow (coefficients are elasticities)*

Region	Short run					Long run				
	Con	ΔT	Δi_{w^*}	Δi_w	ΔF	$T_{\_1}$	$i_{w^*\_1}$	i_{w_1}	$F_{\_1}$	$G_{\_1}$
ESA (t-values)	0		0.15 2.2*	0.03 0.94	0.01 0.63		0.34 1.9+	0.07 0.99	0.21 1.9+	-0.19 -2.9*
WCA (private flows)	1.32 3.0*		0.09 1.07		0.07 2.5*		0.20 1.15		0.20 1.64^	-0.19 -2.7*

Region	Adj. R^2		Diagnostic check				Dummy
	ECM	Level@	Chow	Reset	Jarque-Bera	Multc++	
ESA (t-values)	0.30	0.58 n=78	2.8*	0.05 (0.82)	0.38*	VLow (c)	(i)
WCA (private flows)	0.27	0.50 n=62	0.51*	0.27 (0.60)	0.47*	VLow	(ii)

Notes: See Table 5.2

Constant dummies used:
(i) Botswana -0.43, Kenya -0.06, Madagascar -0.2
(ii) Benin -0.54; Cameroon -0.26; Central African Rep. -0.46; Ghana -0.59; Senegal -0.30; Zaire -0.20.

ESA with grants

$$\Delta G_I = \underset{(-1.33)}{-0.18\Delta G_{t-1}} + \underset{(1.8)\wedge}{0.13\Delta i_{w*t}} + \underset{(0.17)}{0.01\Delta i_{w*t-1}} + \underset{(0.37)}{0.01\Delta i_{wt}} +$$

$$\underset{(1.8)+}{0.05\Delta i_{wt-1}} + \underset{(1.7)\wedge}{0.06\Delta F_t} + \underset{(1.6)\sim}{0.06\Delta F_{t-1}}$$

$$\underset{(-2.18)+}{-0.14} \, (G_{t-2} + \underset{(-015)}{0.03 i_{w*t-2}} + \underset{(-0.23)}{0.03 i_{wt-2}} - \underset{(3.3)*}{0.57 F_{t-2}}) \qquad [5.2.6]$$

R^2-adj = 0.23	Jarque-Bera = 1.9(0.38)	
Reset = 2.3(0.13)	LM = 8(0.01)	
R^2-level = 0.40	BG = 1.4(0.26)	n = 79

All variables are in logarithms. Notes as given in equation [5.2.1].

This result shows that although the short-run impact of grants is extremely weak, nevertheless its long-run elasticity remains very strong (at around 0.60). Similarly, the second-order ECM for the WCA region is also found to be the best functional form, and so is reported on below. The results also indicate that capital inflows within the region have a strong positive impact in both the short and long run.

WCA with total inflows

$$\Delta G_I = \underset{(-3.0)*}{-0.40\Delta G_{t-1}} \underset{(-1.3)}{- 0.14\Delta i_{w*t}} \underset{(-2.7)*}{- 0.24\Delta i_{w*t-1}} + \underset{(1.2)}{0.06\Delta i_{wt}} +$$

$$\underset{(2.0)+}{0.14\Delta i_{wt-1}} + \underset{(2.2)*}{0.10\Delta F_t} + \underset{(3.7)*}{0.21\Delta F_{t-1}}$$

$$\underset{(-5.4)*}{-0.39} \, (G_{t-2} + \underset{(-0.02)}{0.004 i_{w*t-2}} + \underset{(-2.7)*}{0.15 i_{wt-2}} - \underset{(2.3)*}{0.36 F_{t-2}}) \qquad [5.2.7]$$

R^2-adj = 0.43	Jarque-Bera = 6.5(0.04)	
Reset 1.1(0.29)	LM = 0.05(0.81)	
R^2-level = 0.77	BG = 0.4(0.70)	n = 59

All variables are in logarithms. Notes as given in equation [5.2.1].

The variables in the government expenditure function for North Africa are not co-integrated with any of the types of financial instruments, with the exception of multilateral flows. The second-order ECM using multilateral flows is found to be the best functional form and is given below.

NA with multilateral inflows

$$\Delta G_I = \underset{(-5.9)^*}{-0.81\Delta G_{t-1}} - \underset{(-1.7)^\wedge}{0.16\Delta i_{w^*t}} - \underset{(-2.0)+}{0.24\Delta i_{w^*t-1}} + \underset{(3.8)^*}{0.39\Delta T_t} +$$

$$\underset{(4.2)^*}{0.55\Delta T_{t-1}} + \underset{(2.3)^*}{0.08\Delta F_t} + \underset{(4.3)^*}{0.18\Delta F_{t-1}} -$$

$$\underset{(-5.8)^*}{0.65}\ (G_{t-2} + \underset{(-3.5)^*}{0.52 i_{w^*t-2}} - \underset{(15.0)^*}{+1.4T_{t-2}} + \underset{(2.4)^*}{0.23F_{t-2}}) -$$

$$\underset{(-2.1)+}{0.21 DAlg} - \underset{(-2.5)^*}{0.26 Tun} \qquad [5.2.8]$$

R^2-adj = 0.75	Jarque-Bera = 1.2(0.56)	
Reset = 5.4(0.03)	LM = 0.37(0.55)	
R^2-level = 0.95	BG = 0.8(0.45)	n = 34

All variables are in logarithms. *DAlg* and *DTun* are dummies for Algeria and Tunisia, respectively. Notes as given in equation [5.2.1].

Contrary to what one might expect, the equation for the NA region has a statistically significant negative elasticity with respect to concessional interest rates. An observation of the plot of government current expenditure and concessional interest payments shows an upward trend for both series. An alternative estimation that excludes *T* (total revenue) from this functional form[18] results in a similar coefficient for all, with the major difference that the concessional interest rate payment coefficient is not statistically different from zero, although still showing a negative coefficient. This, combined with a low RESET value, suggests that caution should be exercised in using this equation. Non-concessional interest payments are excluded from this equation, owing to lack of sufficient data points.

Table 5.5 reports estimation results for equation [3], using the first-order ECM. It shows that – with the exception of the WCA region, using the second-order ECM – aggregate capital inflows have no effect on government current expenditure in the short run. In the long run, however, such inflows are found to have a statistically significant positive impact in all regions. Within the ESA region, interest payments on concessional loans, both bilateral and multilateral, are found to have a significant and positive short- and long-run impact. However, this is not found to be statistically significant in the WCA region, especially in the long run. The adjustment coefficient is, in general, low, indicating the difficulty of adjusting to past disequilibrum on government current expenditure. However, there exists an important variation across regions, with the highest adjustment coefficient found for the NA region, followed by the WCA and ESA regions.

Following a similar procedure as for tax equations, various estimations for equation [3] based on different types of capital inflows are undertaken. The estimation for the ESA region, using bilateral, multilateral and private capital inflows, respectively, produces coefficients which are not found to be statistically significant. However, the estimation using grants exhibited statistically significant values and, hence, its second-order ECM estimation is given above. For the WCA region, on the other hand, the model based on grants could not pass the relevant co-integration test. The estimation using bilateral flows produces coefficients, which are not found to be statistically different from zero. However, the coefficient for private capital inflows, shows a statistically significant elasticity of 0.07 in the short run, and 0.20 in the long run. Indeed, the latter is lower than the aggregate elasticity obtained from the second-order ECM reported above. In relation to the NA region, the estimation using bilateral flows could not pass a co-integration test, while the estimation with grants, in addition to having poor Jarque-Berra statistics and suffering from high kurtosis, does not indicate a statistically significant elasticity. Private capital flows also indicate a statistically insignificant coefficient. However, the estimation using multilateral flows and a second-order ECM is found to be the best and so is reported on above.

5.2.4 Summing Up

In this section an attempt to quantify the fiscal response of African economies to external finance is made. The method adopted differs from the existing literature at two levels. Firstly, and for the most part, it departs from the assumption that governments of developing countries will seek to maximize utility. This assumption stands as the cornerstone of most studies in this topic. However, in this book, we depart from this assumption in search of realism. Secondly, by using the latest developments in time series econometrics, the analysis presented in this section overcomes the other major shortcomings of the previous studies: namely, spurious regression and poor econometrics. The fact that almost none of the series in the sample are found to be stationary certainly raises questions about the validity of previous empirical studies.

By proposing an alternative decision-making framework based on the stylized facts in relation to Africa, several sets of equations are estimated, using an Error Correction Model. The results of the analysis are mixed. However, the following major points may be generalised from this section. Firstly, the impact of capital inflows on taxes varies across the type of inflows, the nature of taxes and between regions. In general, bilateral flows are found to have a negative impact on direct taxes. The long-run elasticity for direct taxes with respect to bilateral inflows ranges from -0.22, for the WCA region to -0.30 for the ESA region. On the whole, indirect taxes are found to have a statistically significant relationship with private inflows, although grants are also found to be important within the WCA regions. As a result, the long-run elasticity of indirect taxes with respect to private inflows varies from -0.12 for the WCA region, to -0.28 for the NA region. Secondly, capital inflows, in general, have a strong positive impact on current government expenditure in all regions. Such a positive impact is accentuated with the use of grants in the ESA region reaching an elasticity coefficient of 0.57. Private capital inflows within the WCA region also show a positive but less strong elasticity coefficient of 0.23.

A number of important tentative conclusions may be drawn from the above analysis. Primarily, the analysis presented in this section clearly demonstrates the importance of investigating each financial instrument for each of the different regions. This analysis also has important implications in relation to liberalization policies, such as structural adjustment programmes (SAPs), currently being implemented in Africa. Capital inflows to Africa generally came being conditional upon deficit reduction. However, these inflows have an inherent tendency to aggravate the deficit and so may result in governments drifting away from sustainable self-financing behaviour. A further important implication of the analysis relates to the impact of capital inflows on the distribution of income. By ensuring a reduction in direct taxes (as opposed to indirect taxes which usually are levied on ordinary consumer items), bilateral flows could influence the distribution of income in favour of those big firms, the commercial sector and the like, for which income taxes are important. Conversely, the opposite effect may arise from private inflows. Since the former types of inflow comprise the bulk of capital inflows to Africa, their effect is likely to be relatively the more important.

In sum, capital inflows to Africa may be thought of as beneficial, not only if such flows are worth their financial costs, but also as a consequence of their long-run effect on deficit financing and the distribution of income. This requires the computation of similar elasticities at each country level. And, perhaps more importantly, this also suggests that macroeconomic modelling in Africa should explicitly take this issue into account. Hence, the prototype model of Africa developed in Chapter 6 will explicitly incorporate these issues.

5.3 AID AND THE 'DUTCH DISEASE' IN AFRICA

5.3.1 Aid and the 'Dutch Disease': An Overview

From mid-1960s onward, the 'two-gap' model and its recent variant the 'three-gap' model, have emerged as the dominant analytical framework for the analysis of capital inflows to developing countries. The model helps to identify the capital requirement (labeled domestic and external 'gaps') necessary to achieve a target rate of growth designed à la Harrod and Domar. The major criticism of the two-gap model which is relevant in the context of the present study is its extreme structuralism, and, hence, the neglect of the impact of relative prices (Findlay 1973). It is this criticism which has led to emphasis being placed on the 'Dutch disease'[19] literature. Historically, the 'Dutch disease' literature originated from a discussion of the problems associated with managing revenue from a booming sector of the economy.[20] Popularized, among others, by the works of Cordon and van Wijnbergen, the 'Dutch disease' concept has come to play an increasingly important role in the discussion of the macroeconomic impact of temporary resource discovery, in general, and foreign aid, in particular. This section will extend the discussion of this same issue presented in Chapter 3, in order to establish the empirical basis for the explicit incorporation of the 'Dutch disease' effect within the prototype African model developed in Chapter 6.

The argument runs as follows. Revenue is obtained from a booming sector. If part of this is spent on non-traded goods (the 'spending effect'), this leads to a real appreciation in the relative price of non-tradables relative to tradables. This, in turn, draws resources (the 'resource movement effect') out of the booming sector into the non-traded sector (Corden 1984, van Wijnbergen 1984). The growth effect of such a resource shift is considered to be negative, since traded sectors are characterized by 'learning by doing' (i.e., dynamic) externalities, which will have a higher and positive effect on growth (van Wijnbergen 1984 & 1986a, Edwards & van Wijnbergen 1989). It should be noted, however, that the exact form which this effect takes could also depend on the flexibility of prices within the factor market. Corden notes that if the effects of the boom

> have raised the real wage in flexible-factor price model, then with a rigid real wage it would reduce unemployment instead, while if it would have reduced the real wage in the flexi-price model, it would generate unemployment in the fix-price case. (Corden 1984: 369)

This analysis has its origins in the 'dependent economy model' of Salter (1959) and Swan (1960). In both models, small economies are assumed to be price takers within international markets, and hence their terms of trade is taken as given. However, changes in the external economy (such as might be associated with a rise in overseas prices, or excess demand) may disturb the pre-existing equilibrium. This could result in a switching of demand from the traded to the non-traded sector. This, in turn, could entail a rise in the price of domestic, or non-traded goods and, hence, a subsequent supply reaction. Nonetheless, the final result will depend on a number of factors, including the relative speed and magnitude of different effects (Swan 1960: 55–62). Within Salter's formulation, the reaction to such changes, of, say, higher foreign prices or excess demand, will depend on two main factors. Firstly, on their impact on domestic price; and secondly, on the elasticity of substitution between the traded and the non-traded sector from the supply side, and the elasticity of demand substitution from the demand side (Salter 1959: 230). Focusing on these issues the 'dependent economy' model helps to understand such sectoral disequilibrum.

Edwards and van Wijnbergen (1989) argue for similarities between the discovery of natural resources and aid inflows and, hence, for similarities in the macroeconomic impacts of both. This similarity takes a number of specific forms. Firstly, both increase foreign exchange availability, with little or no additional use of domestic factors of production. Secondly, the impact of both is almost certainly temporary in nature. And finally, both come in the form of additional foreign exchange but will, at least partially, be spent on non-traded goods, thus placing upward pressure on the real exchange rate (Edwards & van Wijnbergen 1989: 1485). The policy conclusion of this observation is that subsidies to the traded sectors are essential since a 'Dutch disease' type of problem is likely to occur (van Wijnbergen 1986b: 130). Although their characterization of aid and the discovery of natural resources as temporary could be questioned, the other two observations made by Edwards and van Wijnbergen are important and justify the use of the 'Dutch disease' approach for analysing the impact of aid.

In order to link the relative price effect of capital inflows with the two-gap model, van Wijnbergen (1986b) derived his analysis of the 'Dutch disease' effect from a reinterpretation of the two-gap model. He emphasized that an *ex ante* wedge between the saving and trade gaps implies *ex ante* a home goods market disequilibrum. A binding trade gap corresponds to excess supply of home goods, and therefore, Keynesian unemployment; and a binding savings gap to excess demand for home goods, and therefore, classical unemployment.[21] Using this basic structure, Wijnbergen studied the differential impact of aid which comes in the form of traded goods, or assets easily convertible into such goods, but which may also partly be spent on non-traded goods. This could have an effect on the home goods market and hence, on the real exchange rate. He concludes that substantial, and especially short-term, aid flows in countries which have less access to foreign capital will place upward pressure on the real exchange rate (van Wijnbergen 1986b).

5.3.2 Aid, the 'Dutch Disease' and the African Context

A number of country-specific studies have been undertaken with the aim of assessing the possibility that a 'Dutch disease' effect may be present in various African countries. Younger (1992) presents an account for Ghana and shows the existence of 'Dutch disease' effect in relation to that country. In Younger's study aid not only leads to an appreciation in the real exchange rate, through inflation, but also to financial crowding out of the private sector through governments sterilization of inflows in the pursuit of a tight credit policy, which usually is imposed by international lenders. Benjamin et al (1989) constructed a CGE model for Cameroon with the objective of studying the impact of the oil boom and its 'Dutch disease' effect. Their results point to the important differential impact of a boom in the importable and exportable goods sector, owing to imperfect substitution between these. The impact in the latter, which is generally agricultural, being negative while that in the former, which is mainly manufacturing, could in fact be positive.[22] Kayizzi-Mugerwa (1990) formulated a model of Zambia, which aims to examine the impact of copper prices within that country. The model's underlying theoretical formulation is the 'Dutch disease' literature and the author maintains that the 'Dutch disease' model is largely validated in the case of Zambia. A similar study, which analyses the Egyptian experience of an increase in oil exports within a 'Dutch disease' model framework, is reported in de Macedo (1982). In contrast, in examining the effects of the coffee boom in Tanzania, Musonda and Luvanda (1991) fail to accept the validity of the 'Dutch disease' model for Tanzania. Rather, they emphasize the importance of examining the pattern of the distribution of gains from the booming sector in determining its overall outcome. Love (1994) has shown the 'Dutch disease' effect of diamond production in the agricultural sector (excluding livestock)[23] of the Botswana economy.[24] Given this evidence of the existence of the 'Dutch disease' effect highlighted in individual studies, I will now examine the evidence using cross-section and time series data relating to Africa. However, before proceeding to the estimation, I will first examine how the theoretical connection to the African case is made.

Van Wijnbergen (1986a) uses the 'Dutch disease' model to analyse one of the effects of Aid in Africa. He notes that, by partially being spent on non-traded goods, aid places upward pressure on the real exchange rate. This leads to the contraction of the traded sector and the expansion of the non-traded one. This contraction – or 'de-industrialization', to use the original term – *and* real appreciation results from what is termed 'the spending effect' (Neary & Wijnbergen 1986: 15–17). Within a typical 'Dutch disease' model, this spending effect not only raises the demand for 'specific factors', which are initially employed within the booming sector, but also, and perhaps more importantly, the demand for intersectorally mobile factors, such as labour. This requires either a rise in the wage rate or a fall in the relative price either a rise in the wage rate or a fall in the relative price of non-traded goods, the latter bringing about an increase in the level of unemployment. This is labelled the 'resource movement effect' and reinforces the spending effect (Neary & Wijnbergen 1986: 19).

According to Wijnbergen (1986a), the resource allocation consequences of the 'Dutch disease' in Africa is to shift labour from agricultural cash-crop production in rural areas to service employment, mostly in urban areas. The resulting increase in labour costs within the external sector effectively reduces its competitiveness. Applying this theory to data for a number of African countries, he concludes that 'increases in real volume of aid causes real appreciation.' However, White (1992) notes that Wijnbergen's estimations suffer from mis-specification (outperformed by a first-degree autoregressive process), multicollinearity, wrong t-values and auto correlation. In section 5.3.3, below, I will also correct for possible spurious regression problems, mis-specification and multicolinearity. Before that, however, it is worth questioning whether his theoretical description tallies with a typical African economy.

The contention in this section is that the theoretical reasons forwarded to describe the mechanism of casual links does not actually fit with the stylized facts for a typical African economy, even though the final conclusion arrived at could be similar.[25] Moreover, the approach followed contains a number of serious deficiencies, and hence, an alternative, empirically more robust, approach is required. Such an approach is discussed below. Firstly, I would argue that mobility of resources does not occur that easily, especially in the short run. Thus, in the short run, inflation arising from supply bottlenecks in the non-traded sector is likely to represent a more important influence than demand for labour, as hypothesized by van Wijnbergen. Thus, the spending effect is likely to be important in bringing about inflationary pressure. Secondly, in most urban areas in Africa there exists sufficient labour to meet the demand that may arise from the non-traded sectors, such as services. Thirdly, in the medium to long run, peasants may change their product mix. Thus, although the spending effect may result in a real appreciation in exchange rate, this will usually take place in the context of idle labour in urban areas and a sticky production structure in both the non-traded and traded sectors, especially for perennial crops and minerals. Hence, we cannot be sure how the market clears. However, within a dependent economy framework, these new sets of rigidities could express themselves in the form of domestic inflation.

To sum up, the following major problems may be found with the existing literature. Firstly, as discussed above, the propagation mechanism through which the spending effect works may operate differently in Africa from other parts of the world. Secondly, while most studies are based on aggregated export data, disaggregation by commodity may actually result in differential intrasectoral variation. Thirdly, most time series studies could well be spurious since they do not formally test for the stationarity assumption. Indeed, the ECM model, which would have explicitly addressed the disequilibrum phenomena involved in this theory, is hardly employed in the literature. Thus, in order to rectify these shortcomings, the following simple, linear in parameter, model is formulated. This model, which explicitly emphasizes the spending effect, is formulated based on some stylized facts relating to Africa. 'Dutch disease' effects are examined empirically using data from various African economies.[26] The formulation deliberately emphasizes the spending effect and its inflationary consequences since this is more relevant within the African context. Thus, using equations [1] to [6] below, we will specify the hypothesized relationships.

The first important mechanism is that the foreign inflow (F), together with other factors (O), will positively affect the demand for non-tradables (DD_{NT}),

$$DD_{NT} = f(F_A^a, O) \qquad \frac{\partial DD_{NT}}{\partial F_A^a} > 0 \qquad [1]$$

This demand for non-tradables can lead to the appreciation of the real exchange rate, defined as the ratio of foreign price (P_T) multiplied by the nominal exchange rate (e). (In other words the local currency value of the foreign to domestic price, P_{NT}.)

$$\frac{eP_T}{P_{NT}} = f(DD_{NT}), \qquad f'(DD_{NT}) < 0 \qquad [2]$$

where f' is the first derivative.

Combining equations [1] and [2] yields equation [3],

$$\frac{eP_T}{P_{NT}} = g(F_A^a, O^*), \quad \frac{\partial\,(ep_T/P_{NT})}{\partial\, F_A^a} < 0 \qquad [3]$$

Note that O^* within equation [3] also includes other determinants of the real exchange rate.

Although this is the general mechanism through which the impact of foreign inflows on the real exchange rate may be captured, nevertheless it does not represent an adequate specification for estimation, since it fails to clearly identify other determinants of the real exchange rate falling within O^*. Thus, notwithstanding the objective of this study, which is to isolate the impact of capital inflows on the real exchange rate, it is nevertheless necessary to locate this analysis within the broader framework under which the real exchange rate is determined. In order to accomplish this, we first identified what Edwards (1989) terms the equilibrium exchange rate 'fundamentals'. These variables are then used in specifying our empirical equation.

Three main determinants of the real exchange rate may be identified: firstly, the level of the equilibrium exchange rate (e^*); secondly, the deviation of the (index of) macroeconomic policy (Z) from its sustainable level (Z^*); and thirdly, the nominal devaluation (E_t–E_{t-1}) (Edwards 1989: 133).[27] Using Edwards' formulation the dynamics of the real exchange rate behaviour is given by,

$$\Delta \log e_t = \theta\{\log e_t^* - \log e_{t-1}\} - \lambda\{Zt - Z_t^*\} + \varphi\{\log E_t - \log E_{t-1}\} \qquad [4]$$

where: e is the actual exchange rate, Z an index of macro policy; , and are positive parameters designed to capture adjustment process.

In turn, the equilibrium real exchange rate is determined, *inter alia*, by external terms of trade (*ToT*), the level and composition of government consumption of non-tradables, technological progress, capital accumulation, and finally, capital, exchange and trade controls. Examining these in order, a deterioration in terms of trade brings about a depreciation due to the income effect on demand for non-tradables, which, in turn, leads to lowering of their prices. However, a substitution effect could work against this and, hence, what the net effect might be remains an empirical question. Secondly, the level and composition of government consumption of non-tradables will also depend on spending effects, which will raise the demand for non-tradables, as well as income effects due to high taxes, which reduces demand for these. Thirdly, technological progress could have a negative impact on the relative prices of tradables to non-tradables through its effect on income, which raises the demand for non-tradables. However, this may be tempered, or even offset, by the factor augmentation impact of technology. Fourthly, the impact of capital accumulation will also depend upon within which sector it is carried. Thus, investment in the non-traded sector might lead to depreciation in the real exchange rate through its supply effect. And finally, capital, exchange and trade controls will also affect the equilibrium real exchange rate. Thus, by substituting these determinants of the equilibrium exchange rate into the real exchange rate equation set out above, the real exchange rate, in reduced form, may be specified as follows:

$$\log\left(\frac{eP_T}{P_{NT}}\right) = \gamma_1 + \gamma_2\, y + \gamma_3 \log(G^c) + \gamma_4\, Dev + \gamma_5 \log(ToT) + \gamma_6 \log\left(F_A^a\right) \qquad [5]$$

where: is GDP growth assumed to show technological change; G^c government consumption expenditure assumed to show governments spending on the non-traded sector; *Dev* is nominal devaluation; *ToT* is terms of trade; *F* foreign inflow.

It should be noted that the constant term $_1$ captures, among other things, the impact of the variation of the macroeconomic policy from its sustainable level. With the exception of the coefficients for *F* and *Dev* (which are expected to have negative and positive coefficients, respectively), the sign for the other coefficients are indeterminate a priori. Hence, their sign will depend on the relative weight of substitution and income effects, as well as on income and factor augmentation impact, in the case of technology.

5.3.3 Estimation Results

5.3.3.1 Empirical approach

Estimation results for equation [5] in a reduced form, using cross-sectional and time series data for 12 developing counters are reported in Edwards (1989). A modified version of Edwards' formulation is also used by van Wijnbergen (1986a)[28] for estimating the 'Dutch disease' effect of aid in six African countries. Both estimations are carried using a simple OLS and the results of these lend support to the hypothesis of the existence of a 'Dutch disease' problem. However, the estimations might well suffer from spurious regression, which is discussed below.

Tables 5.7 and 5.8 report estimation results based on a sample of countries from three regions of Africa. For each of these regions, one equation is specified for each aggregate commodity group. We have used four commodity groups, based on the modified UNCTAD price index constructed for each region. The results reported below differ from previous studies in at least four respects. Firstly, they are based on a consistent macroeconomic cross-section and time series data constructed for each country within each of the three regions. Secondly, they are commodity specific. Thirdly, the data is tested both for stationarity and for the existence of co-integration among the variables (see Tables 5.6a–5.6c). Depending on the results of these tests, an Error Correction Model (ECM) is fitted to the data. By starting from a second-order ECM, Hendery's General to Specific (GS) approach is followed in order to arrive at a parsimonious functional form. And finally, unlike in previous cross-country studies for Africa, a structural break (Chow) test is undertaken in order to test the validity of pooling the data across countries. The general first-order ECM equation estimated for each commodity group and region is given below. (See Appendix 4.1 for a specification of the econometric approach used.)

$$\Delta \log\left(\frac{eP_T}{P_{NT}}\right) = \alpha + \Delta \log\left(F_A^a\right)_{t-1} + \Delta \log(ToT) + \Delta \log(G^c) +$$

$$\Delta Dev + \Delta y + \log\left(F_A^a\right)_{t-2} + \Delta \log(ToT)_{t-1} + \Delta \log(G^c)_{t-1} +$$

$$Dev_{t-1} + y_{t-1} + \log\left(\frac{eP_T}{P_{NT}}\right)_{t-1} \qquad [6]$$

Table 5.6a A unit root analysis of the 'Dutch disease' model: an ADF test

Series (all in logarithms)	No trend & intercept term			With trend & intercept term			With intercept alone		
	ESA	NA	WCA	ESA	NA	WCA	ESA	NA	WCA
Real capital flows	-0.43	-0.06	-0.92	-5.32	-1.75	-4.48	-5.17	-1.40	-4.36
Real GDP growth @	-8.70	-5.30	-9.90	-8.66	-5.24	-10.0	-8.64	-5.29	-9.90
Terms of trade	-4.80	-3.23	-4.67	-6.10	-3.55	-5.20	-5.90	-3.62	-5.20
Nominal exchange rate @	-4.13	-1.94	-1.23	-4.37	-3.10	-2.51	-4.39	-2.30	-2.70
Gov't consumption	-0.73	1.24	-0.28	-3.10	-2.80	-3.10	-3.30	-1.18	-3.00
Real exchange rate									
Agricultural raw material	-1.37		-0.88	-2.39		-2.68	-2.45		-2.36
Beverage	-1.44		-1.00	-2.41		-3.00	-2.50		-2.50
Food	-1.28	-1.84	-0.93	-2.56	-3.61	-2.87	-2.61	-1.81	-2.47
Minerals	-1.27		-0.88	-2.40		-2.64	-2.45		-2.37

@ are not in logarithm.

Table 5.6b Mackinnon critical values for the ADF test

No trend & no intercept term			With trend & intercept term			With intercept alone		
1%	5%	10%	1%	5%	10%	1%	5%	10%
-2.58	-1.94	-1.62	-4.03	-3.45	-3.15	-3.49	-2.89	-2.58

Table 5.6c Co-integration test for the 'Dutch disease' model

Equation	Johanssen likelihood ratio	Mackinnon critical value	
		5%	1%
ESA			
Agr. raw material	137.37	94.15	103.18
Beverage	133.18	94.15	103.18
Food	134.69	94.15	103.18
Minerals	136.2	94.15	103.18
NA			
Food	110.32+	102.14	111.01
WCA			
Agr. raw material	179.74	94.15	103.18
Beverage	181.46	94.15	103.18
Food	172.35	94.15	103.18
Minerals	175.5	94.15	103.18

The Johansen test used assumes a linear deterministic trend in the data with intercept, no trend, in the test VAR (i.e., the Co-integration equation (CE), as an indicator of long run equilibrium relation, has no trend).
\+ assumes intercept but no trend in CE and no intercept in test VAR.

5.3.3.2 The data

Real exchange rate is derived using a nominal exchange rate (World Bank, World Tables, 1994), price of aggregate commodities (re-computed from the UNCTAD series) and a domestic price (GDP deflator).[29] Terms of trade are derived using an export and import unit price index (World Bank, World Tables, 1994). Government consumption expenditure (IMF, GFS) is used as a proxy for government spending on non-tradables. Finally, capital inflow is derived by taking the difference between the current and preceding year's stock of bilateral, multilateral and private debt stock, plus grants (World Bank, World Tables, 1994). All flows are considered, since all may place pressure on the real exchange rate.[30] The real level of capital inflow, which is deflated by import unit price for each country, is also used. The results of the time series analysis and estimation results are given in Tables 5.6 to 5.9. These results will be discussed in the following section.

5.3.3.3 Estimation results

Tables 5.7 and 5.9 provide the first- and second-order estimation results for equation [6]. Both tables are presented in order to allow comparison between the two formulations. Unless the two formulations are identical, or nearly identical, from an econometrics perspective, it is usually preferable to use the second-order ECM. Thus, in the context of this book the second-order ECM accommodates an extended foreign inflow and government spending lag structure, which is theoretically more plausible. Therefore, the following discussion is based on a second-order ECM, with the exception of agricultural raw materials and beverage equations for the WCA region, which are based on the first-order ECM.

(a) East and Southern Africa (ESA)

The econometric results for this region confirm the existence of a 'Dutch disease' effect only within the food and beverage sectors. Although the second-order ECM for beverage suggests the possibility of 'Dutch disease' problems, as can be read from the coefficients of capital inflow indicator, its first-order ECM confirms its existence. Thus, it is noted that the impact of capital inflows will vary across commodities.

Two of the findings based on this estimation are worth examining further. Firstly, the apparent absence of 'Dutch disease' effects; and secondly, the finding that government consumption expenditure, which is assumed to show government spending on the non-traded sector, is negative and significant in almost all cases. Before arriving at Tables 5.7 and 5.9, a number of experiments based on different financial instruments were undertaken.[31] The estimation resulting from these is basically similar to the one reported above. The use of both logarithms of government consumption and capital inflows as regressors within the same equations is undertaken after checking for possible correlation between these. The level of such correlation is found to be 0.15, which does not create a multicolinearity problem. The major finding arising from the results presented in this section is that government consumption has both short- and long-run elasticities ranging from -0.18 to -0.60. The use of a rigorous econometric specification and estimation yields different results from those arising out of previous studies, such as that undertaken by van Wijnbergen (1986a). Specifically, the direct effects of capital inflow on the real exchange rate are limited only to the food and beverage sectors. Furthermore, if capital inflows are used to finance government consumption expenditure, in almost all cases,

Table 5.7 *First-order ECM results for Equation 5 (coefficients are elasticities) (long-run values after transformation listed in Appendix 4.1)*

Commodity	Short run						Long run				
	Con	ΔF_1	ΔToT	ΔG	ΔDev	Δy	F_2	ToT_1	G_1	Dev_1	y_1
ESA											
Agr. raw mat.	0.79		-0.07	-0.51	0.0004		0.01	-0.20	-0.45	0.0015	
(t-values)	3.08*		-0.90	-4.9*	1.52~		0.12	-0.69	-3.4*	1.25	-0.33
Beverage	-0.18	0.002	0.85	-0.59		-0.24	-0.35	3.4	0.69	0.0025	-1.28
(t-values)	-0.79	0.08	6.0*	-2.6*		-1.3	-1.5#	3.4*	3.0*	0.52	-0.65
Food	1.00	0.06	-0.37	-0.20			0.25	0.17	-0.21	0.0026	-0.32
(t-values)	2.3*	1.9**	-2.2*	-3.0*			1.46	0.27	-1.6#	0.86	-0.66
Minerals	0.43	0.04		-0.22	0.0215	0.039	0.23	-0.15	-0.21	0.0324	0.31
(t-values)	2.0**	2.3*		-1.13	2.12**	0.26	3.7*	-0.60	-2.2*	3.26*	0.62
NA											
Food	0.55				0.28		-0.14	-0.79		0.037	2.15
(t-values)	2.0**				1.6#		-1.5~	-3.5*		0.14	2.6*
WCA											
Agr. raw mat.	0.39	-0.01	0.56		0.0027		-2.6	6.16		0.02	
(t-values)	2.4*	-1.04	4.1*		3.5*		-5.0*	1.7#*		0.93	
Beverage	2.09	0	0.97	-0.54			-0.12	2.08		0.0022	-0.76
(t-values)	4.5*		6.6*	-4.0*			-1.28	5.6*		0.72	-6.01
Food	0.75		0.48	-0.38		-0.28	-0.12	2.6	-1.21	-0.03	-2.21*
(t-values)	1.6#		3.3*	-2.5*		-1.6#	-0.47	1.5~	-2.33*	-2.4*	-7.09*
Minerals	1.79			-0.22	0.00177	0.12	0.05	-0.03	-0.03	0.0029	0.070
(t-values)	3.8*			-2.58*	2.9*	0.77	1.07	-0.19	-0.40	1.3	1.02

(Continued)

Table 5.7 (Continued)

Commodity	Adj. R^2			Diagnostic check			
	RER_1	ECM	Level@	Chow	Reset	Jarque-Bera	Multc++
ESA							
Agr. raw mat.	-0.25	0.34	0.96	2.2*	0.32	0.004*	ELow
(t-values)	-3.25*				(0.58)		
Beverage	-0.11	0.32	0.60	2.75*	0.84	1.47*	ELow
(t-values)	-2.4*				(0.36)		
Food	-0.23	024	0.69	2.6*	0.40	2.5*	
(t-values)	-4.0*				(0.53)		ELow
Minerals	-0.35	0.28	0.87	2.26*	0.19	2.2*	
(t-values)	-4.3*				(0.66)		ELow
NA							
Food	-0.47	0.44	0.86	2.5*	0.31	0.83*	VLow
(t-values)	-4.7*				(0.58)		
WCA							
Agr. raw mat.	-0.03	0.50	0.50	2.7*	6.3	6.7	VLow
(t-values)	-0.86				(0.02)		
Beverage	-0.29	0.58	0.69	1.19*	0.22	1.05*	VLow
(t-values)	-4.11*				(0.64)		
Food	-0.06	0.39	0.35	0.94*	3	0.05*	VLow
(t-values)	-1.14				(0.09)		
Minerals	-0.29	0.49	0.33	0.95*	0.95	2.22*	VLow
(t-values)	-4.0*				(0.33)		

Notes:
* Significant at 1% and better;
** significant at 5% and # significant at 10% (~ closer to 10%).
@ The long run coefficients and their t-values are computed using the Wickens and Breusch (1988) and Gurney (1989) approach (see Appendix 4.1).
The long-run (level) R^2 is obtained form this same regression.
_1, _2 show one, two period lags.
All variables are as defined in Equation 5.
+ For examining the degree of multicollinearity simple correlation among regressors < 0.25 is considered Extremely Low (ELow), < 0.50 Very Low (VLow) and < 0.60 Low (acceptable).
For the diagnostic tests, values in bracket are P-values.

Table 5.8 Country (constant) dummies used in the estimation of Table 5.7 (those significant at 1% or better)

Commodity	Country					
	Botswana	Ethiopia	Kenya	Madagascar	Tanzania	Zambia
ESA						
Agr. raw mat.		0.17	0.79	1.31	0.96	0.35
Beverage				0.70	0.22	
Food	-0.75	-0.65		0.60		-0.45
Minerals			0.75		0.90	0.31
WCA						
Country		Zaire				
Beverage		-0.34				
NA						
Country		Algeria	Egypt			
Food		1.52	0.60			

this will be the main channel through which the 'Dutch disease' effect might operate. Since most aid flows are targeted at governments, this is likely to represent an important propagation mechanism.

Within the *mineral*-based estimation, contrary to our theoretical expectation, long-run capital inflows are found to have a statistically significant positive effect on real exchange rate within the first-order ECM, and a statistically insignificant but positive coefficient in the second-order ECM. As with the WCA region, the regional price index for the ESA region showed a general rising trend.[32] This, combined with a statistically significant short- and long-run positive impact of devaluation, is likely to work against a direct 'Dutch disease' effect.

A number of other features relating to other determinants of the real exchange rate are also worth highlighting. Firstly, the terms-of-trade indicator is found to be statistically significant only for the beverage sector and, in the short run, the food sector. It has a positive coefficient, indicating the prevalence of the substitution effect. Devaluation is found to be important in the short run and only within the mineral sector. As an indicator of technology, real GDP growth is found to be important in the short run within the beverage and food sectors, and in the long run within mining. In all cases the coefficient exhibits a negative value, indicating the importance of the income rather than the factor augmentation effect.

Table 5.9 Results of second-order ECM

East & Southern Africa (ESA)

1. Agricultural raw materials

$$
\begin{aligned}
\Delta RER = {} & \underset{(-6.8)^*}{-0.62\Delta G} - \underset{(-1.15)}{0.12\Delta G_{t-1}} - \\
& \underset{(-4.1)^*}{0.33}(RER_{t-2} + \underset{(-0.82)}{0.027F_{t-3}} - \underset{(1.28)}{0.257ToT_{t-2}} + \underset{(-1.6)\sim}{0.176G_{t-2}} - \underset{(0.91)}{0.0007Dev_{t-2}} + \underset{(-0.69)}{0.196y_{t-2}} - \underset{(2.5)^*}{1.76}) + \\
& \underset{(2.2)^*}{0.15DEth} + \underset{(3.6)^*}{0.88DKen} + \underset{(4.1)^*}{1.98DMad} + \underset{(3.9)^*}{1.19DTan} + \underset{(3.3)^*}{0.41DZam} \qquad [5.3.1]
\end{aligned}
$$

R^2-adj = 0.44 Jarque-Bera 0.16* Reset 0.12(0.73) LM 0.60(0.44) BG = .60(0.50)
Eth = Ethiopia, Ken = Kenya, Mad = Madagascar, Tan = Tanzania, Zam = Zambia.

Notes:
Values in bracket are t-values. See Appendix 4.1 for diagnostic test P-values. The sign difference between the t-values and the coefficients in the ECM term is due to the fact that t-values refer to the long run coefficient. * implies 1%, ** 5% and ^ 10% (~ closer to 10%) level of significant. LM is hetroschedasticity test while BG is the Breuch-Godfery test for serial correlation. The 5% (2 degrees of freedom) value for Jarque-Bera is 5.99. D stands for constant country dummy (e.g. *DKen* is dummy for Kenya).

2. Beverage

$$\begin{array}{rllllll} \Delta RER = & -0.60\Delta G & -0.56\Delta G_{t-1} & +1.1\Delta ToT & +0.20\Delta ToT_{t-1} & -0.20\Delta y - & \\ & (-3.9)^{*} & (-3.1)^{*} & (7.9)^{*} & (1.5)\sim & (-1.5)\sim & \end{array}$$

$$\begin{array}{llllllll} 0.09(RER_{t-2} & +0.2367F_{t-3} & -5.82ToT_{t-2} & -0.612G_{t-2} & -0.00071Dev_{t-2} & -6.46y_{t-2} & +1.07) + \\ (-1.9)^{**} & (-1.1) & (4.1)^{*} & (1.5)\sim & (1.3) & (3.4)^{*} & (-0.45) \end{array}$$

$$\begin{array}{ll} 0.47DMad & +0.23DTan \\ (1.7)^{**} & (2.7)^{*} \end{array} \qquad [5.3.2]$$

R^2-adj = 0.45 Jarque-Bera 1.36* Reset 0.06(0.81) LM 6.02(0.02) BG = 0.75(0.48)
Notes as given in Equation 5.3.1

3. Food

$$\begin{array}{rllllll} \Delta RER = & -0.18\Delta G & -0.29\Delta ToT & +0.26\Delta ToT_{t-1} & +0.0006\Delta Dev & -0.23\Delta y - \\ & (-2.6)^{*} & (-1.5)\sim & (1.5)\sim & (0.83) & (-2.0)^{**} \end{array}$$

$$\begin{array}{llllll} 0.27(RER_{t-2} & -0.213F_{t-3} & -0.677ToT_{t-2} & +0.156G_{t-2} & +0.401y_{t-2} & -3.9) + \\ (-4.9)^{*} & (1.8)^{\wedge} & (1.0) & (-1.3) & (-0.76) & (2.6)^{*} \end{array}$$

$$\begin{array}{llll} -0.72DBot & -0.74DEth & +0.86DMad & -0.52DZam \\ (-3.2)^{*} & (-4.0)^{*} & (3.8)^{*} & (-3.6)^{*} \end{array} \qquad [5.3.3]$$

R^2-adj = 0.25 Jarque-Bera 3.9* Reset 0.40(0.53) LM 1.5(0.22) BG = 0.90(0.35) Bot = Botswana
Notes as given in Equation 5.3.1

4. Minerals

$$
\begin{array}{lllllll}
\Delta RER = & -0.16\Delta G & + 0.266\Delta G_{t-1} & + 0.0163\Delta Dev & + 0.014\Delta Dev_{t-1} - & & \\
 & (-1.03) & (1.55)\sim & (2.0)^{**} & (1.4) & & \\
 & 0.37(RER_{t-2} & - 0.0267F_{t-3} & - 0.17ToT_{t-2} & - 0.0008G_{t-2} & - 0.016Dev_{t-2} & + 0.64y_{t-2} - 0.64) + \\
 & (-4.7)^{*} & (0.56) & (0.75) & (0.08) & (1.3) & (-1.9)^{**} \quad (-1.3) \\
 & 0.76DKen & + 1.0DTan & + 0.35DZam & & & \\
 & (3.7)^{*} & (3.7)^{*} & (3.3)^{*} & & &
\end{array}
\qquad [5.3.4]
$$

R^2-adj = 0.35 Jarque-Bera 2.5* Reset 0.23(0.64) LM 0.00(0.98) BG = 1.8(0.16)
Notes as given in Equation 5.3.1.

North Africa (NA)

1. Food

$$
\begin{array}{lllllllll}
\Delta RER = & -0.64\Delta RER_{t-1} & - 0.21\Delta G & + 0.29\Delta G_{t-1} & + 0.15\Delta ToT & + 0.28\Delta y - & & & \\
 & (-4.2)^{*} & (-1.0) & (1.4) & (0.90) & (1.3) & & & \\
 & 0.77(RER_{t-2} & - 0.083F_{t-3} & + 0.41ToT_{t-2} & + 0.332G_{t-2} & - 0.103Dev_{t-2} & + 0.12y_{t-2} & - 1.91) & + 1.11\mathrm{DAlg} \\
 & (-5.5)^{**} & (2.6)^{*} & (-2.6)^{*} & (-3.1)^{*} & (0.51) & (-0.31) & (2.4)^{*} & (5.3)^{*}
\end{array}
\qquad [5.3.5]
$$

R^2-adj = 0.50 Jarque-Bera 1.6* Reset 0.93(0.34) LM 0.90(0.35) BG = 1.33(0.28)
Notes as given in Equation 5.3.1.

West & Central Africa (WCA)

1. Food

$$
\begin{aligned}
\Delta RER = \; & \underset{(-2.9)^{*}}{-0.40\Delta G} - \underset{(-1.53)\sim}{0.22\Delta G_{t-1}} + \underset{(3.9)^{*}}{0.75\Delta ToT} + \underset{(2.04)^{**}}{0.35\Delta ToT_{t-1}} - \underset{(-1.6)\wedge}{0.25\Delta y} - \\
& \underset{(-3.2)^{*}}{0.18}(RER_{t-2} + \underset{(-0.69)}{0.062F_{t-3}} - \underset{(1.11)}{0.823ToT_{t-2}} + \underset{(-2.4)^{*}}{0.592G_{t-2}} - \underset{(2.1)^{**}}{1.72y_{t-2}} - \underset{(3.3)^{*}}{9.37})
\end{aligned}
\qquad [5.3.6]
$$

R^2-adj = 0.52 Jarque-Bera 0.32* Reset 0.00(0.99) LM 0.08(0.77) BG = 0.34(0.56)
Notes as given in Equation 5.3.1.

2. Minerals

$$
\begin{aligned}
\Delta RER = \; & \underset{(-2.9)^{*}}{-0.272\Delta RER_{t-1}} + \underset{(1.05)}{0.016\Delta F_{t-2}} - \underset{(-3.7)^{*}}{0.239\Delta G} - \underset{(1.8)\wedge}{0.168\Delta y} - \\
& \underset{(-5.8)^{*}}{0.43}(RER_{t-2} + \underset{(-.05)}{0.00021F_{t-3}} + \underset{(-1.4)}{0.161ToT_{t-2}} + \underset{(-0.15)}{0.00073G_{t-2}} - \underset{(0.82)}{0.19y_{t-2}} - \underset{(5.7)^{*}}{6.22})
\end{aligned}
\qquad [5.3.7]
$$

R^2-adj = 0.54 Jarque-Bera 1.0* Reset 2.12(0.15) LM 2.9(0.10) BG = 0.27(0.60)
Notes as given in Equation 5.3.1.

To sum up, a common phenomenon observed within the region is that adjustment coefficients are relatively higher than for the WCA region, with the exception of minerals. With the exception of beverage (for which the ECM coefficient stands at 9 per cent), the adjustment coefficient ranges from 27 to 37 per cent, meaning that 27–37 per cent of past errors are corrected for in the current period. Within all the models, values for the relevant diagnostic tests are quite acceptable. Perhaps more importantly, evidence for the 'Dutch disease' is not apparent within the minerals and agricultural raw materials sectors. However, government expenditure is, in general, found to have a statistically significant negative coefficient, which leads to a real appreciation. Thus, depending on how government expenditure is financed, there could be room for capital inflows to affect the real exchange rate indirectly.

(b) North Africa

In the database upon which this work is based, three commodity groups were specified for North Africa. These are *agricultural raw materials*, *food* and *minerals*. The application of the model to agricultural raw materials and a minerals-based real exchange rate could not pass the co-integration test. This indicates the absence of a long-run relationship between these variables. Thus, the estimation is undertaken only for the food-based real exchange rate, for which a co-integration relationship is found.

As summarized in Table 5.9, the estimation confirms the existence of 'Dutch disease' problem in the long run, although its potency is low. However, a strong long-run 'Dutch disease' effect could be expected, depending on how government consumption expenditure is financed. Long-run terms of trade are also found to have a negative elasticity, highlighting the importance of the income effect. An interesting aspect of this model is its high adjustment coefficient, which, standing at 77 per cent, indicates a rapid adjustment capability within the region.

(c) West and Central Africa

For the WCA region, we begin from the estimation for the *agricultural raw materials*-based real exchange rate. As can be seen from Table 5.7, and as might be suggested by the theory, the coefficient for capital inflows has a strong and statistically significant value in the long run. Terms of trade, on the other hand, has a positive effect on the real exchange rate, although its short-run effect is less potent. In common with the ESA region, this result would tend to indicate the importance of a substitution effect. As expected, nominal devaluation also has a statistically significant positive impact in the short run. However, caution should be exercised in relation to this result, since the lagged value of the real exchange rate is significant at only around a 20 per cent level. The results of the remaining diagnostic tests are all quite satisfactory. Hence, the findings of this model might reasonably be taken as suggesting the possibility of a 'Dutch disease' effect.

The results of the food-based real exchange rate model are very strong in relation to the entire range of diagnostic tests. The existence of a direct 'Dutch disease' effect arising from foreign inflows is not supported by the data. However, as in the previous cases, government consumption expenditure has statistically significant negative long- and short-run values. Depending on how the latter is financed, a 'Dutch disease' effect may be traced. The coefficient in relation to terms of trade is positive in the short run, suggesting that the substitution effect remains important. Technological progress, again measured as real GDP growth, has a negative effect in the short run, owing to the income effect, but a positive effect in the long run, due to its factor augmentation impact.

The estimation for the *beverage* category also produces similar results. Again, the diagnostic test results are very strong, with these results suggesting possible direct 'Dutch disease' effects in the long run. This suggestion is supported by the statistically significant negative value of current government expenditure, which could partly be financed by aid. The terms of trade effect shows similar results as that for food and agricultural raw materials, having a positive coefficient with a high potency, especially in the long run. The effect of devaluation is not found to be statistically significant, either in the short or long run. The long-run growth effect is negative, suggesting the importance of an income effect.

Contrary to our theoretical expectation, the indicator of capital inflows within the *minerals* equation shows a positive coefficient in the short run. However, these coefficients are not found to be statistically significant at conventional levels of significance. The price index of minerals, ores and metals for the region rose sharply between 1972 and 1980, and again from its lowest level in 1986 to its highest in 1989. As with the ESA region, this, combined with the nearly zero impact of devaluation, could work against a possible 'Dutch disease' effect. However, government consumption expenditure exhibits a statistically significant negative coefficient, in the short run. Terms of trade are found to have no effect within this model, while technological progress has a negative impact, associated with an income effect, in the short run. In relation to the beverage and mineral models, 26 per cent and 43 per cent, respectively, of past errors are made up for in the current period. This is comparatively high by the standard of the other two commodities and might be related to the capacity utilization possibility within these sectors, as noted in Chapter 4.

In sum, there would appear to be similarities between the results from the ESA region and the WCA region. Firstly, within this region the 'Dutch disease' effect is directly observed only in relation to the agricultural, and to some degree, the beverage sectors. However, in almost all cases, government current expenditure exhibits a statistically significant negative coefficient. If part of the latter is financed by foreign inflows, then the 'Dutch disease' effect could work its way through that. Secondly, with the exception of the food sector, in general, terms of trade is found to have a positive impact on the real exchange rate, with a particularly strong long-run impact. This underlines the importance of the substitution effect. And thirdly, in the case of food and agriculture-based real exchange rates, adjustment to equilibrium is found to be extremely slow. However, the results for the beverage and mineral-based real exchange rate suggest a faster adjustment, owing to capacity utilization, as described in Chapter 4.[33]

5.3.4 Summing Up

In this section an attempt has been made to assess the empirical validity of the macroeconomic impact of aid on the real exchange rate. This analysis emerges from a discussion of the 'spending effect', within a classic 'Dutch disease' framework. The study not only proposes an alternative propagating mechanism relevant for Africa, but also attempts to assess the empirical validity of such a mechanism, using recently developed econometric techniques.

The results indicate that the 'Dutch disease' effect varies across regions and commodity categories. However, previous studies were not able to identify such variation, because these studies were based on an aggregate real exchange rate index. Moreover, most of these studies used simple OLS estimation techniques, without giving due attention to the non-stationarity of each series, nor to the co-integration behaviour among the variables. In contrast, this study explicitly adopts a procedure, which takes account of these issues, in conjunction with an ECM approach. This not only rectifies the shortcomings of previous studies, but also highlights the potential for new time series econometrics to explain the temporal and permanent impact of real exchange rate fundamentals, on top of providing an in built error correction mechanism.

Based on this analysis, one may conclude that a 'Dutch disease' effect can be observed in the food and beverage sectors of the ESA region, the food sector of the NA region and the agricultural raw materials and beverage sectors of the WCA region. Interestingly, in almost all cases, government spending on the non-traded sector is found to have a statistically significant negative elasticity. Thus, insofar as part of this spending is financed by foreign inflows, a 'Dutch disease' effect may be observed indirectly. This is entirely plausible since most capital flows in Africa are directed to the public sector. However, the policy implications of the above finding should not necessarily always be an across-the-board devaluation. Rather, for import-dependent economies (such as those examined in this study), policies such as devaluation should be analysed within a broader overall macroeconomic context. In other words, account should be taken of the contractionary impact of devaluation, as well as its implications for public expenditure. On the other hand, a case for protecting other traded sectors may also be made. The findings summarized within this section would also tend to support the view that there is a need for serious macroeconomic management, in the face of capital inflows, whether they come as aid, or in some other form. In this respect, an important instrument of macroeconomic management is government spending and how it is financed. Thus, African macro modelling should, ideally, take account of such considerations. Hence, the African prototype model developed in the following chapter will explicitly attempt to incorporate these considerations.

5.4 Private Investment and Import Compression: Econometric Results

Sections 5.2 and 5.3, focused on the possible macroeconomic problems associated with foreign inflows. It is clear, however, that foreign inflows do have a positive impact. Indeed, one of the most important positive effects of such inflows in relation to Africa stems from the possibility that they offer to tackle the foreign exchange, or import, constraint which these countries face. This effect may be examined empirically by focusing on private investment and identifying the various determinants of such investment. This avenue of enquiry will be pursued within this section.

Determinants of private investment have been analysed using a variety of different theories. The accelerator model (Clark 1917, Keynes 1936, Chenery 1952), the Tobin-q model (Tobin 1969) and the user cost model (Jorgenson 1963) are the basic models upon which much of the analysis is based. Within the African context the application of the Tobin-q model is limited, since capital markets in that Continent remain extremely rudimentary. Thus, the competing models, in relation to this analysis, are Jorgenson's user cost model and a modified accelerator model, which incorporates the specificity of African economies. Jorgenson's user cost model is difficult to employ in Africa, partly as a consequence of data problems relating to depreciation and cost of capital and labour. Moreover, the model assumes substitution between these factors of production. However, this assumption is less plausible in Africa, where foreign exchange constraints are pervasive. The private investment function, set out below, is basically an accelerator-based model (Chenery 1952), modified to accommodate the external constraint to private investment in developing countries (FitzGerald et al. 1992). FitzGerald et al.'s work is further extended by allowing the inclusion of other relevant variables, and formulating this within an Error Correction Model. This externally-constrained private investment function is specified below. Its estimation result, following a unit root and co-integration test, is reported below.

The Model

Private (p) investment (I) is defined as reflecting the adjustment of capital stock (K) to its desired level (K^*)

$$I_p = \lambda (K_p^* - K_{pt-1}) \qquad [1]$$

where: λ is an adjustment coefficient.

The desired capital stock is further defined as,

$$K_p^* = b_1 Y_t + b_2 K_{gt-1} + b_3 M_A + b_4 J_A + b_5 DG \qquad [2]$$

where M is level of import, J_A an indicator of capital flight and DG the level of public debt.

Substituting [2] into [1] and taking the first difference of the result, to circumvent the capital stock data problem, yields equation [3], which is estimated below,

$$I_p = \beta_1 \Delta Y_t + \beta_2 I_{gt-1} + \beta_3 \Delta M_A + \beta_4 \Delta J_A + \beta_5 Z_A + I_{pt-1} \qquad [3]$$

where $\beta_i = b_i$ and Z_A public borrowing.

Equation [3] is estimated using pooled data for the sample of countries in each of the three regions. The estimation is preceded by the analysis of the time series properties of the variables used (Tables 5.10a –5.10c). The series are, in general, nonstationary and co-integrated. Due to lack of sufficient data Z_A and J are omitted from the estimation. The results of this estimation are given below.

East and Southern Africa

$$\Delta \ln\left(\frac{I_p}{Y}\right) = \underset{(0.32)}{0.04}\Delta \ln\left(\frac{Y_t}{Y_{t-1}}\right) + \underset{(4.3)^*}{0.56}\Delta \ln\left(\frac{I_g}{Y}\right)_{t-1} + \underset{(4.3)^*}{0.68}\Delta \ln\left(\frac{\Delta M}{Y}\right)$$

$$\underset{(-3.8)^*}{-0.25}\ln\left[\left(\frac{I_p}{Y}\right)_{t-1} \underset{(-0.80)}{+0.47}\ln\left(\frac{Y_t}{Y_{t-1}}\right)_{t-1} \underset{(10.2)^*}{-0.83}\ln\left(\frac{I_g}{Y}\right)_{t-2} \underset{(2.2)^*}{-2.0}\ln\left(\frac{\Delta M}{Y}\right)_{t-1}\right] +$$

$$\underset{(-2.4)^*}{-0.24 Mad} \underset{(-2.2)^*}{-0.25 Uga}$$

R^2-adj = 0.35	Jarque-Bera = 3.27*	Chow = 1.5*
Reset = 1.7	LM = 2.2(0.15)	R^2-level = 0.44
BG = 3.8(0.03)	n = 76	

Values in bracket are t-values.
* significant at 1% ** at 5% and ^ at 10%
Country constant dummies Mad = Madagascar, Uga = Uganda, CAR = Cent. African Republic, Gab = Gabon, Nig = Nigeria and Alg = Algeria

Table 5.10a *A unit root analysis of the private investment model: an ADF test*

Series (all in logarithms as the ratio of GDP)	No trend & intercept term			With trend & intercept term			With intercept alone		
	ESA	NA	WCA	ESA	NA	WCA	ESA	NA	WCA
Private investment	-0.43	-0.23	-0.87	-3.3	-2.6	-3.9	-3.18	-2.1	-3.9
GDP growth	-8.7	-5.3	-9.9	-8.66	-5.24	-10.0	-8.64	-5.29	-9.9
Import	-1.08	-1.1	-1.01	-3.6	-2.45	-3.7	-3.62	-0.59	-3.5
Public investment	-1.3	-0.41	-1.09	-3.2	-2.96	-5.3	-3.21	-3.0	-4.8

@ are not in logarithm.

Table 5.10b *Mackinnon critical values for the ADF test*

No trend & no intercept term			With trend & intercept term			With intercept alone		
1%	5%	10%	1%	5%	10%	1%	5%	10%
-2.58	-1.94	-1.62	-4.03	-3.45	-3.15	-3.49	-2.89	-2.58

Table 5.10c *Co-integration test for the private investment model*

Equation #	Johanssen likelihood ratio	Mackinnon critical value	
		5%	1%
ESA	210.43	53.12	60.16
NA	70.65	53.12	60.16
WCA	223.08+	39.89.	45.58

Notes:
The Johansen test used assumes intercept no trend in CE and no intercept in the test (i.e., the Co-integration equation (CE), as an indicator of long run equilibrium relation, has no trend).
+ assumes No intercept or trend in CE or test VAR

West and Central Africa

$$\Delta\ln\left(\frac{I_p}{Y}\right) = \underset{(1.7)^\wedge}{0.28}\Delta\ln\left(\frac{Y_t}{Y_{t-1}}\right) - \underset{(1.4)}{0.12}\Delta\ln\left(\frac{I_g}{Y}\right)_{t-1} + \underset{(4.5)*}{0.74}\Delta\ln\left(\frac{\Delta M}{Y}\right)$$

$$\underset{(-6.4)*}{-0.39}\ln\left[\left(\frac{I_p}{Y}\right)_{t-1} - \underset{(2.8)*}{1.28}\ln\left(\frac{Y_t}{Y_{t-1}}\right)_{t-1} + \underset{(-0.92)}{0.11}\ln\left(\frac{I_g}{Y}\right)_{t-2} - \underset{(4.7)*}{3.0}\ln\left(\frac{\Delta M}{Y}\right)_{t-1} + \underset{(-9.0)*}{2.72}\right]$$

$$\underset{(-5.1)*}{-1.1}CAR + \underset{(4.6)*}{1.2}Gab - \underset{(1.8)**}{0.32}Nig$$

R^2-adj = 0.34	Jarque-Bera = 0.10	Chow = 1.9
Reset = 2.2	LM = 1.5(0.23)	R^2-level = 0.59
BG = 0.44(0.65)	n = 114	

Values in bracket are t-values.
* significant at 1% ** at 5% and ^ at 10%.

North Africa

$$\Delta\ln\left(\frac{I_p}{Y}\right) = \underset{(1.1)}{-0.16}\Delta\ln\left(\frac{I_g}{Y}\right)_{t-1} + \underset{(3.1)*}{0.29}\Delta\ln\left(\frac{\Delta M}{Y}\right)$$

$$\underset{(-6.4)*}{-0.19}\ln\left[\left(\frac{I_p}{Y}\right)_{t-1} + \underset{(-2.6)*}{0.89}\ln\left(\frac{I_g}{Y}\right)_{t-2} - \underset{(0.81)}{0.67}\ln\left(\frac{\Delta M}{Y}\right)_{t-1} + \underset{-(3.4)*}{3.8}\right] + \underset{(1.8)**}{0.14}Alg$$

R^2-adj = 0.33	Jarque-Bera = 0.57	Chow = 3.4
Reset = 0.39	LM = 0.32(0.57)	R^2-level = 0.36
BG = 2.8(0.07)	n = 57	

Values in bracket are t-values.
* significant at 1% ** at 5% and ^ at 10%.

Two important features of the private investment functions, estimated above, are worth noting. Firstly, the result conclusively supports the hypothesis that private investment in Africa is externally constrained. Thus, it is reasonable to assume that the import compression argument is a valid one. These results also indicate that the long-run impact of import compression is stronger than its short-run impact. Hence, it is entirely plausible that short-run coefficients might show the role of intermediate imports while the long-run coefficient might imply capacity creation. Thus, research using disaggregated imports could represent a productive area for future study. The second noteworthy feature of the above estimation is that the results suggest crowding-in within the ESA region and crowding-out in the NA region. However, the coefficients for public investment in relation to the WCA region are not found to be statistically significant. This result underscores the variation in the impact of public investment, which exists across regions, as well as its positive impact in relatively less developed regions such as ESA.

5.5 CONCLUSION

In this chapter, the macroeconomic impact of external finance in Africa was examined from three angles. Firstly, by way of the fiscal response literature; secondly through the 'Dutch disease' effect; and finally, in relation to the financing of imports and investment.

To date, the government's fiscal response to external finance has been studied exclusively within an optimization framework. This approach not only is inherently inconsistent, because of the additive assumption, but also diverges from the reality of the situation within developing countries, in general, and African economies in particular. Thus, section 5.2 proposes an alternative decision-making framework, based on a number of stylized facts in relation to Africa. By using an Error Correction Model (ECM), an empirical analysis of the fiscal response to external finance is made. The results indicate firstly, that the impact of capital inflows on taxes varies across different types of capital inflows and regions. Thus, in general, bilateral flows are found to have a negative impact on direct taxes, while private inflows have a similar negative impact on indirect taxes. Secondly, capital inflows are also likely to have a strong positive impact on current government expenditure within the three regions identified in this study. Indeed, it is argued that the combined effect of these may push the government away from a sustainable path of financing its deficit.

Section 5.3 questions both the empirical approach and certain aspects of the theoretical underpinnings forwarded in order to describe the propagating mechanism of the 'Dutch disease' in Africa. Building on this discussion, a new estimation of the 'Dutch disease' effect, using an ECM framework is undertaken. A number of conclusions may reasonably be drawn based on these results. Firstly, it is desirable to calculate a commodity-specific real exchange rate, since the impact of capital inflows will vary across commodities. Secondly, the empirical evidence confirms the existence of a 'Dutch disease' effect in the food and beverage sectors within the ESA, agricultural raw materials and beverage sectors within WCA, and, finally, the food sector within the NA region. And, thirdly, government current expenditure is found to lead to an appreciation in all regions, and for all commodity categories. Hence, if the latter is to be financed by external inflows, then the 'Dutch disease' effect will reveal itself through these.

Finally, section 5.4 describes the externally constrained nature of private investments in Africa. This result emphasizes the importance of financing imports in a bid to accelerate investment. No definitive conclusion may be arrived at in relation to the impact of public investment within the WCA region. However, a crowding-in and crowding-out effect does appear to be taking place within the ESA and NA regions, respectively. In sum, the results presented in this chapter underscore the need to take explicit account of a range of additional considerations in relation to macro modelling in Africa. Hence, such considerations will be incorporated into the prototype African model, developed in the next chapter.

6 Modelling Africa Within a Global Economic Framework

6.1 INTRODUCTION

In the preceding chapters, the trade and finance problems of Africa were examined from both theoretical and empirical angles. In this chapter, I will attempt to locate these problems within a global economy context. This is important for two main reasons. Firstly, it helps one to identify the position of Africa within the world economy. Secondly, it allows one to assess the extent to which Africa's entry into the world economy represents an obstacle to development efforts being undertaken in that continent. This exercise will be formally undertaken using the increasingly popular methodology of modelling North-South economic interaction. Notwithstanding the proliferation of such models, the modelling of the South remains, at best, rudimentary. Indeed, almost no examples of North-South models focusing specifically on Africa have been developed to date.[1]

In this chapter, an attempt will be made to examine both the theoretical and practical efforts at modelling the South within a North-South framework. The chapter is organized as follows. Section 6.2 sketches the broader theoretical framework within which most current North-South models fall. In section 6.3 some of the more important of the existing North-South models are examined. Based on this review, section 6.4 attempts to draw out a number of lessons for improving the modelling of the South. These lessons form the basis for the development of an alternative North-South model focusing specifically on Africa. This model is fully developed in section 6.5.

6.2 BASIC THEORETICAL MODELS

6.2.1 The Mundell-Fleming Model

In open economy macroeconomics, modelling the interaction of finance and trade between countries and the analysis of related policy issues are formulated around what is termed the Mundell-Fleming model, or, following Vos (1994), the Meade-Mundell-Fleming model. As Vos (1994) notes, the model's foundation was laid by Robert Mundell (1960, 1963, 1968) and J. Marcus Fleming (1962), who extended the pioneering work of Mead (1951), focusing on the Keynesian internal–external balance-adjustment analysis (see Vos 1994: 65–66). Following Vos (1994) and Hallwood and MacDonald (1994), among others, the basic structure of the model may be described as follows.

Assuming two countries, North (*N*) and South (*S*), their output supply and demand (equations 1 and 2) and similar demand and supply equation for credit (equation 3) may be given by,

$$Y_N = D_N(Y_N, r) + M_S(Y_S, \phi) - M_N(Y_N, \phi^{-1}) \qquad [1]$$

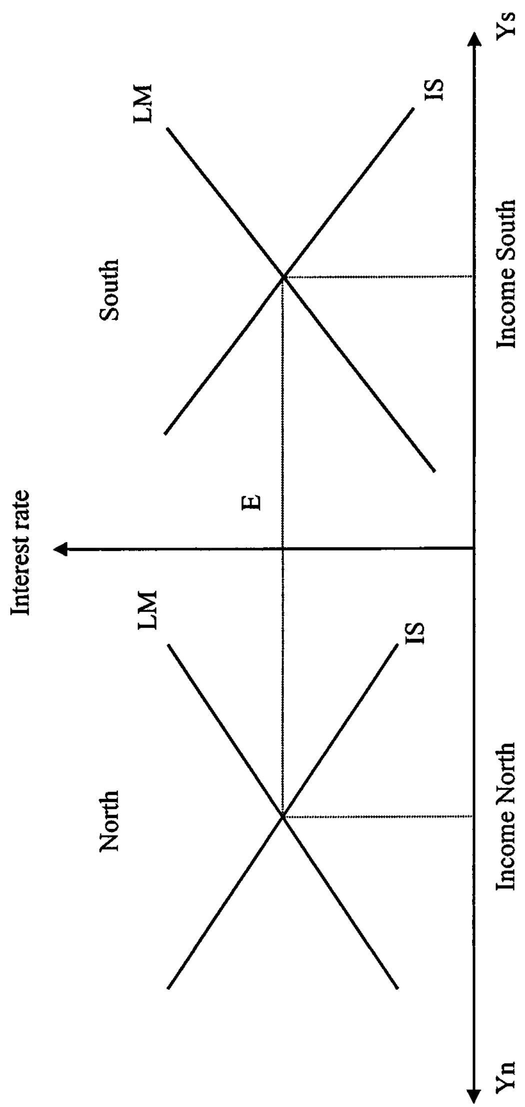
$$Y_S = D_S(Y_S, r) + M_S(Y_S, \phi) - M_S(Y_S, \phi^{-1}) \qquad [2]$$

$$B_N + B_S + H = L_N(Y_N, r) + L_S(Y_S, r) \qquad [3]$$

where: D_i is aggregate domestic demand consisting of private consumption, investment and public expenditure that varies positively with income Y and negatively with the real interest rate r; $\phi = P_S / P_N$ which is the terms of trade; B_i the supply of domestic credit; L_i the demand for credit; H the world stock of reserves treated as an outside asset; M_i import demand.

Based on the model's further assumption, that a perfect capital market exists, interest rates tend to equalize across countries. Import demand (M_i) and, implicitly, export supply will depend on income and terms of trade. The model's solution also depends on the exchange rate regime which is in operation. With a fixed exchange rate the money supply may be taken as endogenous, while it is best considered as exogenous under a flexible exchange rate regime. Based on these assumptions, Diagram 6.1 summarizes the equilibrium condition for the world economy.

Diagram 6.1 The Meade-Mundel-Fleming model



In Diagram 6.1 equilibrium for the world economy is attained at point *E*, where both the money (*LM*) and the product (*IS*) markets are in equilibrium within the two countries. This ensures a unique level of interest rate. Once such a framework is developed, it is quite straightforward to analyse the impact of different policies relating, say, to the impact of financial flows from North to South (see Vos 1994: 68–70 for such an analysis). Indeed, this basic formulation has been expanded upon and modified by a number of authors with the aim of overcoming some of the limitations of this basic formulation. Thus, according to Vos' survey, the basic model has been extended to include private and public sector demand in Frenkel and Razin (1987) while imperfect substitution between domestic and foreign assets is treated in Kouri and Porter (1974) and Dornbusch (1980) (see Vos 1994: 68–69).

6.2.2 The Theoretical Basis of Recent North-South Models

Notwithstanding the importance of the Meade-Mundell-Fleming model, the relevance of such an IS/LM approach in analysing North-South interaction remains limited. This is because the behaviour of agents and the structure of the economy, which is assumed to be the same in the two countries, could, in fact, vary significantly between them. A good example of this relates to differential access to capital markets (see Vos 1994: 70). This suggests the desirability of using different models for the economies of the North and South, which, in turn, implies that the interaction between the two economies may depend on the underlying theory about the structure of these economies. This also represents an important theoretical justification for the proliferation of North-South models in general. Thus, following the works of Ocampo (1986), Vos (1989b) and Dutt (1990),[2] the following discussion will outline the major theoretical classification of North-South models. This will help to locate the model, which we develop in section 6.3, within the relevant literature.

Most existing North-South models may be classified under three theoretical strands, which may be formulated by assuming a common Lewis-type economy in the South and combining this with either a neoclassical, Kaleckian or a Neo-Marxian North. Following the approach of Dutt (1990), I will first outline the incomplete general framework he has developed. The different theoretical approaches will then be defined according to their assumption of 'model closure' for the general framework. This thematic classification is also helpful in understanding the theoretical underpinnings of the recent North-South models, which are examined in section 6.3 and which will inform the version of the model developed in this book.

6.2.2.1 The general framework

In the general framework, the two economies, North (n) and South (s), are assumed to produce a single good N and S, respectively. Both use a Leontief technology, incorporating labour (L) and capital (K) as factors of production. The S good is assumed only to be a consumption good, while the N good is both a consumption and investment good, which can be used in both regions. These assumptions imply the following two quantity and price equations, given as:

$$X_n = c_n^n L_n + c_n^s L_s + g^n K_n + g^s K_s \qquad [1]$$

$$X_s = c_s^n L_n + c_s^s L_s \qquad [2]$$

$$P_n = W_n a_0^n + r_n P_n \left(\frac{K_n}{X_n} \right) \qquad [3]$$

$$P_s = W_s a_0^s + r_s P_n \left(\frac{K_s}{X_s} \right) \qquad [4]$$

$$\text{with } \frac{K_i}{X_i} \geq a_1^i \text{ , } i = n, s \qquad [5]$$

where a_1 is the technologically fixed capital-output ratio, c^i_j denotes the consumption of good j in region i per worker employed in region i, a_0 is the employment-output ratio, g is the rate of growth of capital, r the rate of profit, W is the money wage (rate) and P prices (measured in terms of a common currency with exchange rate fixed at 1).

It is further assumed that only profit earners save a constant fraction, s_n, of their profit. The total consumption expenditure of wage and profit earners is also assumed to be split between N and S goods, with a constant fraction, a, being spent on N goods. Workers in the South are assumed not to save and to consume only Southern goods, while

Southern profit-earners are assumed to save a constant fraction, s_s, and spend a constant fraction, b, of their consumption expenditure on N good, the rest being spent on the S good. Labour and capital are assumed to be internationally immobile. These assumptions imply,

$$c_n^n L_n P_n = a\,[W_n L_n + (1-s_n) r_n P_n K_n] \tag{6}$$

$$c_s^n L_n P_s = (1-a)[W_n L_n + (1-s_n) r_n P_n K_n] \tag{7}$$

$$c_s^s L_s P_s = W_s L_s + (1-s_s)(1-b) r_s P_n K_s \tag{8}$$

$$c_s^s L_s P_n = (1-s_s) b r_s P_n K_s \tag{9}$$

Substitution of equations 6 to 9 into equations 1 to 4 yields,

$$\begin{aligned} 1 = a&\left[\left(\frac{W_n}{P_n}\right)a_0^n + (1-s_n) r_n \left(\frac{K_n}{X_n}\right)\right] + \\ &\left[(1-s_s) b r_s + g^s\right]\left(\frac{K_n}{X_n}\right)k^{-1} + g^n\left(\frac{K_n}{X_n}\right) \end{aligned} \tag{10}$$

$$\begin{aligned} 1 = (1-a)&\left[\left(\frac{W_n}{P_n}\right)a_0^n\left(\frac{X_n}{K_n}\right)\left(\frac{K_s}{X_s}\right)k\pi^{-1} + (1-s_n) r_n \left(\frac{K_s}{X_s}\right)k\pi^{-1}\right] + \\ &\left(\frac{W_s}{P_s}\right)a_0^s + (1-s_s)(1-b) r_s \left(\frac{K_s}{X_s}\right) \end{aligned} \tag{11}$$

$$1 = \left(\frac{W_n}{P_n}\right)a_o^n + r_n\left(\frac{K_n}{X_n}\right) \tag{12}$$

$$1 = \left(\frac{W_s}{P_s}\right)a_0^s + r_s\left(\frac{K_s}{X_s}\right)\pi^{-1} \tag{13}$$

where: $k = \dfrac{K_n}{K_s}$ and $\pi = \dfrac{P_s}{P_n}$

Assuming away capital flows, balance of payment requires balance of trade, which implies

$$(1-a)[W_n L_n + (1-s_n) r_n P_n K_n] = g^s P_n K_s + (1-s_s) b r_s P_n K_s \qquad [14]$$

which, in turn, implies,

$$(1-a)\left[\left(\frac{W_n}{P_n}\right) a_0^n k + (1-s_n) r_n \left(\frac{K_n}{K_s}\right)\right] = g^s + (1-s_s) b r_s \qquad [15]$$

Substitution of equations 15 and 3 into equation 2 implies[3]

$$s_n\, r_n = g^n \qquad [16]$$

$$s_s\, r_s = g^s \qquad [17]$$

Equations 16 and 17 show that, with balanced trade, total income equals total expenditure, in each region, so that saving equals investment. The above framework can be represented by five independent equations, numbered 10, 12, 13, 16 and 17, comprising ten variables, W_n/P_n, W_s/P_s, r_n, r_s, g^n, g^s K_n/X_n, K_s/X_s, k and π and is clearly indeterminate. (In other words, the number of equations does not equal the number of variables.) Focusing on the long-run issues we may assume a given stock of capital in the short run and hence, k is assumed fixed. The condition for the long-run steady-state, equilibrium, where we will treat k as a variable to be determined, entails that K_n and K_s must grow at the same rate. Hence

$$g^n = g^s \qquad [18]$$

Having substituted equation 18, which implies equations 12, 16 and 17 into 10, we arrive at equation 19. However, four more equations are required, in order to close the model. Sections 6.2.2.2 to 6.2.2.4. give us alternative closure rules, which allow us to arrive at a solution to the following general model:

$$k = \left[(1-s_s)\left(\frac{b}{s_s}\right)+1\right]\left\{(1-a)\left[\left(\frac{1}{g}\left(\frac{K_n}{X_n}\right)\right)-1\right]\right\}^{-1} \qquad [19]$$

where g is the common growth rate of capital stock.

6.2.2.2 The Solow-Lewis model

In this model the North is assumed to be a neoclassical economy, with perfect competition prevailing within the goods market. Full employment of labour and capital is assumed at all times, with growth determined by the natural rate, n. The production of the Southern good is constrained by the extent of capital accumulation. Assuming flexible and unlimited labour supply at a given real wage à la Lewis (1954), investment from profits will increase output in the long run. The fixed wage, however, may also be explained by a standard neo-Marxian argument. Thus, the biologically required, socially necessary labour time, taken in conjunction with Marx's description of moral and historical considerations implies a certain wage level below which workers will not work. At this wage level, these workers will join the reserve labour force (see Dutt 1990: 18). These assumptions imply,

$$\frac{K_n}{X_n} = a_1^n \qquad [20]$$

$$\frac{K_s}{X_s} = a_1^s \qquad [21]$$

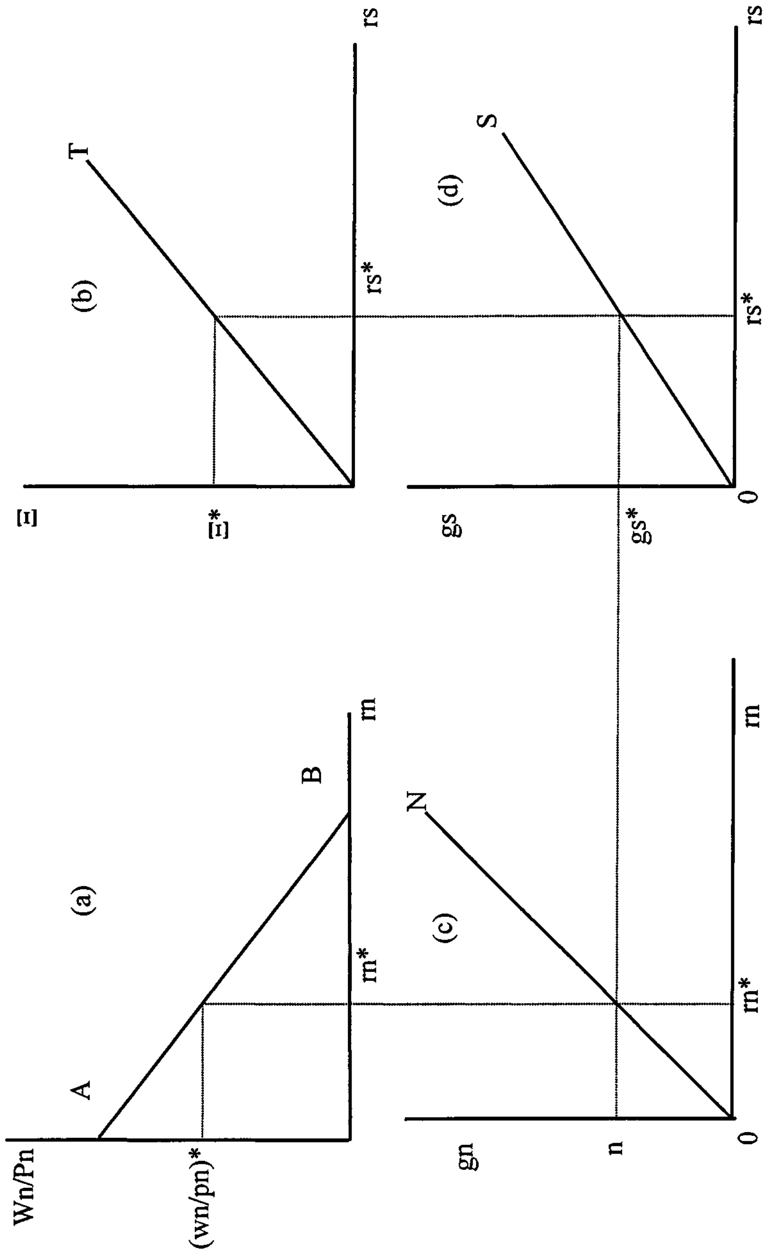
$$g^n = n \qquad [22]$$

$$\frac{W_s}{P_s} = V_s \qquad [23]$$

where V_s is the fixed real wage. Substitution of equations 21 and 23 into 13 implies,

$$\pi = V_s a_0^s + r_s a_1^s \qquad [24]$$

which yields a relation between r_s and the terms of trade, π, shown by OT in panel (b) of Diagram 6.2. Equation 17 yields another relation between g^s and r_s, shown by OS in panel (d) while equation 16 gives the relation between g_n and r_n shown by ON in (c). Substitution of equation 20 into 12 yields, *Diagram 6.2 The Solow-Lewis model*



$$1 = \frac{W_n}{P_n} a_0^n + r_n a_1^n \qquad [25]$$

which gives the Northern wage-profit frontier shown as AB in panel (a). From equation 22 the level of g^n is fixed at rate n, and panel (c) determines (* indicates equilibrium values) g^n* and r_n*, and r_s*, g_s* $\pi*$ and $(W_n/P_n)*$ are determined by diagram 6.2. $K*$ may be determined by substituting equations 20 and 22 into equation 10, in order to arrive at

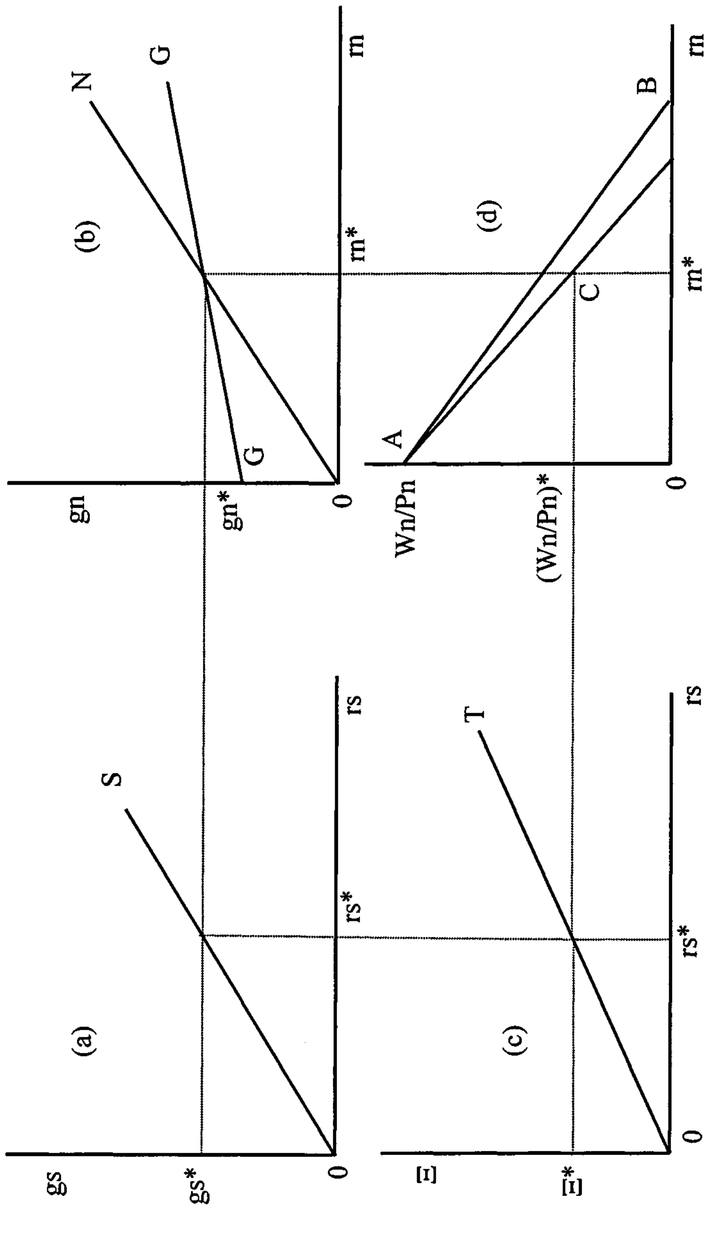
$$k* = \left[(1-s_s)\left(\frac{b}{s_s}\right)\right]\left\{(1-a)\left[\left(\frac{1}{a_1^n n}\right)-1\right]\right\}^{-1} \qquad [26]$$

V_n* (real wage in North) which equals $(W_n/P_n)(P_n/P_s)^{1-a}$, where a (the weight, given by $0<a<1$) is also determined since $(W_n/P_n)*$ and $\pi*$ are determined. This will complete the model solution.

This model may be used to explore the effects of changes in the parameters of the model on economic interaction between the two regions. One notes, for instance, that technological change (understood as lower a_0^s and a_1^s) in the South results in a deterioration in terms of trade of the South. Conversely, within this model, Northern growth is found to improve the terms of trade of the South. Other similar parameter changes and their impact are discussed in detail in Dutt (see Dutt 1990: 163).

Models developed by Findlay (1980, 1981) and Alogoskoufis and Varangis (1992) may be broadly classified under this category. The World Bank's Global Economic model, Bank-GEM (Peterson et al. 1991, Pedersen 1994), may also be taken as falling under this category. This is because the model is based on the NIESR (National Institute of Economic and Social Research) and the London Business School global economic model, both of which incorporate similar features to the Solow-Lewis model, in the long run. However, the London Business School model uses an IS/LM framework to solve for its major endogenous variable, including trade volumes (see Allen & Vines 1994).[4]

Diagram 6.3 The Kalecki-Lewis model



6.2.2.3 The Kalecki-Lewis model

As with the Solow-Lewis model, within this framework the South is assumed to have a Lewis-type economy. Hence equation 21 is assumed. Along Kaleckian, or following Dutt, Kalecki-Steindl lines, the North is assumed as characterized by excess capacity. This implies that equation 20 should *not* be assumed. Instead, a strict inequality, given in equation 5, is applied for $i = n$. Thus, three equations are required in order to close the model. The first comes from the Lewisian assumption, which may be expressed by equation 24. The second is the Kalecki-Steindl desired accumulation function given by

$$g^n = g^n\left(r_n \, \frac{X_n}{K_n}\right) \qquad [27]$$

with both partials being positive. The third is a Kaleckian mark-up pricing equation, given as

$$P_n = W_n a_0^n (1+z) \qquad [28]$$

where z is the fixed mark-up rate.

Substitution of equation 27 in equation 12 and solving for r_n gives

$$r_n = \left[\frac{z}{(1+z)}\right]\frac{X_n}{K_n} \qquad [29]$$

which, when substituted into equation 27 implies g^n is a rising function of r_n , which we assumed to be concave and given by GG in panel (b) of Diagram 6.3. Its intersection with ON, given by equation 16, determines g^n* and r_n*. As before, in panel (d), AB is the wage-profit frontier. However, because of excess capacity, the economy must lie inside this frontier, such as at point C, where (W_n / P_n)* is obtained using equation 28. Note also that at point C, the inequality of equation 5 (for $i = n$) is satisfied. OS in panel (a) shows equation 17 and solves for r_s* and g_s*. In panel (c) OT represents equation 24 and solves for π*. Substituting r_n* into equation 29 solves for (X_n / K_n)*. Substituting this and the common rate of growth into equation 19 solves for k*.

Analysis of parameter changes using this model reveals a number of interesting results. For instance, a rise in mark-up rate, which pushes the GG curve downward, is associated with a deterioration in terms of trade of the South. A similar deterioration in terms of trade may result from productivity growth associated with technological change in the South, while growth in the North may improve the terms of trade of the South. (See also Dutt 1990: 169 for a similar analysis, in relation to other parameter changes.)

Among the existing North-South models, some of which are examined in section 6.3 below, Taylor (1981, 1983, 1991), Darity and FitzGerald (1982), IMF's MULTIMOD (Masson et al. 1990), Vos (1994), Sarkar (1994, 1996) may all be considered as falling under this broad category.

6.2.2.4 The Neo-Marxian North and a Lewis South model

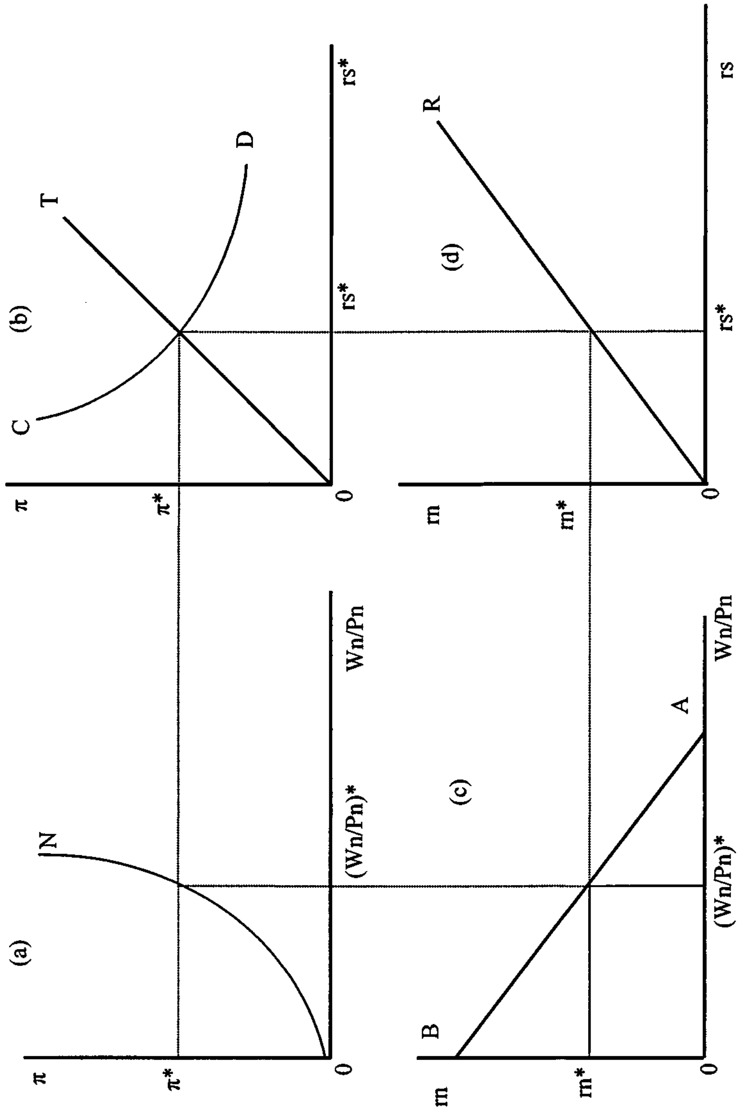
Problems exist with the labelling of this type of model. The widely cited model developed by Vines (1984), as well as the published version, developed by Molana and Vines (1989), have both wrongly been termed '... along Kaldorian lines'. Molana and Vines' model essentially assumes a Lewis-type economy within the South.[5] The North is also assumed to have surplus labour with an exogenous real wage and the level of output taken as supply-determined rather than Keynesian (Molana & Vines 1989: 444). Following Dutt (1990), the economy of such a North might better be termed Neo-Marxian than Lewisian. Certainly, it is wrong to label such models as Kaldorian, since Kaldor explicitly assumed that in the North, 'prices are administered' using mark-up, that there is excess capacity and hence, that output is demand determined through 'a stock adjustment mechanism' (Kaldor 1976: 705). After correcting for this oversight, Sarkar (1994, 1996) developed various North-South models. However, Sarkar's models are best understood as broadly falling under a Kalecki-Lewis classification, as described in section 6.2.2.3, above.

In terms of our equations, full capacity utilization in both North and South is assumed. This implies that equations 20 and 21 hold. The South is assumed to have a given real wage so that equation 23 also holds. Similar assumptions for the North implies,

$$\frac{W_n}{P_n} = V_n \left(\frac{P_s}{P_n} \right)^{1-a} \qquad [30]$$

for a given V_n, which is fixed, say, for Neo-Marxian reasons.

Diagram 6.4 Neo-Marxian North and Lewisian South



Inserting equation 21 into equation 13 implies 24, as in the first model. This gives the OT line in panel (b) of Diagram 6.4. From equations 16 through 18 we get,

$$r_n = \left(\frac{S_s}{S_n}\right) r_s \qquad [31]$$

which gives OR in panel (d). Substitution of 20 into 12 yields equation 25, which gives line AB in panel (c). In panel (a), ON shows equation 30 for a given V_n. Curve CD in panel (b) is derived from OR, AB and ON in the diagram and plots the locus of r_s and π, which satisfy equations 25, 30 and 31. The intersection of OT and CD in panel (b) determines r_n* and π*. r_s* and (W_n / P_n)* can be read from the rest of the diagram. Substitution of the rates of profit into equations 16 or 17 determines g*, and substitution of this and equation 20 into 19 implies,

$$k^* = \left[(1 - s_s)\left(\frac{b}{s_s}\right)\right]\left\{(1 - a)\left[\left(\frac{1}{g^* a_1^n}\right) - 1\right]\right\}^{-1}$$

Analysis of various parameter changes using this model is undertaken in Dutt (see Dutt 1990: 165). It is interesting to note that within this model, technical progress in the South (represented by lower a_0^s and a_1^s) implies a deterioration in its terms of trade, while a similar improvement in the North improves the terms of trade of the South. As noted above, the Vines (1984) and Molana and Vines (1989) models may broadly be taken as falling under this general category.

6.2.2.5 Some points about capital flows

The models outlined above are based on general macro and trade linkages. The emphasis on such a framework is justifiable for primary commodity-exporting countries like those in Africa, since such trade linkages are central in understanding macroeconomic performance. As demonstrated by Vos, '... capital flows do not alter the pattern of asymmetric adjustment' within such an economy (Vos 1989b: 130–38).

Following this line of argument, Vos (1989b) and Dutt (1990) have extended the above framework for the analysis of capital flows from North to South. Both assume that part of the capital stock in the South is owned by the North, and that the North earns and remits profit from that stock. Within this framework, a further assumption is that capital inflows to the South can be thought as a function of North-South profit differential. This implies, among other things, either the complete ownership of the South's capital by the North ('crowding-out') (Vos 1989b: 132, Dutt 1990: 177–81), or no involvement at all by the North (Dutt 1990: 177–81). The complete crowding-out of the South by the North is further accentuated if the saving elasticity of the North is larger than that of the South (see Dutt 1990: 177–81).

The main reason underlying this crowding-out is that, given the stylized fact of lower income elasticity of primary goods and a relatively high savings rate in the North, capital exports[6] entail a faster growth in the supply of commodities than in Northern demand for these. This, in turn, leads to deterioration in the terms of trade of the South (Vos 1989b: 138). This result stands in stark contrast to the Ricardian H-O-S and the 'new trade theories' model prediction of gains from trade, discussed in Chapter 2. Rather, the result accords more closely with the predictions of non-orthodox models. Moreover, the fact that most African countries are becoming increasingly dependent on aid with comparatively limited access to international banks underlines the importance of theories of official capital flows and the credit-rationing theories discussed in Chapter 2. Vos (1989b, 1994) has formulated the credit-rationing argument in an international banks context. These theoretical avenues are briefly discussed below and are integrated into the model developed in this chapter.

To sum up, this section has clearly demonstrated that the view of the economy, or the stylized facts adopted by the researcher, implies different closure mechanisms and hence, more often than not, different results. Such a thematic classification helps to understand the existing models, which are examined in section 6.3 below. Thus, the following section will examine the practice of global modelling, focusing primarily on how the South is modelled, with the aim of arriving at lessons relevant to the modelling exercise undertaken in this chapter.

6.3 STANDARD NORTH-SOUTH LINKAGES

The standard linkages in North-South models may broadly be classified as *financial* and *trade*. These linkages serve as propagating mechanisms for the impact of macro-policy changes across the two regions, and usually run from North to South. The discussion of these linkages will proceed at two levels. Thus, financial linkages will be examined in section 6.3.1, and trade linkages in section 6.3.2.

6.3.1 Financial Linkages

Most North-South models take account of financial flows, linking North with South. However, the emphasis that is placed on finance, relative to trade linkages varies from model to model. For instance the models of, *inter alia*, Muscatelli and Vines (1991), Murshed (1990) and Vos (1994) place more emphasis on financial linkages compared with other North-South models such as MSG2 (McKibbin & Sachs 1991), the IMF's MULTIMOD (Masson et al. 1990) and Project LINK (Ball 1973). Hence, in this section I will examine how these financial linkages are established within a number of existing models.

In the UNCTAD model (see Ball 1973), which is also used by Project LINK as the model of the South, net factor payments are related to external deficits and export revenue. Important financial variables such as exchange rate and net foreign capital inflows are assumed to be determined exogenously. This exogenously given external finance is specified as affecting the level of reserves, which, in turn, affects the level of imports, and hence, investment. This specification allows for the possibility of depicting the phenomenon of 'import compression.' This is important, since import compression is reported to be widespread, not only in the relatively more advanced developing countries, such as Brazil (Fritsch 1988), but also throughout the less developed countries of Africa (Ndulu 1986, 1991 and Rattsø 1992b).

Within the MSG2 model (McKibbin & Sachs 1991), all new loans to the least developed countries (LDCs) are assumed to remain in historical proportions. All other capital inflows are derived from the consistency that requires world balance of payments to sum to zero. For the US, Japan, Germany, the rest of the OECD and OPEC, the current account is determined under the assumption that domestic agents have free, unrestricted access to international borrowing and lending at international rates. For LDCs the scale of borrowing is set exogenously, by consideration of country-specific risk. In modelling commercial flows to LDCs, the MSG2 model emphasizes the supply-determined nature of such flows, and hence the importance of credit rationing to the South.

In Beenstock's (1988) North-South econometric model, the financial linkage is established following the 'loanable-fund' doctrine. The supply of such funds from OPEC and North is equated to the stock of LDC debt, as well as the North's public debt and capital requirement. This stock equilibrium, coupled with capital market specification for the North, determines the interest rate. Interest rates, in turn, affect the debt service of the South, which is included in the balance of payment equation for the South. The other financial linkage is aid, which is included in the balance of payment equation of the South, as being exogenously determined by the North. Indebtedness of the South is approached as follows. LDCs have a desired debt position in stock terms. In the short run the desired may differ from the actual, reflecting adjustment costs. Reserve movements are determined residually through the balance of payment identity. In the long run, the South could have a desired reserve that might be attained by controlling imports, stimulating exports or altering the exchange rate. Although the total supply of funds and its effect on interest rate is based on the classical 'loanable-fund doctrine', the modelling of capital flows to South does not follow a specific financial theory. Rather, it is derived from a consistency rule, which, in the case of aid, is exogenously given. The Beenstock model also adheres to the assumption that capital flows to the South are largely demand driven. Hence, the model neglects supply conditions in the North which are emphasized in other models.

In the OECD model INTERLINK (OECD 1988), financial linkages are established through the use of capital flows. The capital flow to each country is a function of short-term interest rate differentials, expected rates of currency depreciation/appreciation, and domestic and foreign current balances. Foreign interest and exchange rates are taken as exogenous within the single country model. In the linked model, changes in interest rate, exchange rate and money supply of a country are specified as affecting macro variables in other countries, through their influence on capital flows. Hence, the effects of these variables may be felt throughout the whole system. These equations are subject to strong cross-country parameter restrictions, which, together with appropriate weighting matrices, ensure global consistency of net capital flows. Basically, the financial linkages specified in the INTERLINK model are based on portfolio choice theory. Indeed, the model's particular strength lies in the use of appropriately valued asset and liability stocks in the determination of capital flows.

The World Bank's Global Economic model, Bank-GEM (Peterson et al. 1991 and Pedersen 1994), focuses on three types of external capital flows. These are FDI, debt-creating flows and foreign-asset holdings of the private sector. FDI is set as being determined by the same factors as domestic investment: namely, foreign real rate of interest as an indicator of portfolio choice; domestic GDP as an indicator of market size or policy success; and the real exchange rate, which affects profitability. In modelling debt-creating flows, individual LDCs are assumed to receive a fixed share of official concessional funds, the exact size of which will depend on growth of income within OECD countries. Disbursement of official non-concessional loans will depend on GDP growth of the borrower (as a proxy for creditworthiness), the current account balance (representing financing requirements), and the previous period's net disbursements (as an indicator of borrower behaviour). Public commercial borrowing is projected by imposing the growth rate of official non-concessional borrowing, assuming that this falls within the general borrowing strategy of the LDC in question.

Finally, commercial borrowing of the private sector constitutes the residual component of the balance of payments. Portfolio returns and risks associated with portfolio holding, as well as risk differential by domestic and foreign investor, and hence, two-way flow approaches may be used to define the foreign assets of the private sector. Hence, these assets, sometimes referred to as 'capital flight', may be defined as a function of: (1) domestic income growth (which may be associated with lack of opportunities at home or policy credibility); (2) domestic and foreign inflation; and (3) the lagged ratio of foreign asset holdings to total wealth of the private sector within a 'normal' portfolio. The short-term capital flows of the private sector are set as a function of price and volume of imports (in order to show trade credits, which might finance imports), while those of the public sector are defined as the official foreign reserve flows of the balance of payment. The change in reserves is modelled as an adjustment to a desired stock level, which will depend on the dollar value of the exchange rate, as well as the price and volume of imports. Finally, the percentage change in nominal exchange rate is related to the percentage change in domestic and foreign inflation differentials. In general, the Bank-GEM financial modelling is informed by a Mundell-Fleming framework, since financial markets are assumed to clear for world interest rates in an integrated world capital market. Within this framework, private capital inflows are seen as being determined along the lines of a portfolio theory of finance (see Alemayehu 1994 for details about Bank-GEM).

Muscatelli and Vines' (1991) study also focuses on financial linkages. They begin their North-South model by outlining a number of possible causes of the debt crisis. Firstly, domestic policies pursued by the South; secondly, global macroeconomic shocks which result from changes in interest rates, the fiscal and monetary policy adopted by the North, as well as fluctuations in commodity and oil prices; thirdly, creditors' failure to assess risks; and fourthly, trade restrictions applied in the South. The debt crisis has resulted in a variety of expenditure switching and reducing effects. Of these, the former effect was found to have led to inflation, while the latter to import compression and fiscal adjustment, characterized by reduced public spending and high interest rates in the short run. The expenditure reducing effect was also found to have had supply-side effects on long-run growth and developmental potential, with implied demand-side impacts.

In order to locate the above problems in the context of North-South interaction, Muscatelli and Vines (1991) identify the macroeconomic linkages between the two regions. Hence, in the modelling approach adopted, the South is assumed to depend on North for its exports, import of capital goods, and finance. Conversely, the North is assumed to depend on the South in order to meet its demand for raw materials. Further, it is assumed, through the operation of international capital markets, that the economic behaviour of the South can influence that of the North, and vice versa. Thus, the perceived probability of default is likely to adversely affect capital inflows to the South, with a rise in interest rates also having the effect of depressing investment in the South. This, in turn, will affect the short-run demand for Northern goods, and may also have long-run supply effects, as the supply of commodities declines. Moreover, a rise in interest rate will have a negative effect on the debt service costs of the South. Recognition of these linkages has led various authors to focus their attention on three specific areas, in seeking a solution to the debt crisis. Firstly, domestic policies of the South; secondly, macroeconomic policies pursued by OECD countries; and thirdly, measures specifically aimed at reducing the level of outstanding debt.

Murshed (1990) also seeks to explain the debt crisis of the 1980s as representing a recent manifestation of ongoing North-South macroeconomic interactions. For him, the crisis as a whole, its emergence and possible solutions are all rooted in this interaction. Murshed notes a number of stylized features of North-South interaction in the 1980s.

Two such features are a contractionary monetary policy in the North and the intensification of a protectionist tendency toward Southern goods. Such policies have resulted in the collapse of commodity prices and the evolution of indebtedness into a fully blown debt crisis. Adjustment programs designed to tackle debt problems have resulted in entitlement losses and low growth rates. In his model, the North is depicted as functioning in a Keynesian fashion, with income assumed as being demand determined. In the goods market, the financial linkage is established by making Northern absorption partly a function of interest payments on Southern debt. Within this model, disposable income of the North is also set as being boosted by commercial tariffs levied on Southern exports. Capital flows from North to South are set to be a function of interest rates (as in a Mundellian or MacDougall approach), while the South's debt is related to balance of payments. Finally, the balance of payments itself is assumed to depend on macroeconomic conditions in the North.[7] Having analysed the overall model, Murshed concludes that 'the debt crisis as a whole is best viewed as a painful spillover of Northern macroeconomic policy onto the South'.[8] In general, Murshed's model focuses quite sharply on financial interactions relating to macro policy and macroeconomic conditions in the North and their repercussions on the South.

In MULTIMOD (Masson et al. 1990), a model developed and maintained by the IMF, the financial linkages of the finance-constrained developing country is formulated based on its capacity to service external debt. This capacity is measured by comparing the interest on debt to export ratios of LDCs, to an expected or targeted value for a similar ratio, which is exogenously given. In this specification, exchange rate is allowed to have an influence on capital flows to the South. Economic activities in the North will also affect the numerator and denominator, and hence, the overall value of this ratio. A sort of 'import compression' mechanism is predicted when the South's ratio passes the targeted threshold level. The theoretical basis of this approach is a rudimentary credit rationing mechanism based on solvency criteria. Finally, since exports are used in the computation of the relevant ratios, it is reasonable to conclude that MULTIMOD's approach may be used, not only to indicate insolvency, but also short-term liquidity problems.

In Vos' (1994) model, which is termed STAC, financial linkage is established by letting North have unrestricted access to capital markets, while the access of the South is rationed on the basis of an imperfect creditworthiness assessment. This assessment is based on perceived payment capacity, which is calculated by relating interest payment to exports, in a similar fashion to that undertaken in MULTIMOD. Moreover, financial flows from the North are linked to public and private investment by way of the deficit. Imports are determined as residual, thus capturing the 'import compression' phenomenon. Other official flows are taken as being exogenously determined. In Vos (1989b, 1994), as well as Darity and FitzGerald (1982), the theory of credit rationing by oligopolistically functioning international banks is applied in modelling the linkages between the regions. The basic argument of these approaches is that the behaviour of the suppliers, who are basically the international and commercial banks of the North, needs to be taken account of in the determination of such flows. Hence, in relation to lending to the South, the focus is mainly on credit rationing. In Taylor (1981), and Marquez and Pauly (1987), the South's dependence on capital inflows from the North is recognized and understood to result from technological or capital input dependency. The extent of this dependency, which is equal to the regions trade deficit, is assumed to be determined by political factors. Indeed, following Vos (1989b), Taylor (1991) has attempted to model these financial linkages. Finally, the models of Findlay (1980, 1981) and Molana and Vines (1989) do not consider capital flows at all.

To sum up, recent global models have attempted to incorporate different aspects of financial flows. However, the emphasis, the selection of variables and the specification adopted will vary depending on the theoretical approach chosen or the accounting framework adopted. Most existing models which focus on the North emphasize the Mundell-Fleming and portfolio theories of capital movements in modelling financial linkages. However, there are also a growing number of North-South models which are based on theories of credit rationing and oligopolistic banking behaviour. Indeed, the latter approach is quite plausible in explaining private bank flows to African countries, which are usually considered to be the worst risk. Thus, in modelling these flows to Africa a theoretical framework based on oligopolistic banking behaviour will be very important. Hence, this approach, together with some other specific features of African macroeconomics not considered in existing North-South models, will be taken into account in building the model set out in this chapter.

Table 6.1 Summary of financial linkages

North-South models	Uses interest rate from integrated capital market	Uses dis-aggregated capital flows
Beenstock 1988	Yes	Limited
Darity & FitzGerald 1982	No	Limited
INTERLINK, OECD, 1988	Yes	No
MULTIMOD (IMF) Masson et al. 1990)	No	No
Murshed 1990	Yes	No
Muscatelli & Vines 1991	No	No
MSG2 (McKibbin & Sachs 1991)	No, but yes across N	No
STAC (Vos 1994)	No	Limited
Taylor 1981; Marquez & Pauly 1987	No	No
Findlay 1980, 1981; Molana & Vines 198	No	No
UNCTAD, Project LINK (1973)	No	No
Bank-GEM (Peterson et al. 1991, Pedersen 1994)	Yes	Yes
North-South models	Focus on debt, default and N macro policy effect on S	Focus on import compression
Beenstock 1988	Yes	No
Darity & FitzGerald 1982	No	No
INTERLINK, OECD, 1988	No	No
MULTIMOD (IMF) Masson et al. 1990)	Limited	Yes
Murshed 1990	Yes	No
Muscatelli & Vines 1991	Yes	Yes
MSG2 (McKibbin & Sachs 1991)	No	No
STAC (Vos 1994)	Yes	Yes
Taylor 1981; Marquez & Pauly 1987	No	No
Findlay 1980, 1981; Molana & Vines 1989	No	No
UNCTAD, Project LINK (1973)	No	Yes
Bank-GEM (Peterson et al. 1991, Pedersen 1994)	No	No

(Continued)

Table 6.1 (continued)

North-South models	Comprise credit rationing behavior in *N*	Focus on supply side determination of flows (liquidity, risk)	Focus on the demand side determination of flows
Beenstock 1988	No	No	No
Darity & FitzGerald 1982	Yes	Yes	Yes
INTERLINK, OECD, 1988	No	Limited	Limited
MULTIMOD (IMF) Masson et al. 1990)	Yes	Yes	No
Murshed 1990	No	No	Yes
Muscatelli & Vines 1991	No	Yes	Yes
MSG2 (McKibbin & Sachs 1991)	Yes	Yes	Yes, through consistency rule
STAC (Vos 1994)	Yes	Yes	Yes, through deficit financing
Taylor 1981; Marquez & Pauly 1987	No	Yes,	Yes, through deficit financing
Findlay 1980, 1981; Molana & Vines 1989	No	No	No
UNCTAD, Project LINK (1973)	No	No	No
Bank-GEM (Peterson et al. 1991, Pedersen 1994)	No	Yes, but limited	Yes

6.3.2 Trade Linkages

At least two basic approaches have been used in modelling trade linkages between North and South: firstly, one which ensures *endogenous determination* of the relevant trade variables (i.e., exports, imports and their prices), and secondly, an approach based on trade or market *share matrices*. In relation to the first of these approaches, three important aspects may be outlined. The first of these relates to the nature of the market, with the North usually assumed to specialize in industrial goods production and the South in primary goods. The market for industrial goods clears for quantity, or, in some models, for price, while that of primary goods clears only for price. Secondly, it is noteworthy that some models move beyond this simple but illuminating classification, and disaggregate commodities into at least four to five commodity groups. Thirdly, a number of models focus explicitly on the impact of financial variables on the primary commodity market. The second approach, using trade share metrics, also has a number of variants. Thus, bilateral trade may be estimated directly, from a linearized Armington formulation (Hickman & Lau 1973), by using an estimation of total exports, by allowing variation in the share matrices (Klein & van Peterson 1973), or by emphasizing measures of competitiveness (Samuelson & Kurihara 1980).

A very common approach, used in most recent global economic models, is to establish the link between North and South through the specification of the supply of exports from one region, with the demand for imports in the other. This approach has been adopted by, among others, Krugman (1979a), Taylor (1981, 1983, 1991), Marquez and Pauly (1987), Masson et al. (1990), Vos (1994), Muscatelli and Vines (1991) and Moutos and Vines (1988). In none of these models, with the exception of MULTIMOD, are commodities disaggregated. Rather, usually an aggregate manufactured good is specified for the North, and an aggregate primary commodity for the South. However, as described below, the models differ as to how they specify their trade linkages, as well as the assumptions made about the nature of the goods market.

In the UNCTAD model, Project LINK, an attempt is made to model the South. However, the specification of the import/export equation, or trade linkage, for the South is carried in a very simple manner. Thus, exports are simply related to an index of world trade and a ratio of exports to world price, while imports are related to GDP, lagged real foreign inflows, deflated by import price, and the real exchange rate. The major trade linkage is established through market shares. The initial LINK exercise was to estimate the import function of each country, for a given level of world trade. Subsequently, world-level consistency is achieved by making the total world level of trade an adjusting variable. This is termed the Mini-Link. This approach assumes that the level of world trade is the only adjusting variable. An alternative approach, termed the Maxi-Link, is employed in the final version of the Project LINK model. The Maxi-Link is a modified Armington formulation, and is estimated by relating actual to estimated exports. The latter are estimated based on share matrices, estimated imports, a partial adjustment specification of such estimates in the preceding period, and a trend term (see Klein & van Peterson 1973). When constructing models the size of Project LINK and Bank-GEM, the use of a simplified structure is understandable. However, it should be pointed out that this simplicity might come at the expense of ensuring the use of theoretically and empirically sound adjustment mechanisms.

Table 6.2 Summary of trade linkages

North-South models	Uses trade share matrices	Uses endogenous determination of trade variables
Alogoskoufis & Varangis 1992	No	Yes
Beenstock 1988	No	Yes
Darity & FitzGerald 1982	No	Yes
INTERLINK, OECD, 1988	Yes	No
MULTIMOD (IMF) (Masson et al, 1990)	No	Yes
Murshed 1990	No	Yes
Muscatelli & Vines 1991	No	Yes
MSG2 (McKibbin & Sachs 1991)	No,	Yes
STAC (Vos 1994)	No	Yes
Taplin 1973	Yes	No
Taylor 1981; Marquez & Pauly 1987	No	Yes
Findlay 1980, 1981; Molana & Vines 1989	No	Yes
UNCTAD, Project LINK (1973)	Yes	No
Bank-GEM 1991, 1994	Yes	No

North-South models	Directly links macro variables to commodity market	Uses disaggregated commodities	In goods market the North is quantity clearing while South is price clearing
Alogoskoufis & Varangis 1992	Yes	No	No[a]
Beenstock 1988	Yes	No	No[b]
Darity & FitzGerald 1982	No	No	Yes
INTERLINK, OECD, 1988	No	Yes	No[c]
MULTIMOD (IMF) (Mas. et al '90)	No	Yes	Yes
Murshed 1990	Limited	No	Yes
Muscatelli & Vines 1991	Limited	No	No[b]
MSG2 (McK. & Sachs 1991)	No	No	No[b]
STAC (Vos 1994)	No	No	Yes
Taplin 1973	No	Yes	No[b]
Taylor 1981; Mar. & Paul 1987	No	No	Yes
Find. 1980, '81; Mol. & V. 1989	No	No	No[b]
UNCTAD, Project LINK (1973)	No	Yes	No[b]
Bank-GEM 1991, 1994	No	Yes	No[b]

[a] interest also clears [b] both are price clearing [c] price clearing in the North is limited

The Bank-GEM model followed two approaches in dealing with trade linkages. The first was to use a modified Armington-type specification. The modification relates to the inclusion of price pass-through effects, a time trend[9] and the use of an error correction method within the estimation. This approach is then used in the specification of trade in manufactures (SITC 5-9). For trade in food and beverage (SITC 0+1), raw materials (SITC 2+4) and energy (SITC 3), a similar approach to that used in Project LINK is proposed. However, it is not clear which version of the LINK's linkage mechanism is to be used.[10] Neither does the Bank-GEM model clearly explain the market structure used in its commodity market. For manufactured goods it seems that a middle path between monopoly and perfect competition is chosen. However, there is no guarantee that the price specification used will yield the intended results (see Peterson et al. 1991: 18). Indeed, within such a set-up, price is more likely to be flexible than fixed.

A global trade model, very much in the tradition of the export share matrix, is that of Taplin's (1973) model of world trade.[11] Taplin's model (discussed at length in Chapter 2) is based on the 'Expanded World Trade Model (EWTM)', developed by the Research Department of the IMF for the short-term forecasting of trade flows and analysis of economic policies. The version discussed here treats the world as divided into 27 countries and regions, comprising each of the 25 developed countries, the CEMA (the former 'socialist' countries) and the rest of the world (RW). The RW encompasses the developing countries in total. The level of imports for each developed country is determined by an import function. Economic activity (measured as autonomous spending) and relative prices are both represented as explanatory factors within the import function. However, due to a shortage of relevant information, economic activity and exports are used to determine the imports from the CEMA region. The imports of the rest of the world are set as a function of current and past foreign exchange receipts. The level of exports of each country and region are obtained by distributing the forecasted imports by an export share matrix. In common with Project LINK, export share matrices lie at the heart of the system. Thus, using Armington's approach, the share matrices are estimated by regressing the change in market shares onto a proportionate change in price ratio.

Another widely cited global model is MSG2, in which the linkage between North and South is set in a vertically integrated fashion. The

North produces consumption and investment goods, while the South supplies primary inputs, including oil, for use in the North's production process. Thus, the demand for goods from the South is a derived demand for Northern goods. Output of the North is specified, in a Cobb-Douglas form, as a function of value added and primary inputs. Value added is further specified, also in Cobb-Douglas form, using capital and labour as inputs, while primary inputs are defined as a Cobb-Douglas function of oil and non-oil primary inputs. Oil is then specified as a Cobb-Douglas function of domestic production and imports from OPEC. For goods from OPEC and the LDCs, a single world uniform price is assumed. Prices of commodities from the South and OPEC are defined by a mark-up over a basket of OECD goods. By making this mark-up, a positive function of the demand for OPEC and LDC exports – in effect, the price of OPEC and the South's commodities – are assumed to be demand determined. However, the downside of this assumption is that it overlooks the important distinction that the oil market clears for output and the primary commodity market for price, which is taken as a stylized fact in most recent North-South models. However, a useful development incorporated into the MSG2 model is the use of an integrated or nested production structure. Although the MSG2 specified such relations at an aggregate level, the method may also be applied in relating sectoral supply to sectoral demand, within the two regions or countries. The specification of such sectoral linkages would allow for the examination of the sectoral implications of macro linkages in general, and of trade linkages in particular.

Based on Vernon's (1966) theory of 'product cycle', Krugman (1979a) has formulated trade patterns that emerge from technological change within a North-South framework. He assumes a world of two countries, consisting of an innovating North and a non-innovating South. Innovation takes the form of developing new products, which could, after a lag, be produced in the South. The lag in the adoption of new technology by the South gives rise to trade. Interestingly, Krugman concludes that the

> North always exports new products and imports old products... Each good is at first produced in and exported by the North; then when technology becomes available to South, the industry moves to lower wage country. Case studies in such a world reveal a Vernon-type product cycle. (Krugman 1979a: 260)

Although his theory cannot usefully be applied to the South in general, Krugman's general point remains valid for particular countries, particularly in East Asia. However, its relevance to low-income, institutionally-weak African countries remains very limited.

One of the trade linkages used in the North-South model developed by Alogoskoufis and Varangis (1992) relates to an attempt to link the fiscal condition of the North with the primary commodity price of the South. This is a very small model, which is analytically similar in structure to that of the Mundell-Fleming model. In the section of the model dealing with the North, for a given set of supply and demand parameters, macro equilibrium depends on the relative price of commodities to manufactures, and on the real interest rate. A similar equilibrium structure is also maintained in the section dealing with the South. Finally, the two models are combined and solved for the equilibrium values of real interest rate and relative prices. The model conveys an important point, that the relationship between world interest rate and primary commodity prices could be negative or positive, depending on the origin of shocks. Thus, if demand and supply shocks originate, say, from the North, the relationship between real interest rate and relative prices is negative. This result indicates the presence of a strong linkage between the fiscal deficit in the North and price of primary commodities. The model developed by Beenstock (1988) also emphasizes such commodity and financial market linkages.

In the IMF's MULTIMOD (Masson et al. 1990), trade in goods is disaggregated into three basic commodity groups: oil, primary commodities and manufactures. Trade in oil is assumed to take place at a unique world price, which is determined exogenously. For the industrialized countries a domestic demand equation determines oil consumption, with oil imports determined as a residual, once domestic sources have been tapped. For the two groups of LDCs specified in the model, namely capital importing and capital exporting, exports of oil are taken as endogenous and world demand is equated with world supply. Any increase in demand is shared between the two regions in fixed proportions, with production passively responding to demand at a given price. Primary commodities produced by the South are assumed to have perfectly flexible prices, which will ensure market clearing. Relative price changes in favour of primary products, or profitability, are assumed to induce a shift of resources into this sector, with associated positive repercussions. Manufactured products are assumed to be produced by all countries and are mark-up priced. With the exception of high-income oil earners, the import and export of manufactures is taken as endogenous to the model.

The trade linkage is established with the North's export of manufactures, through an export equation that comprises foreign absorption and real effective exchange rate as explanatory factors. Another trade linkage is established with the commodity imports from the South using an import function, which contains the variables for Northern GDP and real exchange rate as arguments. Owing to the endogenous determination of the main linkages,[12] the model is characterized as a dynamic version of the Mundell-Fleming model. An important feature of MULTIMOD is its market structure. Specifically, manufactured goods are (fix-price) quantity clearing, while primary commodities are (flexiprice) price clearing.

The North-South models of Taylor (1981, 1983, 1991), Darity and FitzGerald (1982), Marquez and Pauly (1987), Vos (1994) and Sarkar (1994, 1996), among others, are also based on a similar market structure, with the Northern goods market clearing for output, and commodity markets for price. These models fall under the same theoretical grouping as the Kalecki-Lewis models discussed in the previous section. In contrast, the trade linkages within the models of Findlay (1980, 1981), as well as Molana and Vines (1989), describe a perfectly competitive market within both regions. These markets accommodate goods produced using a neoclassical production function.[13] Thus, in these models, the demand for imports within each region will depend on relative price and real income.

In the OECD's INTERLINK model, volume of imports and price of exports are determined endogenously, with domestic demand, costs and international prices used as explanatory variables. However, with the exception of energy suppliers, non-OECD countries are taken as price takers, with their export prices assumed to follow that of competitors. Food and raw materials are taken as a function of demand within the OECD. Such single-country estimates are passed to the trade linkage model where a consistent export volume (by way of share equations)[14] and import price estimates are determined. This is undertaken by allocating country-based estimates of global import demand among individual exporting countries, which, in turn allows for the determination of import prices for each country. The main determinant of the export share is the export market growth elasticity which, itself, depends on past trends, competitiveness and the commodity export composition of a country. These export and import prices are, in turn, passed to the individual country models, as revised inputs. The process is then iterated, in order to arrive at an internationally consistent model solution. Global consistency between import and export volume is enforced by combining the structure of the system, as described above, with parameter restrictions across a set of export volume equations. In general, this trade linkage is similar to the one used in Project LINK and proposed for use by Bank-GEM. However, while in LINK, consistency is achieved by estimating exports, allowing for possible factors to influence the share-based estimation, parameter restriction plays a significant role in INTERLINK.

6.4 SUMMING UP

So far, in this book, I have examined both the theory and practice of North-South modelling. The theoretical section of this discussion has shown that the assumed stylized facts, or view of the economy, will determine the structure of the North-South models which are developed. As a result, the implications of particular shocks or policies could vary across different types of model.

An interesting conclusion may be arrived at when these theoretical models are contrasted with the stylized facts in relation to Africa. As described in Chapter 1, African countries are price takers within the international commodity market, with the market for their commodities characterized by price clearing. An 'unlimited' labour supply is also found to represent a plausible hypothesis for most of these countries. Moreover, African nations will tend to trade with (Northern) countries, which have excess capacity, and which are dominated by big firms with price-making capacity. In fact, as demonstrated by Yeats (1991), for some commodities, such as metals, African countries will tend to pay an average premium of 23 per cent above the unit value for other developing countries (Yeats 1991: 201). The discussion presented in Chapter 1 also shows the extent to which African countries are dependent on aid. These countries are also likely to be the worst risk for private lenders, and commercial banks in particular. These stylized facts underscore the relevance of the Kalecki-Lewis model in depicting analytically the incorporation of these national economies into the world economy. However, this incorporation would not be complete without, first, describing the financial interaction of these economies. Hence, the discussion relating to official inflows presented in Chapter 2, combined with an international credit-rationing hypothesis, will need to be integrated into the Kalecki-Lewis model, in order to strengthen the relevance of this model for Africa. This line of argument stands as the main justification for adopting this structure in the model constructed in the following section.

Two other important issues arise from the survey of models presented in this chapter. Firstly, undertaking a survey of existing models is extremely important in identifying the specific linking mechanisms, which will need to be incorporated during model construction. Hence, the linkages identified within these models will be used to guide the construction of the model set out below. Secondly, the above survey demonstrates that the modelling of the South remains extremely rudimentary. Indeed, in the case of Africa, such modelling has been neglected almost entirely. The major implication of these findings is that insufficient account has been taken of the basic macro features of the South within existing North-South models. This implies a need to identify the salient macro features of African economies, as was undertaken in Chapter 3, and to integrate these within a North-South modelling framework. Hence, the following section will be devoted to such an exercise.

6.5 Africa within a North-South Framework: A Neostructuralist Global Econometric Model (AFRIMOD)

The specification of the North-South model outlined below is based on the theoretical North-South models of Taylor (1981, 1983, 1991), Darity and FitzGerald (1982), Kanbur and Vines (1986), Murshed (1990) and Vos (1994), as well as on the empirical models of Marquez and Pauly (1987) and Masson et al. (1990). In relation to the theoretical discussion set out above, the basic characteristic of the model is its effort to combine a Kaleckian/Keynesian North, a Lewis-type economy for the South, and an oil-producing and -supplying region (representing the OPEC countries). The North and OPEC will be dealt with in a very limited fashion, with an attempt to develop and elaborate upon the modelling of Africa taken as the prime objective. This approach stands in opposition to the current practice in North-South modelling, in which the focus has, mainly, been on elaborating upon the section of the model dealing with the North. All parameters, with the exception of two equations, and some ratios, have been econometrically estimated. This means that the model may also be interpreted as an empirical model. The discussion will be organized as follows. In sections 6.5.1 to 6.5.5, a North-South model will be specified. Although the specification set out below takes a linear form, all estimations are undertaken using a log-log model. However, in order to ensure compatibility with the identities specified in the model, appropriate conversion of the log-log model is undertaken. Section 6.5.6 outlines some practical analytical solutions, which help in understanding the major issues, which are addressed within the model. Finally, a glossary of symbols used and coefficients estimated is given at the end of the chapter.

6.5.1 The North

The modelling of the North adopted in this book is not an elaborated one. There are two main reasons for this: firstly, the focus of the book is mainly on the modelling of the South, and Africa in particular; secondly, if need be, an elaborated model of the South developed in this book may be combined with the existing models which have an elaborated North. Notwithstanding the existence of a number of models incorporating an elaborated North, I have specified below a less elaborated model of North, based on Taylor (1981). The use of this less elaborated model for the North has two desirable consequences. Firstly, it allows one to specify the North along theoretical lines, which are best suited to the purposes of this book. Secondly, incorporation of this less elaborated model for the North allows one to understand the interaction of the two regions and hence, subsequent feedback effects of the North on the South.

6.5.1.1 The major macro aggregates sub-bloc

The North is assumed to be an economy with excess capacity, with output taken as being demand determined, along Keynesian/Kaleckian lines. This is given by equation 1, which is the aggregate equilibrium condition, and the basic closure of the model for the North.

$$Q_N = C_N + I_N + G_N + X_N - M_N \qquad [1]$$

The demand component comprises a simple consumption function that depends on income (equation 2), an investment function, which depends on income and world interest rate (equation 3) and exports and imports (given in equations 4 and 5, respectively). By making the two regions, OPEC and the South, the destination and source for exports and imports of the North, respectively, equations 4 and 5 ensure a trade linkage among the three regions.

$$C_N = a_2 + b_2 Q_N \qquad [2]$$

$$I_N = a_3 + b_3 Q_N - c_3 i_W \qquad [3]$$

$$X_N = PM_N^{fg} \, (MM_O^{fg} + MM_A^{fg}) + M_{OT} + otX_N \qquad [4]$$

$$M_N = MR_N^S + P_{oil} \, (MO_N^O + XO_{NA} + XO_{WC}) + otM_N \qquad [5]$$

The Northern (manufactured) price equation (equation 6) is based on a Kaleckian mark-up pricing approach, which assumes an oligopolistic market structure in the North. The specification follows recent works of Taylor (1981, 1983, 1991), Darity and FitzGerald (1982), Marquez and Pauly (1987) and Vos (1994). It is positively related to prices of intermediate inputs, comprising wages, imported raw materials and oil price, and inversely related to excess capacity in the North.

$$PM_N^{fg} = a_6 + b_6 P_{oil} + c_9 w_N + d_6 P_R - e_6 EXCAP \qquad [6]$$

Following a Kaleckian/Kaldorian tradition, private saving is assumed to come from profit and non-wage income, which, in turn, depends on the mark-up pricing scheme specified in equation 6. Following Murshed, the level of saving is further augmented by factor income from abroad as well as interest income from Southern debt. Since such income usually accrues to multinational firms and banks, their propensity to consume out of these factor incomes is assumed to be negligible. This is given in equation 7.

$$\begin{aligned} S_N = s_N \, & \left[\tau\left(w_N b_N + P_{oil} m_N\right)\right] Q_N + (1+\mu_s) \, i_w B_s + i_{w*} F_S + \\ & i_w \, \left(DC_N - J_N - J_{OT}\right) + fp_S \end{aligned} \qquad [7]$$

Factor payment receipts from the South is formulated based on a historical trend of factor payments and foreign direct investment (FDI) to South. Thus, the coefficients in equation 8 below are average ratios of factor payments to FDI for the years 1983–90.

$$fp_S = a_8 FDI_{OT} + b_8 FDI_{NA} + c_8 FDI_{WC} + d_8 FDI_{ES} \quad [8]$$

The North also interacts with the OPEC (oil-producing and -exporting countries) through its oil consumption function, which is given in equation 9, as well as subsequent demand for oil imports, which is given by equation 10. Consumption of oil in the North is related to price of oil, the price of a substitute, such as coal, and the level of economic activity in the North.

$$COIL_N = a_9 - b_9 P_{oil} + c_9 P_{coal} + d_9 Q_N \quad [9]$$

$$MO_N^O = (C_{oil_N} - Q_{oil_N}) - XO_{NA} - XO_{WC} \quad [10]$$

6.5.1.2 The official capital flows sub-bloc

Following Vos (1994), the deficit of the North may be specified as in equation 11, where it is financed by issuing bonds, or by assuming that the government in the North is a borrower, having preferential access to international capital markets.

$$DEF_N = \Delta DC_N = G_N + i_w DC_N + \Delta F_S - t_N(1 - P_{oil} m_N) Q_N \quad [11]$$

However, the Vos version of this is extremely aggregated and does not specify how inflows to the South are determined and allocated. Hence, a major extension of Vos' approach is undertaken by further specifying official capital flows to the South, using equations 12 and 13. As discussed in Chapter 2, given the total inflow to the South (in equation 11) as a policy variable in the North, or determined by the North's affordability criteria, the allocation of the total inflow across the South, given by equation 12, is based on the theoretical approaches of, *inter alia*, Ruttan (1992), OECD (1985), Mikesell (1968), Mosley (1987), Dudley and Montmarquette (1976), and McGillivary and White (1993). This literature emphasizes economic, strategic and political self-interest, as well as developmental/humanitarian considerations. Of these, economic considerations are represented by the first two arguments within equation 12, strategic and political self-interest by the third argument and developmental/humanitarian considerations by the fourth argument. This specification is extended to include indicators of relative repayment capacity (represented by the fifth argument in equation 12), since this represents another important economic variable not considered in the literature. As shown in Chapter 4, the formulation of equation 12, using an ECM, allows the error correction term to capture not only the impact of recent past budgetary practices but also previous historical/colonial ties.

$$\Delta F_A = a_{12} - b_{12}\left(\frac{M_{OT}}{M_A}\right) - c_{12}\left(\frac{FDI_{OT}}{FDI_A}\right) + d_{12}SAP + e_{12}\left(\frac{Y_{OT}^P}{Y_A^P}\right) + f_{12}\left(\frac{DSR_{OT}}{DSR_A}\right) \qquad [12]$$

6.5.1.3 The foreign direct investment sub-bloc

Following the discussion presented in Chapter 2 and the empirical analysis of Chapter 4, equation 13 is specified using a simple 'eclectic' approach to the determination of foreign direct investment (Dunning 1993) and theory of industrial organization (Helleiner 1989). The first argument in this equation shows market size, the second is used to capture the concentration of FDI in the mining sectors of most African countries, the third argument is a dummy, which indicates the number of countries who followed a programme of deregulation, or adopted a structural adjustment package or similar policy incentive, and finally, the lagged dependent variable is used to capture other historical considerations, as well as 'economies of specialization' or internalization used in pursuing FDI. In the first two arguments the variables are computed relative to other South, in order to indicate the choice faced by Northern agents.

$$FDI_A = a_{13} - b_{13}\left(\frac{Q_{OT}}{Q_A}\right) - c_{13}\left(\frac{MIN_{OT}}{MIN_A}\right) + d_{13}SAP + e_{13}(FDI_A)_{t-1} \qquad [13]$$

Both equations 12 and 13 are fitted to the three regions, which form the focus of this study.

6.5.1.4 The commodity sub-bloc

The commodity sub-bloc arises out of the empirical analysis presented in Chapter 4. Ideally the modelling of the commodity could have been undertaken along the lines of Hwa (1985) and Ramanujam and Vines (1990), both of which are based on the theoretical work of Adams and Behrman (1976).[15] However, this could not be carried out due to the absence of available data on stockholding. As discussed in Chapter 4, the commodity bloc specified in equations 14 and 15 indirectly addresses the stockholding behaviour of Northern agents. Following an econometric analysis, the equilibrium version is found to be relatively the better and hence, this version below is used.

$$X_i^{dd} = a_{14} + b_{14}Q_N - c_{14}i_w - d_{14}\left(\frac{P_{R_i}}{PQ_N}\right) \qquad [14]$$

Solving equation 14 for P_{Ri} and taking the log of the result gives equation 14.1. This equation is used for estimating the simultaneous equations-based model (given in Appendix 4.3). Results reported in Table 8.2 below refer to the ECM-based estimation of equation 14.

$$P_{R_i} = a_{14} + b_{14}Q_N - c_{14}i_w + d_{14}PQ_N - e_{14}X_i^{dd} \qquad [14.1]$$

$$X_i^{ss} = a_{15} + b_{15}\left(\frac{P_{Ri}}{PQ_S}\right)_{t-1} + c_{15}\left(\frac{I_s}{Y_s}\right)_{t-k} \qquad [15]$$

where: k is the number of lag period and i stands for commodity i.

$$X_i^{dd} = X_i^{ss} \qquad [16]$$

Equations 14 and 15 are used for four commodity categories (i = 1...4) consisting of food, beverage, agricultural raw material, and, finally, metals, ores and minerals. As discussed in Chapter 4, as well as in Bond (1987), this distinction is found to be empirically important. Thus, through equation 16, the global commodity market for each commodity category clears for price (i.e., flexi-price). As discussed in Chapter 2, this is in line with various studies relating to the functioning of commodity markets, starting from the classic works of Prebisch (1962) and Singer (1950). Following a lag period, the price derived in this market, in turn, determines the supply of exports from Africa (equation 33). Moreover, through the identity given in equation 50, supply from Africa has an effect on global supply, which is given in equation 15. Thus, as illustrated in Diagram 4.1 of Chapter 4, the global commodity market and African supply are dynamically linked.

6.5.2 The South: Africa

6.5.2.1 The major macro aggregates sub-bloc

Within this sub-bloc, the South is divided into two regions, comprising Other South (OT) and Africa (A). The latter, in turn, is further divided into three sub-regions, based on the UNECA classification. These are East & Southern Africa (ESA), North Africa (NA) and West & Central Africa (WCA).[16] As discussed in Chapter 1, an historic and economic justification for such a classification, based on the nature of each region's interaction with Western Europe, may be found in Nzulu et al. (1979) and Amin (1972). The model specified below is a prototype model used for each region. The rest of the World and Other South categories are, on the whole, assumed to be exogenous to the model, the major features of which are outlined below.

Unlike the North, the South is assumed to be a supply-constrained economy. In general, the long-run, supply-constrained nature of such economies may be depicted by a production structure characterized by full-capacity utilization (Taylor 1981, 1983). However, in Africa, the past two decades have witnessed some vital sectors of the economy being faced with under-capacity utilization, arising from problems relating to the supply of imported inputs. This has been especially true of manufacturing, which is dependent on intermediate imports, as well as those sections of the agricultural sector which are dependent on imports of fertilizer and transport facilities. This theme has recently been taken up in the 'import compression' literature in general, and by Ndulu (1986, 1991) and Rattsø (1992a) in particular. Hence, I have explicitly incorporated these considerations in modelling the South through equations 18, 19 and 20. All type of foreign inflows, except foreign direct investment (FDI), are specified as determining the level of imports.

In relation to public and private investment, these are linked to the level of imports through equations 18 and 19. As discussed in Chapter 3, as well as in FitzGerald et al. (1992), the investment functions are based on a theoretical framework that depicts the externally constrained nature of investment in developing countries. Given the flow of foreign finance (whether based on trade or on external borrowing), as well as outflows of foreign exchange (with debt service payment included), the level of imports is defined (by way of equation 20) as an accommodating variable. The level of reserves is also assumed to be zero, which is not an unreasonable assumption, given the precarious nature of reserves in Africa. A further simplifying assumption which is employed is that (after settling external financial obligations, including capital flight) all types of aid are best considered as representing an additional source of external finance, which will enhance the level of imports. Although this assumption is very limiting in the context of 1970s Africa, where project aid was important, it is quite relevant for the 1980s and 1990s. Moreover, equation 20 is also central in incorporating the basic themes summarized in the import compression literature. This equation depicts a situation in which imports are squeezed by foreign obligations, of which debt servicing is central.

Thus, equations 17–23 together summarize the major macro bloc of the South. Beginning with equation 17, this equation illustrates the supply of output from the South (the estimation procedure for the capital output ratios is discussed below).

$$Q_A = a_{17} + \sigma_{AP} I_{AP} + \sigma_{Ag} I_{Ag} \qquad [17]$$

where: $\sigma_{AP} = \dfrac{\Delta Q_A}{\Delta K_{AP}}; \quad \sigma_{Ag} = \dfrac{\Delta Q_A}{\Delta K_{Ag}}$

$$\Delta K_{Ag} = I^*_{Ag} = a_{18} + b_{18} Q_A + c_{18} M_A + d_{18} I_{Ag_{t-1}} \qquad [18]$$

subject to: $I^f_{Ag} \le \alpha M$

where: * shows desired level of investment, is the share of M that went to the public sector investment, superscript f is the foreign exchange-constrained level of investment.

$$\Delta K_{AP} = I^*_{Ap} = a_{19} + b_{19} Q_A + c_{19} M_A + d_{19} I_{Ag_{t-1}} \qquad [19]$$

subject to: $I^f_{Ap} \le (1-\alpha)M$

$$M_A = X_A + \Delta F_A + \Delta B_A + FDI_A + i_W J_S - \Delta J_A - (1+\mu) i_W B_A - i_{W*} F_A - k_8 FDI \quad [20]$$

where: $k = b$, c and d

$$C_{oil\,A} = a_{21} + b_{21} P_{oil} + c_{21} \Delta F_A + d_{21} Q_A \quad [21]$$

Equation 21 summarizes consumption of oil by the South. However, unlike Marquez and Pauly (1987), in which oil consumption of the South is considered to be a substitute for capital in the context of cost minimization, we argue here for its complementary. Thus, it has a relatively rigid (inelastic) demand that depends on its own price, availability of external finance and the South's level of output. The econometric estimation would also appear to lend support to this position.

$$MM_A^{fg} = a_{22} + b_{22} PM_N^{fg} + c_{22} Q_A + d_{22} \Delta F_A \quad [22]$$

$$XO_A = a_{23} + b_{23} P_{oil} + c_{23} FDI_{A\,t-1} \quad [23]$$

Equation 22 gives manufactured imports of South, which is specified as a function of own price, domestic demand and availability of foreign inflows. The export of oil function, specified in equation 23 is not used in relation to the ESA region, since that region does not produce oil. Rather, exports of oil are assumed to depend on the relative (to coal) price of oil, economic activity in the North and supply inducing factors such as FDI. Since the econometric analysis did not produce a statistically significant result in relation to the price of coal and Northern economic activity, they are omitted from equation 23. The importance of supply factors in oil export functions is discussed in Oshikoya's (1989) model for Nigeria. He uses output of oil as a regressor. However, since the relationship between output and exports are proportional, this is tantamount to regressing a variable on itself. Thus, in order to rectify this shortcoming, lagged (domestic) investment in the sector is used within this model. The latter, however, turns out to be statistically insignificant while FDI remains significant. Hence, this serves as justification for the inclusion of FDI within equation 23.

6.5.2.2 The fiscal response sub-bloc

The fiscal response of the South to external finance is modelled using equations 24–32. Considering the empirical findings of Chapter 5, government fiscal response in most African countries is assumed to depend on the influence of an uncertain external economic environment (particularly in relation to foreign inflows), as well as the political economy of deficit financing. Following the discussion presented in Chapter 5, tax revenue is modelled using equations 24 and 25, which deal with direct tax and indirect taxes, respectively. Government expenditure and borrowing, as well as the relevant identities, for this sub-bloc are modelled using equations 27–32, where Z represents borrowing from banks along with resource transfers from the private sector, $Z_b + Z_{pr}$ (see Alemayehu et al. 1992 and FitzGerald 1993).

$$T_A^d = a_{24} + b_{24}Q_A + c_{24}\Delta F_A \qquad [24]$$

$$T_A^{iex} = a_{25} + b_{25}C_p + c_{25}(X+M)_A + d_{25}\Delta F_A \qquad [25]$$

$$T_A = T_A^d + T_A^{iex} + otGR_A \qquad [26]$$

$$G_A = a_{27} + b_{27}T_A + c_{27}\Delta F_A + d_{27}G_{A\,(-1)} \qquad [27]$$

$$S_{Ag} = T_A + otGR_A - G_A \qquad [28]$$

$$S_{Ap} = a_{29} + b_{29}Q_A \qquad [29]$$

$$S_A = S_{Ag} + S_{Ap} \qquad [30]$$

$$\Delta F_A = \Delta F_{Ag} + \Delta F_{Ap} \qquad [31]$$

$$Z_A = Z_B + Z_{pr} = I_{Ag} - S_{Ag} - \Delta F_{Ag} \qquad [32]$$

6.5.2.3 The commodity export supply sub-bloc

The supply of exports from Africa is modelled based on the analysis presented in Chapter 4. As described in this chapter, the real exchange rate-based model fits the data best and, hence, it is this version of the model, which is employed here. The ECM version of the export supply equation (equation 33) shows both the short-run and a long-run impact of price and capital formation indicators. The short-run parts of the argument are based on (latent) capacity utilization theory (Wickens & Greenfield 1973, Goldestin & Khan 1978, Chu & Morrison 1986 and Hwa 1985). The last argument in equation 33 is used to indicate the problem of capital formation (investment) in the sector. The lag structure (i.e., k) is five to six years when i is beverage or minerals while one to two years for food and agricultural raw materials.

$$XR_{A_i} = a_{33} + b_{33}\left(\frac{eP_{Ri}}{PQ_A}\right)_{t-k} + c_{33}K_{t-k} \qquad [33]$$

6.5.2.4 The 'Dutch disease' sub-bloc

The interaction between equations 33, 34 and 35 describes a 'Dutch disease' possibility, which was discussed in detail in Chapter 5. Using the alternative framework set out in this book, foreign inflows could lead to an appreciation in the exchange rate, through the demand that might be created in the non-traded sector. Indeed, the latter could further affect the performance of the traded sector, through equation 33 above. Thus, the econometric result obtained in Chapter 5 is based on the reduced form equations derived from the broader framework given in Edwards (1989). However, in order to make the specification consistent within the North-South model specified in this chapter, the following two steps are followed. Firstly, in equation 34, domestic price is set as a function of excess demand and other determinants of price. At the second stage the real exchange rate is defined, in equation 35, using the nominal exchange rate, which is assumed fixed, as well as the price of exports, which was determined in the commodity sub-block of the model.

For economies with an important food sector, Taylor (1983) has described the formation of prices using excess demand. Within a national macroeconomic framework, and when data permits, the disaggregation of excess demand into food and non-food sectors has quite profound implications (see Taylor 1983: 39–48). However, in the estimation given below, an aggregate version of a similar equation is used. This equation incorporates the possibility of imported inflation, or a mark-up pricing effect, and also explicitly employs foreign inflows. Moreover, by using an ECM, price stickiness is also assumed. The basic specification is given by equation 34.

$$PQ_A = a_{34} + b_{34}\Delta F_A + c_{34}MUP \qquad [34]$$

$$RER_{Ai} = \frac{eP_{R_i}}{PQ_A} \quad i = 1..4\text{, for the four commodity categories} \qquad [35]$$

6.5.3 Major Oil Exporting Countries (OPEC)

The total output of OPEC is assumed to depend on demand for oil both in the North and South which, in turn, depends on the level of output for each region, as shown in equation 36.

$$Q_O = m_{No}Q_N + m_{So}Q_S \qquad [36]$$

Given the import of oil to the North (equation 10) and that of Africa (equation 21), oil imports for the rest of the South are derived as residual (equation 37). Although imports and consumption of oil may safely be assumed to be equal in the ESA region and the majority of countries in WCA (equation 21), this assumption does not hold for NA and the major oil producers of WCA (Gabon, Cameroon and Nigeria). Thus, oil consumption for oil-producing countries actually equals production less exports.

$$MO_{OT}^{O} = Q_O - MO_N^O - C_{oil\,A} \qquad [37]$$

$$MM_O^{fg} = m_{oN}P_{oil}Q_O \qquad [38]$$

$$\Delta J_O = P_{oil}Q_O - (PM_N^{fg} \cdot MM_O^{fg}) - otM_O + i_w J_O \qquad [39]$$

Finally, equation 38 summarizes the portion of OPEC's income that is spent on Northern goods, with the remainder, including interest income on savings, saved in international banks, as per equation 39.

6.5.4 International Banking

This section is based on the work of Darity and FitzGerald (1982) and Vos (1994). In this literature, in contrast to the pure theory of capital movement discussed in Chapter 2, international banks are assumed to work on a segmented capital market, characterized by credit rationing.[17] In order to capture this phenomenon, we begin by specifying the basic closure of this bloc (equation 40),

$$\Delta B^{s+p_N} = \Delta J_{OT} + \Delta J_N + \Delta J_O + \Delta J_A - \Delta DC_N \qquad [40]$$

$$\Delta J_N = a_{41} + b_{41} J_N + c_{41}(i_w - r_N)_{t-1} \qquad [41]$$

$$\Delta J_A = a_{42} + b_{42} J_A \qquad [42]$$

Following Vos (1994), equation 40 equates the supply of funds from the three regions, net of Northern government demand for deficit financing, with the demand for credit by South, as well as the private sector of the North. Equations 39, 41 and 42 summarize the supply of funds. The credit rationing is effected as follows. First, priority will be given to Northern firms, as specified in equation 43.

$$\Delta B^d_{pN} = a_{43} + b_{43} I_N \qquad [43]$$

The remainder of funds are, then, directed to the South. The supply of credit to the South could, in principle, be specified using two approaches.

In Vos' model, suppliers' perception of default is believed to be inferred from a critical outstanding stock of bank debt to export earning ratio (Vos 1994: 218). From the borrower's perspective Vos' model essentially maintains that there is a certain debt management scheme, which is employed by Southern governments. Hence, the demand for bank loans in the South is limited by a maximum targeted level for the interest to foreign exchange earnings ratio.[18] Thus, the ratio essentially implies the possibility of downward adjustment of demand for foreign inflows by Southern borrowers, based on their own assessment or debt management scheme, irrespective of supply. Here, demand is not necessarily supply determined, and neither is it perfectly elastic.

On the other hand, the IMF's MULTIMOD (Masson et al. 1990) follows quite a different formulation, comparing an interest-to-export ratio with a certain critical maximum as an indicator of repayment capacity. Thus, the ratio basically determines supply, with demand, by the South, implicitly assumed to be perfectly elastic. Both suppliers and borrowers are assumed to use the same indicator. By ensuring that this ratio lies well below the target level, borrowers may ensure an increase in the supply of funds.

Based on the experience of Africa, detailed in Chapter 1, the absence of debt management and the existence of nearly perfectly elastic demand are likely to represent the more realistic set of assumptions.[19] Hence, MULTIMOD's approach is followed. Moreover, since the South represents an aggregate category, Vos' (1994) model does not detail a mechanism which may be used to show how bank flows are allocated among borrowers in the South. Consequently, Vos' model is extended to incorporate the assumption that Africa represents a poorer risk category than the rest of the South and hence, that it is only allocated surplus capital, once demand for such capital from the rest of the South has been met. The latter, in turn, will be determined by its historical maximum share, which is assumed to be exogenous within this model. There are two main reasons why this is likely to represent a realistic picture for African countries. Firstly, as documented by Eaton and Gersovitz (1980) and Odedokun (1996), bank flows to these countries are likely to be supply constrained. Secondly, Kasekende et al. (1995) describe how such flows to Africa are characterized by a high level of supply volatility. Hence, these flows are given as in equation 44.

$$\Delta B_A = \Delta B_N^{s+pN} - \Delta B_{pN}^{d} - \Delta B_{OT} \qquad [44]$$

where: $\Delta B_A \leq \Delta \bar{B}$, $\Delta \bar{B}$ is the historically determined maximum.

The second extension to Vos' model relates to the allocation of funds across Africa. In this study, the debt service ratio (equation 47) is used as the relevant indicator of both solvency and liquidity in the African context. This is consistent with the findings of Kasekende et al. (1995) and other recent studies which focus on short-term flows to Africa. Given the debt service ratio, the allocation mechanism developed in this study is based on the relative position of each African region's solvency indicator to the target level for the same ratio set by suppliers. Thus, it is assumed that although Africa is a worst-risk category among Southern borrowers, allocation of inflows destined for Africa will depend on the relative level of the debt service ratio for each region. This is formally given as follows,

$$\Delta B_{Ai} = \eta_i \Delta B_A \qquad [45]$$

$$\eta_{\mathrm{i}} = \frac{(\lambda^* / \lambda_i)}{\sum_{i=1}^{n} \left(\frac{\lambda^*}{\lambda} \right)_i} \qquad [46]$$

$$\lambda_{\mathrm{i}} = \frac{i_W (1 + \mu_S) B_{Ai} + i_{W*} F_A + \Pr in_{Ai} + otDS_i}{X_{Ai}} \qquad [47]$$

where: λ* is exogenously determined maximum debt service ratio (formulated by suppliers). λi is debt service ratio of the i^{th} risk group (region) in Africa. The sum of in equation 46 over n adds to 1.

Once this credit rationing is effected, the financial market eventually clears for interest rate, by way of equations 43 and 3.

6.5.5 Identities Used

$$XR_{Ai} = XR_{ESi} + XR_{NAi} + X_{WCi} \qquad [48]$$

where: $i = 1 \ldots 4$, the four commodities.

$$X_{Ai} = \sum_{i=1}^{4} XR_{Ai} + otX_A + P_{oil} XO_A \qquad [49]$$

$$X_i^{SS} = XR_{Ai} + XR_{OTi} \qquad [50]$$

$$\Delta J_A = \Delta J_{ES} + \Delta J_{NA} + \Delta J_{WC} \qquad [51]$$

$$Q_A = Q_{ES} + Q_{NA} + Q_{WC} \qquad [52]$$

6.5.6 Some Partial Equilibrium-based Analytical Solutions

In this section some basic and partial analytical solutions to the above model are set out. The results are partial, since general equilibrium effects and stability conditions of the model are not discussed. However, although partial, this discussion does help to synthesize some of the major theoretical underpinnings of the proposed model.

The South

Owing to the focus of the study, the South is left as relatively disaggregated, with total output determined using the output-capital ratio, given in equation 17. Since output in the South is assumed to be both private and public capital constrained, an increase in capital will raise output. However, such capital flows do have macroeconomic effects, one of which is the fiscal response.

The fiscal response

An important aspect of the South part of the model is the attempt to show the fiscal posture of the South within a North-South framework. Thus, inserting equations 24, 25 (using identity 26), 27 and 18 into a definition of public deficit (I_{Ag}–S_{Ag}) from equation 32 and solving for Z_S results in,

$$\begin{aligned} Z = {} & (a_{18} + a_{27} - a_{24} - a_{25}) + (b_{18} - b_{24})Q_A + \\ & (c_{18} - c_{25})M_A + (c_{27} - c_{24} - d_{25})\Delta F_A - otGR_A + \\ & b_{27}T_A + d_{18}I_{Ag_{t-1}} - b_{25}C_p - c_{25}X + d_{27}GA_{t-1} \end{aligned} \qquad [6.7a]$$

The fiscal deficit in the South is financed either through foreign inflows, which are usually predetermined in the North, or through domestic financing (Z). Thus, the public deficit is adjusted by a partial financial crowding-out process, presumed in Z, that would affect Ip, either directly or through the imposition of an inflationary tax. This phenomenon is not examined further in this study. However, crowding-in/out, in its rudimentary form may be seen in the model by examining the effect of Ig on Ip.

From the above equation, leaving aside the equilibrium effects, economic activity might induce a deficit through the demand that it creates for investment, but may also dampen it through its effect on government revenue. The net effect will depend on the two elasticities (b_{18} and b_{24}). Similar effects may also be read from the coefficients of imports. This partial result shows that foreign inflows have a negative impact on the deficit, through its expenditure-inducing (c_{27}) and revenue-depressing effects (the sum of c_{24} and d_{25}). However, the general equilibrium effect could be different, since foreign inflow, through imports, may induce a rise in output. Foreign trade, expansion in private consumption (openness of the economy) and government efforts in enhancing non-tax revenue could also help to reduce the government deficit. On the other hand, the deficit is positively related to the levels of investment and government consumption.

The commodity market

The unique feature of this North-South model is the inclusion of a commodity model sub-bloc, which is commonly built independent of a global macroeconomic model. This market is assumed to be a flexi-price market that encompasses Northern agents running a stock in order to meet demand/supply for commodities. The market functions through the equilibrium condition outlined in equation 16. Using equations 14–16, the partial model for price could be given by,

$$P_{Ri} = -\left[a_{15} - a_{14} + b_{15}\left(\frac{PR_i}{PQ_S}\right)_{t-k} + c_{15}\left(\frac{I_S}{Y_S}\right)_{t-k} - b_{14}Q_N + c_{14}i_w\right]\frac{PQ_N}{d_{14}} \qquad [6.7b]$$

It can be read from the first-order partial derivative of the above equation that for a given level of demand, an increase in supply of commodities will negatively affect the price level. This value is given by,

$$\frac{\partial \mathrm{P}_{\mathrm{R}i}}{\partial \mathrm{I}_{\mathrm{S}t-k}} = -\frac{c_{15}}{d_{14}Q_{St-1}}PQ_N \qquad [6.7c]$$

This is a consequence of the flexi-price structure of markets under which commodity producers of the South operate. Moreover, Southern price is negatively related to current and lagged real exchange rate, world interest rate, profitability and the possibility of financing investment within the export sector. Thus, notwithstanding the hypothesis that a high level of supply leads to high income, owing to a strong belief in 'the small country assumption' or ultimately Say's law, the adoption of a global framework helps in identifying the possibility of a deterioration in terms of trade. This solution not only highlights the 'fallacy of composition in policy advice' but also the point that, unless the production/marketing structure is changed, individual country efforts could ultimately be self-defeating at the aggregate level.

The 'Dutch disease'

A characteristic observed in many African countries' interactions with the North is the phenomenon of the 'Dutch disease'. As described in Chapter 5, the focus here is on what is termed the 'spending effect', which, in turn, will affect the supply of exports. Thus, foreign inflow, through its spending effect, will raise the demand for non-tradables, which will affect the real exchange rate, as defined in equations 35–34. Following a one-period lag, this, in turn, will have an effect on the traded sector, which may be depicted by equation 33. Hence, incorporating equation 34, by inserting the lagged values of equation 35 into equation 33 and taking its first-order partial derivative with respect to foreign inflow, gives,

$$\frac{\partial \ XR_A}{\partial \ F_A} = \frac{-b_{33}c_{34}ePR_{i_{t-k}}}{(a_{34} + b_{34}F + c_{34}MUP)^2} \qquad [6.7d]$$

where: k is periods of lag.

This partial equilibrium result shows that the 'Dutch disease' impact of foreign inflows for a given level of nominal exchange rate may be detrimental to exports, if it is large enough to offset its impact on capital formation within the export sector. Generally, the non-traded sector is positively related to the current and lagged level of foreign inflows and inversely related to export-enhancing factors. This highlights the policy dilemma of export promotion and domestic production, especially of food.

Southern macro balance

The macro balance of the South is derived by combining the private and public investment, saving and foreign inflows components within a single ex-post identity, which equates the saving gap with foreign inflow. Thus, imports of the South (equation 20) are substituted into the two investment equations (18 and 19). This ensures that the import compression phenomenon is taken into account. By inserting equation 17 into equation 29, Southern savings may also be linked with the capital-constrained output of the South. Finally, the investment and saving gap is set to match the level of foreign inflows, coming in the form of aid, FDI and bank loans, in order to yield the macro balance equation for the South. This latter equation is then solved for the Southern level of output. Since the resulting algebra is extremely long, the analysis presented in this section is based on some of the values of first-order partial derivatives.

$$\frac{\partial\ Q_A}{\partial\ M_A} = \frac{c_{25}}{(b_{18} + b_{19} - b_{24})} \qquad [6.7e]$$

$$\frac{\partial\ Q_A}{\partial\ i_w} = \frac{-(c_{19} + c_{18})J + (c_{18} + c_{19})(1 + \mu_S)B_A}{(b_{18} + b_{19} - b_{24})} \qquad [6.7f]$$

$$\frac{\partial\ Q_A}{\partial\ \Delta B_A} = \frac{1}{(b_{18} + b_{19} - b_{24})}$$

and $$\frac{\partial\ Q_A}{\partial\ B_A} = \frac{(c_{18} + c_{19})(1 + \mu_S)i_w - c_{18} - c_{19}}{(b_{18} + b_{19} - b_{24})} \qquad [6.7g]$$

$$\frac{\partial\ Q_A}{\partial\ \Delta F_A} = \frac{(1 + c_{24} + d_{25} - c_{18} - c_{19} - c_{27})}{(b_{18} + b_{19} - b_{24})}$$

and $$\frac{\partial\ Q_A}{\partial\ F_A} = \frac{(c_{18} + c_{19})i_{w*}}{(b_{18} + b_{19} - b_{24})} \qquad [6.7h]$$

From equation 6.7e it can be seen that, given the investment and saving elasticity, the level of output in the South is directly related to the level of imports. Thus, when imports are scarce, as is the case in the 1980s, the level of investment, and consequently output, will also be adversely affected for a given level of the capital output ratio.

Similarly, from equation 6.7f, if (a) the demand impact of Southern output on investment is larger (or smaller) than its impact on savings, and (b) import elasticity, with respect to the cost of borrowing from banks, is larger than its elasticity with respect to interest revenue from capital flight, then this could indicate the existence of a direct (or inverse) relationship between world interest rate and Southern level of output.

The impact of capital inflows and debt stock on the level of output may be read from equations 6.7g and 6.7h. The partial results suggest that for a given level of income elasticity of investment and saving, the impact of debt stock on output of the South will depend on the level of interest rate (both concessional and non-concessional) as well as the sensitivity of investment to imports. In the case of capital flows, their fiscal impact also matters, and this may be inferred from the values of c_{24}, c_{25} and c_{27}.

The North

As indicated above, the Northern model is kept at a highly aggregated level, owing to the fact that the focus of this study is mainly on Africa. Hence, the partial analytical solution for the North is limited to the discussion of North's macro balance. Equilibrium in North may be attained by ensuring that the North's macro balance holds. That is, the investment-saving gap, including the fiscal deficit, should equal the external gap, given as imports, plus net factor and current transfer receipts less exports. Combining the deficit, as defined in equation 11, with equations 3, 4, 5 and 7 in the North's macro balance equation (i.e., $I–S + DEF = M–X + NFP + NCTr$), and solving the result for one important macro variable in the North, say investment, can help to highlight the partial implication of the model in the North. Since the resulting algebra is extremely long the following discussion is, again, based on the first-order partial derivative of such an investment equation.

$$\frac{\partial I_N}{\partial i_w} = s_N(B + B\mu_S + DC_N - J_N - J_{OT}) - DC_N \qquad [6.7i]$$

$$\frac{\partial \mathrm{I}_N}{\partial \mathrm{Q}_N} = (1 - m_N P_{oil})t_N + s_N \tau (m_N P_{oil} + w_N b_N) \qquad [6.7j]$$

Equation 6.7i shows that the ex-post level of investment is positively related to interest-yielding lending. It is also inversely related to the cost of borrowing. In both cases the saving rate is important. The latter result underscores the importance of saving on net lending. As could be expected in a Keynesian set-up, investment is positively related to the level of output (equation 6.7j). However, a rise, either in the level of intermediate inputs or in its price, may depress investment, if saving from the mark-up based profit, excluding the wage based component, is less than the tax revenue levied on intermediate imported inputs.

The international financial market

The credit-market component of the model highlights the segmented nature of this market. It also highlights how credit rationing is put into practice, with the South often being the last to be allocated such credit. However, eventually, the market will clear for world interest rate, as can be shown using equations 3, as well as equations 39–43. We may arrive at the equilibrium solution for this market by letting excess demand clear for world interest rate. Solving this final equation for world interest rate gives the following partial equilibrium solution,

$$i_w = \frac{a_{43} + a_3 b_{43} + b_3 b_{43} Q_N + B_A + B_{OT} + \Delta DC_N - J_N - J_O - J_A - J_{OT}}{c_3 b_{43}} \qquad [6.7k]$$

The result indicates that interest rate is positively related to investment demand as well as the demand for credit in both North and South. However, it is inversely related to the deposit and crowding-out effects of cost of investment financing (c_3).

6.5.7 Parameters of the Model

Two sets of parameters are used in the above model. In general, the model is based on the single-equation ECM-based estimation of the functions specified above. The main results of this econometric study are discussed in Chapters 4 and 5 of this book. However, for a few equations, parameters are derived using different sources and methods. Hence, section 6.5.7.1 outlines this latter type of parameter, while section 6.5.7.2 discusses the estimation approach used and lists the complete parameter values of the model.

6.5.7.1 Parameters derived and used from previous studies

(a) Capital output ratio

The capital output ratio used is derived from an estimation of a similar equation to that of Sarmad (1990) and Khan and Reinhart (1990). The approach is based on a production function, designed to show the impact of public and private investment, together with other productivity indicators captured by the constant term on growth of real output. Although, in terms of the relevant diagnostic test, the function is not satisfactory, nevertheless it represents a better approximation than existing estimates such as that undertaken by Sarmad (1990), since his sample contains only two countries from Africa. Table 6.3 summarizes the estimated coefficients derived from equation 17 for each region.

Table 6.3 Regional capital-output ratio parameters

Region/ Parameter	a_{17}	(t-values)	σAP	(t-values)	σAg	(t-values)
ESA	-0.36	(-7.5)	0.37	(1.5)	1.62	(4.0)
NA	-0.17	(-2.2)	0.46	(2.3)	0.38	(1.0)
WCA	-0.36	(-7.5)	1.09	(4.1)	1.96	(4.5)

(b) Capital flight from Africa

The values used in relation to this analysis are based on those of Hermes and Lensink (1992). In their econometric estimation using an 'exclusive' definition of capital flight (Vos 1990),[20] they report the following results, which have similar regressors as the equation specified in our model.

$$\Delta J/Y_s = \underset{(-3.57)}{-0.06} + \underset{(10.97)}{0.92}\,(\Delta F_s/Y_s) + \underset{(2.83)}{0.02}\,REXH84 - \underset{(-0.076)}{0.02}\,FINC$$

$n = 66 \qquad \text{adj } R^2 = 0.66 \qquad F = 25.31$

where: ΔJ = capital flight; Y = GDP; ΔF_s = annual flow of long-term debt; $FINC$ = exchange rate adjusted interest rate differential between domestic and US financial asset; and $REXH84$ = the overvaluation of the effective exchange rate with 1984 as equilibrium year.

Vos' re-estimation of the same data, with the aim of determining the coefficients of stock adjustment (Vos 1994: 339) resulted in marginal coefficients ranging from 0.18 to 0.24, with a constant term lying between -0.03 and 0.01. Based on the latter, the constant parameter 0.01 and the marginal coefficient of 0.24 are used. The findings of Hermes and Lensink (1992) in relation to the impact of capital inflows are also worth noting. However, my own estimation – using stock of capital-based outflows, generated using flow data running from 1970, but excluding the financial incentive variable for 18 African countries – indicates an insignificant coefficient for the capital inflow variable. The stock adjustment coefficient also lies in the range of 0.05 to 0.11. However, owing to the possible problem with my stock data formulation, I have opted to use the estimation based on Hermes and Lensink (1992), re-computed in Vos (1994: 339).

$$\Delta J_A / Y_A = \underset{(0.19)}{0.01} + \underset{(6.38)}{0.24}\,(J_A / Y_A)_{t-1}$$

$R^2 = 0.36$ $F = 107.7$ $n = 65$ (t-values in brackets)

6.5.7.2 Estimated parameters of the model

Assuming no specification problem a system estimation for all equations would ideally have rendered efficient estimates. However, this entails a major problem for a model of our size. Hence, a more manageable, three-step approach is adopted in this study. Firstly, a number of essential equations, such as those relating to the global commodity market, are simultaneously estimated. Secondly, the potential use of bloc recursivity is exploited when that is possible. (For example, the result of the global commodity sub-bloc is incorporated into the African supply of commodities, as discussed in Chapter 4.) And finally, for other estimations, resort is made to a single equation error correction model (ECM).[21]

Unless otherwise expressed, all the estimations are undertaken using a log-log model. Thus, coefficients reported in Table 6.4 below may be interpreted as elasticities. The econometric estimation of the model starts from a second-order ECM. However, when the second-order ECM produces similar results to that of its first-order variant, I have opted for its first-order form, on the grounds of parsimony. All parameters of the model are reported in Table 6.3. When the coefficient reported is not an estimated one, this is noted. In general, two estimated coefficients for one explanatory variable are given. These values refer to the short-run (change, column 2) and long-run (level, column 4) values for the regressor in question. The lag length of the regressors is reported in columns 3 and 5. Column 6 provides remarks about the degree of the ECM and other relevant information. The following example illustrates how Table 6.4 may be read.

In the main text of the model, detailed in this section, each equation is set out in a standard format. Thus, equation number 2, is given by,

$$C_N = a_2 + b_2 Q_N$$

The first-order ECM estimation for this equation is formulated after transforming C_N and Q_N into logarithmic form and rewriting it as

$$\Delta \ln C_N \ = \ a_2 + b_2 \Delta \ln Q_N + b_2{}^* \ln Q_{Nt-1} - \ c_2 \ln C_{Nt-1}$$

Thus, in Table 6.4, the first column lists all coefficients of the regressors, including the lag-dependent coefficient, given by c_2 in the above example. Column two summarizes the short-run values of these regressors (b_2 in the example above), with the level of lags listed in the third column. The fourth column gives the long-run value of the regressors (b^*_2 in the above example) and fifth column lists the level of lag for the latter (-1 in the example above). The last coefficient (c_2) gives the error correction term, which is labelled as lag dependent in the table.

Table 6.4 Estimated parameters of the model

The North (N)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
a_2	16.40				OLS estimation from Marquez & Pauly (1987) model
b_2	0.60				
a_3	0.27				OLS estimation; see App. 6.1
b_3	0.89				
c_3	-0.09				
a_6	1.50				OLS estimation from Marquez & Pauly (1987) model
b_6	0.09				
c_6	0.33				
d_6	0.35				
e_6	-0.16				
a_8	0.50				average ratio; see App. 6.1
b_8	0.48				
c_8	1.42				
d_8	3.50				
a_9	-2.60				OLS estimation; see App. 6.1
b_9	-0.58				
c_9	0.89				
d_9	0.38				
a_{12}	8.00				see Chapter 4, section 4.2.2
b_{12}			-1.91	-2	
c_{12}			-0.51	-2	
Lag depend.			-0.89	-1	
a_{12}	4.40				see Chapter 4, section 4.2.2
b_{12}	-2.04	-1			
f_{12}	-0.13	-1			
a_{12}	5.50				
b_{12}	-1.56	-1	-2.29	-2	see Chapter 4, section 4.2.2
d_{12}	2.02				
e_{12}	3.13	-1			
Lag depend.			-0.86	-1	
a_{13}	-1.25				see Chapter 4, section 4.2.1
b_{13}	-5.50	-1	-0.17	-2	
c_{13}			-1.50	-2	
d_{13}	0.73				
Lag depend.			-1.00		
a_{13}	0.63				see Chapter 4, section 4.2.1
b_{13}			-0.66	-1	
c_{13}			-1.11	-1	
Lag depend.			0.71	-1	
a_{13}	-0.2				see Chapter 4, section 4.2.1
b_{13}			-0.19	-1	
c_{13}			-0.09	-1	

The North (N)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
Lag depend.			-0.82	-1	
a_{14} (i=Agr.)	-3.70				see Chapter 4, section 4.4
b_{14}	0.38		0.01	-1	
c_{14}	-0.15	-1	-0.25	-2	
d_{14}	-0.17		-0.48	-1	
Lag depend.			-0.67	-1	
a_{15} (i=Agr.)	-0.01				from Maximum Likelihood (FI
b_{15}	0.08	-1			estimation, see App. 4.3
c_{15}	0.30	-1			
a_{14} (i=Bev.)					see Chapter 4, section 4.4
b_{14}	0.90		0.25	-1	
c_{14}	-0.003	-1	0.09	-2	
d_{14}	-0.32		-0.19	-1	
Lag depend.			-0.78	-1	
a_{15} (i=Bev.)	3.6				see Chapter 4, section 4.4
b_{15}	0.003	-2	0.06		
c_{15}	-0.15	-5	-0.57		
Lag depend.			-0.59	-1	
a_{14} (i=Food)	-0.86				see Chapter 4, section 4.4
b_{14}	0.36		0.23	-1	
c_{14}	-0.19	-1	-0.02	-2	
d_{14}	-0.92		-0.39	-1	
Lag depend.			-0.39	-1	
a_{15} (i=Food)	2.4				see Chapter 4, section 4.4
b_{15}	-0.16	-1	0.13	-2	
c_{15}	-0.74	-2	-0.13	-3	
Lag depend.			-0.52	-1	
a_{14} (i=Min.)					see Chapter 4, section 4.4
b_{14}	-0.42		0.21	-1	
c_{14}	-0.01	-1	-0.11	-2	
d_{14}	-0.31		-0.34	-1	
Lag depend.			-0.53	-1	
a_{15} (i=Min.)	1.62				see Chapter 4, section 4.4
b_{15}	0.07		0.09	-2	
c_{15}	0.49	-5	0.48	-6	
Lag depend.			-0.80	-1	

East & Southern Africa (ESA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
a_{18}					see Chapter 5, section 5.4
b_{18}			0.02		
c_{18}	0.62		0.20	-1	
Lag depend.			-0.21	-1	
a_{19}	2.9				
b_{19}			-0.11	-1	see Chapter 5, section 5.4
c_{19}	0.68		0.51	-1	
d_{19}	0.56		0.21	-2	
Lag depend.			-0.25	-1	
a_{21}	-0.80				First-order ECM, see App. 6.1
b_{21}	-0.92		-0.25	-1	
c_{21}			0.05	-1	
Lag depend.			-0.70	-1	
a_{22}	0.85				First-order ECM, see App. 6.1
b_{22}	-0.25		-0.03	-1	
c_{22}	0.74		0.07	-1	
d_{22}	0.03		0.03	-1	
Lag depend.			-0.44	-1	
a_{24}	0.60				see Chapter 5, section 5.2
b_{24}	1.10		0.31	-1	
c_{24}			-0.08	-1	
Lag depend.			-0.40	-1	
a_{25}	-0.70				
b_{25}	0.46		0.13	-1	see Chapter 5, section 5.2
c_{25}	0.42		0.15	-1	
d_{25}			-0.01	-1	
Lag depend.			-0.21	-1	
a_{27}	-0.40				see Chapter 5, section 5.2
depend.(ecm2)			-0.49	-1	
b_{27}	0.58				
b_{27}	0.56	-1	0.51	-2	
c_{27}	0.01		0.01	-2	
Lag depend.			-0.53	-2	
a_{29}	0				First-order ECM, see App. 6.1
b_{29}	0.96		0.45	-1	
Lag depend.			-0.73	-1	
a_{33} (i=Agr.)	0.35				see Chapter 4, section 4.3
b_{33}	0.33	-1	-0.03	-2	
c_{33}	0.18	-2	0.17	-3	
Lag depend.			-0.14	-1	
a_{33} (i=Bev.)	0.40				see Chapter 4, section 4.3
b_{33}	-0.05	-2			
c_{33}			-0.06		
Lag depend.			-0.41	-1	
a_{33} (i=Food)	0.16				see Chapter 4, section 4.3

East & Southern Africa (ESA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
b_{33}			0.04		
Lag depend.			-0.34	-1	
a_{33} (i=Min.)	0.20				see Chapter 4, section 4.3
b_{33}	0.23	-2			
c_{33}			0.43	-6	
Lag depend.			-0.18	-1	
a_{34}					ECM, see App. 6.1
depend.(ecm2)			0.60	-1	
b_{34}	0.004	-1	0.01	-2	
c_{34}	0.14		0.02	-2	
c_{34}	-0.10	-1			
Lag depend.			-0.02	-2	

North Africa (NA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
a_{18}	-0.40				see Chapter 5, section 5.4
b_{18}			-0.02	-1	
c_{18}			0.11	-1	
Lag depend.			-0.25	-1	
a_{19}	-0.20				see Chapter 5, section 5.4
b_{19}	0.29				
c_{19}			0.12	-1	
d_{19}			-0.17	-2	
Lag depend.			-0.19	-1	
a_{21}	-1.22				First-order ECM, see App. 6.1
b_{21}	-0.97		-0.14	-1	
c_{21}					
d_{21}			0.16	-1	
Lag depend.			-0.64	-1	
a_{22}	3.33				First-order ECM, see App. 6.1
b_{22}	-0.55		0.33	-1	
c_{22}	0.43				
Lag depend.			-0.52	-1	
a_{23}	-0.40				First-order ECM, see App. 6.1
b_{23}	-0.71		0.19	-1	
Lag depend.			-0.50	-1	
a_{24}	0.56				see Chapter 5, section 5.2
b_{24}			0.45	-1	
c_{24}	-0.15		-0.05	-1	
Lag depend.			-0.60	-1	

North Africa (NA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
a_{25}	-2.10				see Chapter 5, section 5.2
b_{25}					
c_{25}	0.92		0.36	-1	
d_{25}			-0.04	-1	
Lag depend.			-0.48	-1	
a_{27}	-0.05				see Chapter 5, section 5.2
depend.(ecm2)			-0.54	-1	
b_{27}	0.52		0.32	-2	
b_{27}	0.38	-1			
c_{27}	0.08	-1	0.02	-2	
Lag depend.			-0.33	-2	
a_{33} (i=Agr.)	-2.05				see Chapter 4, section 4.3
b_{33}	0.63	-1	0.52	-2	
c_{33}	0.61	-1	0.12	-2	
Lag depend.			-0.22	-1	
a_{33} (i=Food)	0.20				see Chapter 4, section 4.3
b_{33}	-0.52	-1	0.31	-2	
c_{33}			-099	-1	
Lag depend.					
a_{33} (i=Min.)	-1.04				see Chapter 4, section 4.3
b_{33}	0.48	-1	0.39	-2	
b_{33}			0.59	-6	
Lag depend.			-0.62	-1	
a_{34}	-0.40				ECM, see App. 6.1
b_{34}	-0.003	-1	0.05	-2	
c_{34}	0.54		0.18	-1	
Lag depend.			-0.08	-1	

West & Central Africa (WCA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
a_{18}	-0.50				see Chapter 5, section 5.4
b_{18}	0.27		0.17	-1	
c_{18}	0.64		0.31	-1	
Lag depend.			-0.33	-1	
a_{19}	4.00				see Chapter 5, section 5.4
b_{19}	0.28		0.50	-1	
c_{19}	0.74		1.15	-1	
d_{19}			-0.04		
Lag depend.			-0.39	-1	
a_{21}	0.10				First-order ECM, see App. 6.1
b_{21}	-1.10		-0.10	-1	

West & Central Africa (WCA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
c_{21}	0.03		0.02	-1	
Lag depend.			0.18	-1	
a_{22}	1.80				First-order ECM, see App. 6.1
b_{22}	-1.01		-0.03	-1	
c_{22}	0.33		0.06	-1	
d_{22}	0.04		0.03	-1	
Lag depend.			-0.50	-1	
a_{23}	-1.60				First-order ECM, see App. 6.1
b_{23}			0.54	-1	
c_{23}	0.17				
Lag depend.			-0.30	-1	
a_{24}	-1.00				see Chapter 5, section 5.2
b_{24}	1.41		0.49	-1	
c_{24}			-0.09	-1	
Lag depend.			-0.38	-1	
a_{25}	-0.40				see Chapter 5, section 5.2
b_{25}	0.63		0.20	-1	
d_{25}	0.02		0.01	-1	
Lag depend.			-0.31	-1	
a_{27}	-0.20				see Chapter 5, section 5.2
depend. (ecm2)			-0.25	-1	
b_{27}	0.85		0.15	-2	
b_{27}	0.36	-1			
c_{27}	0.02		0.03	-2	
c_{27}	0.02	-1			
Lag depend.			-0.22	-2	
a_{29}	-0.70				First-order ECM, see App. 6.1
b_{29}	1.55		0.35	-1	
Lag depend.			-0.33	-1	
a_{33} (i=Agr.)	-0.50				see Chapter 4, section 4.3
b_{33}	0.48	-1	0.08	-2	
Lag depend.			-0.12	-1	
a_{33} (i=Bev.)	-1.00				see Chapter 4, section 4.3
b_{33}	0.18	-1	0.13	-2	
b_{33}	0.13	-5	0.07	-6	
c_{33}			0.06	-6	
Lag depend.			-0.26	-1	
a_{33} (i=Food)	-0.65				see Chapter 4, section 4.3
b_{33}	0.27		0.03	-2	
c_{33}	0.18	-1	0.06	-2	
Lag depend.			-0.15	-1	
a_{33} (i=Min.)	-0.3				see Chapter 4, section 4.3
b_{33}			-1.28	-2	
b_{33}			0.39	-6	
a_{34}					ECM, see App. 6.1
depend. (ecm2)			0.38		

West & Central Africa (WCA)

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
b_{34}	0.02		0.005	-2	
b_{34}	-0.02	-1			
c_{34}	0.22	-1	0.03	-2	
Lag depend.			-0.02	-2	

OPEC and International Banking

Parameters	Short-run Value	Short-run Lag	Long-run Value	Long-run Lag	Remark/reference for more information on the estimation
m_{NO}	0.00038				Average using data 1983-90
m_{SO}	0.0008				Average using data 1983-90
m_{oN}	0.22				Average using data 1983-90
a_{41}	-1.38				See section 8.8.1b above
b_{41}	6		0.27	-1	ECM, see App. 6.1
c_{41}	-0.02				
Lag depend.			-0.41	-1	
a_{42}	0.01				Vos (1994), see section
b_{42}	0.24				6.5.7.1b above
a_{43}	18				
b_{43}	0.34				Average using data 1983-90
μ_S	0.40				Vos (1994)
λ^*	30%				Assumed

Note: The values of coefficients are estimated results without any sign change. The sign in the model specification is theoretical expected sign. Thus, in equation 3 the interest rate coefficient is $-c_3 = -0.09$.

Glossary of symbols used

N	North
S	South
A	Africa
ESA	East and Southern Africa
NA	North Africa
WC	West and Central Africa)
OT	Other South (excluding Africa)
λ	Debt service ratio
τ	Mark-up rate in North (Price)
δ_{AP}, δ_{Ag}	Output-capital ratio of the private and public sector, respectively
ΔB_A	Net commercial bank credit flow to Africa
$\Delta B^d{}_{pN}$	North private sector demand for bank credit
ΔB_{OT}	Net commercial bank credit flow to Other (non-African) South
$\Delta B_N{}^{S+pN}$	Net commercial bank credit flow to South and North's private sector
ΔDC_N	Northern government debt (flow)
ΔF_A	Foreign inflows (net of commercial bank lending and FDI) to Africa
ΔF_{Ag}	Foreign inflow to the public sector of Africa
ΔF_{Ap}	Foreign inflow to the private sector of Africa
ΔF_{OT}	Foreign inflows (net of commercial bank lending and FDI) to Other (non-Africa) South
ΔF_S	Foreign inflows (net of commercial bank lending and FDI) to South
$\Delta J_{O, A,, OT, N}$	Flow of saving deposit in international banks by OPEC, Africa Other South and North
μ_S	Bank mark-up rate over world interest rate on Southern borrowers
b_N	The labour output ratio in North
C_N	Consumption in North
C_p	Private consumption in Africa
$COIL_A$	Consumption of oil in Africa
$COIL_N$	Consumption of oil in North
DC_N	Northern government outstanding debt

DEF_N	Deficit in North
e	Nominal exchange rate (Africa)
$DSR_{OT,\,A}$	Debt service ratio of Other South and Africa respectively
$EXCAP$	Excess capacity in North
F_A	Stock of foreign inflows (net of commercial bank lending and FDI) to Africa
FDI_S, $FDI_{A,\,OT}$	Direct foreign investment, FDI to South, Africa and Other South
F_{OT}	Stock of foreign inflows (net of commercial bank lending and FDI) to Other (non-Africa) South
fpS	Factor payments for South
F_S	Stock of foreign inflows (net of commercial bank lending and FDI) to South
G_A	Government consumption expenditure in Africa
GDP_{mi}	GDP in mining sector
G_N	Government expenditure in North
H^d_{Ni}	Commodity stock demand (North)
H^s_{Ni}	Commodity stock supply (North)
$I_{A,\,Ag,\,Ap}$	Investment in Africa, Africa public sector and private sector, respectively
I_N	Investment in North
I_S	Investment in South
Y_S	GDP in South
i_w	World interest rate
i_{w*}	World interest rate on concessional
$J_{O,\,A,OT,\,N}$	Saving deposit in international banks by OPEC, Africa, Other South and North
$K_{Ag,\,Ap}$	Capital stock in public and private sectors in Africa
$MM^{fg}_{O,\,A}$	Import of manufactured goods by OPEC and Africa, respectively.
M_N, M_{OT}	Import of North and other South respectively
m_{No}	Import propensity of oil consumption in North
m_{Ns}	Import propensity of oil consumption in South
m_{oN}	import propensity of OPEC for Northern goods
MO^o_N	Import of oil by North
MR^S_{Ni}	Import of primary commodities by North from Africa $i = 1\ldots4$
MUP	Manufactured unit price index

$othDSi$	Other debt service component (discrepancy)
$otGR_A$	Other government revenue
otM_N	Other imports of North
otX_N	Other exports of North
P_{coal}	Price of coal
$PM^{fg}{}_N$	Price of manufactured goods of North
P_{oil}	Price of oil
PQ_A	Domestic price in Africa
PQ_N	Domestic price in the North
PR_i	Export price of primary commodities from Africa
$Prin_{Ai}$	Principal payment by Africa
Q_N, Q_{OT}, Q_A	Output in North, other South and Africa, respectively
Q_{OILN}	Output of oil in North
$\widetilde{Q}$	Growth rate of African output
S_{Ag}, S_{Ap}	Saving of Africa , public and private, respectively
S_N, $S_{A,\ sg,\ sp}$	Saving of North & Africa (total, public and private), respectively
t_N	Tax rate in North
T_A , $T^{d,\ iex}{}_A$	Total revenue, Direct and indirect tax revenue, respectively in Africa
w_N	Wage rate in North
$X^{dd}{}_{Si}$	Global supply of primary commodities from South
X_N	Export of the North
X_A	Export of Africa (total)
XO_A	Export of oil by Africa (total)
XO_{NA} ,XO_{WC}	Export of oil by North Africa and West and Central Africa, receptively
XR_{Ai}	Export Supply of primary commodities from Africa
$X^{ss}{}_{Si}$	Global demand for primary commodities from South
$Y^p{}_{OT,\ A}$	Per capita income of other South and Africa respectively
Z_A	Total resource transfer from Africa
Z_B	Public borrowing from banks
Z_{pr}	Resource transfer from private to the public sector

7 The Effect on Africa of External Shocks Generated in Developed Countries

7.1 INTRODUCTION

In this chapter, an attempt will be made to assess the impact of a range of global shocks on African economies, using the model specified in Chapter 6. The chapter does not exhaust the full potential of AFRIMOD for the analysis of external shocks and economic policies. Rather, the model will be used to examine a number of crucial external shocks and policy simulations. The chapter is organized as follows. Section 7.2 describes the accounting framework used in the model. This framework serves both as a consistent database of the world and as a base run value in the calibration of the model. Section 7.3 briefly discusses the model solution algorithm employed, the stability conditions of the model and calibration procedure followed. In section 7.4 the results of selected external shocks and policy simulations are discussed. Finally, section 7.5 brings the chapter to a close by highlighting a number of conclusions arising out of the preceding discussion.

7.2 WORLD ACCOUNTING MATRICES (WAM) AS DATABASE FOR AFRIMOD

Vos (1988, 1989a), Luttik (1992) and de Jong and Vos (1995b) have developed a global accounting framework, which organizes trade and financial data by source and destination. This framework, termed the World Accounting Matrix (WAM), consists of four sub-matrices. These are labelled (1) current, (2) capital account transaction by origin and destination, (3) gross domestic investment, and (4) gross national saving. These sub-matrices are supplemented by an assessment of stocks of international assets and liabilities as well as GNP (see Diagram 7.2a below).

Diagram 7.2a A World Accounting Matrix for n countries

	1	2	...	n		1	2	...	n	
1	A_{11}	A_{12}	...	A_{1n}	X_1	I_1				I_1
2	A_{21}	A_{22}	...	A_{21}			I_2			
•	•							•		
n	A_{n1}	A_{n2}	...	A_{nn}	X_m	I_n				I_n
	M_1		...	M_n	C_T	I_1		...	I_n	I
1	S_1				S_1	B_{11}	B_{12}	...	B_{1n}	C_1
2		S_2				B_{21}	B_{22}	...	B_{21}	
•			•			•				
n				S_n	S_n	B_{n1}	B_{n2}	...	B_{nn}	C_n
	S_1		...	S_n	S	D_1		...	D_n	F

Source: Luttik (1992: 34).

The WAM approach assumes the existence of a direct link between current and capital account flows, the domestic resource gap and balance of payments. Employed within a global context, this implies that world export of goods, services and transfers should equal world imports of goods, services and transfers, and, thus, that the world current account should sum to zero. World foreign saving should also sum to zero, since some countries will be in surplus, while others in deficit, in each accounting year. Similarly, global saving should equal global investment. For the world economy, comprising *i* countries, this may be summarized[1] as follows (see Vos 1988 & 1989a, Luttik 1992, de Jong & Vos 1995b).

$$S_i - I_i \equiv E_i - M_i + R_i \equiv \Delta FA_i - \Delta FL_i + (\Delta RES_i + EO_i) \qquad [7.1]$$

$$\sum_i^n (S_i - I_i) \equiv \sum_i^n (E_i - M_i + R_i) \equiv 0 \qquad [7.2]$$

$$\sum_{i}^{n}[(\Delta FA_i - \Delta FL_i) + (\Delta RES_i + EO_i)] \equiv 0 \qquad [7.3]$$

where: S = gross national saving, I = gross domestic investment, E = export of goods and non-factor services, M = import of goods and non-factor services, R = net factor income and current transfer from abroad, FA = change in total external financial assets, FL = change in total external financial liabilities, RES = change in reserves, EO = errors and omissions.

The WAM rests on equation [7.1], which is the basic accounting framework for each country. For the world economy, the conditions under equations [7.2] and [7.3] will then follow logically.

These equations form the basic identities for the world economy. Based on these relationships, countries and regions are linked within the WAM through trade and financial matrices, organized by origin and destinations (Luttik 1992: 22). This WAM framework in matrix format is set out in Diagram 7.2a. The Northeast quadrant shows gross domestic investment, the Northwest quadrant summarizes the current account, the Southwest quadrant, national savings and the Southeast quadrant, the flow of funds account. These flow categories may be combined with satellite matrices/vectors and applied to stock data (see Luttik 1992 for details).

The WAM improves upon existing global accounting frameworks in a number of specific respects. Firstly, it maintains consistency at a global level; secondly, it explicitly allows for aggregation or disaggregation within its framework; and thirdly, it shows the origin and destination of transactions. Owing to these attributes, the WAM may usefully serve as a database for the analysis of trade and finance within a global framework.[2] Hence, in this study, this framework, with its 1990 value, will be used to adjust our regional data in order that it may accord with the 1990 WAM format.

Table 7.2b shows the WAM for 1990. The WAM values summarized in this table will be used as the accounting framework for the model developed in Chapter 6. The year 1990 is taken as the base year, since this is the latest year for which a WAM is available. The use of this WAM ensures global consistency, as explained in equations [7.1]–[7.3]. Thus, the final solution of the model is calibrated around the 1990 WAM values. The African data in the WAM is grouped according to whether it relates to North Africa (NA) or Sub-Saharan Africa (SSA).

The NA data is used directly, while an adjustment is made to the SSA data. Thus, in relation to SSA, a two-step process is adopted. Firstly, regional data for all countries within WCA and ESA regions is compiled, based on the UN-ECA classification. Then, since this regional data obviously does not tally with the WAM-based data, the WAM-based SSA data is allocated between WCA and ESA regions, based on the proportion of the two derived from the regional data compiled.

7.3 Model Solution Algorithm and Stability Conditions

7.3.1 Model Solution

The model is solved with the Guass-Seidel algorithm, using EVIEWS software. Guass-Seidel is a fairly standard, and widely used algorithm for large-scale simultaneous equation models. The beauty of Guass-Seidel lies in its ability to render a solution without going through the difficult processes of derivatives, matrix inversion and similar procedures usually required in arriving at a numerical solution. Such procedures are extremely difficult in large-scale models. Rather, Guass-Seidel employs an iterative scheme, starting from an initial guess, until some specified tolerance level is reached. Obtaining convergence will usually depend on a variety of factors (see Heien et al. 1973, Press et al. 1989 for more details on these).[3]

Having solved the model using this algorithm, the solution for the year 1990 is calibrated using only the constants, in order to yield the actual values for 1990.[4] Each endogenous equation is included in the model in its full ECM dynamic form. For almost all equations the solution reproduces substantially closer values to that of the base run. In order to ensure a full reproduction of the base run, the constant values for each endogenous equation are calibrated. This method of calibration maintains the slope coefficients, which are the behavioural and structure indicators, intact. The latter coefficients are assumed to be more important than the constant terms.

Table 7.2b Balanced World Accounting Matrix (WAM) for 1990 (in billions of US$)

	Current Account											
	USA	JAP	GERM	UK	ODC	EEU	LDCot	NA	SSA	OBC	INT	TOTAL
Current Account												
USA	0.00	106.56	40.00	60.74	248.58	6.03	169.53	6.51	5.63	22.42	2.09	668.09
JAP	103.74	0.00	24.76	27.34	107.95	4.00	110.22	2.64	6.42	25.41	9.34	421.83
GERM	51.44	17.99	0.00	52.76	305.65	19.10	52.76	5.32	4.93	6.01	6.85	522.81
UK	67.30	39.71	39.19	0.00	184.17	6.85	33.92	2.18	8.29	6.68	2.19	390.46
ODC	240.82	95.07	286.28	195.99	735.68	34.24	167.76	23.62	27.80	26.45	23.12	1856.82
EEU	4.81	4.71	16.71	3.86	37.35	38.61	26.46	1.81	1.01	0.62	0.15	136.11
LDCot	198.40	113.95	55.43	32.71	168.90	21.64	125.65	5.56	7.25	61.46	3.63	794.56
NA	6.14	1.21	6.38	2.51	29.51	1.91	6.03	1.07	0.45	0.35	5.77	61.33
SSA	13.58	2.94	5.65	2.85	30.03	0.57	3.89	0.29	4.27	0.68	2.14	66.89
OBC	40.85	17.51	10.59	13.94	17.26	1.17	53.19	0.96	1.41	8.11	3.92	168.91
INT	6.05	2.75	6.08	4.11	24.07	0.34	12.83	0.99	1.48	0.48	16.15	75.34
Subtotal	733.12	402.40	491.07	396.81	1889.14	134.47	762.23	50.97	68.93	158.68	75.34	5163.15
Capital Account												
USA	814.00											814.00
JAP		993.82										993.82
GERM			380.82									380.82
UK				167.64								167.64
ODC					1164.53							1164.53
EEU						318.14						318.14
LDCot							766.44					766.44
NA								33.68				33.68
SSA									17.59			17.59
OBC										44.38		44.38
INT											0.00	0.00
Subtotal	814.00	993.82	380.82	167.64	1164.53	318.14	766.44	33.68	17.59	44.38	0.00	4701.04
Change in reserves												
Errors & omissions												
Total	**1547.13**	**1396.21**	**871.89**	**564.45**	**3053.67**	**452.61**	**1528.67**	**84.65**	**86.52**	**203.06**	**75.34**	**9864.19**

	Capital Account												
	USA	JAP	GER	UK	ODC	EEU	LDCot	NA	SSA	OBC	INT	Subtot	Total
Current Account													
USA	879.03											879.03	1547.13
JAP		974.38										974.38	1396.21
GERM			349.08									349.08	871.89
UK				173.99								173.99	564.45
ODC					1196.85							1196.85	3053.67
EEU						316.50						316.50	452.61
LDCot							734.11					734.11	1528.67
NA								23.31				23.31	84.65
SSA									19.63			19.63	86.52
OBC										34.15		34.15	203.06
INT											0.00	0.00	75.34
Subtotal	879.03	974.38	349.08	173.99	1196.85	316.50	734.11	23.31	19.63	34.15	0.00	4701.04	9864.19
Capital Account													
USA	0.00	14.99	9.53	28.49	44.65	0.73	2.04	1.26	0.14	-3.19	1.69	100.32	914.33
JAP	2.61	0.00	16.33	32.83	50.75	1.32	8.72	1.29	0.45	1.37	-1.16	114.52	1108.34
GERM	3.24	0.00	0.00	21.18	31.63	0.04	2.65	-0.07	0.30	3.92	1.35	64.24	445.06
UK	4.47	6.94	25.45	0.00	89.45	-0.05	7.21	2.05	1.23	3.31	1.02	141.09	308.73
ODC	29.67	62.04	50.42	55.43	176.36	0.85	69.14	6.95	3.74	11.87	6.94	473.39	1637.91
EEU	0.02	-0.14	4.46	-2.35	-1.58	-0.41	0.10	0.00	0.00	-0.12	0.60	0.58	318.72
LDCot	20.52	16.79	1.89	3.55	16.52	-0.51	-0.02	-0.01	0.01	2.45	9.80	70.97	837.41
NA	0.16	-0.10	0.16	-0.03	-0.25	-0.03	0.23	0.00	0.00	0.00	0.98	1.12	34.80
SSA	0.18	-0.07	0.15	0.64	2.98	0.06	0.38	0.00	-0.02	-0.02	3.40	7.68	25.27
OBC	4.49	2.00	0.43	0.89	3.99	0.03	0.31	0.03	0.03	0.07	0.16	12.44	56.82
INT	2.08	5.08	2.80	4.08	11.01	0.13	2.57	0.28	0.20	0.30	0.62	29.16	29.16
Subtotal	67.44	107.52	111.62	144.72	425.51	2.16	93.33	11.77	6.07	19.96	25.40	1015.52	5716.55
Change in reserves	-0.19	-0.34	-0.68	0.01	0.08	1.01	-1.52	-0.36	-0.21	-0.07	2.28	0.00	0.00
Errors & omissions	-31.95	26.77	-14.96	-9.98	15.48	-0.95	11.49	0.07	-0.22	2.77	1.48	0.00	0.00
Total	**914.33**	**1108.34**	**445.06**	**308.73**	**1637.91**	**318.72**	**837.41**	**34.80**	**25.27**	**56.82**	**29.16**	**5716.55**	**15580.75**

Notes to Table 7.2b: USA=United States of America, JAP=Japan, GERM=Germany, UK=United Kingdom, ODC=other developed countries (i.e., Canada, France, Italy, Belgium, Luxembourg, Denmark, Greece, Ireland, The Netherlands, Portugal, Spain, Austria, Iceland, Norway, Sweden, Switzerland, Finland, Australia, New Zealand, Israel and South Africa), EEU=Easter Europe, LDCot=Developing Countries excluding Africa, OBC=Official Banking Centers, INT=International Organizations; NA=North Africa and SSA=Sub-Saharan Africa.
Sources: WAM Database (electronic), Money and Finance Research Group, ISS, The Hague, The Netherlands. See also Jong et al (1993) for details of the country classification.

7.3.2 Stability Conditions

The stability condition of the model depends on the four excess demand functions. The first of these, for the commodity market, is a flexiprice market, and, hence, the excess demand in the market is assumed to clear for world commodity price. The second demand function, for the non-traded sector in South, is assumed to clear for domestic price P_S. The third function, for the Northern goods market, clears for quantity of output, Q_N, owing to our assumption of a Keynesian framework. And, finally, the excess demand for bank loans, is assumed, after credit rationing, to clear for world interest rate. Equations [7.8] and [7.9] depict the Northern government bond market and macro determination of imports in South, respectively. These excess demand functions, in their general form, may be given by the following equations (see Vos 1994).

$$\frac{dP_R}{dt} = f\left[ED_C\,(Q_N, Q_{S,}\, i_w, P_R,\, PQ_A)\right] \qquad [7.4]$$

$$\frac{dQ_N}{dt} = f\left[ED_N\,(Q_N,\, Q_A, i_w, P_R, PQ_A)\right] \qquad [7.5]$$

$$\frac{di_w}{dt} = f\left[ED_B\,(Q_N,\, Q_A\,, i_w, P_R, PQ_A)\right] \qquad [7.6]$$

$$\frac{dP_A}{dt} = f\left[ED_A\,(Q_N,\, Q_A\,, i_w, P_R, PQ_A)\right] \qquad [7.7]$$

$$DEF_N(Q_N,\, i_w, P_R) - \Delta DC_N = 0 \qquad [7.8]$$

$$M_A - X_{Ai} - \Delta F_A^{net} = 0 \qquad [7.9]$$

where: ED_A, ED_B, ED_C and ED_N, indicate excess demand in African non-traded goods, international banking, commodity, Northern goods markets, respectively; t is time, and ΔF_A^{net} net capital inflows to Africa (see the glossary of symbols used in Chapter 6).

Vos (1994) has analysed the general linear and nonlinear stability conditions of his STAC model. (This model has similar theoretical underpinnings to the model developed in this book.) Having analysed the trace of the matrix and the determinant of the Jacobian, he concludes that these stability conditions do, in fact, hold (Vos 1994: 305–9). Since AFRIMOD is completely linear, the Jacobian for the model is equal to the determinants of the coefficient matrix.[5]

The existence of a numerical solution for AFRIMOD suggests that the Jacobian is non-singular and, hence, that there is no local stability problem. Nevertheless, in spite of the theoretical analysis of the trace of the matrices (reported in Vos 1994), as well as the numerical exploration undertaken as part of this study, it is worth examining the validity of the model's stability conditions using a structural sensitivity analysis. Such an analysis is usually undertaken in two stages. Firstly, the symmetry and linearity of the model is examined, with a view to assessing the stability of multipliers. And secondly, the sensitivity analysis itself is undertaken (Zellner & Peck 1973: 154–62, Jamshidi 1989: 48–67).[6] The latter is computationally expensive for large models like AFRIMOD and also requires the use of specially designed software. Hence, such an analysis is not pursued here. However, various runs (using Eviews) are experimented with, in order to assess the sensitivity of the model. The results of this analysis indicate that the model is fairly stable. Additional supporting evidence with respect to the stability of the model is also provided by symmetry and linearity tests for selected variables. These are reported in Table 7.3 below.

Table 7.3 shows the Zellner-Peck test of symmetry (SYM) and linearity (LIN) for the two 'types' of simulations (relating to policy and external shocks) analysed using the model. The result is based on the formula given below (see Zellner & Peck 1973, Jamshidi 1989).

Let the deviation from the base run for a variable y in period t be given by,

$$\delta\, y_t \Delta = y_{t,\Delta} - y_{t,0}$$

where: $y_{t,0}$ is the value of y in period t for the base run and $y_{t,}$ is value of y in period t after policy or external shock change by units.

Then,

$$SYM(\Delta,\ -\Delta) = \frac{\sum_{t=1}^{T} \left|\delta y_t, \Delta + \delta y_t, -\Delta\right|}{\frac{1}{2}\sum_{t=1}^{T}\left(\left|\delta y_t, \Delta\right| + \left|\delta y_t, -\Delta\right|\right)} \qquad [7.10]$$

$$LIN(k\Delta,\ \Delta) = \frac{\sum_{t=1}^{T} \left|\delta y_t,\ k\Delta - k\delta y_t, \Delta\right|}{\frac{1}{2}\sum_{t=1}^{T}\left(\left|\delta y_t, k\Delta\right| + \left|k\delta y_t, -\Delta\right|\right)} \qquad [7.11]$$

where: k is an amplification factor (assumed to have a value of 2 in the test below), SYM and LIN stand for symmetry and linearity, respectively.

If the model's response is characterized by symmetry and linearity, the value of SYM and LIN coefficients will approximate zero since the numerator will be zero (see Zellner & Peck 1973, Jamshidi 1989). The upper limit is usually difficult to establish. For instance, Jamshidi (1989) took 0.5 as the upper threshold, while Zellner and Peck consider a numerical value of around 0.3 as the threshold. Following the original formulation adopted by Zellner and Peck, the best judgment about the values may be made by conceptualizing the results (SYM and LIN) as percentage deviations for mean absolute distance from the base run.

The first three columns of Table 7.3 report the test results for a Northern policy simulation of a ±5% change in the level of aid to the South. The remaining columns report test results for an external shock simulation of a ±1 point change in world interest rate. The values reported are results obtained using the formula of symmetry and linearity, given as equations [7.10] and [7.11] for $t = 9$ (1990–98). As can be read from Table 7.3, these values are, on the whole, close to zero. However, some variation does exist across variables. Thus, the export variables are found to depart from linearity and symmetry, while, for the public deficit, the results show perfect linearity and symmetry. Such disparity is possible because each variable reacts differently, both as a consequence of its own dynamics, as given by the equation which represents it, and due to the general equilibrium effect.[7] Based on the results summarized in Table 7.3, it is fair to conclude that the model is linear and symmetrical and that it, at least, has local stability. This, in turn, ensures the stability of multipliers. However, as noted by McKibbin and Bok (1993), the main problem with many large macroeconometric models is that they are unstable. Indeed, this would appear to be true for a number of the AFRIMOD variables, such as those relating to exports. In such a situation, McKibbin and Bok (1993) suggest a careful constraining of parameter estimates as a solution.

Table 7.3 Zellner and Peck symmetry and linearity test

Policy simulation (aid to the South)			External shock simulation (interest rate change)		
Variable	**SYM (±0.05)**	**LIN (k=2) [on ±0.05]**	**Variable**	**SYM (±1)**	**LIN (k=2) [on ±0.05]**
PR_A	0.131849	0.000685	PR_A	0.127286	0.003372
PR_B	0.020638	0.000480	PR_B	0.002363	0.001555
PR_F	0.008677	0.000652	PR_F	0.003087	0.002829
PR_M	0.112067	0.00064	PR_M	0.198016	0.003620
PDEF_ES	0	0	*PDEF_ES*	0	0
PDEF_NA	0	0	*PDEF_NA*	0	0
PDEF_WC	0	0	*PDEF_WC*	0	0
XR_ES	1.424321	1.145035	*XR_ES*	0.062771	0.388333
XR_NA	1.138572	1.140491	*XR_NA*	1.175849	1.179492
XR_WC	1.996231	1.987624	*XR_WC*	1.924767	1.896718
Q_ES	0.327078	0	*Q_ES*	0.218054	0.001760
Q_NA	1.128924	0	*Q_NA*	0.229353	0.000218
Q_WC	0.82428	0	*Q_WC*	0.310863	0.000127

Note: PR stands for export price; subscript *A*, *B*, *F* and *M* stand for agr. raw material, beverage, food and mineral, respectively. The suffix *_ES*, *_NA* and *_WC* stand for ESA, NA and WCA regions. *PDEF* is public deficit and *Q* is real output.

7.4 Analysis of External Shocks and Policy Simulations Using AFRIMOD

This section reports the results of external shocks and policy simulations carried using AFRIMOD. The following simulations are run by invoking a permanent shock in the model for eight consecutive periods, starting from the base year (1990). The eight-year period is chosen arbitrarily, on the assumption that this will reflect the medium-term nature of the model. A further justification for the choice of eight simulation periods is that the maximum lag length in the model is seven years.

The effects of this shock are reported as percentage deviations from the base run. The base run simulation is obtained by running the model for the eight consecutive periods without including any policy changes or external shocks. Thus, this base run may be interpreted as representing the effect of the model's own dynamics. Although the dichotomy between the impact of external shock and Northern policy is sometimes blurred, the simulations carried below are categorized using such a dichotomy, if only to simplify the presentation. Three policy shocks (two from the North and one from the South) and three external shock simulations (one each from the North, OPEC and the rest of the developing countries) are conducted.

Policy simulations

(i) Doubling the level of aid from its current level
This simulation is financed by (a) bonds issued in North's market and (b) budget financed (i.e., government expenditure in North is reduced by the amount of aid given to the South). The level of aid to the South in the base run is set at around 0.3 per cent of the GDP of OECD countries. Experience has shown that the DAC target of 1 per cent is found to be practically difficult for most OECD countries. However, the experience of the best performers, such as the Netherlands, could be reproduced by all OECD members if the doubling of the existing level of aid was possible. Hence, the simulation undertaken in this section will examine such a scenario.

(ii) A 66.7 per cent debt stock reduction
This simulation examines the possible impact of the World Bank and IMF's recent, vigorously publicized[8] Highly Indebted Poor Countries (HIPC) initiative. This initiative comprises two phases. Phase one requires a three-year record of compliance with an IMF program. This leads to the decision point for acceptance into the HIPC initiative. Acceptance requires having indicators that show the country be beyond debt sustainability thresholds. These are defined as a 20–25 per cent debt service ratio and present value of debt to export ratio of between 200 to 250 per cent. If countries find themselves above these thresholds they are eligible for the Nepal terms, under which they are entitled to a two-third reduction in debt stock. This reduction is applied to all types of debt, including multilateral. Phase two of the new initiative comprises the implementation of another three-year IMF program and, if

accepted within the HIPC category, an 80 per cent debt stock reduction. Since it is widely believed that few African countries are likely to reach this phase in the foreseeable feature, the simulation below is for the first phase only (see Oxfam, 1997 for a critical review of this issue).

(iii) Annual 10 per cent increases in public investment in Africa
In this simulation aid is financed by other government revenue of African countries.

External shocks simulations

(iv) A one-point rise in world interest rate
This approximates the fluctuation of the six-month US dollar-based LIBOR from 1988 to 1990.[9] Since world interest rate is an endogenous variable, the external shock simulation is conducted by changing the constant term (a_{43} in equation [6.7k] of Chapter 6). One possible interpretation for such a shock could be an exogenous rise in Northern demand for private credit, due, say, to an institutional change in Northern banking systems. Alternatively, the provision of government incentives for those who invest (for example, in Eastern Europe) could serve to explain such a shock.

(v) A 175 per cent increase in world oil price
This simulation reproduces a shock similar to the second oil price shock of 1978 to 1979. I have opted for this assuming the magnitude (nearly 260 per cent) of the first oil shock of 1973 is not likely to be repeated, given the lessons drawn from that experience. Moreover, the second oil price shock is a relatively recent and a mild one, which might feasibly be carried by OPEC.

(vi) A 10 per cent increase in export supply of commodities by the South, excluding Africa
The average rate of export growth of the America's (western hemisphere) was 11 per cent in 1990 and 10 per cent in 1991, while the corresponding rates for South Asia were 16 and 14 per cent, respectively (UNCTAD 1993). Thus, the 10 per cent simulation attempts to approximate this scenario. This simulation is useful in understanding the fallacy of composition in policy advice, such as an across-the-board devaluation by all countries, as well as the 'add-up problem' of commodity exports.

7.4.1 An Increase in the Level of Aid to the South

Three main issues are clarified by simulating an increase in the level of aid to the South. Firstly, the effects of such an increase on the different variables selected for inclusion is made clear. The second issue upon which light is thrown relates to the question of whether the financing mechanism of aid matters or not. Finally, the simulation helps to clarify whether the effects of an increase in the level of aid is likely to vary across regions and commodities.

Diagrams 7.4.1(a) to 7.4.1(c) show the impact of an increase in aid on real commodity exports and price of commodities. The results indicate that, in general, both prices and exports show a negative deviation from the base run.[10] The potency of the effect is highest when aid is bond financed. This effect manifests itself through three main channels. Looking first at bond/deficit-financed aid, this is likely to have a double effect. Firstly, by raising the demand for credit, upward pressure is placed on interest rate. The latter affects the price of commodities directly, through the speculative demand placed on particular commodities, and, indirectly through its investment, and hence, aggregate demand-depressing effect in the North. The combined effect of this is to depress demand for commodities and hence prices and exports. This effect is less potent when the aid is budget financed, chiefly because the interest rate effect is minimized. This is shown in Diagrams 7.4.1b and c by the fact that the broken line, representing budget-financed aid, lies above the solid lines, representing bond-financed aid.

The oscillating pattern for minerals, which is also observed for all other simulations set out in this chapter, results from using both the short-run and two-periods lag long-run effect of interest rates together within the same simulation. Thus, in the base run, although the interest rate rises steadily, the rate at which it does so is not constant. Since the long-run interest rate is not significant in relation to other commodities, the pattern with respect to interest rate for these other commodities may reasonably be assumed to result only from the short-run impact. The sharp decline in exports for the ESA region results from the long-lag effects, which are felt after five years. Similarly, the decrease in food price (Diagram 7.4.1c) in the period of the shock results from a comparatively strong short-run one-period lag effect of interest rate. This effect is particularly strong for bond-financed aid due to the impact of the latter on interest rate.

Two important conclusions may be drawn, based on the above analysis. Firstly, compared to budget financing, deficit financing is likely to have an adverse effect on commodity prices and African export revenue. Thus, the method of financing of aid matters. This result would tend to support the conclusions of Vos' (1994) study.[11] Hence, if bond/deficit financing is the preferred means of financing in the North, there could emerge an asymmetric relationship in policy choice between the South and the North. Secondly, the effect of this policy will depend on the particular dynamics of each commodity. Thus, depending on the composition of exports of different regions, and their sensitivity to interest rate and Northern demand, different regions may be affected in different ways by the same policy shock. This underscores one of the underlying theoretical bases of this book, which holds that the structure of an economy matters. In relation to Africa, the export structure for the ESA region is found to be comparatively the most vulnerable.

Diagrams 7.4.1d and e show the impact of aid on public revenue and expenditure. In line with the econometric results presented in Chapter 5, the impact of aid on public expenditure and revenue is found to be positive and negative, respectively. This result shows the working of the fiscal response effect. The result is also interesting because it takes account of the general equilibrium effect of aid.[12] However, the effect of this aid on the public deficit is found to be negative, with public revenue, in general, declining. This effect is very small for the WCA region and highest for the NA region. This is attributed to the fact that elasticity of government revenue to foreign inflows are found to be relatively higher, in both the long and short run, in NA than in the two other regions. In the WCA region, the foreign inflow effect is significant only in the short run, and hence, its potency is low. The nature of financing of aid is found to have a negligible effect on public revenue, with identical results being obtained for both. This results from the negligible impact of world interest rate on public revenue in the South. This contrasts strongly with its effects on public expenditure, shown in Diagram 7.4.1e, for which, deficit-financed aid is found to have a strong potency. Hence, expenditure is found to be sensitive to the nature of financing, especially in the NA region. This is brought about by higher interest payments in response to a rise in interest rate, which results from the deficit financing of aid. The strength of this effect within the NA region may be explained by the high private debt composition within that region.

Finally, Diagram 7.4.1f shows the impact of aid on real output. The general decline in output would tend to accord with the discussion set out in the previous paragraph. Only within the NA region is the nature of financing of aid found to have a differential impact. Although both deficit- and budget-financed aid depresses output in the North, the impact of the latter is found to be comparatively stronger. The main reason underlying this result is the fact that the demand effect of a cut in public expenditure is higher than the interest rate-induced lower investment-demand (and hence aggregate-demand) effect. This, combined with the commodity price effect of deficit financing, brings to light the asymmetric relationship in policy choice of how to finance aid from the North and South's perspective. In contrast to some global models,[13] the results of which suggest that aid leads to a rise in South's GDP, the impact of such aid inflows on the level of real output in Africa is found to vary across regions. This may be explained both by the level of disaggregation, and the inclusion of the macroeconomic effect of aid, within the model developed in this book. Thus, although aid might initially result in a rise in the level of imports and hence output, its macroeconomic ('Dutch disease' and 'fiscal response') and terms of trade effects work against this initial positive impact. Thus, aid would appear to have no noticeable effect on output within the NA region but a declining effect in the WCA region. In the ESA region, aid is initially found to have a positive effect, only to decline later. In this region, two years after initial capital inflows, a rise in public expenditure is observed. This is mainly attributed to a strong two-year lag short-run impact of imports, which is made possible through this inflow. This, in turn, has the effect of crowding-in private investment. The combined effect is a gentle rise in output over the six years of the simulation. The decline in output within the WCA region is attributed to the offsetting effects of export earnings. This arises as a consequence of the heavy weight of minerals and agricultural raw materials in the export basket for this region, with the price of the latter falling strongly, following the shock. Moreover, although aid-financed imports could have led to a rise in output through its positive impact on investment, the lack of a positive relationship between public and private investment in this region is likely to have limited such possibilities.

Two important conclusions may be drawn, based on the above simulation. Firstly, aid to Africa is likely to have profound macroeconomic effects. This manifests itself in the negative effect, which such aid has on the price of commodities and on Africa's fiscal balance. On the positive side, such aid may also provide relief for countries facing an import compression problem. The second important point is that deficit, rather than budget, financing of aid is likely to have an adverse impact on the South. However, this method of financing will have a comparatively lesser effect on Northern output. This may highlight a possible policy choice conflict between the two regions, owing to the structure of their interaction.

Diagram 7.4.1a
The effect of a 100 per cent increase in bond (solid lines) and budget (broken lines) financed aid to the South on commodity exports from Africa

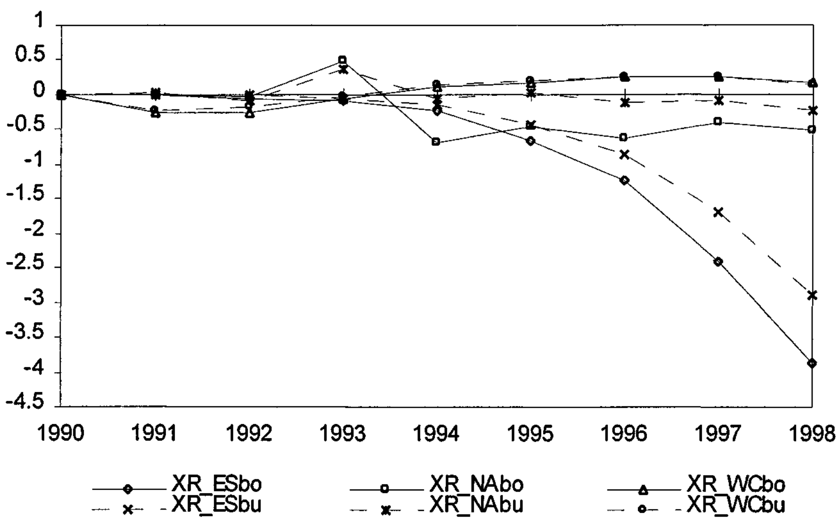


Diagram 7.4.1b
The effect of a 100 per cent increase in bond (solid lines) and budget (broken lines) financed aid to the South on African commodity prices

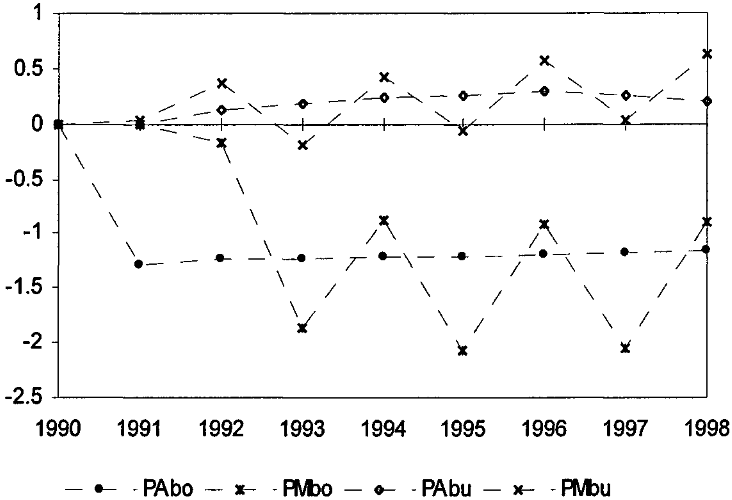


Diagram 7.4.1c
The effect of a 100 per cent increase in bond (solid lines) and budget (broken lines) financed aid to the South on African commodity prices

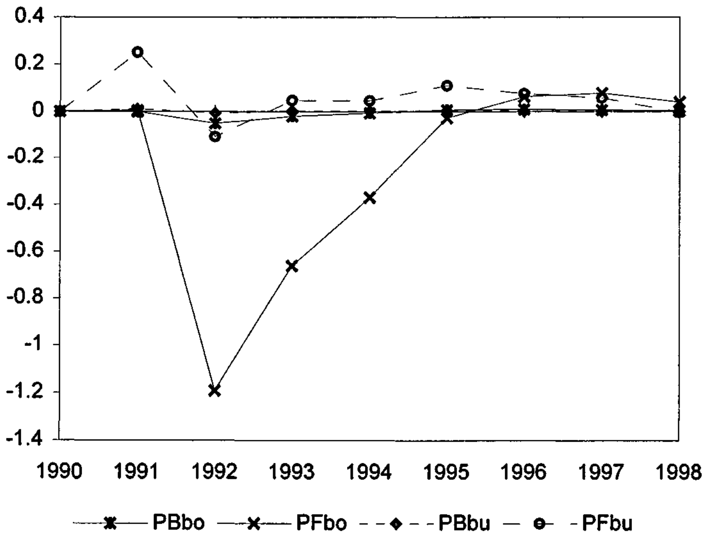


Diagram 7.4.1d
The effect of a 100 per cent increase in budget financed aid to the South on government revenue in Africa

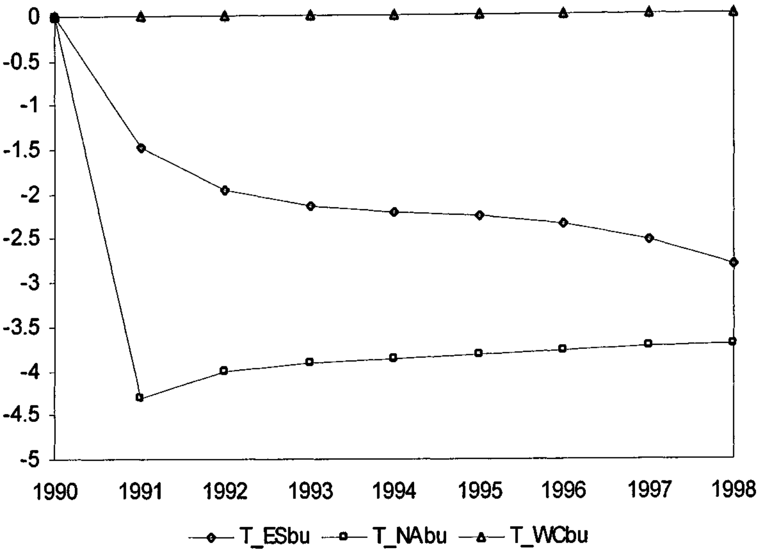


Diagram 7.4.1e
The effect of a 100 per cent increase in bond (solid lines) and budget (broken lines) financed aid to the South on government expenditure in Africa

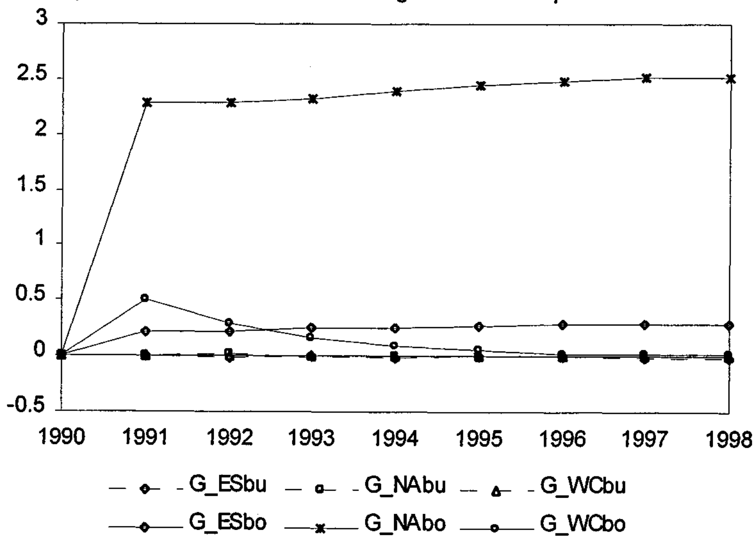
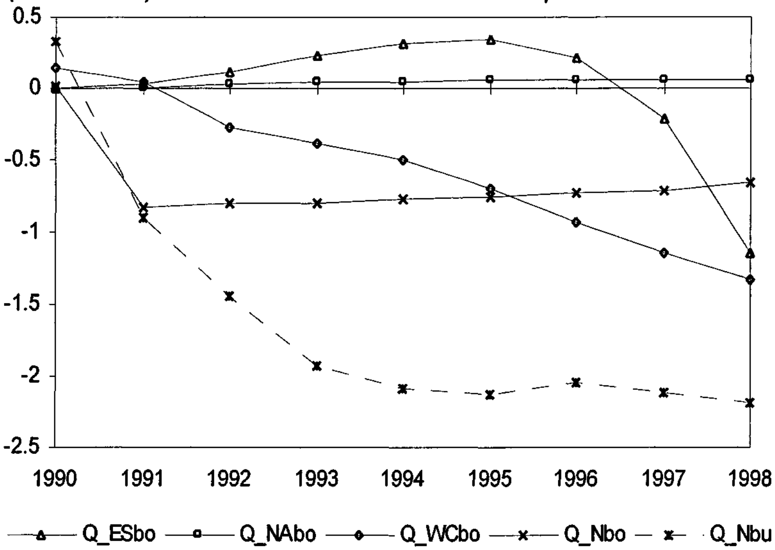


Diagram 7.4.1f
The effect of a 100 per cent increase in bond (solid lines) and budget (broken lines) financed aid to the South on real output from Africa



7.4.2 Debt Cancellation to Africa

There is a heated debate among donors and recipients alike as to the possible impact of debt cancellation on Africa. However, the generally held expectation is that debt cancellation will alleviate some of the major economic problems facing African nations. In order to test this policy the 'Nepal terms', which is incorporated into the HIPC initiative, is simulated. As noted above, this initiative entitles participating nations to a two-thirds total debt stock reduction. The impact of this policy on debt service ratios and private capital flows to Africa is illustrated in Diagrams 7.4.2a and b, respectively.

The results of the simulation indicate that this policy has virtually no effect on the real level of output, and hence these results are not reported here. The main channel through which this output effect might be expected to manifest itself is by way of lower interest payments, which allows a higher level of imports and hence higher public and private investment. Increased private investment will also be facilitated by resolving the debt overhang problem. The mere reduction in interest payments is found to have too weak an effect to counteract the model's own dynamics, which are heavily influenced by commodity price, and other effects. However, the results of the simulation indicate that reducing interest payments does have an effect in reducing the burden of debt servicing. This is illustrated in Diagram 7.4.2a. From this diagram, it can be seen that the effects of a reduction in interest payments are most pronounced in the relatively less developed regions, such as ESA. Indeed, using MULTIMOD, Soludo (1993) has obtained similar results for the South in general. This is not a surprising result, since the relative debt burden of poor regions is very high

However, a less clear picture emerges with respect to private capital inflows to Africa, once the 'debt overhang' problem has been solved by debt cancellation. As can be seen from Diagram 7.4.2b, immediately following the shock, private inflows will increase to the ESA region and decline in the other regions. However, following this immediate shock, such inflows are likely to remain fairly stable, thereafter. This upward shift in the level of inflows to the ESA region results from an impressive improvement in the debt service ratio (shown in Diagram 7.4.2a), following the cancellation of debt. As demonstrated by Soludo (1993), this may be explained by the forward-looking assessment of the South's debt servicing capacity by Northern agents. Since the model developed here employs MULTIMOD-type debt-repayment assessment criteria, it is reasonable to assume that a similar inflow will result. However, the above simulation represents an advance on previous models, in that it highlights how this effect could vary across regions. The model also highlights the important result that it is not simply a decline in the debt service ratio which matters, in terms of attracting private inflows. Rather, the degree to which it declines and the resulting relative position of a particular region in relation to the rest of Africa, and the South,[14] in general, are both important. This finding has particular relevance for both NA and WCA regions.

To sum up, the above simulation indicates that debt cancellation is not a panacea to the African debt problem. It is also shown that the impact of such a cancellation is likely to vary markedly across regions. However, debt cancellation can alleviate the pressure on the fiscal balance of government, both directly, by reducing the expenditure burden, and indirectly, by providing positive signals to private lenders.

Diagram 7.4.2a
The effect of a 66.7 per cent bilateral and multilateral debt cancellation on Africa's debt service ratio

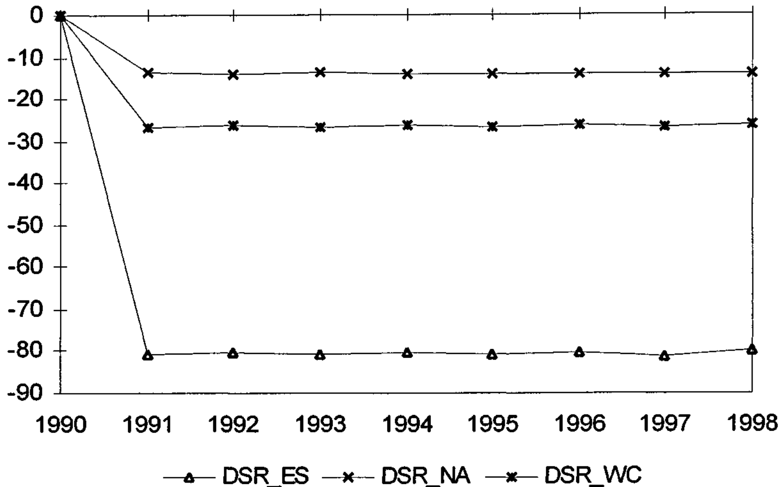
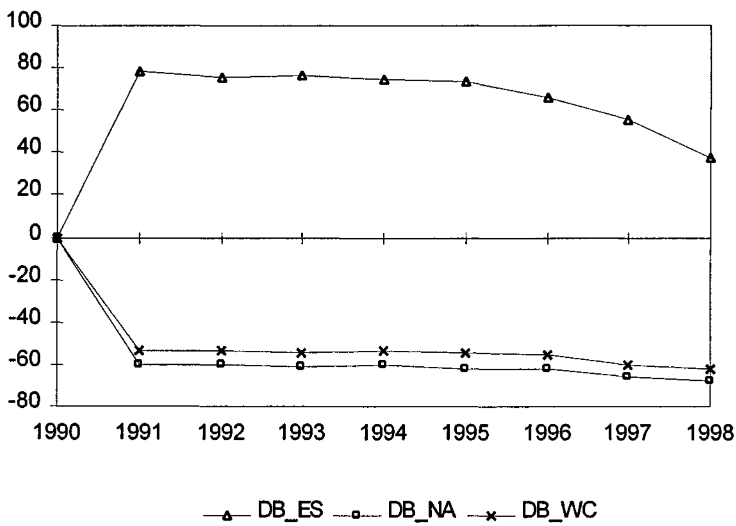


Diagram 7.4.2b
The effect of a 66.7 per cent bilateral and multilateral debt cancellation on private capital flows to Africa



7.4.3 An Increase in Public Investment

AFRIMOD may also be used to simulate domestic policy options. Thus, in order to illustrate the value of the model in analysing domestic policies within a global framework, a 10 per cent permanent, annual increase in public investment, financed by other government revenue, is assumed. The impact of this policy on real output, private investment and real exports is given in Diagrams 7.4.3a, b and c, respectively.

In general, public investment is found to have a positive impact on the level of output, as shown in 7.4.3a. However, some variation exists across regions. Thus, the impact of public investment is strongest in the ESA region, owing to a higher capital output ratio and crowding-in. This is illustrated in Diagram 7.4.3b. The relatively weaker impact in the WCA and NA regions is attributed to lack of crowding-in and the evidence of crowding-out, respectively, for the two regions. These results follow logically from the findings presented in Chapter 5. The relatively higher level of output in WCA, compared to NA, results from differences in the capital output ratio of public investment in the two regions. The general equilibrium effect of this policy on Northern output is also shown in Diagram 7.4.3a. The demand for Northern goods generated in Africa owing to this policy shock has a positive, albeit less potent, effect on Northern output.

The impact of this policy on the export of commodities is, in general, insignificant. However, a slight trend, at first declining and thereafter recovering, may be noted. The declining trend is partly a dynamic result that operates through the impact of public investment on productivity and exports. This results in an increase in supply and hence, a fall in price, through the operation of the global market. The subsequent supply response following a lag period is a decline in real exports. As discussed in Chapter 4, such an effect is found to be strongest in relation to the agricultural raw material sector of the NA region and the food-exporting sector of the WCA region. For the ESA region, such an effect is dampened by an offsetting impact of private investment on exports and hence, a sharp rise in such exports. Only the mineral sector of this region is found to be affected, after a lag, in a similar fashion to the other regions. This is shown by a slight fall in supply in the sixth period.

Diagram 7.4.3a
The effect of an annual 10 per cent exogenous increase in (public revenue financed) public investment on real output

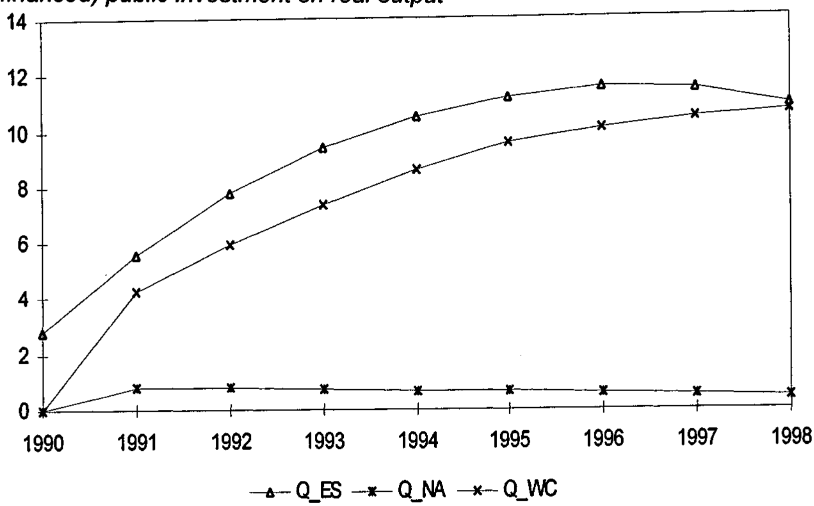


Diagram 7.4.3b
The effect of an annual 10 per cent exogenous increase in (public revenue-financed) public investment on private investment

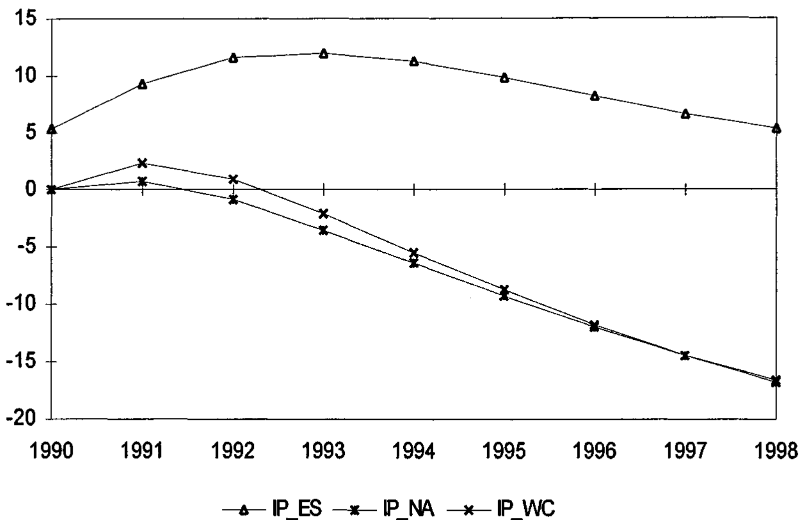
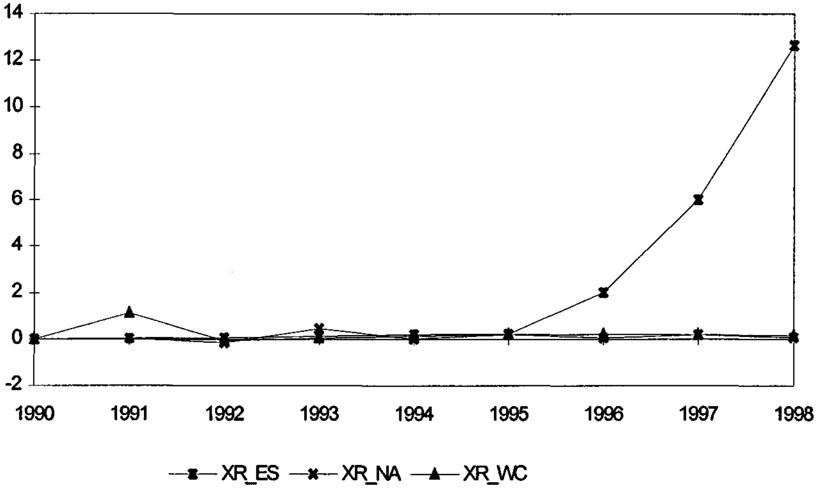


Diagram 7.4.3c
The effect of an annual 10 per cent exogenous increase in (public revenue financed) public investment on real exports



7.4.4 An Increase in the World Interest Rate

In order to assess the effects of world interest rate, a one-point exogenous rise is invoked within the model. The first impact of this is to raise the debt service ratio. As can be seen from Diagram 7.4.4a, this has an adverse effect in all regions. The variation between regions may be explained by a divergence in export performance[15] following the shock. This result indicates that an increase in interest rate will raise the debt burden of Africa, both directly and indirectly, through the operation of the world commodity market. An increase in interest rate is also likely to have an adverse effect on private inflows.[16]

As shown in Diagram 7.4.4b, the impact of an increase in interest rate on commodity price will vary between commodities. Thus, the effect of this external shock is most severe for agricultural raw materials and minerals, whose global demand is relatively more sensitive to changes in world interest rate. Hence, regions which have a larger composition of these commodities in their export basket are likely to suffer more, for an equal level of external shock. This would tend to lend

Diagram 7.4.4a
The effect of a 1-point permanent exogenous rise in the world interest rate, 3 months LIBOR on the debt service ratio

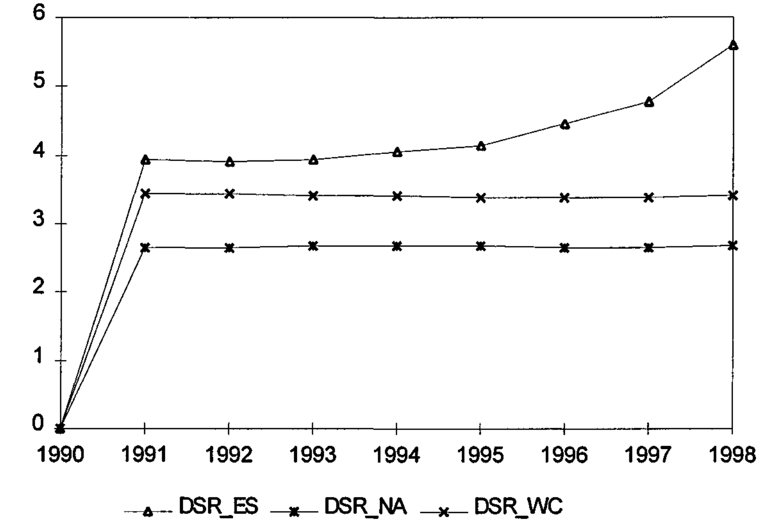
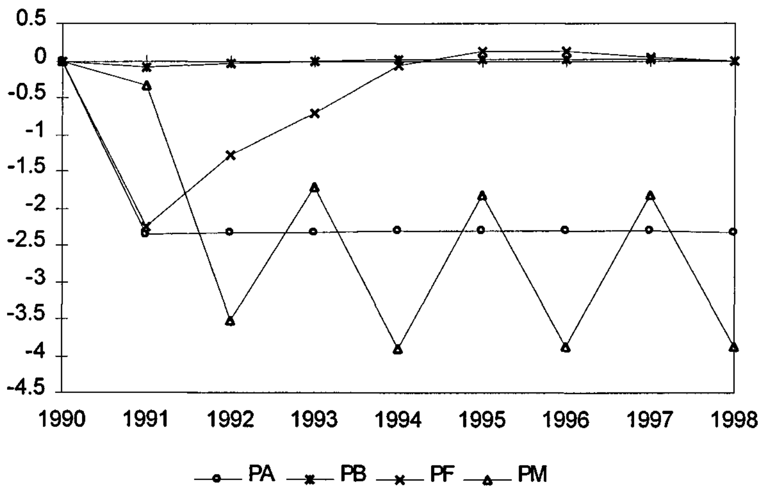


Diagram 7.4.4b
The effect of a 1-point permanent exogenous rise in the world interest rate, 3 months LIBOR on commodity price



support to the general proposition raised in relation to the previous simulation, that the effect of an external shock will depend on the production structure of a region. To sum up, the important point, which emerges from this simulation is that Northern macro policy, such as that relating to world interest rate, will have a serious impact on commodity prices and export earnings of African producers. Such policies may also have an impact on private capital flows to Africa. In all cases the model suggests the likelihood that this change in world interest rate will have an adverse macroeconomic effect.

7.4.5 An Increase in Oil Price

In order to analyse the impact of the actions of oil producing and exporting countries, a 175 per cent increase in oil price, equivalent in magnitude to the second oil price shock, is invoked within the model. This is likely to have a number of effects, which are illustrated in Diagram 7.4.5a. Firstly, such a shock will probably create a recessionary situation in the North. It could also result in an initial rise, and subsequently, a secular decline of bank credit available to Northern agents and Southern borrowers. And finally, it is likely to bring about a general decline in world interest rate, with a recovering trend as time passes. These results differ from most outcomes reported in the literature, but accord in certain respects with those produced by Vos (1994). This may be explained by the fact that Vos' model has similar theoretical underpinnings to the one developed here, particularly in relation to how it deals with credit rationing.

Vos' model indicates the likelihood that an oil shock will result in a general decline in interest rate. This is explained by the fact that a rise in oil price will lead to an increase in deposits by OPEC member states into international banks, which, in turn, will push interest rates downward. However, in contrast to Vos' (1994) model, the simulation presented here suggests that the interest rate will have a tendency to rise over time.[17] In other global models, such as those developed by Bruno and Sachs (1985), McKibbin and Sachs (1991), MULTIMOD (Masson et al. 1988) and the World Bank's GEM (Allen & Vines 1992), interest rate is found to rise after the shock. In these models, although a rise in oil price results in an increase in the supply of funds from OPEC, this will also have an adverse impact on savings and hence, on the supply of funds from the North, due to the recessionary impact of the shock. In spite of the recessionary impact on investment, this is likely to result in a rise in world interest rate. The results of AFRIMOD suggest a reconciliation of these two features. Thus, in the early period of the shock the supply of funds from OPEC will have a negative impact on interest rate. However, as time elapses, the recessionary impact starts to take effect, which results in a slow recovery in the interest rate. However, since Vos' (1994) model is not dynamic, this effect is not captured within that model.

The impact on the level of imports of each region, shown in Diagrams 7.4.5b and c, will depend on a number of factors. Thus, as shown in Diagram 7.4.5b, whether the region is oil exporting and/or has the financial means to secure the necessary imports may be important, as it is for the WCA and NA regions. Similarly, whether the region is able to adjust to the shock through import compression may also be important. Thus, as illustrated in Diagram 7.4.5c, in the ESA region, such a shock is likely to have an adverse impact on output through its import compression effect. Further disaggregation of the regions, say into oil importers and oil exporters, would be useful in showing, for example, whether import compression holds for particular types of non-oil-exporting economy.[18]

Diagram 7.4.5a
The effect of a 175 per cent permanent increase in oil price on interest rate, oligopolistic lending and Northern output

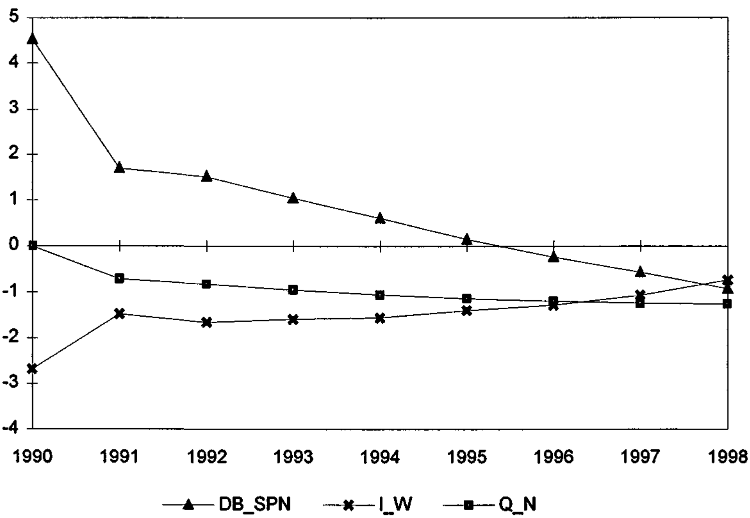


Diagram 7.4.5b
The effect of a 175 per cent permanent increase in oil price on imports to Africa

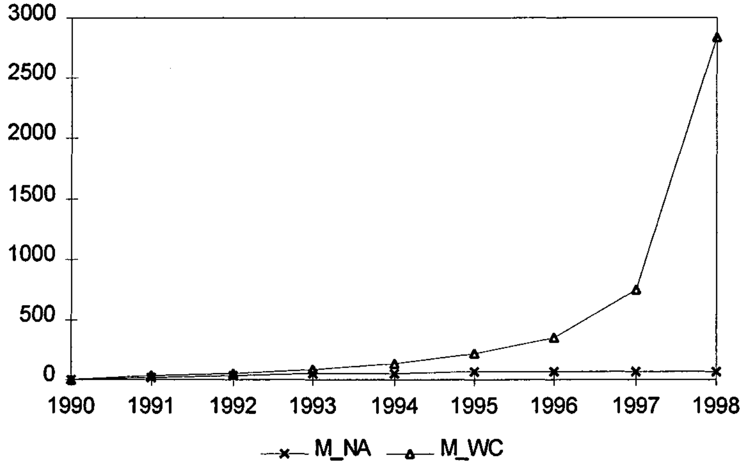
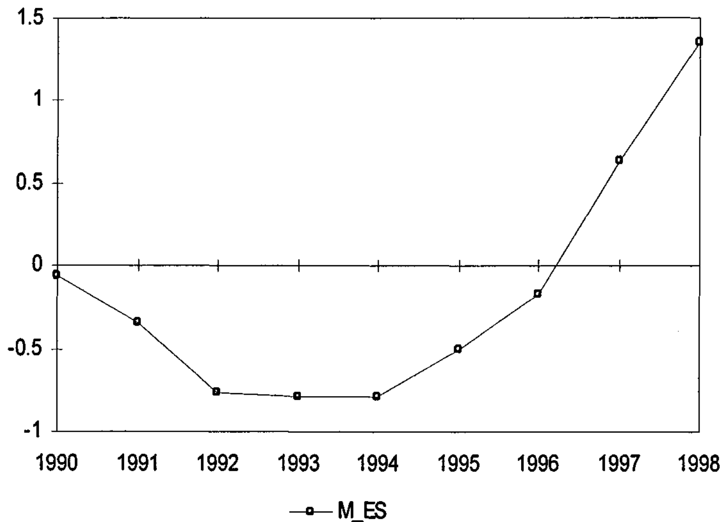


Diagram 7.4.5c
The effect of a 175 per cent permanent increase in oil price on imports to East Africa



7.4.6 An Increase in Supply of Commodity Exports by Other South

The final simulation exercise experimented with is a 10 per cent increase in the supply of commodity exports by other developing countries of the South to Africa. As shown in Diagrams 7.4.6a and b, the immediate impact of this shock is reflected in world commodity price and exports. From the first of these diagrams, it is clear that the small country assumption fails dismally to hold for all commodity categories. The fall in price is worst, however, for food. This may be explained by the fact that the supply of food from 'other South' is nearly 40 times larger than for Africa. As discussed in relation to the previous simulation, the oscillation observed in mineral price, and hence, by extension, export revenue and the vulnerability indicator, may be attributed to the particular dynamics of that market.[19] However, in spite of these oscillations, the overall effect of this supply shock is a secular downward trend within this market. This general decline in prices triggers various effects. The most important of these, illustrated in Diagram 7.4.6b, is a decline in the level of real exports. This, in turn, will have knock-on effects on the capacity to import, and hence, may result in import compression.

Given this simulation result, it is possible to compute the amount of capital inflow required to maintain the same level of imports and hence, the same level of output and output growth as was in place, prior to the shock. This hypothetical level of capital inflow, measured as a proportion of the base run level of annual bilateral and multilateral flows, is given in Diagram 7.4.6c. In plain English, this diagram illustrates the vulnerability of each region to indebtedness, owing to an external shock such as a deterioration in terms of trade.

This takes us back to the central proposition, put forward at the beginning of this book, that the African debt problem is deeply rooted in the position of the continent as a small commodity supplier within the world economy. If we accept this proposition as accurate, then it follows logically that Africa will remain vulnerable to debt unless this fundamental problem is resolved. Although all three regions are found to be vulnerable, the degree of vulnerability varies across regions, depending on the composition of commodity exports. Hence, those regions whose export composition comprises commodities, which are relatively vulnerable to world market shocks, will suffer the most. As shown in Diagram 7.4.6b, the most vulnerable region is NA. This is followed by the WCA region, which appears to suffer from various degrees of vulnerability to indebtedness, as illustrated in the hypothetical situation set out in Diagram 7.4.6c. The high degree of vulnerability to debt, shown in this diagram for the ESA and NA regions, may be explained by the level of export earnings and the projected base run value of flows, which are, themselves, a function of export performance.

7.5 CONCLUSION

This chapter has shown not only the potential of the model developed in this study, for the analysis of external shocks and policy simulation, but also the implication of such shocks for African economies. The model is essentially one of the new generation of macroeconometric models consisting of econometrically estimated parameters and a globally consistent accounting framework. The model is solved using a Guass-Seidel algorithm. Both the theoretical analysis of the trace of the matrices for the excess demand function, and the symmetry and linearity test undertaken, indicate that the model is fairly stable.

Diagram 7.4.6a
The effect of a 10 per cent increase in supply by other (non-Africa) South on world commodity price

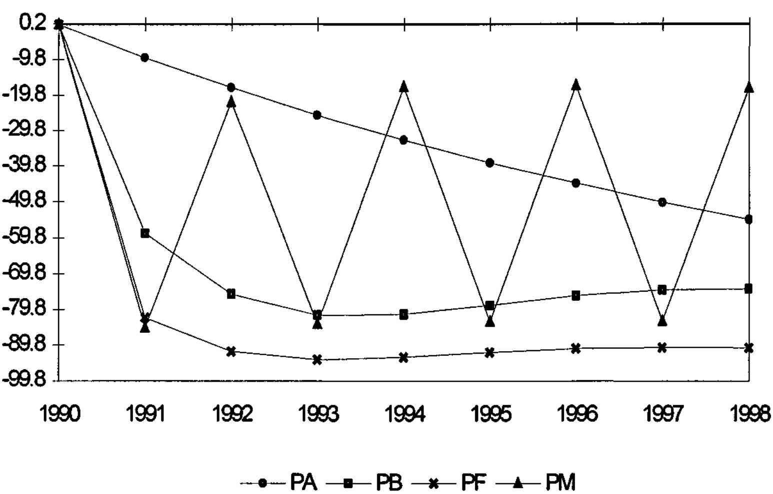


Diagram 7.4.6b
The effect of a 10 per cent increase in supply by other (non-Africa) South on real commodity exports from Africa

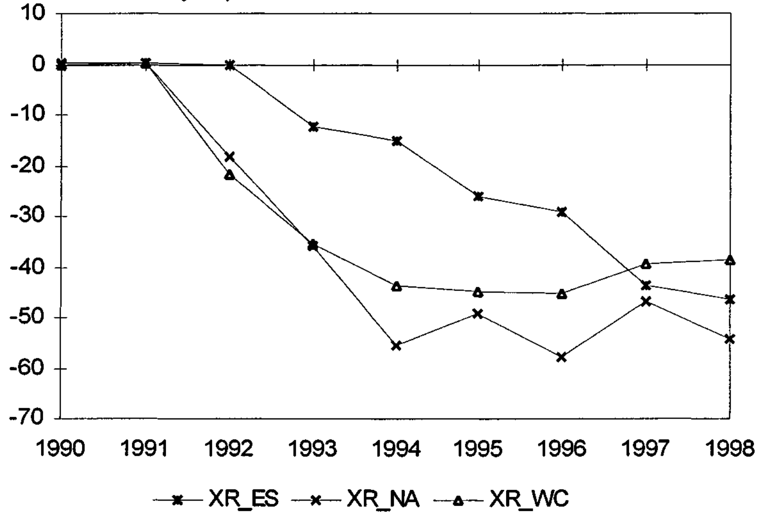
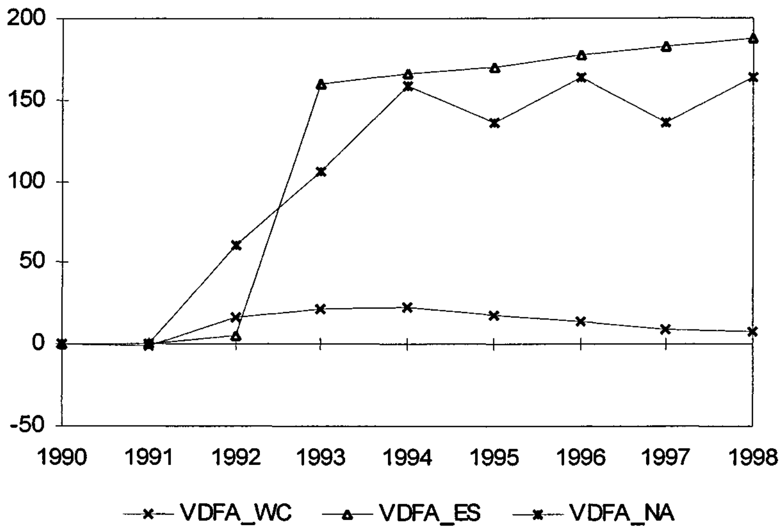


Diagram 7.4.6c
Vulnerability to debt: The effect of a supply-induced decline in world commodity price on flows of official finance to Africa



However, it is worth noting some important limitations of this model. The first of these relates to the fact that, while the modelling of Africa is quite sophisticated, by the standards of the existing literature, the modelling of the North, applied here, is generally rather crude. This sets a limit as to the extent to which it is possible to undertake an in-depth analysis of North-South interaction. Naturally, this is a consequence of the fact that the focus of this study is explicitly on Africa. Nevertheless, it would be desirable for future work in this area to combine African models, such as the one developed in this book, with more sophisticated Northern models. The second major limitation of the study is that the other developing countries, and the rest of the world, are generally assumed as exogenous. While some attempt has been made to simulate[20] the effects of other developing countries on Africa, nevertheless the modelling of 'other South' is not as dynamic as that undertaken in relation to Africa. Again, this is due to the scope and focus of the study, which is explicitly on the interaction between the North and Africa. Hence, useful insights might result from future work, which attempts, explicitly, to model these regions. A final weakness of this study is that the econometric estimation adopted is based on a single-equation ECM. This implicitly assumes that the theoretically specified functions are the most relevant long-run cointegration vector. To the extent that this assumption departs from reality, the estimation technique clearly has limitations.

However, in spite of these various limitations, the various simulations conducted, although not exhaustive, do highlight some of the structural and policy issues facing African economies in their interaction with the North. These have been discussed at some length in this chapter. In the concluding chapter, I will summarize the major findings of the study as a whole, and highlight some policy implications of these various findings.

8 Concluding Remarks

This study has attempted to model the macroeconomic interaction between Africa and the North. There are two main reasons why such an exercise might be considered important. Firstly, building a macroeconomic model of Africa which is based on stylized facts and econometric estimation within a world economy framework is an exercise that has value in itself. This claim may be justified since no such models of Africa may currently be found within the literature. Indeed, a number of policy questions and external shocks, not discussed in this book, may be analysed using the model developed here. Nonetheless, models are usually built with specific objectives in mind. In this respect, the model developed in this book is no exception. Hence, the second main justification for the present study, which is to examine the questions outlined in Chapter 1, using the simulation exercise set out in Chapter 7. Chapter 7 also outlined various policy implications of the model, as well as how such a model might be used to analyse external shocks and policy questions by locating these within a North-South macroeconomic framework. The main points arising out of this exercise are summarized below.

The first point worth noting is that Northern macro polices are likely to have a dual impact on Africa, both through finance and trade.[1] Hence, any analysis of the impact of external shocks and Northern policy on Africa will be incomplete if this finance-trade linkage is not adequately explored. Examining these two aspects within a global economic framework allows one to explore those dimensions of development problems which would otherwise have remained obscured were the national economy to be taken as the sole unit of analysis. Further, such an analysis is crucial in revealing the context under which individual national economies function. Letting these various insights guide experimentation with the model developed in this book allows for a number of major issues to be clarified. These may be summarized as follows:

1. The debt problem in Africa is essentially a commodity problem. Hence, a decline in world commodity price must be counteracted by a proportional inflow of foreign capital if a decline in output (which is, itself, capital constrained) is to be avoided. However, such an inflow of capital will imply a corresponding increase in debt.

   As the analysis in Chapter 1 has shown, the historical interaction of African economies with the North has left them with an external sector dominated by the export of commodities and import of manufactured goods. This has resulted in a secular deterioration in the terms of trade of Africa. Both rising and declining commodity prices are shown to create the pre-conditions for indebtedness. Rising commodity prices improve creditworthiness of the debtors in the eyes of lenders, as well as capacity to pay in the eyes of debtors. Declining prices, combined with the belief in the existence of a cyclical commodity price pattern, has also led to indebtedness, associated with attempts to overcome what is perceived as a 'temporary' foreign exchange problem. However, when such a pattern of trade and indebtedness is structural, the debt problem appears as a systemic phenomenon embedded in the macroeconomic interaction of North and South, in general, and the effects of the commodity market, in particular.

   The simulation of an increase in supply of commodities by other developing countries clearly demonstrates the likelihood that an increase in the supply of commodities will lead to a decline in commodity prices.[2] Thus, a 10 per cent increase in the supply of commodities by other developing countries leads to a 10–50 per cent fall in the price of agricultural raw materials, a 50–75 per cent fall in the price of beverages, an 80–90 per cent fall in the price of food, as well as a fall in the price of minerals, ranging between 15 and 80 per cent, for the period under simulation. If this fall in price is to be compensated by borrowing, for a given level of export volume, then this implies an increase of 10–20 per cent on the base run level of capital flows into WCA, for the period under simulation. The corresponding figures in relation to the NA and ESA regions range between 60 and 160 per cent, and 5 and 180 per cent, respectively.

   The vulnerability to indebtedness or aid can emerge even from apparently positive actions, as shown by the first simulation (doubling the level of aid to the South). The simulation of an increase in aid to the South also underscores the differential impact, which the manner of financing of aid by the North, has on Southern economies. For instance, doubling the existing level of aid leads to a 0.5–4 per cent decline in exports from the ESA region when this is financed by a Northern deficit. However, when such aid is financed through budgetary cutbacks in the North, the corresponding decline in exports from ESA stands at 0.25–3 per cent. In relation to the NA region, the use of bond-financed aid implies a decline in exports of around 1 per cent, while budget-financed aid brings about a reduction of only around 0.1 per cent. No major change is observed for the WCA region due to the nature of its financing. Thus, based on the specific results above, it is shown that from Africa's perspective budget-financed aid is to be preferred. However, from the North's perspective, such budget financing leads to a decline in Northern output of between 1 and 2.5 per cent, with a corresponding reduction of 1 per cent, when the aid is bond/deficit financed.

Various other specific points may be read from the simulations presented in Chapter 7. However, the general finding arising from these various simulation experiments is that the debt problem is intricately linked with the trade problem. In summary, based on the above analysis, it may be concluded that the place of African economies in the world economy is such that they are sellers in a flexiprice market and buyers in a mark-up price market. Given these structural features, an increase in Southern productivity, a rise in world interest rate and Northern recession are shown to work against the South in general, and Africa in particular.

2. African economies are extremely sensitive to world interest rate. This effect is twofold. Firstly, high interest rates will have an adverse impact on debt servicing, and hence place fiscal pressure on these economies. Secondly, by affecting world demand for commodities, an increase in the level of interest rates will have an impact on African commodity markets.

   The simulation in relation to world interest rate has shown two propagation mechanisms for Northern policy on Africa: a direct effect, by which interest rates will affect the size of debt burden and subsequent private capital inflows; and an indirect effect, through the demand for commodities. The latter is found to take two forms. Thus, a rise in world interest rate depresses commodity prices directly, through its commodity speculative demand effect, and indirectly, by affecting Northern income and hence, depressing demand. The combined effect in Africa is import compression, and when loans are obtained to redress the foreign exchange problem, debt accumulation. Specifically a one point increase in world interest rate leads to a 2.5 per cent fall in world commodity price of food and agricultural raw materials, as well as a 0.5 to 3.9 per cent fall in the price of minerals. The effect on beverage price is found to be negligible, chiefly as a result of the low interest elasticity for this commodity. Similarly, a rise in world interest rate leads to an increase in the debt service ratio of 2.5 per cent, 3.5 per cent and 4 to 5.5 percent for NA, WCA and ESA regions, respectively. The policy implication of this analysis is that debt alleviation initiatives will need to pay special attention to macroeconomic interaction, regional variations and the commodity price implications of Northern policy, if they are to have any chance of succeeding.

3. Contrary to the impression given by multilateral donor institutions, the public deficit in Africa is not merely a domestic phenomenon. Rather, it is very much linked to foreign inflows, their method of financing in donor countries, commodity price dynamics and the latter's impact on the external trade of Africa.

   In general, capital flows to Africa are found to have negative and positive impacts on public revenue and expenditure, respectively. However, there would appear to be some variation in this across regions. Thus, doubling the existing level of aid leads to a 1.5–2.5 per cent decline in public revenue, from the base-run level, within the ESA region, and a fall of around 4 per cent in NA.[3] In contrast, the same change in aid levels leads to a 2.25 per cent increase in public expenditure in NA, while in the ESA and WCA regions, the level of such expenditure remains fairly constant, at around 0.25 per cent.[4] The first simulation in Chapter 7 has shown what the fiscal response of African economies would be to an increase in aid. This simulation has also demonstrated that the method of financing is likely to have a direct bearing on public expenditure. Thus, aid financed by a Northern deficit is likely to depress commodity prices more than aid financed through budget cuts. More specifically, a bond-financed doubling of the existing level of aid leads to a 0.25–2 per cent decline in the price of minerals, while budget financing may lead to a small increase of around 0.2 per cent, over the simulation period.

The corresponding figures in relation to the price of agricultural raw materials are a decline of around 1 per cent, when bond financed, and around 0.2 per cent when budget financed. For beverage prices, the method of financing does not appear to make a significant difference, while for food prices, bond financing may result in a decline in price from the base run of up to 1.2 per cent. Thus, from the African perspective, budget financing of aid is to be preferred. However, output in the North is found to be depressed more heavily by budget financing, which entails a 1 to 2.5 per cent decline from the base-run, than by bond financing, which entails only a 1 per cent decline from the base run. This highlights the existence of a conflict in policy choice between the two regions and hence, underscores the need to consider the global macroeconomic impact of Northern policy on Africa when policy proposals for fiscal discipline in Africa are made.

4. Within our simulation, domestic policy options could represent an important instrument for mitigating structural problems. However, the impact of public investment on private investment varies not only across regions, but also across time. Thus, a 10 per cent increase in public investment in the ESA region leads to a 5–10 per cent increase in private investment in that region. In NA and WCA the initial rise in private investment of around 2 per cent quickly fell to a low of 15 per cent by the end of the simulation period. This policy has led to an increase in output of 5–10 per cent in ESA, 4–10 per cent in WCA, and nearly 1 per cent in NA. In less developed regions, such as ESA, public investment has a positive impact on private investment due to its crowding-in effect. Hence, flexible and timely evaluation of such domestic macro policy options is crucial. On the other hand, although the magnitude is small, such policies may lead to an increase in the level of output in the North through a rise in demand for Northern goods.[5] This indicates the possibility that Global Keynesianism is in operation.

5. For similar policy shocks, although the general pattern is similar, different regions may respond in quite different ways. This underlines one of the important points in the structuralist argument, that the specific structure of a particular region is important.

   In the particular case of the three regions which form the subject of this book, these would appear to exhibit a common general pattern, following policy/external shocks. However, within that broader pattern, these regions also exhibit their own unique reaction. This is shown in all simulations undertaken in Chapter 7. This point may be illustrated by examining the impact of a Northern deficit-financed doubling of aid to Africa. Thus, this policy results in an initial rise in output of up to 0.4 per cent leading to an eventual 1 per cent decline in ESA, a decline in output of 0.5–1.4 per cent in WCA and around a 0.1 per cent increase in output of NA. The impact of a doubling of deficit-financed aid on public revenue is also found to vary across regions. Thus, this policy was found to have almost no effect in WCA, while leading to a 2–2.5 per cent fall in public revenue in ESA and a fall of about 4 per cent in NA. Similarly a two-third debt stock cancellation leads to a decline in debt service ratio of nearly 80 per cent for ESA, while bringing about only a 25 per cent and 12 per cent reduction in WCA and NA, respectively. A range of other, regionally-specific, variations may also be observed, based on these simulations. These variations may be attributed to three main factors. Firstly, variation in the composition of commodity exports as well as the price dynamics of commodities for each region. Secondly, the differential operation of fiscal response and 'Dutch disease' effects of external finance in each region. And thirdly, variation in the composition of private and multilateral debt stock, as well as current flows to each region. The major implication of these variations is that future research by regional organizations, such as the Economic Commission for Africa, should focus on developing macro models of each country and linking these with Northern macro models. Such an exercise would provide an effective tool for the analysis of the macroeconomic impacts of Northern policy and external shocks on Africa.

To sum up, the analysis undertaken in this book has shown that there exists a complex and dynamic interaction between North and South. This is characterized by an economic structure which makes the African economy extremely vulnerable to the North's macro policies and external shocks.[6] It has also been shown that international finance mechanisms operate in quite a unique fashion in relation to agrarian economies, which are exporters of primary commodities, importers of manufactured goods and on the periphery of global capital markets. The implication of this finding is that international finance studies in agrarian economies need to explicitly link considerations relating to commodity trade and external finance.

The Neostructuralist macroeconomic approach of building macroeconomic analysis on the specific economic structure of an economy, which, itself, is the result of a specific historical process, represents a fruitful avenue for macroeconomic research in Africa. However, macroeconomic studies of Africa undertaken to date may be grouped into two, quite different categories. Firstly, a number of studies have been undertaken, at higher level of abstraction and theoretical contour, not based on rigorous empirical work but with a good sense of history.[7] Secondly, a new generation of economists has attempted to undertake empirically rigorous studies devoid of the historical focus which is becoming common in the economics departments of many African universities. Although the two approaches may be of great value, in their own right, a fruitful study of macroeconomic issues in Africa calls for a combining these two approaches. Indeed, the two approaches may be seen as complementary, since the former provides us with historically-formed stylized facts, while the latter helps us to investigate these empirically. The Neostructuralist's dictum of 'historically formed economic structures matters' can, as has been attempted in this book, be seen as a helpful analytical framework in this endeavour. This approach has paramount significance in Africa, where the burden of history, which moulded its economy, is still felt today. However, the need to articulate this structure empirically represents a necessary and important prerequisite for drawing up an appropriate course of action.

Appendices

Appendix 1
Country Classification

1. North

Comprises OECD countries, World Bank definition including Greece and Portugal: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States. In terms of regional classification it is North America (USA and Canada), EEC, Australia, Japan and New Zealand.

2. South

All developing countries (World Bank, World Tables definition).

3. Other South

All developing countries excluding Africa (World Bank, World Tables definition).

4. OPEC

OPEC members excluding African and Western Hemisphere suppliers: Bahrain, Kuwait, Qatar, Saudi Arabia, United Arab Emirates (UAE) Iran and Iraq.

5. Africa*

5.1 East and Southern Africa (ESA)

Economic Commission for Africa (ECA) definition including Sudan: <u>Angola</u>, Botswana, <u>Comoros</u>, <u>Djibouti</u>, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. *Samples used for econometric estimation of ESA model:* Botswana, Ethiopia, Kenya, Madagascar Malawi, Tanzania, Uganda, Zambia.

5.2 North Africa (NA)

ECA definition, excluding Sudan: Algeria, Egypt, Libya, Morocco and Tunisia. *Samples used for econometric estimation of NA model:* Algeria, Egypt and Tunisia.

5.3 West and Central Africa (WCA, ECA definition)

West Africa: Benin, Burkina Faso, Cape Verde, Cote d' Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo.
Central Africa: Burundi, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Congo, Rwanda, Sao Tome & Principe, Zaire and D.R. Congo.
Samples used for econometric estimation of WCA model: Benin, Burkina Faso, Gabon, Ghana, Nigeria, Senegal, Sierra Leone Cameroon, Central African Republic, Zaire and D.R. Congo.

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* Due to lack of complete data, countries which are underlined are not included in the regional database used in the model.

Appendix 4.1
The Econometric Approach Followed

1. An Overview

The estimation in this book is undertaken using an Error Correction Model (ECM). This approach is based on the assumption that a long-run (equilibrium) relationship exists between variables in a specified equation. This, in turn, is assumed to be captured by a cointegration analysis. Following Engel and Granger (1987), two or more time series are cointegrated of order *d*, *b*, denoted *CI* (*d*, *b*), if they are integrated of order *d*, but there exists a linear combination of them that is integrated of order *b*, where $b<d$. There are two ways of testing the existence of cointegration between variables of interest and formulating an ECM model. The first approach (the Engel-Granger two-stage approach) begins by testing whether the variables of interest are stationary or not. If variables contemplated in the model follow an $I(1)$ process, then, in the first stage, estimates of the long-run equilibrium equation (using OLS) is made. An ADF test on the residual of the long-run equation will then be conducted. This is to determine whether the variables in question are cointegrated (whether the error term follows a stationary process). If the error term is stationary (taken as proof of cointegration) in the second stage, we could combine the error term with the first difference of the variables (short-run indicators) to estimate the final model. This approach has a number of shortcomings, particularly when there are more than two variables in an equation (see Engel & Granger 1991, Banerjee et al. 1993, Enders 1995, among others). This has led to the popularity of Johansen's approach which is better at handling multivariate systems (see Johansen 1988, 1991; Johansen & Juselius 1990). Following Johansen (1988, 1991) we may consider a VAR model given by:

$$X_t = \Pi_1 X_{t-1} + \ldots + \Pi_k X_{t-k} + \mu + \phi D_1 + \varepsilon_t \quad (t = 1,\ldots,T) \qquad [4.1a]$$

In general, economic time series are non-stationary processes, and VAR systems like equation 4.1a can be expressed in the first differenced form. Using $=1-L$, where L is the lag operator, equation 4.1a can be rewritten as,

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1}\Delta X_{t-k+1} + \Pi X_{t-1} + \mu + \phi D_1 + \varepsilon_t \qquad [4.1b]$$

where:

$$\Gamma_i = -(\mathrm{I} - \Gamma_1 - \ldots - \Gamma_i) \quad (i = 1,\ldots,k-1) \text{ and } \Pi = -(\mathrm{I} - \Pi_1 - \ldots - \Pi_k)$$

Model 4.1b is a traditional first-difference VAR model except for the term X_{t-1}. The Johansen procedure is based on an examination of matrix Π, which contains information about the long-run relationship. The analysis of the long-run relationship in the model is based on examining the rank of this matrix. If this matrix has a full rank, the vector process X_t is stationary. If the rank equals zero, the matrix is a null matrix and equation 4.1b remains a traditional VAR. The third and most interesting possibility is when 0< rank (Π) = $r<P$, which implies there are p X r matrices and such that Π = '. The cointegration vector has the property that $'X_t$ is stationary even though X_t itself is non-stationary. The Johansen procedure helps to determine and identify the cointegrating vector(s). The empirical study in this book used both the Engel-Granger and the Johansen approaches.

2. ERROR CORRECTION MODEL (ECM) FORMULATION

Once the variables in question are cointegrated, we can formulate an ECM, following the Granger representation theorem (Engel & Granger 1987), which states that cointegrated variables have an ECM representation. A general representation of ECM with a one-period lag and one exogenous variable (see Banerjee et al. 1993, Thomas 1993, Kennedy 1992, Enders 1995, among others) may be written as,

$$\Delta y_t = \alpha_0 + (\alpha_1 - 1)(y_{t-1} - x_{1t-1}) + \beta_{10}\Delta x_{1t} + (\alpha_1 - 1 + \beta_{10} + \beta_{11})x_{1t-1}$$

If we add and subtract $(\beta_{10} + \beta_{11})x_{1t-1}$ on the right-hand side, we arrive at the equation used for estimation, which may be given by,

$$\Delta y_t = \alpha_0 + (\alpha_1 - 1)(y_{t-1} - kx_{t-1}) + \beta_{10}\Delta x_{1t} + \varepsilon_t$$

where k, the long-run coefficient, is $\dfrac{(\beta_{10} + \beta_{11})}{(1-\alpha_1)}$.

At a general level, if we have a long-run relationship given by,

$$Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 Z_t \qquad [4.2a]$$

The ADL for this can be written as,

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_3 Y_{t-i} + \sum_{i=0}^{k} \alpha_4 X_{t-i} + \sum_{i=0}^{k} \alpha_5 Z_{t-i} + \varepsilon_{1t} \qquad [4.2b]$$

By adding and subtracting terms appropriately (see above), the ECM formulation of equation 4.2b can be given as,

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{k-1} \alpha_{6i} \Delta Y_{t-i} + \sum_{i=0}^{k-1} \alpha_{7i} \Delta X_{t-i} + \sum_{i=0}^{k-1} \alpha_{8i} \Delta Z_{t-i} + \\ + \alpha_9 \left[Y - \beta_1 X - \beta_2 Z \right]_{t-k} + \varepsilon_{2t}$$

where:

$_{6i} = (\ _3 - 1)_i + \ _{3,i+1} + \ldots + \ _{3,k-1}$ for $i = 1, \ldots k-1$ and

$_{j,i} = \ _{j,i} + \ _{j+1,\,i+1} + \ldots + \ _{5,\,k-1}$ for $j = 4, 5$ and $i = 1, \ldots k-1$

$_9 = \ _{3,i} + \ _{3,i+1} + \ldots + \ _{3,}\, k$ for $i = 0, \ldots, k$ and

$_1 = (\ _{4,i} + \ _{4,i+1} + \ldots + \ _{4,k}) / \ _9$ and

$_2 = (\ _{5,i} + \ _{5,i+1} + \ldots + \ _{5,k}) / \ _9$ and $_{2t}$ is a white noise process.

The terms in square brackets [ ] show the long-run model.
If we adapt this general ECM formulation with a one-period lag and six (a reasonable figure, in the context of most of our equations) exogenous variables we arrive at,

(a) The long-run relationship

given as,

$$y = \gamma_0 + \gamma_1 x_1 + \gamma_2 x_2 + \gamma_3 x_3 + \gamma_4 x_4 + \gamma_5 x_5 + \gamma_6 x_6$$

(b) The ADL formulation

The Autoregressive-Distributed Lag (ADL), denoted ADL (m.n,p) [where *m* represents the number of lags of the endogenous, *n* the number of lags for the exogenous and p the number of exogenous variables] for our formulation will be ADL (1,1,6). This representation (from which an ECM can be formulated) is given as,

$$y =$$

$$\beta_0 + \beta_{11}x_1 + \beta_{12}x_{1t-1} + \beta_{21}x_{2t} + \beta_{22}x_{2t-1} + \beta_{31}x_{3t} + \beta_{32}x_{3t-2} \ldots + \alpha_1 y_{t-1}$$

(c) The ECM representation

The ADL representation, as set out above, helps us to derive the general ECM representation. This ECM representation is given by,

$$\Delta y_t = \beta_0 + (\alpha_1 - 1)\left[y_{t-1} - \sum_{j=1}^{6} x_{jt-1} \right] + \sum_{j=1}^{6} \beta_{j0} \Delta x_{jt} + \sum_{j=1}^{6} (\alpha_1 - 1 + \beta_{j0} + \beta_{j1}) x_{jt-1}$$

A first- and second-order ECM formulation is chosen in this study in order to minimize the complexity of the lag structure. Ideally one needs to start from a generous lag structure and test down to arrive at a parsimonial equation. The large size of my model meant that I was not able to follow this approach strictly.

(d) Inferring the long-run values

It may be generalized that the following formula gives the long-run coefficient for each of the exogenous terms and i different lags,

The constant term: $\gamma_0 = \dfrac{\beta_0}{1 - \sum_{i=1}^{n} \alpha_i}$

Coefficient of the exogenous variables: $\gamma_j = \dfrac{\sum_{i=1}^{n=1} \beta_{ji}}{1 - \sum_{i=1}^{n} \alpha_i}$

where: j = exogenous variable j
n = maximum lag level (1st order, 2nd order...)

Most of my coefficients are estimated using panel data. Applied time series analysis using such data is not yet well developed. Thus, the estimated coefficients may have a number of shortcomings. However, this approach is widely used in applied work. To tackle possible shortcomings, I conducted relevant tests for each country and generally found that the models show cointegration. This points to the need to conduct further study when the new technique is refined. Interested readers may refer to Anderson and Hsiao (1982), Levin and Lin (1993), Pesaran and Smith (1995), Pedroni (1995), McCoskey, Kao and Chiang (1998), Kao (1997, 1999), and Njuguna (1999) on the newly emerging issues of time series analysis in panel data. Njuguna (1999) in particular provides a summary of the newly developed tests.

(e) T-values of the long-run coefficients

The t-values of the long-run coefficients should be generated using the Wickens-Breusch transformation (see Gurney 1989: 89–90). These may be computed by regressing

$$\frac{y-[1+(\alpha_1-1)]y_{t-1}}{(\alpha_1-1)} \text{ on all except } Y_{t-1}$$

3. Hypothesis of Diagnostic Test

This section briefly summarizes the test used in the analysis.

(a) Cointegration test

I use both the Engel and Granger and the Johansen tests.

H_0 = Unit-root (of the error term) exists / the error term is non-stationary
H_1 = The error term (of the cointegration equation) is stationary

For the Johansen test, the null is that no cointegration relationship exists. Mackinnon critical values are used in both cases.

(b) Specification test

I use Rumsy RESET (1)

$H_0 = u \sim N(0, \sigma^2 I)$
Coefficient of fitted vector = 0 => no specification problem

$H_1 = u \sim N(\mu, \sigma^2 I)$
Coefficient of fitted vector 0 => specification problem

Moreover, RESET (2) is also tested for all the equations and the result is similar, and often better, than the RESET (1).

(c) Normality test

I used a Jarque-Bera, which tests for the hypothesis of the value of 0 and 3 for skewness and Kurtosis, respectively. Although this applies for large samples (n>1000), nevertheless it may serve as a good indicator. Other visual inspection, which is done in estimation, is also important, even if this statistic may reject normality (see Mukherjee et al. 1998).

H_0 = Normality
H_1 = H_0 is not correct

(d) Parameter restriction test

I used a Chow break test.

$H_0 = \ _1 = b_{1j} xt$

where: $_1$ is the restricted coefficient and b_{1j} = the unrestricted coefficients.

H_1 = H_0 is not correct.

Appendix 4.2
Stationarity Condition of the Expected Profit Indicator (Π)

Following the theoretical discussion presented in section II, the expected profitability/price instability index is computed for each of the commodity groups and regions. The index is computed by subtracting the three-year moving average of real exchange rate from each current level of real exchange rate,

$$\Pi^{\sigma}{}_{t} = \left(\frac{eP_s}{P_d}\right)_t - k^{-1}\sum_{i=1}^{k}\left(\frac{eP_s}{P_d}\right)_{t-i}$$

where k is assumed to be three years. Thus, the expected long-term average price is formulated by taking the evolution in past three years of the real exchange rate. This variable is tested for stationarity using the Augmented Dickey-Fuller Unit Root Test. The result is reported below.

Augmented Dickey-Fuller Unit Root Test on $\Pi\sigma$

Region	Food	Agr. raw material	Beverage	Minerals, ores and metals	1% Mackinnon critical value
North Africa	-5.7	-8.04	NA	-9.25	-2.6
W&C Africa	-11.66	-11.67	-9.67	-10.53	-2.57
E&S Africa	-9.1	-8.83	-9.34	-8.33	-2.58

As this table shows, the series are clearly stationary. On the other hand all the other explanatory variables are non-stationary, there being $I(1)$ variables. This indicates the absence of a long-run bivariate relationship. Estimating variables with different levels of integration throws up a number of problems (Thomas 1993: 164, Banerjee et al. 1993, Ch. II) in bivariate analysis, although not in some multivariate systems. However, given the nature of our model, which is a multivariate system in which a subset of the regressors are cointegrated, we have estimated the model using this variable.

Some remark about the transformation of the data is in order. As all variables are in logarithmic form, taking the log of the price instability indicator will hide the negative deviation side of the story. Hence, one ideally should use the actual variable. However, this creates a problem of the functional form, which is log-linear. The best transformation, with a log-log functional form, and, at the same time, not losing sight of the negative deviations, is to take the difference between the log of real price and log of the moving average of the price. Formally, this may be expressed as,

$X = f(P, P^*, Z)$

where: P is the relative price, P^* the price instability indicator (comprising a moving average of lagged P) and Z represents other regressors.

$P^* = P - [\{Pt\_1 + P\_2 + P\_3\}/3]$ Definition

$\text{Log}(P^*) = \text{Log}(P) - \text{Log}([...])$ Taking logarithm of all variables

$\text{Log}(P^*) = \text{Log}(P / [...])$

This will allow both the desired functional form (log-log) and the information about negative deviation (when [ ] > P) to be shown simultaneously. It is this value which is used for estimation purposes.

Estimation result

This series has exhibited a very high correlation (in most cases higher than 0.80) with the price variables in all regions. In spite of the multicolinearity problem involved, the estimation is carried using relative prices and capital formation indicators as regressors. For the ESA region, the estimation shows high R-square and insignificant t-values, indicating the likelihood of multicollinearity. Moreover, the estimation is undertaken using only the profit and capital formation indicators, with the former effectively replacing the real exchange rate, especially for minerals and agricultural raw materials. For food, the profit indicator shows a short-run negative coefficient while, for minerals, a positive long-run one. In relation to the other commodity categories, the coefficient is not significant. Similarly, for the

WCA region, the estimation, in general, was not found to be statistically significant. The profit indicator shows a positive value only for the capacity utilization aspect of minerals, although estimation with profit and capital formation indicators shows the profit indicator effectively replacing the real exchange rate. Neither are most of the estimates for the NA region found to be significant. However, for minerals, the profit indicator showed a negative coefficient, both in the short and long run, while for food it shows a positive short-run coefficient. To sum up, the lesson from this exercise is that the profit indicator is nearly identical with the real exchange rate, and, hence creates a serious multicollinearity problem. Therefore, it is appropriate to use either of the two, but not both. This highlights a serious shortcoming of previous studies, which commonly used both.

Appendix 4.3
Results Using First Difference Values in the Global Commodity Model

In this appendix I report the result of the estimation of the global commodity market, using the first difference of the series in the model. Both the equilibrium and disequilibrum versions of the model are estimated. The equilibrium model essentially uses equations 1 and 2 set out in section 4.4.2. In this model, adjustment is instantaneous. In the disequilibrum model equations 2 and 5, where stickiness is assumed in the supply of exports, are used. In both cases the equilibrium condition for equation 3 is imposed.

1. The Equilibrum Model

The equilibrium model is estimated using the Full Information Maximum Likelihood (FIML) estimation method. The method has the advantage of taking all restrictions into account while estimating. Moreover, it has excellent asymptotic properties. On the down side, the method is sensitive to specification problems in any one of the equations, since that situation will affect the entire system. The estimation proceeds by maximizing the likelihood function of the model. In this model, the estimation is undertaken by imposing a constraint on the world and domestic prices in the supply equations. The constraint ensures an identical coefficient, with opposite signs, for the two regressors (see Table 3 below for the unconstrained version). Results of this equilibrium model are given in Table 1.

Table 1 Estimates for the Constrained Equilibrium Model, FIML& 3SLS

Agricultural Raw Materials (FIML)

$$\Delta \ln X_t = \underset{(0.02)}{-0.01} + \underset{(0.07)}{0.08} \ln\left(\frac{\Delta P_w}{\Delta P_s}\right)_{t-1} + \underset{(0.27)}{0.30}\,\Delta \ln\left(\frac{I_s}{Y_s}\right)_{t-1}$$

$$\Delta \ln \mathrm{P}_{w_t} = \underset{(0.10)}{-0.19} + \underset{(0.58)}{1.45}\Delta \ln Y_{N_t} - \underset{(0.19)}{0.23}\Delta \ln i_{w_t} + \underset{(1.4)}{3.1}\Delta \ln P_{N_t} - \underset{(1.65)}{0.98}\Delta \ln X_t$$

Beverage (FIML)

$$\Delta \ln X_t = \underset{(0.02)}{-0.01} + \underset{(0.07)}{0.10} \ln\left(\frac{\Delta P_w}{\Delta P_s}\right)_{t-1} + \underset{(0.33)}{0.30} \ln \Delta\left(\frac{I_s}{Y_s}\right)_{t-4}$$

$$\Delta \ln \mathrm{P}_{w_t} = \underset{(0.14)}{-0.17} + \underset{(0.83)}{0.76}\Delta \ln Y_{N_t} - \underset{(0.25)}{0.36}\Delta \ln i_{w_t} + \underset{(1.9)}{2.5}\Delta \ln P_{N_t} - \underset{(1.6)}{0.08}\Delta \ln X_t$$

Food (3SLS) (FIML which could not converge)

$$\Delta \ln X_t = \underset{(0.05)}{0.06} + \underset{(0.19)}{0.07} \ln\left(\frac{\Delta P_w}{\Delta P_s}\right)_{t-1} + \underset{(1.02)}{0.001} \ln \Delta\left(\frac{I_s}{Y_s}\right)_{t-2}$$

$$\Delta \ln \mathrm{P}_{w_t} = \underset{(0.11)}{-0.16} + \underset{(0.78)}{1.2}\Delta \ln Y_{N_t} - \underset{(0.21)}{0.07}\Delta \ln i_{w_t} + \underset{(1.5)}{2.9}\Delta \ln P_{N_t} - \underset{(0.30)}{0.55}\Delta \ln X_t$$

Minerals, Metals and Ores (2SLS) (FIML failed)

$$\Delta \ln X_t = \underset{(0.13)}{-0.11} + \underset{(0.75)}{0.33} \ln\left(\frac{\Delta P_w}{\Delta P_s}\right)_{t-1} + \underset{(2.7)}{2.8} \ln \Delta\left(\frac{I_s}{Y_s}\right)_{t-1}$$

$$\Delta \ln \mathrm{P}_{w_t} = \underset{(0.12)}{-0.08} + \underset{(0.76)}{1.5}\Delta \ln Y_{N_t} - \underset{(0.25)}{0.03}\Delta \ln i_{w_t} + \underset{(1.9)}{1.13}\Delta \ln P_{N_t} - \underset{(0.11)}{0.02}\Delta \ln X_t$$

Notes:
Figures in bracket are standard errors. In almost all cases the values are similar to the hetroschedastic consistent standard errors.
R^2 and other indicators such as D.W. are not reported, due to their ambiguity in the simultaneous model. For instance the value of R^2 is bounded by $(-\infty, 1)$, not (0, 1). Hence small values are not a good indicator of 'poor fit' (see Goldstein & Khan 1978: 278).
For minerals, both estimations methods (FIML and 3SLS) yield nearly identical results. Hence we report only the FIML-based results.

2. THE DISEQUILIBRUM MODEL

The estimation of the disequilibrum model using equations 2 and 5.1 was not successful. The estimation for agricultural raw materials and minerals also failed to converge. In Table 4.2, estimation results of food and beverage, respectively, are reported. The model is estimated using a Three Stage Least Square Iterative (3SLSI) procedure, by fully taking into account the non-linear constraints of the entire structure of the model. As a generalized least square method this takes the residual of the reduced form equation, estimated by the Two Stage Least Square (2SLS) method, as well as their covariance matrices for transforming the estimating equations iteratively, until convergence is achieved. The procedure is asymptotically Full Information Maximum Likelihood. The estimated results following this procedure are reported below.

Table 2 The Disequilibrum Model: 3SLSI

Food

$$\underset{}{\Delta \log X_t} = \underset{(0.05)}{0.05} + \underset{(0.0.19)}{0.02}\Delta \log P_{w_{t-1}} + \underset{(0.12)}{0.02} \log \Delta P_{s_{t-1}} - \underset{(0.83)}{0.07} \log \Delta\left(\frac{I_s}{Y_s}\right)_{t-2}$$

$$\Delta \log P_{w_t} = 24.8 - 172.4\Delta \log Y_{N_t} - 46.2\Delta \log i_{w_t} +$$
$$18.8\Delta \log P_{N_t} - 435.6\Delta \log X_t - 52.3X_{t-1}$$

$$\underset{(0.83)}{\lambda = 0.88} \quad \underset{(0.07)}{a_0 = -0.06} \quad \underset{(3.4)}{a_1 = 0.45} \quad \underset{(1.01)}{a_2 = 0.12} \quad \underset{(0.02)}{a_3 = -0.003} \quad \underset{(0.7)}{a_4 = -0.05}$$

Beverage

$$\Delta \log X_t = -0.07 + 0.16\Delta \log P_{w_{t-1}} + 0.46 \log \Delta P_{s_{t-1}} + 0.40 \log \Delta\left(\frac{I_s}{Y_s}\right)_{t-4}$$
$$\quad (0.06) \quad (0.12) \qquad\qquad (0.26) \qquad\qquad (0.44)$$

$$\Delta \log \mathrm{P}_{w_t} = -0.84 + 0.93\Delta \log Y_{N_t} - 1.29\Delta \log i_{w_t} +$$
$$10.51\Delta \log P_{N_t} + 21.55\Delta \log X_t + 12.X_{t-1}$$

$$\underset{(0.38)}{\lambda = 0.44} \quad \underset{(0.07)}{a_0 = -0.09} \quad \underset{(0.58)}{a_1 = 0.10} \quad \underset{(0.21)}{a_2 = 0.10} \quad \underset{(0.08)}{a_3 = -0.13} \quad \underset{(0.91)}{a_4 = 1.1}$$

Notes: As given under Table 1.
Figures in bracket are standard errors and refer to structural coefficients. In almost all cases the values are similar to heteroschedastic consistent standard errors.
The plausibility of the parameters should be inferred from the coefficients of the structural equations.

3. The Unconstrained Estimation

Results reported in this section are based on an unconstrained model. That is, the world price and the domestic price coefficients, unlike in Table 1, are not constrained to have identical values.

Table 3 Estimates of the Equilibrium Model, FIML& 3SLS

Agricultural Raw Materials (FIML)

$$\Delta \ln X_t = -0.02 + 0.04\Delta \ln P_{w_{t-1}} + 0.12 \ln \Delta P_{s_{t-1}} + 0.30\Delta \ln\left(\frac{I_s}{Y_s}\right)_{t-1}$$
$$\quad (0.02) \quad (0.09) \qquad\qquad (0.09) \qquad\qquad (0.29)$$

$$\Delta \ln \mathrm{P}_{w_t} = -0.17 + 1.4\Delta \ln Y_{N_t} - 0.23\Delta \ln i_{w_t} + 2.9\Delta \ln P_{N_t} - 0.71\Delta \ln X_t$$
$$\quad (0.10)(0.57) \qquad (0.19) \qquad (1.37) \qquad (1.32)$$

Beverages (3SLS)

$$\Delta \ln X_t = \underset{(0.04)}{-0.01} + \underset{(0.09)}{0.10}\Delta \ln P_{w_{t-1}} + \underset{(0.13)}{0.11} \ln g\Delta P_{s_{t-1}} + \underset{(0.45)}{0.32} \ln \Delta\left(\frac{I_s}{Y_s}\right)_{t-4}$$

$$\Delta \ln P_{w_t} = \underset{(0.14)}{-0.20} + \underset{(0.83)}{0.59}\Delta \ln Y_{N_t} - \underset{(0.25)}{0.50}\Delta \ln i_{w_t} + \underset{(1.9)}{3.4}\Delta \ln P_{N_t} - \underset{(0.57)}{1.56}\Delta \ln X_t$$

Food (3SLS)

$$\Delta \ln X_t = \underset{(0.08)}{0.06} + \underset{(0.19)}{0.06}\Delta \ln P_{w_{t-1}} + \underset{(0.29)}{0.006} \ln \Delta P_{s_{t-1}} + \underset{(1.02)}{0.002} \ln \Delta\left(\frac{I_s}{Y_s}\right)_{t-2}$$

$$\Delta \ln P_{w_t} = \underset{(0.11)}{-0.16} + \underset{(0.77)}{1.2}\Delta \ln Y_{N_t} - \underset{(0.20)}{0.08}\Delta \ln i_{w_t} + \underset{(1.4)}{2.9}\Delta \ln P_{N_t} - \underset{(0.29)}{0.59}\Delta \ln X_t$$

Minerals and Ores (FIML)

$$\Delta \ln X_t = \underset{(0.27)}{0.05} - \underset{(1.1)}{0.48}\Delta \ln P_{w_{t-1}} - \underset{(1.1)}{0.08} \ln \Delta P_{s_{t-1}} + \underset{(3.8)}{3.9} \ln \Delta\left(\frac{I_s}{Y_s}\right)_{t-1}$$

$$\Delta \ln P_{w_t} = \underset{(0.40)}{0.51} + \underset{(0.82)}{0.59}\Delta \ln Y_{N_t} - \underset{(0.16)}{0.23}\Delta \ln i_{w_t} + \underset{(1.4)}{0.18}\Delta \ln P_{N_t} - \underset{(0.18)}{0.11}\Delta \ln X_t$$

Notes: As given under Table 1.

Appendix 5.1
The Structure of Heller's Model

Heller's model is set as a maximization problem of a utility function [U], given as equation 1a, subject to two budget constraints, given as equations 2a and 3a.

$$U = \alpha_0 + \alpha_1(I_g - I^*_g) - \frac{\alpha_2}{2}(I_g - I^*_g)^2 + \alpha_3(G_s - G^*_s) - \frac{\alpha_4}{2}(G_s - G^*_s)^2 + \alpha_5(G_c - G^*_c) - \frac{\alpha_6}{2}(G_c - G^*_c)^2 - \alpha_7(T - T^*) - \frac{\alpha_8}{2}(T - T^*)^2 - \alpha_9(B - B^*) - \frac{\alpha_{10}}{2}(B - B^*)^2 \qquad [1a]$$

where: I_g is government investment, G_s government 'socioeconomic' consumption, G_c government expenditure on civil consumption, T taxation and B is borrowing. Asterisks (*) indicate a target level for each variable. This functional form is chosen to ensure diminishing marginal utility from each of the arguments.

$$I_g = B + (1 - \rho_1)T + (1 - \rho_2)A_1 + (1 - \rho_3)A_2 \qquad [2a]$$

$$G_s + G_c = \rho_1 T + \rho_2 A_1 + \rho_3 A_2 \qquad [3a]$$

where: A_1 and A_2 are total foreign grants and loans, respectively, and ρ's are budget constraint parameters.

Before optimizing this function, each of the desired levels for the choice variables, are further specified, as given below:

$$I^*_g = \alpha_{11} Y_{t-1} + \alpha_{12} I_p \qquad [4a]$$

where: Y is total output and Ip real private investment.

$$T^* = \alpha_{13} Y_t + \alpha_{14} M_{t-1} \quad [5a]$$

where: M is total real imports.

$$G_c^* = \alpha_{15} G_{c,t-1} \quad [6a]$$

$$G_s^* = \alpha_{16} E + \alpha_{17} Y_t + \alpha_{18} (Y_t - Y_{t-1}) \quad [7a]$$

where: E is primary school enrolment.

$$B^* = 0 \quad [8a]$$

Having arrived at the desired level of the choice variables, using equations 4a to 8a, equation 1a is optimized with respect to current policy variables, subject to the budget constraint 2a and 3a. The structural equations required for the estimation are obtained from the first-order condition of the optimization, using Lagrangian multipliers associated with the constraints. This is the basic Heller model. See also Mosley et al. (1987) for an extension of this basic model, and White (1993) for a reduced version of the model. Binh and McGillivray (1993) present a justification for avoiding the linear term in Heller's model.

Appendix 5.2
Estimation Using Other Approaches

In this appendix we will briefly outline the results of the ECM-based estimation, using an alternative specification. I have used the main variables included in van Wijnbergen's (1986a) estimation, based on the African data. The explanatory variables are limited to real GDP and a one-period lag capital inflow indicator. We could not use current and one-period lag capital, as was done in van Wijnbergen (1986a), due to problems of multicolinearity.

The result of the estimation varies both across regions and commodities. The estimation using the ESA data yields a number of interesting results. With some ambiguity, it would appear that the 'Dutch disease' effect is evident for beverage and, to a greater extent, agricultural raw materials. However, this does not hold for the other commodities. In relation to minerals, a relatively high cost of adjustment, or the contractual nature of mineral extraction activities by transnational corporations, might represent alternative explanations for the absence of a 'Dutch disease' effect. Moreover, in the case of both minerals and foods, the rise in the real exchange rate might also be partially explained by the level of devaluation. In the specification used in the text of this book, such an effect is assumed to be captured by explicitly specifying devaluation as one of the regressors. The findings in relation to the WCA region support the hypothesis of the existence of a 'Dutch disease' effect for beverages, and also suggests its possibility for food. However, this hypothesis was not found to be statistically acceptable in relation to other commodities in that region. For the NA region the 'Dutch disease' effect is confirmed for minerals, and there is a strong empirical suggestion that this effect is also evident for food. However, for agricultural raw materials no such effect would appear to be in evidence.

These results should be interpreted with some caution, for a number of reasons. It has been observed that, in a situation where the regression coefficient of the real exchange rate (RER) with foreign inflows (FF) is either positive or not statistically different from zero, a separate regression of the domestic price on FF shows a positive and statistically significant sign. Under such circumstances, a positive relationship in the model value may be possible, if there is an offsetting increase, either in the foreign price of commodities, or the level of the nominal exchange rate arising from a devaluation. Thus, the inclusion of terms of trade and devaluation as regressors within this study may account for this effect.

In Chapter 4, we have used debt stock data within the ECM. In such a formulation, the short run value for change in debt stock shows the flow variable in which 'Dutch disease' effects are expected, while its long-run value, or level, may indicate a debt overhang. Estimation for the three regions, using such an approach yields mixed results. The estimation suggests a negative relationship between capital inflows and exports of beverages, in all regions. This might implicitly suggest the existence of a 'Dutch disease' effect.

Appendix 6.1

Appendix 6.1 Test statistics of estimated parameters of the model not reported in other chapters

Eq. no.	Const. value a *	Short-run t-values a	Short-run t-values b	Short-run t-values c	Short-run t-values d	Long-run t-values b	Long-run t-values c	Long-run t-values d	Long-run t-values ECM	adj. R^2	SE	F	n	Estimat. method
3						50.8	5.0			0.93	0.76	1632	55	OLS
9	-2.0	-0.77^	-4.6	4.3	1.3^					0.51	0.19	7.9	20	OLS
ESA														
21	1.8	6.9	-11.0	0.88^		-4.9	1.8		-8.7	0.79	0.22	37.3	79	ECM1
22	2.4	5.3	-1.71	6.9	1.9	-0.67^	2.1	2.0	-6.4	0.43	0.14	7.3	94	ECM1
29			1.91			5.5			-6.2	0.35	0.61	8.8	72	ECM1
34		ecm2		c	c lag									
		7.31	0.80^	2.8	-1.9	1.7+	1.9		-2.9	0.47	0.05	14.8	96	ECM2
NA														
21			-7.9		0.54^	-2.0		6.0	-6.8	0.77	0.25	26.7	39	ECM1
22	3.3	2.4	-1.9	2.0		2.7	-0.1^		-5.0	0.30	0.20	4.4	58	ECM1
23	1.8	5.6	-7.1			1.7+			-6.8	0.75	0.22	28.3	56	ECM1
29			-0.62^			5.7			-5.6	0.36	0.64	11.3	55	ECM1
34	-0.40	-1.9	-0.3^	4.0		0.4^	2.32		-2.02	0.30	0.06	4	38	ECM1
WCA														
21	0.41	2.2	-11.2	1.5~		-1.7+	1.0^		-4.5	0.65	0.32	27.6	115	ECM1
22	2.7	5.4	-2.5	4.0	4.1	-0.51^	3.7	2.3	-5.7	0.41	0.16	7.11	89	ECM1
23	4.4	6.1	-7.6	1.4^		0.02^			-4.4	0.84	0.23	25.8	33	ECM1
29	-1.02	-2.8	6.7			3.9			-4.1	0.36	0.59	18.8	96	ECM1
34		ecm2	B	b lag	c									
34		4.4	1.7+	-2.0	1.5~	0.55^	2.2		-1.8	0.48	0.11	9.9	58	ECM2
41	-1.16	-7.7	11.02			2.53	-1.9		-6.6	0.57	0.30	39.4	117	ECM1

* The coefficient of the constant before the calibration; All are significant at 5% or better. ^ not significant; + (~) significant at 10% (or closer).
Adj.R^2 is adjusted R^2; SE= standard error of regression; F= F-value, n=number of observation; ECM1 (ECM2) first (or second) order error correction model.

Notes

Chapter 1

1. Naturally, these aggregated figures show only an 'average' scenario for African nations in general. However, there are significant exceptions to the picture painted by these statistics. Specifically, Burundi and Guinea-Bissau, in the WCA region, had a debt service ratio of 40 and 94 per cent, respectively, by 1992, while Uganda and Madagascar in the ESA region had ratios ranging from 40 to 70 per cent and from 50 to 60 per cent, respectively, from the mid-1980s. In relation to debt to GNP, Mozambique recorded a ratio ranging from 300 to 580 per cent from the mid-1980s to the early 1990s, while Guinea-Bissau had a debt to GNP ratio of between 130 and 300 per cent from 1980–90. Finally, the debt to GNP ratio for Congo and Cote d'Ivoire stood at close to 200 per cent during the mid-1980s (source: World Bank, World Debt Tables, electronic, 1994).
2. However, the Bank acknowledges that many African nations were faced with unfavorable terms of trade during the early 1980s.
3. In subsequent publications – notably *Africa's Adjustment and Growth in the 1980s*, published jointly with UNDP – the Bank argues forcefully that Sub-Saharan Africa has been in relatively 'good shape' compared to other parts of the developing world and that policy mistakes have been the *principal* cause of its economic crisis. However, the ECA (1989b) argues that the Bank has based its conclusions on 'pseudo-statistics' and selective reporting. Re-examination of the data by ECA analysts would tend to suggest that the Bank's argument cannot be substantiated (see ECA 1989b and Mosley & Weeks 1993 for a brief summary).
4. However, according to the Bank, the effects of the protectionist policies of developed nations may be rendered less significant due to the low capacity of African manufacturing, an inability to produce temperate products as well as the continent's preferential status within the

EEC. See also Amjadi et al. (1996) for a recent argument along these lines, as well as proposals for a possible policy conditionality plan for privatizing African shipping lines.

5. See White (1996a) for a review of this debate.

6. In contrast, Collier and Gunning (1999) argue that lack of openness represents one of the major causes of poor performance of African economies.

7. This basically includes the system of government, public enterprises, the private sector, domestic markets, research and development, forces of nature and climate, ethnicism and society's value system, external commodity markets and finance and transnational corporations.

8. Collier (1991) cites the Zambian economy and copper price as a classic example of negative shocks. In Collier's opinion two errors are made. Firstly, the price fall was treated as temporary, and, secondly, foreign exchange shortages were handled by rationing. Notwithstanding an acknowledgment of the effect of negative shocks, he emphasized poor policies in what he called 'controlled' economies as representing a major problem. However, it could be argued that the root cause of these policy problems lies in the structure of the economy of these countries, and in their external trade in particular. Taken in this light, policy problems, per se, may be of only secondary importance.

9. However, Ghura (1993) is extremely optimistic in stating that judicious macro and trade policies may stimulate growth in Africa, even if external conditions do not improve. This viewpoint is essentially similar to the types of empirical studies undertaken in support of bank-type policies.

10. This is measured as the divergence in the rate of growth of a country's exports from that of the world as a whole, over the period under study, multiplied by the total exports of the country in question. This is taken from a simple model, which specifies the different factors affecting exports (see Stein 1977: 106).

11. See Leys (1996) and Ofuatey-Kodjoe (1991) for critiques of dependency theory in the African context.

12. Makandawire (1989 cited in Elbadawi et al. 1992) summarizes the two contending views about the cause of African crisis as structuralist and neoclassical. He notes:

> The structuralist view is one which highlights a number of features and 'stylized facts' that almost every point contradicts the neoclassical view ... class based distribution of income rather than marginal productivity based distribution of income; oligopolist rather than the laissez-faire capitalist market; increasing returns or fixed proportion functions rather than 'well-behaved' production functions with decreasing returns and high rates of substitution; non-equivalent or 'unequal exchange' in the world rather than competitive, comparative advantage based world system; low supply elasticities rather than instantaneous response to price incentives (Makandawire 1989). (Elbadawi et al. 1992)

13. See Stewart (1993) for a discussion of this issue.
14. See, however, Helleiner (1993) who argues for an emerging consensus on this issue.
15. See Amin (1974, Chapter Two) on the mercantilist period.
16. Amin (1972) has termed this the pre-mercantile period.
17. Wallerstein characterizes the trade of the period as trade in 'luxuries', with such trade being undertaken between external arena and not in an integrated world economy framework. Wallerstein and Amin define luxuries as those goods, the demand for which comes from the part of the profit that is consumed. Suraffa defines luxuries as goods which are not used in the production of other goods. He, however, took it as trade/exchange in which 'each can export to the other what is in his system socially defined as worth little in return for the import of what in its system is defined as worth much'. Or, in Alpers' phrase, 'trade from which each side believed itself to be profiting' (Wallerstein 1976: 31 and footnote 3).
18. Maghreb refers to North Africa.
19. This stands in sharp contrast to the current categorization of North Africa as geographically and economically distinct from Sub-Saharan Africa. For justification of this view see Sommers and Assefa (1992) and various World Bank/IMF classification schemes for Africa.
20. The original work is written in 1933.
21. The commonly argued case that since Ethiopia was not colonized, it represents a 'counter factual' for how other parts of Africa might have developed in the absence of colonialism, is a very weak one. Firstly, a good part of the history of Ethiopia has been a history of wars under the ideology of either religion, region, nationality or a combination of these. This has created a serious crisis in the agricultural sector (see

Gebrehiwot 1917). Secondly, Ethiopia's history has been characterized by two clearly distinct antagonistic classes: the landed aristocracy and the peasantry, with corresponding state structures (see Gebru 1995). Given the history of conflict which characterizes Ethiopia's history, the main preoccupation of the landed aristocracy and church has been to maintain its power. Thirdly, colonialism had the effect of disrupting the dynamic caravan trade which linked the Southwest parts of Ethiopia to the rest of the East African region. And, finally, Ethiopian independence was basically a besieged one. Since it was encircled by hostile and powerful colonial forces, naturally this had an influence on the political and economic structure of the country. More specifically, Ethiopia developed as a militaristic nation, with a dependent economy based on the export of commodities and import of manufactures.

22. First by the Portuguese, and later by the British, Dutch, Germans and Scandinavians.

23. In describing the impact of underdeveloped nations' interaction with Western Europe, Baran noted

    > [the population of these nations] found themselves in the twilight of feudalism and capitalism enduring the worst features of both worlds. Their exploitation is multiplied, yet its fruits were not to increase their productive wealth; these went abroad or served to support parasitic bourgeoisie at home. They lived in abysmal misery, yet they had no prospect of a better tomorrow. They lost their time-honored means of livelihood, their arts and crafts, yet there was no modern industry to provide new ones in their place. They were thrust into extensive contact with advance of the West, yet remained in a state of the darkest backwardness. (Baran 1957: 144)

    Perhaps we should not be surprised that Baran's description, written nearly four decades ago, remains relevant today.

24. Imports of palm oil by Britain, groundnuts by France, palm kernels (for cattle cake) by Germany and (for the manufacturing of margarine) by the Dutch represented the main items traded during the 19th century, prior to the onset of formal colonialism at the end of that century. (For a description of this, see particularly Chapter 4 of Hopkins 1973.)

25. These were prompted by the so called 'cotton famine' in Europe, following the American civil war.

26. The motives underlying colonialism represent a widely debated topic. For instance, Austen (1987) argues that

> within [the] general context of intense multifaceted international competition, the economic rational for African colonization was to a considerable extent pre-emptive, designed to assure access to potential rather than actual markets and commodities as well as trade routes ... to Asia. (Austen 1987: 116)

27. There are many examples of Africans being forced into cash crop production. This occurred in Tanganyika (today's mainland Tanzania), in the Portuguese colonies, in French Equatorial Africa and French Sudan (today's Mali). In Congo Brazzaville the French enforced cotton cultivation by banning traditional agricultural activities. These policies of coercion were resisted to the extent possible. The revolts in Tanganyika and Angola represent cases in point (see Rodney 1972: 172–81, Austen 1987: 140–42).
28. This was the policy followed by Germany in what is now called Namibia. Indeed, the extermination of the Africans was so extensive that, when they discovered diamond, the Germans had to look for migrant labour for mining from other regions (see Longmire 1990: 203–4).
29. The English translation appeared in 1979.
30. See also Amin (1972) for a political and social analysis of how the region's commodity production and exports were controlled.
31. Pim places this at the center of his investment analysis and argues that the main investment was in areas with extensive mineral wealth, plantation possibilities and a mass of unskilled labour. This involved heavy expenditure in communications, which required an expansion of the export sector for its finance. The latter, in turn, required a large labour supply, which was secured by direct and indirect compulsion, affecting every aspect of native life (Pim 1977: 229).
32. France was in possession of such a protected market in West Africa. The protectionist policy was the result of pressure from French metallurgical, textile and chemical industries, which had difficulty competing with Britain (Hopkins 1973: 160). Portuguese industrialists had also created such protected markets in Africa, especially for their textile industry (Seleti 1990: 36).
33. Portuguese colonialism does not qualify as 'matured' in his analysis.
34. In virtually all African countries, one to three commodities account for 50–90 per cent of total exports. Indeed, in the period 1982–86, in 13 African countries 1 product, in 8 countries 2 products, in 6 countries 3

products, and finally, in 8 African countries 4 products accounted for over 75 per cent of export earning (see Adedeji 1993 for details).

Chapter 2

1. See also Vos (1994) and Helleiner (1989: 1451) for a detailed discussion on this.
2. In contrast to this approach, another strand of the literature focuses on 'immiserization of the recipient'. In their study of the implication of capital flows Brecher and Diaz-Alejandro (1977) showed that capital inflows to small open economies would reduce the recipients welfare, measured in terms of consumption. This condition is vividly illustrated when foreign profit remittance absorbs the increase in total output due to capital inflow (Brecher & Diaz-Alejandro 1977: 319). Quibria (1986), using a simple model of 'North' (growing à la Solow and saving in a Keynesian way) and 'South' (saving in a Kaleckian way), concluded that capital flows (even in a situation of no distortion) may result in immiserization of the recipient.
3. Magdoff (1992) provides some statistics on FDI for the recent past. Thus, in 1960, 47 per cent of FDI originated from the US, 45 per cent from Europe and 0.7 per cent from Japan. The figures for 1973 stood at 48, 39 and 4.9 per cent respectively, and at 28, 50.2 and 11.5 per cent respectively, for 1989. Magdoff also notes that, contrary to popular belief, the bulk of FDI actually goes to industrialized rather than Third World nations, with the latter's share declining from 31 per cent in 1967 to 19 per cent in 1989. In relation to the structure of FDI, in 1990 investments in finance, insurance and banking in LDCs were almost one-third higher than in manufacturing (40.1 per cent versus 31.3 per cent of total investments).
4. See also Jungnickel (1993) on the recent pattern towards investment in services.
5. This optimization is described as the borrowing problem in finite horizon and is given by:

   $\max U(C_1, C_2 \ldots C_T)$

   Subject to:

   $Q_t = F(K_t\ L_t)$

   $K_{t+1} = K_t(1-d) + I_t$

$$C_t = (Q_t - rD_t) - I_t + (D_{t+1} - D_t)$$

$$D_t \leq \max \sum_{i=t}^{T} (1+r)^{(t-i-1)} (Q_i - I_i)$$

where: Q = output, K = capital, L = labour, d = depreciation, I = investment, C = consumption, D = stock of debt, r = discount rate and t = time.

6. This can be understood as 'the absence of a legal framework to limit the borrowers liability and safeguard the lender's right' (Folkerts-Landau 1985: 326). This differs from domestic credit, where the lender is protected by bankruptcy law or collateral.
7. It should be noted that such an approach was not intended to address the risk of individual projects, as had been the case with earlier approaches. Rather, this approach was characterized by public guarantees of debts and 'cross-default clauses' which were related to the ability of the country, as opposed to individual borrowers within the country, to pay the external debt. This was enforced by *syndication* of lending banks. Folkerts-Landau refers to these – syndication and cross-default clauses – as *the new financial innovations*.
8. Indeed, a number of theories focus on the behavior of bank managers, specifically in relation to loan disbursement and risk-taking (see for instance Darity & Horn 1988).
9. Even such categorization is difficult since some of the studies focus on both explanations. Nevertheless, it is legitimate to divide these studies along this line based on the degree of emphasis the authors placed on these alternative explanations.
10. However, as Gasper (1992) points out, the aid literature has traditionally been dominated by economists, who, as a discipline, have traditionally been less concerned with ethics. For this reason, he argues, ethical concerns have not been rigorously dealt with (Gasper 1992: 10).
11. As Mosley et al. note: (a) the right have argued against the allocative case for aid, while (b) the left argue that there has been an improper focus on the distribution of income rather than on issues of power. Mosley maintains that, while the latter proposition is a matter of value judgment, the former represents a testable proposition (Mosley et al. 1987: 14). Gasper (1992) argues that Mosley et al.'s (1987) study is governed by the degree of faith he places in the power of empirical analysis to identify effects as opposed to informing value judgements.

He concludes 'this positivism helps explain weaknesses in identifying the structure of the evaluative arguments on aid' (Gasper 1992: 9). In effect, Gasper seems to be arguing in favour of making a priori value judgments before moving on to research the quantifiable aspect of a problem. His criticism would have been reasonable if it was limited to the degree of emphasis placed, as opposed to the important issue of studying the quantifiable (or what he labels the positivist) aspect.

12. However, Miksell appears to discount humanitarian considerations in noting how the US acted against President Nasser of Egypt, in spite of an undertaking to help the poverty-stricken people of that nation (Miksell 1968: 7).
13. The authors group the studies into six categories based on implicit restrictions imposed on a general form, which includes three of the stated motives for aid (excluding the humanitarian one). These sub-groups are: the recipient need/donor interest; hybrid (which comprehensively models the above three motives); bias (which deals with small country and income bias in allocation); developmental (which is similar to the recipient-need model, i.e., allocation is based on the developmental needs of the recipient, but does not include donor interest); administrative/incremental (in which allocation is based on past experience), and, limited dependent variable studies (which take into account eligibility for aid).
14. However, some economists, such as Kindleberger, have argued that there is nothing 'new' in the new trade theories. Indeed, they argue that some of the ideas presented in these theories had already been discussed, for instance in Ohlin (1933) (see Krugman 1992: 425). There is also no clear consensus as to which theories should be included in the 'new', with Stewart (1984), for instance, including technological gap models within this category.
15. Greenway and Milner (1986) classify intra-industry trade theories under a number of broad categories. Firstly, Neo-Heckscher-Ohlin, intra-industry trade models in which factor endowment is seen as important. Secondly, Neo-Chamberlinian models of monopolistic competition, in which intra-industry trade is analysed in terms of a monopolistic competition framework. And, finally, Neo-Hotelling models of monopolistic competition, which is essentially similar to the latter, but differs in terms of its treatment of product differentiation (Greenway & Milner 1986: 1-22).

16. Indeed, Emmanuel poses this question even more graphically, in stating

    The copper of Zambia or the Congo and the gold of South Africa are no more primary than coal, which was only yesterday one of the chief exports of Great Britain, sugar is about as much manufactured than Scotch Whisky or the great wines of France; before they are exported coffee, cocoa and cotton have to undergo a machine processing no less considerable, if not more so, than in the case of Swedish or Canadian timber; bananas and spices are no more primary than meat or dairy products. And yet the price of the former decline while those of the latter rise, and the only common characteristic in each case is that they are, respectively, the product of poor countries and the product of rich countries. (Emmanuel 1972: xxx).

17. See Bloch and Sapsford (1996) for recent evidence along similar lines.
18. The Ethiopian economist Gebrhiwot (1917) has already discovered the terms of trade deterioration three decades before Prebisch and Singer
19. Prebisch notes how full factor mobility, especially of labour, would have lowered the high wages of US workers in his study. However, this finding is academic, for he states that 'the protection of this [USA's] standard of living, attained by great effort, should have prevailed over the uncertain advantage of an academic concept'. Thus he concludes, 'the classic rules of the game [free international trade and gains from trade] form an indivisible whole, and, if one is eliminated, the other cannot logically serve as absolute standards governing relations between the center and the periphery' (Prebisch 1962: 7).
20. Patnaik (1996) shows that even if export earnings are used for capacity creation in the primary sector, trade causes retrogression in this sector. This is because contraction of the manufacturing sector reduces the stimulus for expansion in the primary sector, and hence the expansion of the primary sector requires a larger level of public expenditure. However, the latter is adversely affected by contraction in the manufacturing sector, with further dynamic repercussion in the primary sector (Patnaik 1996: 215–16).
21. Unlike the classical economists, and even Keynes (1912, cited in Thirlwall 1991), who believed in diminishing return and hence an improvement in terms of trade to primary commodity producers, it was Kindleberger who first noted a secular decline in the terms of trade of primary commodity producers (Kindleberger 1943 cited in Thirlwall 1991; see also Sarkar 1986 and Thirlwall 1991 for details.)

22. See also Thirlwall (1991) for a brief summary and a concise survey of this empirical debate.
23. However, recently it is argued that the construction of this series might have an upward bias (see Sapsford & Balasubramanya 1994, footnote 2).
24. Based on this reconstructed data, the deterioration is 0.5 per cent per annum, rather than 0.7–0.8 per cent, as originally calculated by Prebisch.
25. The formulation of this equation differs from the original formulation of the model (Goldestin & Khan 1978) since it includes exchange rate, lagged price effect and supply shock, which is broadly defined to include other factors which influence exports from region *R*.
26. However, it should be noted that the equilibrium model applied by Bond incorporates those variations from the basic model, as listed in footnote 25 above.
27. This earlier work on short-run modelling is included at the end of this section, specifically within equations [6] and [7], in order that this might combine with the medium-run framework.
28. More specifically, these relate to the effects of current prices on future supply through investment and, in turn, the effect of change in capacity on commodity prices.
29. Thus, according to this classification scheme: (i) 'food' includes wheat, rice, soya beans, ground nut oil, coconut oil, palm oil, fish meal, sugar, meat and bananas; (ii), 'beverage' covers coffee, cocoa and tea; (iii) 'agricultural raw materials' includes cotton, wool, rubber, hides, jute, sisal, tobacco and timber; and finally (iv) 'metals and minerals' covers copper, iron ore, tin, aluminium, zinc, nickel, lead and phosphate.
30. Since there is no basic difference between the work of Adam and Behrhman, the model specified here, and that of Hwa, we will not describe Adam and Behrman`s work. Rather, we hope that the model which we do describe, along with Haw's model, show the same basic features as contained within Adam and Behrman's (1976) model.
31. They have estimated the expected price equation by presuming that the excess of the expected rate of return, over the sum of the carrying cost and the interest rate obtainable on alternative financial assets must be an increasing function of the outstanding stock of commodities. This is done on the assumption that commodity stockholders may be compen-

sated for the risk associated with holding these stocks. Finally, a number of adjustments are made to this estimate, using time series data (see pp. 14–18).

32. Palaskas and Gilbert (1990) argue that storage disequilibrum is an implausible basis for a price adjustment theory. This discussion is postponed to Chapter 4 where this issue is revisited at the estimation stage.

33. Details on the production function form is reported to appear in the original research, which we do not have access to. However, for our own purposes a crude production function concept is sufficient.

34. Project LINK is an ongoing project, which works on connecting all world macro models (see Chapter 6 for further details on this).

35. This system is given in a linear matrix form as follows: $M_i = c_i X_i + Z_i$. By transforming the vector of c_i's into a diagonal matrix C and representing the vector of f.o.b.-c.i.f. adjustment factors $1/\Lambda_j$ by ϕ, the model becomes:

    $M = CX + Z$ ...... (1') $X = A\phi M$ ...... (2') and $B = X - M$ ...... (3').

    The solution to this system can be given by:

    $$M = (I - CA\phi)^{-1}Z \qquad (1'')$$

    $$X = A\,(I - CA\phi)^{-1}Z \qquad (2'')$$

    $$B = (A - I)(I - CA)^{-1}Z \qquad (3'')$$

    I denotes the identity matrix and the superscript -1 is an operation for a matrix inversion.

36. For different commodity groupings, the functional form may vary slightly. Thus, imported consumption goods may become directly related to autonomous spending, which indirectly affects income, income affects consumption and consumption, in turn, determines imports. Raw material imports may also have a similar indirect link but, in this case, through the demand for inputs. In other words, autonomous spending affects demand, demand affects output and output, in turn, determines inputs. In relation to manufactured imports, these are generally directly linked to the import content of investment (Taplin 1973: 183–84).

37. While estimating the import function, due to lack of fit, statistical problems and gaps in data, some deviation from the assumed framework has had to be made. Specifically, for CEMA, imports are made a function of GDP, while for New Zealand, GNP is used, with previous

period exports being employed in the case of Turkey. For developing countries as a whole, imports are set to depend on foreign exchange earnings, defined as exports plus invisible balance, including capital inflow, and transfers in the current and preceding years.

38. Using a regression technique, market share elasticties are computed. This technique is used as follows. In general, the approach is to regress the change in current market share on proportionate changes in the current price ratio. Taplin (1973) applies such an approach both to total world trade, and to individual commodity groups. The commodity grouping results vary slightly from those obtained using the total. For instance, based on total trade, the elasticity is found to be approximately 0.43, while for commodity groups it varies from 0.15 to 1.275 (see Taplin 1973, Table 3, p. 193).

39. See Labys in Adam and Behrman (eds) 1978, Chapter 8.

Chapter 3

1. A detailed version of this model and its estimation method is reported in Olayide et al. (1980). A shorter explanation of aspects of the model structure, particularly in relation to supply, as well as a full specification of model structure are reported in Olafin and Iyaniwura (1983). The discussion here is based on the latter reference.

2. Boutros-Ghali and Taylor (1980) also propose a SAM-based macro model for Egypt. However, since the formulation of this model is governed by 'basic needs' considerations, which are not the objective of this study, we do not examine this here.

3. A modified version of this model is found in Benjamin (1990). However, this model differs from the previous one in a number of important respects. Firstly, in its treatment of investment behavior. Secondly, in how it deals with formal and informal financial markets. Thirdly, in the fact that it disaggregates sectors of the economy by institutions (both public and private). And, finally, in that it allows fiscal balance to affect interest rates and money supply. The model is then closed by making nominal exchange rate and foreign capital inflow exogenous. In this model, the rate of interest (as cost of borrowing for investment and reward to saving) is given a strong role in allocation of resources, although the income effect and the intertemporal prices effect on saving and consumption is believed to offset its effect. However, the rudimentary nature of most African countries' money markets and rigidity in mobility of resources seems to contradict this basic mechanism of

the 1990 model. Despite this setback the model underlines the importance of observing sectoral adjustment over time, which could differ at different stages of the sectoral adjustment process. (For example, in a situation of booming sector like that of oil in Cameroon, manufactures can contract in the short run but expand in the coming years).

4. See also Harton and McLaren (1989) for a shorter version of this model and its application to the analysis of alternative adjustment policies.
5. The tradable sector is, itself, further divided into manufacturing (importable) and exportable mineral resources.
6. In relation to the income identity, real income is calculated as absorption plus exports, net of imports, in real terms. Change in money supply is equated to government expenditure, net of its revenue, exports net of imports and change in private domestic credit and capital inflow.
7. Two exceptions to this include a fairly disaggregated but extremely simplistic Keynesian model developed by Asmerom and Kocklaeuner (1985), as well as quite a promising supply-driven model developed by Lemma (1993).
8. A similar CGE model for Rwanda, focusing on demand for working capital, domestic credit (as opposed to import) rationing and financial repression has been developed by Decaluwé and Nsengiyumva (1994).
9. Although the authors claim that theirs is the first generation of models in Africa, Harris' (1985) survey and the discussion in this section shows this not to be the case.
10. In fact, it could be argued that it would be timely to update Trap's (1993) work, based on subsequent experience of stabilization and structural adjustment efforts, as well as a number of other studies undertaken with the aim of assessing adjustment in Africa.
11. Trap labels these economists the 'neoclassical-structuralists'. However, it could be argued that this label represents a contradiction in terms.
12. Their survey begins by examining problems in using an aggregate regression approach to explore growth. This is tackled by examining the response of economic agents (i.e., rural households and manufacturers) in the face of risk. This analysis is augmented by examining the market in which these agents function. In all cases, agents' response is more often found to be behavioural rather than structure-determined in nature.

13. This represents a departure from Ndulu's (1986) original assumption of mark-up pricing. However, it could be argued that Ndulu's, rather than Rattsø's, assumption is the more realistic.
14. Ndulu (1991) is clear that the exogeneity of growth (i.e., dependence of growth on exogenous factors) will depend on the relative importance of these factors (say, barter terms of trade) *vis-à-vis* the endogenous one (say, volume of exports which he and Svedberg take as policy related). By reconstructing Svedberg's (1990) decomposition analysis in order to isolate these factors, for the period 1980–88, rather than 1970–85, originally used by Svedberg, he found, unlike Svedberg, a strong role for barter terms of trade.
15. Griffin's hypothesis that there exists a negative relationship between aid and domestic savings has been severely criticized from a host of different angles. His approach is found to be weak, owing to misspecification in the definition of savings and consumption within his model. Thus, consumption is assumed to be a function of income plus aid, while saving is not. This assumption effectively overlooks the feedback effect of aid on savings via income through the multiplier effect (see White 1992 for a full survey of these criticisms).
16. This is basically similar to the time period used in the above-cited works.
17. To my knowledge, there is no global econometric model for Africa. In fact, econometric-based global models are extremely rare in the literature. Hence, this initial attempt could serve as a useful starting point for further research in this extremely important area, which is vital in the ongoing globalization process.
18. This has its historical roots in the work of the French 'physiocrat' Quesnay. A rigorous discussion of national accounting was also undertaken in England, during the 17th century, based on the work of William Petty. This was followed by the work of Gregory King (1696, cited in Luttik 1992) who developed national income estimates for England and Wales showing per capita income, expenditure and saving. Numerous other writers have built on this work, over the centuries, culminating in the pioneering work of R. Stone and J. Meade, in collaboration with J.M. Keynes. The UN has also played a useful role in standardizing this work, through its recommendation of a 'System of National Accounts (SNA)', which was first introduced in 1953 (Luttik 1992: 16–17). The new SNA (UN et al. 1993) tackled many of the problems which have been discussed in this section and, it would

appear that analytical consistency between BOP and SNA has finally been achieved.

19. Electronic data for 21 African nations constructed on the basis of these alternative assumptions may be obtained from the author.

Chapter 4

1. Private capital flows will be examined in Chapter 6, using a credit-rationing framework. Such grants are assumed to follow a similar pattern to official flows.
2. The econometric methodology adopted here is further discussed in Appendix 4.1.
3. This is defined as the sum of multilateral and bilateral aid flows.
4. In some of these countries, principal rescheduling began to occur again from the mid-1980s onward.
5. It is noted that for equal levels of per capita income, countries with a high population might receive a higher level of inflows. This could be interpreted as suggesting the need to use population size as one of the indicators. The functional form adopted (log-log model) entails that this will collapse to mere GDP ratio, if the population ratio for the two regions is included. However, the use of the per capita ratio for the regions allows for implicit recognition of this fact and hence this is the approach followed in this study.
6. This may be measured either using a proxy indicator, such as the number of commercial banks, or directly, in terms of the total credit disbursed.
7. According to Palaskas, the Ady (1968) model for cocoa and the French model (cited in Palaskas 1986) for apples are the only two such models published prior to 1960. During this period, although the supply response literature was extensive, specification of supply functions was rare (see Palaskas 1986: 12).
8. See Lim Lin Shu (1975: 67–69) for a comparison of these and relevant algebra.
9. A typical formulation of such an investment function is one which relates current investment I_t (which is the difference between the current and lagged level of capital stock, $K_t - K_{t-1}$) with that of the desired

(K^*) and actual (K) level of capital stock with an adjustment variable α included. Formally this is given as,

$$I_t = K_t - K_{t-1} = \alpha\,(K^*_t - K_{t-1})$$

(See Palaskas 1986 for an analysis of an alternative specification of K^*.)

10. At estimation stage these 'other' factors took different forms. For food and beverage, price of fertilizer and lagged stock level are used. For agricultural raw materials, a time trend and price of oil (as representing input price) is used. For metals, lagged stock level and interest rate (indicating cost of capital) are used.
11. See Chapter 3 of Guvenen et al. (1991) for an excellent survey of these developments.
12. This is an important result since one can use output figures as a proxy to area, data for which is hard to come by.
13. A simple OLS being the most common one.
14. See section 4.4 and Chapter 6. Hwa (1985) represents a good example of a study, which includes stockholding variables within commodity models, while Alogoskoufis and Varangis (1992) include macro variables in their commodity model.
15. Indeed, most studies use output of a commodity instead of exports on the assumption that change in output is easily convertible to change in exports. Export supply models, on the other hand, employ exports for this purpose, on the assumption that change in exports result from change in output.
16. The expected profit indicator applied by Chu and Morrison (1986) is again used, with minor changes. This may also be interpreted as a price instability index, since it is computed as the deviation of current price from a moving average price (at a specified lag), which is assumed to show the long-run average price.
17. In this study, a five-year lag is assumed.
18. See Bond (1987) for a discussion of the empirical validity of this argument.
19. As with FDI, capital inflows and other official flows are important for the mining sector.
20. Although, in a simple level-based OLS estimation, simultaneous equation bias may also arise from a lack of a complete demand and supply

model, the complete demand and supply model may be estimated simultaneously (as undertaken by Goldstein & Khan 1978). However, the limitation of simultaneous equation bias might not arise in relation to the use of the ECM approach. (See Kennedy 1994: 251, for example. See also Hamilton 1994 and Rao 1994 for a formal treatment of this issue.)

21. According to the UNCTAD classification, the category 'food' covers wheat, maize, rice, sugar, beef and veal, bananas, pepper and soybean and fishmeal. 'Tropical beverages' are defined as including coffee, cocoa and tea. Finally, 'vegetable oil seeds and oils' is taken as referring to soybeans, soybean oil, sunflower oil, groundnut, groundnut oil, copra, coconut oil, palm kernels, palm kernel oil and palm oil.
22. Specifically, Chow, Jarque-Bera and Reset along visual inspection.
23. And significantly negative for agricultural raw materials in the ESA region.
24. In fact, an ECM regression of domestic price (GDP deflator) on foreign inflows was run separately, in order to justify this proposition. The result indicates a strong positive relationship, with a likelihood of 'Dutch disease' effects for multilateral debt. Such debt represents an important flow to Africa.
25. This is likely to be determined by, amongst other things, the import content of industries, pattern of consumption of a section of the urban population, and levels of debt servicing and capital flight.
26. However, one problem with this hypothesis is in explaining why a rise in price is associated with lower exports, if the demand for foreign exchange is so elastic. See Bevan et al. (1987) for an alternative explanation for this apparently perverse relationship, based on the concept of rationing.
27. Current price is chosen in Model III, cognizant of the assumed correlation between foreign inflow and domestic price (which is the denominator in the relative price computation).
28. Subject to a cointegration test and exclusion of the possibility of multicoliniarity.
29. These are Botswana, Ethiopia, Kenya, Madagascar, Malawi, Tanzania, Uganda and Zambia.
30. See Alemayehu (1996) for further details on these.

31. Bilateral, multilateral, grants and private flows are all tried for this purpose.

32. The exceptions being the long-run capital formation in Model I and short-run capital inflow in Model III.

33. An example of this being the 'recovery rate' in tree crops.

34. This would appear to be a short-run value, although that is not stated clearly.

35. The 'long run' being defined here as long lags of five years. In spite of an error in their glossary in defining real and current prices, it would seem that this study is, in fact, based on real prices.

36. Although the coefficient of this variable is likely to be positive, the possibility of a negative coefficient cannot be ruled out. Specifically, this may occur if an increase in Northern income is associated with faster growth in domestic production than in consumption of importables (see Goldstein & Khan 1978: 276 and the reference cited there).

37. In the GK model the change in price is assumed to be represented by a partial adjustment process of the form,

$$\Delta \log P_w = \gamma \; [\log X_t - \log X_t^{ss}] \quad \gamma > 0$$

By substituting a supply equation into this formulation and solving it for various prices, an equation for estimating the disequilibrum model, taken in conjunction with equation 5, is arrived at. GK and Abebayehu (1990) estimated these equations using a FIML method. My attempt to estimate a similar model rendered an extremely inferior result. This raises the question as to whether GK and Abebayehu's models were free from spurious regression. This issue will be re-examined in section 4.4.3.

38. Based on their empirical results, the model is invariably found to have a partial adjustment coefficient of less than one.

39. This might be trend stationary at a weak 10 per cent significance level.

40. Apart from the obvious fact that de-trended values hardly overcome the non-stationarity problem, we note that some de-trended series, such as indicators of domestic prices are found to be an $I(2)$ series. For this reason a transformation based on first difference is preferred.

41. UNCTAD has reported such data from 1966 onwards.

42. Specifically, those models relating to demand for agricultural raw materials and beverage.

43. The exception relates to the supply of agricultural raw materials.
44. Defined, according the UNCTAD definition, as non-oil-exporting developing countries.
45. A more involved formulation using a Koyck transformation (1954) or the adaptive expectation formulation of Cagan (1956) requires the construction of an underlying model, in order to transform the unobserved series based on expected values, into terms comparable to observed values. However, this approach is not adopted in this study, since the underlying model is integrated into the aggregate demand equation and hence, is not explicit.
46. Future work using a longer series and, where possible, explicit stock data may shed light on this issue. However, I was not able to pursue this option, for lack of available data.

Chapter 5

1. The association which Papanek is referring to is between low saving and high foreign capital inflow for common exogenous reasons. Bowles (1987) has attempted to investigate the causality question using the 'Granger Causality' concept. His analysis suggests that casual relationships are not universal and that, in countries where such a relationship does hold, it is found to depend on the structure of aid, whether from bilateral and multilateral sources or not. Gupta (1975) has used a simultaneous equation model which allows for both the direct and indirect effects of aid. He suggests that the negative effects of capital inflows have been grossly overestimated and that the total indirect and direct effects of such inflows may also be positive. However, his estimation of the savings function shows a negative coefficient, both with aid and with foreign capital inflows in general.
2. See White (1992) for a recent survey on this debate.
3. Public consumption is further disaggregated into civil consumption (comprising government administration, public debt servicing, security and diplomacy expenditure) and 'socio-economic' consumption (comprising non-capital current expenditure).
4. Contrary to such demand optimism, it can be argued that the short-run macroeconomic impact of aid from the demand side could be contractionary (see Bhaduri & Skarstein 1996 for the theoretical derivation of such a possibility).

5. These may either be imported intermediate or capital formation.
6. The Pack and Pack model attempts to test the displacement hypothesis by theoretically relating it to the nature of indifference curves that the government is assumed to face. Thus, in its broadest sense it is a variant of the analysis, which is based on the utility maximization framework.
7. Since the time series variables which form the basis for this study have not been tested for the plausibility of the stationarity assumption, and since no other diagnostic tests have been reported, it is not possible to determine whether this doubt is, in fact, justifiable.
8. Although the constraint is meant to handle such a trade-off, the functional form adopted is similar to utility functions related to linear expenditure systems which are based on the additive assumption, which, in turn, requires independence among choice variables (see Alchian 1971, Koutsoyiannis 1975 for a discussion and further reference).
9. This inconsistency stems from the additive assumption upon which the framework depends.
10. The philosophical underpinnings of such an approach may broadly be labelled *critical realism* (see Lawson 1989 and Lawson et al. 1996).
11. This inevitably assumes the existence of a stable political structure as well as a government concerned with long-term issues. However, the prevalence of government short-termism in most African countries may result in a lower priority being attached to such long-term issues.
12. In principle, this may be captured by using a cost minimization function, subject to the desired growth/developmental expenditure target. This approach is similar to those cited above, except that the concern for budgetary equilibrium has been replaced by a concern for attaining the desired (downward adjustable) expenditure level, even if that implies incurring a budget deficit. However, such a function is difficult to quantify since these costs are political in nature and could vary, depending on the valuation placed on them by policy makers in different countries. However, in this study, an ordinal rating of the associated costs beginning with foreign inflows, for which costs are lowest, followed, in ascending order, by domestic revenue and deficit financing has been followed. This is assumed to be the relevant stylized fact in the African context. Formally, since such a cost function takes the form of $C = f(P_i, F_i)$ where i = 1,2,3 and P_i is the cost of using one of the financing mechanisms F_i subject to the constraint $Ig^* = g\ (F_i)$

where Ig^* is desired level of growth, the Lagrange-based optimization equation $f(f(P_i, F_i) - \lambda[g(F_i) - Ig^*])$ will yield an identical equation structure to the one outlined here if it is assumed that $P_1<P_2<P_3$.

13. A 'Dutch disease' type of problem is not usually anticipated.
14. See Romer (1989) for an analysis of such funds and their macroeconomic implications for countries, which depend on commodity aid and associated counterpart funds. (This aspect of such funds will not be discussed in this section.)
15. For details of the derivation of the resource transfer (Z) from a consistent macroeconomic framework, see FitzGerald (1993).
16. This equation can show the impact of deficit on the level of inflation if the deficit is financed, say, by an increase in the money supply.
17. As described in Chapter 1, a historical justification for such a classification can be found in Nzula et al. (1979) and Amin (1972).
18. This is excluded because the correlation coefficient between T and interest payments on concessional loans stands at 0.66.
19. This term was first coined in print in *The Economist* of 26 November 1977 (see Corden 1984). For the discussion of its effects in The Netherlands, see Ellman (1981).
20. Which, in the case of The Netherlands, is the natural gas sector.
21. This can be seen from the following accounting identity given by van Wijnbergen (1986b). Y is income, A absorption, n non-tradables and t tradables.

$$\begin{aligned}\text{(ex ante) saving gap} &= Y - \mathrm{A} \\ &= Y_n + Y_t - A_n - A_t \\ &= (Y_n - A_n) + Y_t - A_{\mathrm{t}} \\ &= (Y_n - A_n) + \text{(ex ante) trade gap.}\end{aligned}$$

22. Fardmanesh (1991a, 1991b) has undertaken a similar analysis for oil exporters. He notes that contrary to the core 'Dutch disease' model, the manufacturing sector of oil-exporting developing countries has in fact expanded following the oil boom. Indeed, a similar pattern is observed for Egypt and Nigeria. Neary and Wijnbergen (1986) have accommodated this phenomenon within the core model by relaxing the assumption of free trade. They stressed that in many countries, these sectors are protected (i.e., semi-traded). Benjamin et al. (1989) have explained

this through the imperfect substitution assumption, while Fardmanesh (1991a, 1991b) prefer to attribute this to a rise in the world price of manufacturing that was witnessed in the wake of the two oil price hikes. However, he does not commit himself to a possible mark-up pricing scheme, which his analysis might otherwise suggest. Rather, he bases his analysis on the assumption that a rise in manufacturing price, possibly due to a mark-up pricing scheme, leads to a rise in output. Nonetheless, following the analysis presented in Chapter 3, the main reason for expansion could also relate to the new foreign exchange earnings, which relieve the import compression problem, which previously had represented a constraint in the manufacturing sector.

23. Love (1994) has undertaken an excellent political economy analysis of the spending effect from the booming sector in Botswana. He notes how government expenditure unduly favors livestock development in an effort to facilitate the transition by a traditional dominant group of cattle owners to a contemporary capitalist class of commercial farmers. He observes how the interests of this group is maintained and legitimized by the new orthodoxy in economic thinking.
24. A number of PhD theses and other studies aiming to describe the 'Dutch disease' effect of oil in Nigeria have also been undertaken, mainly in North America.
25. Such a distinction is important because policy interventions at different stages of the mechanism can be effective when the propagating mechanisms are realistically captured.
26. This section will not concern itself with examining the final impact of aid – or, indeed, the boom itself – on sectoral performance. A simple model incorporating such an analysis is presented in Fardmanesh (1991a). Within the latter model the manufactured, agricultural and the non-traded sectors' value added are regressed on relative price and revenue from the booming sector. The negative coefficient of the latter may be taken as indicating the existence of a 'Dutch disease' problem. However, this approach is not adopted in the present study, since establishing an appreciation in the real exchange rate is sufficient to prove the point. This is because it has already been established in Chapter 4 that commodity exports are positively related to the real exchange rate.
27. The theoretical analysis which precedes such an empirical specification is developed in Chapters 2 and 3 of Edwards (1989).

28. See Appendix 5.2 for an ECM estimation using van Wijnbergen's form of specification.
29. Different types of prices are used as a proxy for the price of traded and non-traded goods. Thus, in a study on Brazil, Krugman (1988) uses world export price and Brazilian wholesale prices, respectively. US wholesale price or any trading partners' prices may also be used as an indicator of foreign price. Van Wijnbergen (1986a) uses import prices and the consumer price index (CPI). Although CPI and GDP deflators may be used interchangeably as an indicator of domestic prices, they are found to be good proxies within some countries and very poor proxies in others (see Dornbusch & Helmers 1988). Due to the lack of a complete series for CPI, I have used a GDP deflator in this study instead.
30. Indeed, experiments using the sum of bilateral and multilateral flows and grants lead to no major difference in results.
31. In particular, experiments are made based on real levels of bilateral, multilateral and grant flows.
32. More specifically, the price index for the region rose sharply, during the period from 1972 to 1979. Then, following a dramatic fall between 1979 and 1987, it rose sharply again in 1990. (For more details, see Chapter 4.)
33. It is worth noting that while food and agricultural commodities have a short gestation period, beverage and minerals have a longer one.

Chapter 6

1. The theoretical model developed by Rattsø (1992b), along the lines of Taylor (1981) and the non-formal analysis of Kiss (1984) may be the only exceptions to this generalization.
2. Unless otherwise stated, the discussion in section 4.2.2 is based primarily on Dutt (1990, particularly Chapters 2 and 8) and, to a lesser extent, on Ocampo (1986). In the discussion which follows, in order to avoid unnecessary repetition, frequent citation of these studies will not be made.
3. Solving equation 15 for g^n, inserting the result into equation 2 solving it again for g^n, and multiplying the result by (P_n / P_n) (with interpretation of the result) will, in a fairly straightforward fashion, yield equation 16. Similar steps may be taken in order to arrive at equation 17.

4. In the latest version of this model, the South is taken as comprising Latin America, the newly industrialized countries and Africa. However, the author was not able to obtain access to this (unpublished) African model.
5. This section of the model is rightly specified along Kaldorian line (see Kaldor 1976: 705).
6. These may be perceived either as passive finance, within a Kalecki-Lewis model, or assumed Northern ownership in the South, within a Solow-Lewis model.
7. For example, through the effects of monetary policy on interest rates, as well as terms of trade between North and South.
8. Murshed specified his North-South model at both comparative static and dynamic levels. It seems that the two versions provide different conclusions about the impact of the North's macro policy. Thus, while the former underscores its negative impact on the South's debt, the latter does not. Murshed did not comment on this apparently contradictory result (see Murshed 1990: 87).
9. This is included in order to approximate convergence of consumers' test or preference, especially between developed countries and the newly industrialized countries.
10. Ideally, the Maxi-LINK should be used since this is relatively the stronger linkage mechanism.
11. This model, which was discussed in detail in Chapter 2, serves as a useful illustration of how market share models are formally modelled.
12. These are: price and volume of goods traded, exchange rate and interest rate.
13. However, Molana and Vines (1989) assumed production technology of a fixed-coefficient type within the North, since labour is assumed to be in surplus. For the South, their Cobb-Douglas function has three arguments: land, labour and capital.
14. For each category of good and service, a weighted (by import volume demand) market growth variable is constructed. In order to ensure system consistency, the elasticities of this market growth variable are, in general, imposed in the region of unity.

15. See Alemayehu (1995) for a discussion of some theoretical implications of the incorporation of such models into a global model of Africa.
16. However, the Sudan is excluded from NA and included in the ESA region, since its economic structure is similar to the latter.
17. See Vos (1994, and Chapter 4 in particular) for an excellent historical analysis of the segmented nature of the global capital market.
18. This maximum/critical ratio not only limits borrowing but also indicates a high probability of default (Vos 1994: 216).
19. However, non-market restrictions on the flows of bank credit to Africa could be responsible for limiting the total level of inflows. Within the model, this is ensured by limiting the market-based flow to Africa to its historical maximum level.
20. The definition of capital flight (*CF*) used is:

    $$CF = \Delta D + FDI - CA - \Delta RES - \Delta B$$

    where ΔD is flows of debt, FDI foreign direct investment, *CA* current account balance, ΔRES change in reserve, and ΔB the change in domestic banking claims on foreign banks.
21. Most global models use estimations from other studies. However, the recent IMF model (MULTIMOD) uses a single-equation (first-order) ECM-based estimation. Our approach is similar to the latter but improves on it in two respects. Firstly, it allows for simultaneous estimation to be undertaken in some of the blocs. And, secondly, it starts its estimation from a second-order ECM (following a General to Specific approach). Finally, as noted in Chapter 4, the use of an ECM approach helps to tackle the problem of simultaneous equation bias.

Chapter 7

1. The global consistency of balance of payment statistics was discussed more than two decades ago by Mundell. He explored, in general terms, the point that the balance of payment position for all countries should add to zero. This is also referred as 'Cournot's law' (see Mundell 1968: 143–47).
2. See de Jong and Vos (1995a) for a recent analysis of trade and finance, using a WAM. An earlier analysis is also contained in FitzGerald and Luttik (1991).

3. Most notably, Heien et al. (1973) provide a simple and powerful analysis of the algorithm, as well as problems associated with its use.

4. Since this is a painstaking process, it is advisable to run the model by bloc or by equation, and subsequently to combine these blocs and then to run the model one final time. This procedure is extremely helpful not only in detecting errors but also for calibration purposes. Moreover, it is noteworthy that ECM estimation is extremely powerful in reproducing the base run values, with only a minor calibration.

5. Suppose a linear function is given in matrix form by $AX = D$ where A is an nxn matrix of a_{ij} coefficients, X an nxn matrix of x_i variables and D an $nx1$ vector of constant values. If we take each of the rows of the left hand side variables as functions denoted by y_i, the Jacobian is given by,

$$|J| = \left| \frac{\partial\ (y_1, y_2, \ldots y_n)}{\partial\ (x_1, x_2, \ldots x_n)} \right| \text{ which in turn} = |A|$$

Thus, for a linear model the Jacobian is essentially the determinant of A and hence, as long as A is non-singular, the stability condition holds.

6. See Jamshidi (1989) for an excellent and simple methodological discussion of structural sensitivity analysis and an illustration using MULTIMOD.

7. Similar results relating to the implicit GDP deflator of the USA are reported in Zellner and Peck (1973).

8. This was launched at a joint IMF-World Bank press conference held in September 1996.

9. The value of this stood at 8.13, 9.27 and 8.35 per cent, for the years 1988, 1989 and 1990, respectively (IMF 1994).

10. The only exception to this being exports in WCA and price of beverage.

11. However, while Vos' conclusions are derived from a model that has a single aggregate category of South, the above findings relate only to Africa.

12. The so-called indirect impact on output and income is modelled, in this book through imports.

13. For example, MULTIMOD (see Jamshidi 1989: 38).

14. The relative position of each region to the South in general is not examined here.
15. The best export performance is observed in the NA region, and the worst in ESA.
16. Private inflows are modeled as being sensitive to this ratio, as shown in the debt cancellation simulation.
17. The difference between the results of Vos' model and the one presented here may be attributed to the use of econometrically estimated parameters and a higher degree of disaggregation in this model. Moreover, the model developed in this book is a dynamic one, both in terms of time and the inclusion of short-run and long-run effects together. In contrast, the dynamic element in Vos' model lies in the stock adjustment and inclusion of current responses to lagged variables.
18. Such a disaggregation would be particularly relevant in relation to WCA and NA regions.
19. See also section 7.4.1 for a discussion of this phenomenon.
20. For example, an increase in the export of commodities from the rest of the South is simulated.

Chapter 8

1. The financial impacts relate to debt, debt service, financial inflows and their macroeconomic effect, while the trade-related impacts operate mainly through commodity prices.
2. This occurs by way of the 'adding-up' effect.
3. However, such a doubling of aid appears to have no significant effect on public revenue within the WCA region.
4. However, by the end of the simulation, this effect collapses to nearly zero in the WCA region.
5. A 0.3 per cent increase in Northern output, from its base run value, due to a 10 per cent increase in public investment in Africa.
6. Specifically a flexi/mark-up price market, imported capital-constrained investment in South, a Southern fiscal posture and domestic price which is sensitive to the external sector.
7. Examples of such an approach are the works of Samir Amin (1972, 1996) and Bade Onimode (1988).

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(Note: Ethiopian names are cited using 'first' names, without comma.)

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