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WINE ECONOMICS

Quantitative Studies and Empirical Applications

Edited by
Marie-Claude Pichery and
Eric Giraud-Héraud

Applied Econometrics Association Series

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Wine Economics

Quantitative Studies and Empirical Applications

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Softcover reprint of the hardcover 1st edition 2013

First published 2013 by
PALGRAVE MACMILLAN

Palgrave Macmillan in the UK is an imprint of Macmillan Publishers Limited, registered in England, company number 785998, of Houndmills, Basingstoke, Hampshire RG21 6XS.

Palgrave Macmillan in the US is a division of St Martin's Press LLC, 175 Fifth Avenue, New York, NY 10010.

Palgrave Macmillan is the global academic imprint of the above companies and has companies and representatives throughout the world.

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ISBN 978-1-349-45018-3 ISBN 978-1-137-28952-0 (eBook)
DOI 10.1007/978-1-137-28952-0

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources. Logging, pulping and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

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

A catalog record for this book is available from the Library of Congress.

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Acknowledgements

This book, containing as it does contributions from experts from Europe, America and Australia, aims to present insights into a variety of problems and situations encountered by wine professionals around the world. Some chapters are derived from presentations at meetings of the European Association of Wine Economists (EuAWE) in Angers (France, June 2011) and Coimbra (Portugal, June 2012). Others have been written specifically for this book.

We have been greatly helped by Alejandro Fuentes Espinoza, who has assisted in the editorial preparation, and by Claudia Tscheitschonigg, who took the time needed to read it carefully and correct the inevitable linguistic errors. We would also like to express our gratitude to the AEA; without its assistance, you would not be holding this book in your hands.

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Introduction and Overview

Eric Giraud-Héraud and Marie-Claude Pichery

Who would have thought in 1990 what we have been able to achieve in 20 years? VDQS,[1] the old French certification neglected by the wine authorities, has become the beacon for the **V**ineyard **D**ata **Q**uantification **S**ociety. It was founded by a group of academic researchers coming mainly from applied econometrics and members of the AEA (Applied Econometrics Association, founded in 1973) and was based on the challenge of developing contributions of knowledge on the economics of the wine and grape sector. After more than 20 international conferences, our initial challenge can be regarded as having been met largely successfully; each year, new studies, scientifically validated by a rigorous process, provide new elements of reflection (and action) to the decision makers of the wine world.

When Henri Serbat, misuses of authority as President of the VDQS-EuAWE,[2] suggested that the time had come to collect the best research papers in order to create a handbook, we immediately agreed, even though we did not at the time realise the magnitude of the task required to create such a work of reference. But now we are able to offer you a collection of writings embracing all economic aspects of the wine sector. The following 16 chapters show the richness of the contributions of economists in their preferred area (not only for tasting). The works presented in this book have in common the use of econometric techniques and mathematical formalisation to describe today's new challenges facing consumers, producers (growers and traders), investors and the public regulators of the sector. Some of the topics discussed have been recently developed by economists (for example global warming, wine tourism, etc.) although they had previously mostly been covered by specialists in management, marketing and geography. Other fields correspond to new investigations into traditional topics (for example ranking wines or consumer behaviours) and new analyses in strategic choice (for example how to bottle wine or to sell bulk wine, to select grape varieties for replanting, or to distinguish attitudes, intentions and behaviour in exporting). This book also provides an opportunity to draw up an inventory of the positioning of the different market players and to explore the alternative to regulations for public policy.

The book begins by addressing the consumption of alcohol and the purpose of welfare by analysing the characteristics of the demand for wine and alcohol substitutes, substances which provide considerable satisfaction to consumers without being generally regarded as basic necessities. The chapter by Jan Bentzen and Valdemar Smith analyses such point of view, focusing on drinking patterns and their change in OECD countries through the relationship between alcohol consumption and self-reported indices of life satisfaction. These authors argue that changes in drinking patterns can affect life satisfaction both negatively and positively. A detailed survey of literature on the link between income and happiness is followed by a model for the happiness–alcohol relationship including controls for shifts in aspirations. A panel data set for 21 OECD countries covering the period 1961 to 2005 is used to obtain empirical measures of the different effects. The results may help explain the demand for alcoholic beverages in terms of both level and structure, a particularly complex phenomenon which fundamentally depends on a series of variables that go well beyond consumer income and changes in prices and product features.

Chapter 2, by James J. Fogarty, clarifies the economic measure of consumer satisfaction and describes the loss of 'welfare' created by coercive taxation and a policy of artificial price increases. The author develops an original optimal alcohol tax model which distinguishes three types of consumer: moderate, informed (on the private cost of consumption) abuser, and uninformed abuser. Introducing specific rates for beer, wine and spirits, the approach used balances the savings from externality cost reductions due to alcohol taxations against the welfare losses that alcohol taxes impose on responsible consumers. Based on Australian data, current alcohol taxation approaches are evaluated, and estimates are presented of the welfare loss associated with current approaches versus optimal alcohol tax rates.

The chapter by Ruben Hoffman and Yves Surry analyses the ways in which advertisement expenditure influences the demand for alcoholic and non-alcoholic beverages in France. Using annual data for the period 1977 to 2004, a conditional dynamic demand system is estimated econometrically for spirits, champagne and sparkling wines, still wine, beer and non-alcoholic beverages. Advertising expenditure is modelled as affecting per capita demand for alcoholic and non-alcoholic beverages through a translation parameter. Special attention is given to the impact of the Evin Law implemented in 1991 in France which restricted the use of advertising for alcoholic beverages. The results show that the law has affected consumer demand for alcoholic beverages and support is found for the existence of subsistence levels which in the model is captured by translation variables.

The second part of the book focuses more on consumer behaviours and prices. In Chapter 4, Hyunok Lee and Daniel A. Sumner develop an analysis of the economic value of wine names through the place names or geographic indicators used to identify wines. Given that region of origin is difficult or impossible to duplicate, they investigate the place name 'Champagne' in the sparkling wine market in the United States. Using an econometric model, they measure the price effects on using this place name, and compare the prices of wines from Champagne relative to other French sparkling wines that do not claim the place name Champagne. In this chapter, the authors explore an econometric approach within a hedonic price framework using data on sparkling wines collected from the *Wine Spectator*. The model includes wine characteristics such as the label name, the region, the score, the vintage and the release year. They establish that the place name Champagne systematically translates into much higher prices.

Indeed, the price of wine appears to be explained by a multitude of considerations related to changes in agricultural production, and also by consumer demand, which is especially difficult to control. Jean-Franccois Outreville illustrates this paradox in Chapter 5 by showing how difficult it is even to postulate a correlation (ceteris paribus) between the size of the bottle and the selling price of the product. Does the bottle size affect the price? In order to answer this question, his contribution investigates the relationship between price and bottle size for the same wine, controlling for vintage and quality. Different kinds of data are collected: prices posted on company websites for Champagne and auction hammer prices from the Chicago Wine Company for Bordeaux wine. The results show that in the case of Champagne the posted price of bottles increases more than proportionally with the size of the bottle. This relationship is verified independently of the perceived quality of the wine (producer, vintage) or the region of production. It is postulated that the hypothesis of scarcity may explain this relationship. However, investigation based on prices determined at auctions for Bordeaux wines mitigates these results, as there the premium for larger bottles is much smaller than for posted prices.

Next, Matteo M. Galizzi proposes a better understanding of the economic rationality of the consumer for the purchase of a hedonic product. In a meticulous literature review, the author develops the need to appeal to the behavioural sciences to understand the hidden rationality of consumer satisfaction, and show how the product can be influenced by many parameters that extend well beyond price, to both quality and a set of specifications for labelling and reputation. The experimental analysis is based on plentiful and precise qualitative and quantitative information (including aromas, awards, grape variety, regional provenance, prices, expert rankings) provided by three wine guides in Italy, edited by the Associazione Italiana Sommelier, the Seminario Permanente Luigi Veronelli and Slow Food-Gambero Rosso. An empirical analysis founded on a probit model provides a contribution which reports ample evidence on the most significant determinants of actual wine judging in Italy.

In this connection, Pascale Bazoche, Pierre Combris, Eric Giraud-Héraud and Jean-Baptiste Traversac illustrate in Chapter 7 how experimental economics clarify more precisely the effect of labelling and quality certificates on consumer demand. These authors propose estimating consumers' willingness to pay (WTP) for wine characteristics using incentive-compatible laboratory experiments with participants randomly selected from the general populations of France and Germany. The main question is to identify the value of a supposedly well-known Appellation of Origin (namely Appellation d'Origine Contrôlée Bourgogne). Results show that sensory characteristics and label information influence French and German consumers differently. They also reveal that for middle-range wines the Appellation of Origin information is of little value outside the country of origin. Moreover, it appears that the small differences observed in the average WTP for each wine, in each country and information condition, do not result from consumers' lack of discrimination.

The third part of the book addresses wine ranking and financial issues and permits a better understanding of consumer behaviour by using the fact that it is known that the various buying guides, rankings, and other public certificates of quality abound in the area of wine more than in any other food sector. But how is it possible to account for a very high heterogeneity of possible judgements, even those made by renowned expert oenologists? Michel Balinski and Rida Laraki show how the problems of aggregation of judgements, even though traditionally regarded as inextricably bound up by the Arrow paradox, can be solved by innovative methods. In the case of wine tasting, based on the data from the famous tasting organised in Paris on 22 May 1976, the authors show that the traditional methods of ranking wines give too much importance to extreme opinions – highly favourable or deeply unfavourable – and so often do not arrive at truly consensual decisions. Hence, a new method of aggregation is presented, with the reasons why it is better than any known method, in both theory and practice . Called *majority judgement,* its use in several scenarios of marking by judges is described, revealing that it is meaningful; strategy-proof in grading; partially strategy-proof in ranking; and coherent, thus difficult to manipulate. In fact, they show that at the time of that *Jugement de Paris,*[3] California did *not* defeat Gaul! Their research into social choices may allow a challenge to be made to rankings as famous as those of Bordeaux wines in 1855.

What is known, however, is the importance of such classification to the behaviour of the various stakeholders in the economy. Indeed, in the case of super premium and icon wines, this type of classification is not a simple guide to the consumption of a food product, but it is also (and perhaps especially) a financial investment guide for investors and speculators disinterested in hedonic pleasure, and essential to the economist who wants to understand the operation of markets. Philippe Masset and Jean-Philippe Weisskopf clarify this view by establishing the opportunity and the specificity of such a financial product and its profitability. After a presentation on investing in estates or companies active on the wine market, they show how a small number of bottled fine wines are now viewed as an integral part of a range of assets at an investor's disposal. Research questions consequently tend to look at the interaction between wine and other asset classes, portfolio diversification benefits, and differences in risk components of wine as well as its behaviour across economic cycles. This chapter synthesises results on these different topics (international market and trade, associated costs and taxes, characteristics of carefully selected bottled wines, choice of investment-grade wines, creation of wine indices and wine funds, duration of wine investment and so on) and endeavours to give an up-to-date view of the specific market for fine wines.

This is followed by Paul Amadieu, Jean-Pierre Couderc and Jean-Laurent Viviani's examination of the investment policies and financing implemented by French wine businesses in times of crisis, and especially in connection with business cycles. This study includes a description of these policies and their consequences on the financial performance of these companies: level of cash (and ability to maintain it), financial profitability, and possibly financial risk. Taking into account the dynamic of financial structure, investment policy and cash management, the authors show why it is difficult to understand the consequences of the crisis for each company in this economic sector. They stress the sensitivity of financial performance to the business cycle, and four aspects are particularly examined: working capital management, human resources, financing and investment policy.

The fourth part of the book discusses intermediary markets and strategic decisions of wine growers. The chapters address both the marketing and the technical efficiency of the strategic choices of production. The first situation, set out by Tim Coelli and Orion Sanders, concerns Australian wine grape growers who have faced difficult market conditions in recent years (reductions in grape prices and increases in irrigation water prices having a significant effect on farm profitability) and then supported significant pressure to be as efficient as possible. An exploratory study, using a subset of the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) irrigation survey, consisting of data from the Murray and Murrumbidgee river basins in Australia, allows production frontiers and the efficiency levels of the individual farmers to be estimated.

Another field, developed by Gordana Manevska-Tasevska, is concerned with the influence of grape assortment in terms of assortment size and product function/product consistency on the technical efficiency of grape-growing family farms in Macedonia. This subject is of great interest and importance while decisions have to be taken for restructuring and modernising viticulture for the winemaking Western Balkan Countries (WBCs) and the Early Transition Countries (ETCs). Rural development programmes have encouraged grape producers to uproot old vineyards consisting of regional/local grape varieties and replace them with recognised European grape varieties. These producers need to develop a long-term strategy, with a compromise between table grapes and wine grapes; moreover, adjustments to match EU regulations and practices, including wine regulations, are considered to be the key to improving the competitiveness and environmental sustainability of the Macedonian wine sector. A two-stage Data Envelopment Analysis (DEA) method extended with bootstrapping is applied to the three-year average (2006–2008) of a panel dataset for 300 farms. The analysis reveals very high potential for revenue increases. Farmers with lower variety diversification, specialising in growing local and regional varieties and table grape varieties, achieved higher efficiency. The results led the author to suggest that the ongoing revitalisation and investments in Macedonian grape assortment should primarily be directed towards regionally recognised and table grape varieties.

In the following chapter, based on the population of processing wineries in Italy, Giulio Malorgio, Cristina Grazia, Francesco Caracciolo and Carla De Rosa investigate producer interest in adhering to product certification systems emphasising quality over quantity marketed. Concerning Geographical Indications (GIs), this chapter aims at empirically investigating wineries' strategic choices of bottled volumes. Starting from a dataset covering the entire population of Italian wineries that processed wine in 2008, the authors estimated a sequential probit model to characterise wineries' long- and short-term strategies. Notably, this model is applied in order to examine the influence on bottled volumes of GI wines of a winery's size, structural and organisational characteristics, procurement characteristics, territory and product range. Results show that high-volume strategies are likely to be favoured by scale economies in the processing activity and scope economies arising from sourcing grapes from multiple geographical areas and suppliers. Moreover, the results empirically corroborate the volume-constraining nature of DOC/DOCG with respect to IGT, this latter allowing greater flexibility in exploiting market opportunities. Finally, the authors provide some concluding remarks on the possible product development and marketing strategies for Italian GI wineries.

In a sample of Spanish wineries, Isabel Bardají, Belen Iraizoz and Julio Estavillo, noting the trends in demand and trade and the profound transformation of the wine industry that has been observed in recent years, consider that the move towards foreign markets appears inevitable, but foreign market entry represents a major break from the usual business approach of most producers. Changes in the decision-making process require behavioural modifications which may react to the increasing difficulty of selling to the domestic market (due to seeking new markets and increasing exports). The authors, especially interested in strategic decisions, focus on the motives underlying decisions by exploring the internal determinants of export behaviour. Their analysis consists in explaining the relationship between attitudes, intentions and behaviour. The primary purpose is to identify the explanatory factors of the export intentions of Spanish wineries. An additional contribution in this chapter is to test the TPB (theory of planned behaviour) in the formation of export intentions. By using the ordinary least squares (OLS) method, with a stepwise technique in order to determine export intentions, predictions of specific export intentions are obtained with a two-stage procedure. The results show that exporting is a key issue for most wineries facing a competitive environment, although the domestic market continues to be the main outlet for most. The main finding suggests that export intention varies across firms, ranging from an active export strategy to the consideration of exports as a mere possibility. Some variables influencing the wineries' intentions have been identified.

The last part of the book is devoted to new issues that have hitherto furnished a very limited number of publications in the literature on wine economics. Franccoise Bensa and Marie-Claude Pichery explore how the renewed interest in local agriculture (due to specific consumer demand and the need to consider the carbon footprint of food) can promote on-site or direct wine sales and stimulate wine tourism. The authors argue that studies carried out by national and local tourism boards show that the classic tourist visiting a wine region is no longer satisfied with just buying a product: instead, he/she expects to have an unforgettable experience by visiting the vineyards and meeting the producers face to face. Because of this new phenomenon, winemakers must now go beyond simply working in the vineyard or in the cellar, and adapt to those new tourists and develop relevant marketing skills. By using the method of structural equation applied to two surveys in France (Burgundy and Alsace) among winemakers, the chapter draws an accurate, up-to-date portrait of the wine tourism-related activities implemented by winemakers, and evaluates the consequences of these activities on on-site sales. The analysis of the sample shows, in Burgundy as in Alsace, that even if the wine tourism activities offered by the winemakers do not have an immediate influence on on-site sales to individuals, they do nevertheless permit the creation of a relationship of confidence with the consumer that encourages the growth of customer loyalty and the increase in sales over the long term. This shows that in fact wine tourism activities are important, both in order to attract consumers and to build a relationship between them and the domain, and indeed these are the principal motivations declared by winemakers offering wine tourism activities. As a result, the three principal elements that push the development of these activities are, in order of importance: increasing direct sales, creating customer loyalty, and attracting new customers.

Finally, the last chapter, by Julian Alston, Kate B. Fuller, James T. Lapsley, George Soleas and Kabir P. Tumber, allows us to relate many of the issues developed in this book to the major challenge of global warming. These authors show how it is possible to distinguish the changes generated by the external economic environment from those introduced as a deliberate strategy by companies to increase the alcohol content of wines offered to consumers. Indeed, many economists and others are interested in the phenomenon of the rising alcohol content of wine and its potential causes. Has the alcohol content of wine risen? And if so, by how much, where, and when? What roles have been played by climate change and other environmental factors compared with evolving consumer preferences and expert ratings? The authors explore these questions using international evidence, combining time-series data on the sugar content of wine grapes in the United States and on the alcohol content of wine from a large number of countries that have experienced different patterns of climate change and the influence of shifts in policy and demand. They conclude that the alcohol content of wine has increased significantly, and that this increase can be attributed more to decisions made by grape growers and winemakers than to any exogenous effects of climate change.

Alston et al.'s chapter clearly highlights the role of economic and social analyses in the wine sector. It seems that the understanding of economic mechanisms and the strategic decisions of stakeholders throughout the supply chain provide new perspectives on the evolution of this agriculture sector. The formalised approaches presented throughout this book are used to measure these effects and facilitate critical analysis of the ideas presented by the various authors. Wine, a symbolic example of the agrifood sector, is a particularly fertile field of investigation for testing economic theories, statistical methods and operational research analyses. This is the whole point of this book; we hope it will satisfy a wide audience of social scientists, professionals and regulators of the wine industry and, of course, all wine lovers!

Notes

1. VDQS = *Vin Délimité de Qualité Supérieure* was a French certification system abandoned in 2012 in order to simplify the labelling of wines.
2. VDQS = Vineyard Data Quantification Society; EuAWE = European Association of Wine Economists.
3. The *Jugement de Paris* (24 May 1976), a blind tasting by an almost exclusively French jury, declared that California dethroned the greatest wines of Burgundy. That day marked the discovery of New World wines by the often reactionary international commentators' palates.

Part I

Alcohol Consumption and Welfare

1

Life Satisfaction and Alcohol Consumption: An Empirical Analysis of Self-Reported Life Satisfaction and Alcohol Consumption in OECD Countries

Jan Bentzen and Valdemar Smith

1.1 Introduction

Since the 1960s the level of alcohol consumption, as well as the drinking patterns, have changed significantly in several OECD countries. From a producer's point of view, structural demand shift is of particular interest as the observed changes may reflect shifting preferences of consumers. The old, traditional wine-producing countries have experienced a decline in domestic wine consumption, and additionally there has in some cases been a shift towards increased beer consumption, for example in Spain beer consumption is exceeding wine consumption. In the northern European non-wine-producing countries a decline has been observed in the shares of beer and spirits in alcohol consumption. In general, patterns in alcohol consumption may have been in a process of convergence in the OECD countries during recent decades where the level of alcohol consumption – as well as the structure among the various alcoholic beverages – exhibit less variation than the conditions a few decades back in time.

Naturally, the changing patterns in alcohol consumption may reflect changes in relative prices and income levels, but also new consumers entering the market. However, the magnitude of the changes also suggests that changes in consumer preference might play a significant role. Assuming that consumers act as rational individuals, adjustments in the composition of consumer goods reflect higher utility. Therefore, these alterations must have been associated with more well-being or happiness, as a traditional welfare economics approach to this issue would suggest. Accordingly, the issue of whether shifting drinking patterns is linked to more well-being is the main hypothesis to be tested in the empirical part of the present analysis.

By now, a huge amount of literature and empirical data for happiness or well-being is available. Improvements in these indices of 'life satisfaction' – usually based on self-reported data – might be influenced by a number of traditional factors, such as income, employment, inflation and economic and political freedom, that usually appear in the empirical studies of happiness. But patterns of alcohol consumption are also expected to affect life satisfaction; wine in particular is usually assumed to be linked to enjoyment of life or happiness.

The aim of this chapter is to analyse whether alcohol consumption influences the level of well-being, and this will be addressed by using panel data for 21 OECD countries. Appropriate data is available from 1961 to 2005 for both happiness (a 'life satisfaction index') and alcohol consumption. This gives a rather large dataset for use in the econometric analysis, but it is especially the data for well-being, with its somewhat subjective, self-reported values, that poses some challenges for the econometric analysis.

The chapter is organised as follows. In Section 1.2 we present a literature review with a focus on the relationship between happiness and alcohol consumption, including the sparse empirical evidence on this issue. Section 1.3 deals with modelling the happiness–alcohol relationship. The next Section 1.4 deals with the data for alcohol consumption and the life satisfaction index covering the 21 OECD countries; the latter also includes a concept capturing the structure of alcohol consumption with respect to beer, wine and spirits, but leaving the technical details to the Appendix. The empirical results concerning the link between happiness and alcohol consumption are reported in Section 1.5, and finally Section 1.6 concludes.

1.2 Literature review and issues in the happiness–income link

In the economics literature on happiness and life satisfaction, a large number of studies deal with the income–happiness nexus. In this literature there is an expectation of a positive relationship between income and self-reported happiness or well-being. In empirical studies, happiness is modelled as a function of income as well as other explanatory variables. However, there may be a problem of endogeneity, as higher well-being might increase working abilities and thereby income. Thus, not only do several factors complicate the empirical assessment of this happiness–income link, but there is also an ambiguity about the interpretation of concepts like 'happiness' and 'life satisfaction', as discussed in the literature on these issues where reviews of these most important topics can be found, as in Easterlin (2001), Frey and

Stutzer (2002), Graham (2005), Di Tella and MacCulloch (2006), Stevenson and Wolfers (2008) and Blanchflower and Oswald (2011).

In addition to income, other macroeconomic factors have been applied in relation to empirical models of happiness. Di Tella et al. (2001) find people happier in case of low unemployment and inflation; and political and economic freedom have been investigated in the happiness literature – see Frey and Stutzer (2002). The primary focus of the present analysis is not on these issues but on whether specific consumer goods such as alcoholic beverages will appear with significant impacts in a model of life satisfaction. To the best of our knowledge, no empirical evidence exists on this topic, but – indirectly related to the present topic – many studies report detrimental health effects from excessive intake of alcohol, for example Gutjahr et al. (2001) and Norström and Ramstedt (2005). Still, a moderate level of alcohol consumption may appear with positive effects, especially concerning heart disease (de Lorimier 2000). However, next to the health effects, the consumption of alcoholic beverages could be assumed – in accordance with rational behaviour – to have a positive influence on utility and well-being. It may not be only the level of alcohol consumption but also the structure concerning the respective beverages that may influence well-being. There is some empirical evidence of convergence in tastes, cf. Aizenman and Brooks (2008) and Fogarty (2010). Drinking patterns also affect, for example, liver function and may therefore have detrimental health effects; see Stranges et al. (2004) and Astudillo et al. (2010), which provide incentives to change the composition of alcoholic beverages in a more balanced direction, in addition to considering the overall level of alcohol intake. Consequently, diversity in the composition of drinking patterns appears to have a positive influence on well-being.

General empirical studies of happiness based on individual data report that better-off people are happier than the poorer ones, where positive relationships within countries seem to exist (Stevenson and Wolfers 2008). Studies of happiness across countries and over time do not give much support to the positive link, which appears in the literature as the so-called Easterlin Paradox. When increases in income do not seem to increase happiness, this may be explained by an assumption that people rely on relative levels of income when answering surveys on their present level of well-being, instead of basing their answers on absolute levels, Graham (2005). There are continuous shifts in people's aspirations, in the sense that an increase in the level of a variable that affects happiness may accompany a simultaneous increase in the level of aspiration, and therefore people's answers to surveys about their well-being will remain remarkably stable. In surveys, individuals will usually come up with answers in the same narrow range of the respective scales used, no matter that the variable that affects happiness shifts over time. In the literature the graphical exposition is as shown in Figure 1.1.

Assume X affects life satisfaction. In the case of no shift in aspirations, an increase in the explanatory variable X will also correspond to a higher level

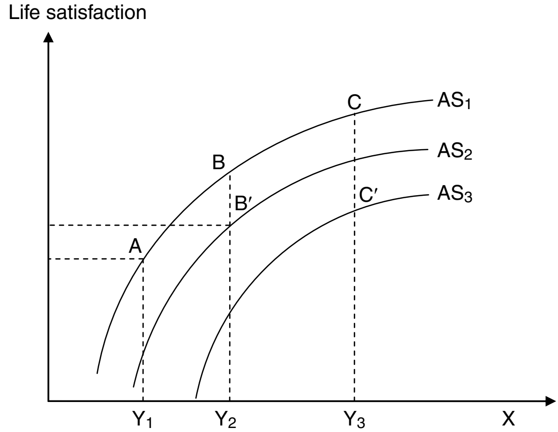

Figure 1.1 The life satisfaction and 'aspirations' connection

of happiness, as indicated by the movement A, B and C along the AS_1 curve. When aspirations shift over time – due to relative comparisons of well-being – then the AS_2 curve is relevant for time period 2, etc., and the actual movement will be from A to B′ and then to C′ in period 3. This can partly explain the empirical fact that self-reported levels of happiness or life satisfaction do not seem to increase with, for example, increasing wealth or income.

When people make comparisons and it is their relative income that is important for the reporting of well-being, this can partly explain the paradox appearing in the happiness data (Stevenson and Wolfers 2008). There may be a positive impact from increases in income – or increases in ability to purchase specific consumer goods as, for example, alcoholic beverages – but the continuous shifts in aspirations and the importance of making relative comparisons with the past or with other people will imply a missing correlation between well-being and income (see Frey and Stutzer 2002 and Bjornskov et al. 2008). One solution to the problem is to include a time trend in the model – expected to appear with a negative slope – as discussed in, for example, Blanchflower and Oswald (2000) and Alesina et al. (2001). Thus uncertainty in the empirical studies of the link between life satisfaction and income exists, and this will be considered in relation to the choice of empirical model in Section 1.3.

1.3 Modelling of the happiness–alcohol relationship

In line with other empirical studies of happiness, the econometric model is of the standard form, as equation (1) with H as the happiness variable:

$$H_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it} \qquad t = 1, \ldots, T \qquad i = 1, \ldots, N \tag{1}$$

Where X is the set of explanatory variables like income and other characteristics, β is the vector of parameters to be estimated and the error term captures unobserved characteristics and measurement errors. Using panel data for T time periods and N countries, (individual) fixed effects are usually included, but also time fixed effects may be considered, as in equation (2):

$$H_{it} = \alpha_i + \omega_2 D2_t + \ldots + \omega_T DT_t + X_{it}\beta + \varepsilon_{it} \qquad (\mathrm{DS}_t = 1 \text{ if } S = t, \ else\ 0) \quad (2)$$

The time effects may capture the shifts in aspirations as discussed in part two, but the fixed time effects assumes identical parameter estimates across countries for the given points in time. Still, the use of equation (2) is much more appealing than equation (1) as the present case involves time-shifting preferences. Another option might be to include individual trends, as in equation (3):

$$H_{it} = \alpha_i + \delta_i trend + X_{it}\beta + \varepsilon_{it} \quad (3)$$

In this case the slope parameter may vary across countries and with expected negative values when aspirations are shifting, as exhibited in Figure 1.1. The slope of the time trends are constant for the respective countries considered, but equation (3) still allows for country fixed effects.

All of the three above equations rely on level values of the data to be used in the estimation procedure, but as discussed in relation to Table 1.3 some variables may have non-stationary time series properties. In the latter case with unit roots in (some) variables, level regressions may be spurious and therefore also differenced values of the relevant variables should be considered to avoid the problem. It may not be reasonable from an economic point of view to expect cointegration present in, for example, happiness, income and various alcohol characteristics, as the time series properties of these variables seem to vary considerably, so a cointegration model of level variables is not considered in the present analysis.

A first-difference version of equation (2) will be:

$$\Delta H_{it} = \omega_2(\Delta D2_t) + \ldots + \omega_T(\Delta DT_t) + \Delta X_{it}\beta + \Delta\varepsilon_{it} \quad (4)$$

The time fixed effects will not – like the individual fixed effects – disappear in the differing process, and thus equation (4) still allows for time effects with first-difference values of the variables,[1] and with unbiased and consistent estimates from the pooled OLS estimator. Thus, the last equation may be expected to be the most suitable model of the happiness–income relationship.

As the intention is to investigate for the importance of alcohol in a more broad sense, alternatives to the level of alcohol consumption are considered. Usually, total alcohol consumption is measured as the sum of the three main beverages (beer, wine and spirits) measured in litres of pure alcohol, and thereby the beverages appear as perfect substitutes in aggregate alcohol consumption. However, consumers normally have a utility function where the utility or well-being is affected differently by the various forms of alcohol. The marginal utility of drinking one extra unit of, for example, beer is assumed to be decreasing, and furthermore it depends on the actual consumption level of spirits and wine, unless the indifference curves for well-being as a function of spirits, beer and wine are homothetic. Thus, a more equal composition – a more balanced pattern – of the various forms of alcoholic beverages for a given intake of alcohol is expected to result in higher marginal utility of the specific beverage as compared to a situation with a skewed consumption pattern. In general, we expect the partial effect of a more balanced structure between the various alcohol forms to have a positive effect on well-being. In Appendix A1.2 we develop an aggregate measure of the structure of alcohol consumption.

1.4 Alcohol consumption and life satisfaction

The empirical analysis is based on a data set for 21 OECD countries, which includes information on both the level of alcohol consumption – including specific beverages – and an index of happiness ('life satisfaction'). The data for alcohol consumption comes from a combined dataset including information from the WHO database and World Drink Trends (1999, 2005). The final dataset includes per capita levels of consumption of beer, wine and spirits covering the entire period 1961 to 2005.

The data for happiness or well-being is taken from the Happy Planet Index report,[2] where the HPI index is a composite of three components – life expectancy, life satisfaction and ecological footprint, respectively. Measurements of well-being obtained from survey data[3] are based on answers to the question 'All things considered how satisfied are you with your life as a whole these days?'[4]

For the present purpose the life satisfaction variable is used, as this indicator represents the subjective well-being of individuals. The HPI life satisfaction indicator is constructed from other databases like the World Database of Happiness,[5] and this makes it possible to use a long time span, from 1961 to 2005, in the empirical tests.

Real GDP per capita, which is used as a control variable, comes from the Penn World Tables.[6] In total, the data sources allow for the construction of a panel dataset of a reasonable size (N=21, T=45) for the econometric modelling and estimation of the life satisfaction–alcohol relationship. Data for the total alcohol consumption and the life satisfaction index is shown in Table 1.1.

According to the table the average level of alcohol intake has not changed in a significant way since 1961, but the standard error decreased considerably from 1961 to 2005. Accordingly, a process of convergence has taken place, at least when evaluated from the so-called σ-convergence concept, defined as declining standard errors (cf. Sala-i-Martin 1995). Especially for

Table 1.1 Total alcohol consumption and life satisfaction in 21 OECD countries, 1961 and 2005 (pure alcohol, litres per capita, 15+ years)

	Alcohol consumption (A)		**Life satisfaction index (LS)**	
	1961	**2005**	**1961**	**2005**
Austria	10.95	11.08	69.6	79.4
Belgium	8.5	10.63	69.9	79.5
Denmark	6.55	11.71	72.4	77.8
Finland	2.91	9.31	68.8	78.8
France	26.03	11.43	70.8	80.2
Germany	11.03	11.99	68.7	78.9
Greece	10.87	9.01	69.9	79.0
Ireland	4.94	13.69	70.0	79.4
Italy	19.24	8.02	69.8	80.3
Netherlands	3.97	9.68	73.7	79.3
Norway	3.74	6.00	73.6	80.0
Portugal	18.92	11.54	64.8	78.1
Spain	14.64	11.68	69.5	80.6
Sweden	6.04	7.00	73.5	80.5
Switzerland	12.33	10.83	71.6	81.2
UK	7.14	11.75	70.9	78.9
USA	7.80	8.61	70.3	77.7
Canada	7.39	7.70	71.3	80.2
Australia	9.16	9.02	71.0	80.8
New Zealand	9.40	9.68	71.0	79.7
Japan	4.03	7.59	68.3	82.1
Mean	9.79	9.90	70.4	79.6
Std.err.	(1.28)	(0.43)	(0.44)	(0.24)

Notes: Alcohol consumption is the number of (pure) alcohol litres per inhabitant (15+ years). Due to missing observations (for spirits consumption in 1961) the data for Greece, Portugal and Spain relate to the most recent data from 1976, 1964 and 1962, respectively.

Sources: The World Health Organization (the WHOSIS database), World Drink Trends (1999, 2005), Nordic Alcohol Statistics 2003–2007, Stakes (2009), Abdallah et al. (2009).

wine there have been relatively large shifts, see also Appendix Table A1.1. Wine-producing countries such as France or Italy experience a huge drop in the wine consumption whereas the 'beer or spirits countries' have had a strong increase in the level of wine consumption. In this process there seems to evolve a 'balanced' structure in the total alcohol consumption in the sense of more equal shares concerning the alcoholic beverages, which may be partly explained by increased globalisation affecting consumption patterns.

The review in Fogarty (2010) concludes that there is little support for the idea that alcohol demand should vary considerably across countries. This conclusion is consistent with the data for 2005.

A measure of the structure of the alcohol consumption is developed in Appendix A1.2, and this also includes an alternative measure of the level of alcohol consumption (A_L), which is calculated as

$$A_L = \sqrt{B^2 + W^2 + S^2} \tag{5}$$

where B is the consumption of beer, W is the consumption of wine and S is the consumption of spirits, all measured in alcohol equivalents. If any one component dominates A_L is large, and in contrast A_L is at its minimum if the three components have the same size for a given level of total consumption. Thus A_L includes structural elements as well the overall level of consumption.

The alternative measure of the consumption structure from Appendix A1.2 is

$$A_S = \frac{B + W + S}{\sqrt{3}\sqrt{B^2 + W^2 + S^2}} \tag{6}$$

Table 1.2 shows the results from calculating these measures of alcohol consumption for 1961 and 2005 for the 21 OECD countries included in the sample.

The results for the structural measure A_S reveal a development towards a more 'balanced' pattern of alcohol consumption. As evident from Appendix Table A1.1, this tendency is not accompanied by greater changes in the overall average level of consumption of the respective beverages. The structural developments are country-specific, and probably also reflect necessary adjustments in traditional consumption levels such as the former high levels of wine consumption in southern Europe which are not compatible with the present economic and social structure, including health considerations. Potentially, price effects may be at work and if convergence of the prices of the respective beverages takes place, this will imply substitution effects in the direction of a more balanced structure of alcohol consumption.

Before including the data for life satisfaction, real income and alcohol consumption in the econometric modelling and estimation, the time series properties of the data set must be considered. In case unit roots are present in some variables, but not all, this may involve problems related to the so-called spurious regression case. Also when all variables show up with non-stationary time series properties, there is a need for appropriate considerations of whether some form of a cointegration model – with an economic interpretation – exists and can be modelled and estimated from the dataset. Appendix Table A1.2 presents panel data test results concerning unit roots in the variables from Tables 1.1 and 1.2. The conclusions from the test results in Table A1.2 are rather mixed in relation to the modelling strategy, as the critical value for the 5 per cent level of significance rejects a unit root for some of the variables, as in the case when a hypothesis of trend-stationarity is tested. Therefore, when estimating models including life satisfaction, real income and alcohol consumption (level/structure) in level values, spurious

Table 1.2 The structure of alcohol consumption (A_S) and the level of alcohol consumption (A_L), 1961 and 2005

	Structure (A_S)		**Alcohol consumption (A_L)**	
	1961	**2005**	**1961**	**2005**
Austria	0.97	0.89	6.53	8.02
Belgium	0.73	0.85	7.73	6.57
Denmark	0.73	0.94	5.15	6.68
Finland	0.79	0.95	2.12	5.83
France	0.72	0.85	20.92	8.86
Germany	0.88	0.92	7.25	7.34
Greece (1976)	0.87	0.94	6.88	8.76
Ireland	0.76	0.89	4.42	7.96
Italy	0.64	0.74	17.32	6.62
Netherlands	0.89	0.93	2.43	5.94
Norway	0.86	0.95	2.51	3.81
Portugal	0.62	0.87	16.30	7.79
Spain (1962)	0.77	0.92	10.99	5.92
Sweden	0.88	0.94	3.96	4.05
Switzerland	0.94	0.93	7.60	6.23
UK	0.70	0.96	5.91	6.52
USA	0.90	0.91	4.99	5.37
Canada	0.83	0.92	4.72	5.00
Australia	0.75	0.90	6.53	5.65
New Zealand	0.73	0.93	6.90	5.28
Japan	0.77	0.82	2.30	3.79
Mean	0.80	0.90	7.31	6.29
Std.err.	(0.02)	(0.01)	(1.11)	(0.32)

Notes: The structure variable (A_S) and level variable (A_L) as defined in Appendix 1.2.

Sources: The World Health Organization (the WHOSIS database), World Drink Trends (1999, 2005), Nordic Alcohol Statistics 2003–2007, Stakes (2009).

regressions could be problematic, and the standard solution in the literature is to first-difference the variables in order to turn these into stationarity.[7] Usually, real income is considered to be a non-stationary variable, which is also the result when applying an ADF test to the country-specific time-series data. As long as the time series properties for the other variables may be of non-stationarity, the most logical conclusion will be to use first-differences of the variables in the model.

1.5 Estimating the happiness–alcohol model

Firstly, the specifications in equations (2) and (3) are estimated where country and time fixed effects are included, as well as country-specific time trends in the latter model. The dependent variable is 'happiness', and measured via the life satisfaction data from the general happiness index (HPI) mentioned in part 4. The explanatory variables are alcohol consumption and the structure of alcohol consumption, with income included as control variable. Natural log values of variables are used in all cases, and standard errors of the estimated parameters (in Tables 1.3 and 1.4) have been corrected from a consistent estimate of the covariance matrix allowing for heteroscedasticity[8] because an ARCH(1) test indicates autoregressive conditional heteroscedasticity for the residuals from the panel estimates.[9]

Table 1.3 Fixed effects parameter estimates of the life satisfaction model, 1961–2005 (OECD, OECD Europe)

	OECD		**OECD Europe**	
	Eq. (2)	**Eq. (3)**	**Eq. (2)**	**Eq. (3)**
Income (Y)	0.133**	0.131**	0.093**	0.130**
	(0.054)	(0.042)	(0.033)	(0.060)
Alcohol (A)	−0.037	−0.005	−0.058**	−0.029
	(0.024)	(0.021)	(0.021)	(0.018)
Structure (A_S)	0.158	0.115	0.221**	0.112
	(0.097)	(0.078)	(0.056)	(0.077)
Log L	1850.3	2238.5	1614.9	1807.0
$\bar{R}^2$	0.87	0.95	0.92	0.95
N	915	915	692	692

Notes: 'Structure' is calculated from equation A4 (Appendix 1.2). Robust standard errors are reported in parenthesis and a * indicates a parameter estimate significant for at least the 10% level, and ** for at least the 5% level of significance. In all cases log values of variables are used.

Table 1.4 First-differences parameter estimates of the life satisfaction model, equation (4), 1961–2005 (OECD, OECD Europe)

	OECD		**OECD Europe**	
Income (ΔY)	0.104**	0.115**	0.113**	0.129**
	(0.042)	(0.042)	(0.052)	(0.052)
Alcohol (ΔA)	–	−0.014**	–	−0.012**
		(0.005)		(0.005)
Structure (ΔA_S)	–	0.023**	–	0.017*
		(0.010)		(0.009)
Log L	2874.7	2815.2	2365.4	2328.7
$\bar{R}^2$	0.07	0.07	0.15	0.19
N	915	893	695	676

Notes: 'Structure' is calculated from equation A4 (Appendix 1.2). Robust standard errors are reported in parenthesis and a * indicates a parameter estimate significant for at least the 10% level, and ** for at least the 5% level of significance. In all cases log values of variables are used.

The parameter estimates in Table 1.4 all include country fixed effects and time fixed effects for equation (2) – and country-specific trends in equation (3). The time effects are assumed to capture the shifts in aspirations and thus allow for more valid estimates for the other variables included. The general conclusion concerning the level and structure of the alcohol consumption is obviously that the contribution to the life satisfaction index is weak, that is only in one case is a positive[10] parameter estimate (A_S) found, which just fulfils the 10 per cent level of significance. Similarly, the level variable (A) is significant in only one case and with a negative sign, indicating a negative relationship to life satisfaction. In all cases, the control variable turns up with a positive sign in accordance with both expectations and other empirical studies from the happiness literature. Note that including non-European OECD countries in the sample, that is OECD in total, results in only non-significant parameters, suggesting considerable diversity in attitudes between European countries and the rest of the world.

The structural measure of alcohol consumption – the balance between the three main alcoholic beverages – is somewhat correlated with income and thus may involve problems of multicollinearity in the model. Due to non-stationarity of some of the variables included, the happiness model is estimated in first-differences using equation (4) that still allows for time effects. Table 1.4 exhibits the results for OECD as well as for OECD Europe.

There is evidence of a negative influence from the alcohol consumption (ΔA) – even significant in the two cases – and more positive evidence is found for the structural variable (ΔAS) in this model of happiness. The parameter estimates of the ΔAS variable are smaller than found in the models reported in Table 1.4, but as the first-difference modelling approach from equation 4 is probably the most appropriate from an econometrics point of view, the Table 1.4 results are the most reliable. Income will influence life satisfaction positively, and the parameter estimates are rather stable across the two country-specific samples; also, including the alcohol variables does not seem to change the income parameter estimates very much. Likewise, estimating the model without the income variable will diminish the degree of explanation considerably, but this also reveals that the explanatory contributions from the alcohol variables are small. The degree of explanation ($\bar{R}^2$) is more modest than in Table 1.4 but still at a reasonable level for OECD Europe.

Thus, there is no room for concluding that the level of alcohol consumption should have major influences on this type of life-satisfaction model, but nevertheless, small and significant positive effects might be related to the structure of the drinking patterns. This conclusion must be treated with care, as problems related to the measurement of the respective variables – not least the ‘life satisfaction index’ – and the econometric modelling may be improved upon and therefore future research into this topic might reach differing results.

1.6 Conclusions

During recent decades a number of OECD countries have seen large changes both in the levels of alcohol consumption and in structural changes concerning the relative shares of beer, wine and spirits. With narrowing cross-country differences in alcohol consumption levels, this has to a high degree influenced the consumption of wine, where traditional wine-producing countries have experienced dramatic declines in wine consumption – and the opposite tendency appearing in other places, such as some of the northern European countries. A common feature seems to be a certain development towards a more 'balanced' structure of alcohol consumption in the respective countries, that is, diminishing differences in the shares of beer, wine and spirits in the total intake of alcohol. According to the data for happiness, the level of well-being has evolved very slowly since the 1960s, and can best be explained by assuming that when people state their level of well-being there is an ongoing relative valuation of the level of life satisfaction. In order to correct for these problems, especially in the happiness data, the econometrics involve time trends, time dummies and first-difference estimates using a panel dataset. Even with a relatively large dataset it has not, however, been easy to prove a hypothesis of increased alcohol consumption improving well-being; but a more balanced structure of drinking patterns does seem to be more positively associated with life satisfaction.

Appendix 1.1

Table A1.1 The consumption of beer, wine and spirits, 1961 and 2005

	1961			2005		
	Beer	**Wine**	**Spirits**	**Beer**	**Wine**	**Spirits**
Austria	4.97	3.21	2.77	6.7	4.1	1.6
Belgium	7.57	1.24	0.94	5.49	3.55	0.62
Denmark	5.03	0.53	0.99	5.06	4.43	1.78
Finland	0.57	0.32	2.02	4.59	2.24	2.82
France	2.53	20.56	2.95	2.31	8.14	2.62
Germany	6.47	1.86	2.70	6.22	3.15	2.3
Greece	0.98	5.74	3.67	2.2	4.51	2.38
Ireland	4.23	0.32	1.25	7.04	2.75	2.51
Italy	0.40	17.24	1.59	1.73	6.38	0.42
Netherlands	1.88	0.40	1.69	4.72	3.26	1.56
Norway	1.75	0.21	1.78	2.98	2.0	1.28
Portugal	0.39	16.28	0.71	3.75	6.65	1.27
Spain	1.05	10.49	3.10	4.52	3.59	1.31

Continued

Table A1.1 Continued

	1961			2005		
	Beer	**Wine**	**Spirits**	**Beer**	**Wine**	**Spirits**
Sweden	2.35	0.55	3.14	2.6	2.9	1.1
Switzerland	4.49	5.77	2.07	3.1	5.1	1.8
UK	5.81	0.28	1.04	4.93	3.53	2.41
USA	3.71	0.87	3.26	4.47	1.36	2.65
Canada	4.10	0.40	2.31	4.20	1.50	2.10
Australia	6.36	0.88	1.19	4.56	3.12	1.16
New Zealand	6.71	0.38	1.58	4.09	3.04	1.37
Japan	0.99	0.02	2.08	1.72	0.29	3.37
Average	3.44	4.17	2.04	4.14	3.60	1.83
Std. err.	*(0.51)*	*(1.39)*	*(0.19)*	*(0.36)*	*(0.40)*	*(0.17)*

Notes: Alcohol consumption is the number of (pure) alcohol litres per inhabitant (15+ years). Due to missing observations for consumption of spirits, the data for Greece, Portugal and Spain (for 1961 in the table) relates to the most recent data from 1976, 1964 and 1962, respectively. The sum of beer, wine and spirits does not in some cases correspond exactly to the total alcohol consumption in Table 1.1, which is due to both the quality of the data as well as some special alcoholic beverages not included in Table A1.2.

Sources: The World Health Organization (the WHOSIS database), World Drink Trends (1999, 2005), Nordic Alcohol Statistics 2003–2007 and Stakes (2009).

Appendix 1.2

Measuring the structure of alcohol consumption

Alcohol consumption is usually measured in litres of pure alcohol per capita for the respective beverages, and thus total alcohol consumption is the simple sum of beer, wine and spirits:

$$A = B + W + S \tag{A1}$$

An implicit assumption is therefore full substitutability among the beverages concerning the aggregation, as the structure of total consumption – defined by the relative size of the beverage components – does not matter, as beer, wine and spirits are simply added together, as stated in (A1).

An alternative measure of total alcohol consumption might be the length of the vector (B, W, S) defined from the respective beverages. Hereby, alcohol consumption is defined by A_L:

$$A_L = \sqrt{B^2 + W^2 + S^2} \tag{A2}$$

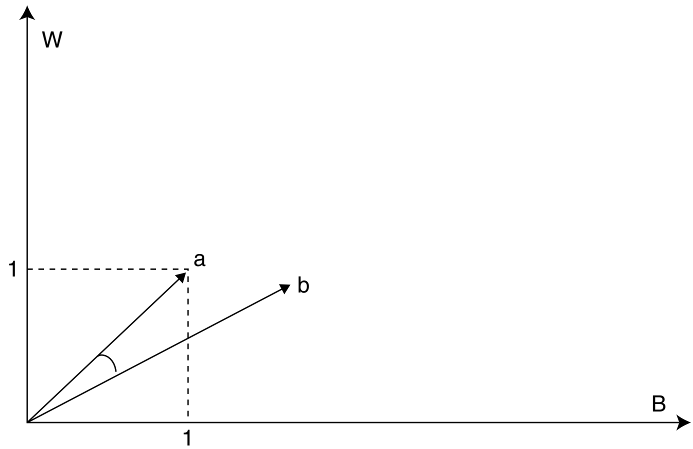

Figure A1.1 Measuring the beverage structure: Cos Θ

With this definition, the structure of alcohol consumption will also influence the measure A_L in (A2), but the result will not have an intuitive interpretation as A from (A1).

One possibility of evaluating or assessing the structural component is to 'measure' the angle between the vector **b** = (B,W,S) and a vector of unit values **a** = (1,1,1). In the two-dimensional space, in the present case beer and wine, the structure is defined by cosine Θ from the graph.

Hence, the measure of the structural component will be defined from the *dot product* between **a** and **b**, and the length of the vectors:

$$Cos\ \Theta = \frac{\mathrm{a} \bullet \mathrm{b}}{|\mathrm{a}| \cdot |\mathrm{b}|} \tag{A3}$$

The concept can be expanded to the *n*-dimensional space where the measure is denoted the *angular separation* – and with no obvious graphical exposition when *n* exceeds 3. The use of angular separation comes from Jaffe (1989), applied in relation to R&D topics, and is also used by Anderson (2009) concerning grape varieties.

In the present case *n* equals 3 and the structural component calculated from (A3) is simplified due to unit values in the vector **a**, and becomes:

$$A_S = \frac{B + W + S}{\sqrt{3}\sqrt{B^2 + W^2 + S^2}} \tag{A4}$$

Combining (A1), (A2) and (A4) gives:

$$A = \sqrt{3} \cdot A_L \cdot A_S \tag{A5}$$

The total consumption of alcohol (A) can thereby be decomposed into a component reflecting the length (A_L) of the beverage vector **b** and a structural component (A_S) having a value between zero and unity.

Appendix 1.3

Table A1.2 Panel unit root test result: the life satisfaction index (LS), real income (Y) and alcohol consumption (A, A_L, A_S), 1961–2005

	IPS test statistic	Lags
The Life Satisfaction index:		
Intercept	−2.26*	0
Linear trend	−3.02*	1
Real income (Y):		
Intercept	−2.03*	0
Linear trend	−2.61*	1
Alcohol consumption (A):		
Intercept	−1.67	2
Linear trend	−2.21	2
Alcohol consumption (A_L):		
Intercept	−1.56	2
Linear trend	−2.29	2
Structure (A_S):		
Intercept	−1.76	0
Linear trend	−2.22	0

Notes: The number of lags (0, 1 or 2) is selected from the AIC/SBC information criteria, and all variables are in logs. The 5 per cent critical values (for N=20, T=40) are −1.85 for the test including an intercept, and −2.48 when also adding a trend (Im et al. 2003). * indicates significance at the 5 per cent level, i.e. rejecting a null hypothesis of non-stationarity.

Notes

1. cf. Wooldridge (2002, p. 279).
2. www.happyplanetindex.org
3. www.worlddatabaseofhappiness.eur.nl
4. Harmonising the answers in surveys from various countries, considering the difficulty of ascertaining that respondents are referring to the same scale or concept of ‘life satisfaction’ when answering, involves a high degree of uncertainty in the data set.
5. www.worlddatabaseofhappiness.eur.nl
6. www.pwt.econ.upenn.edu (Version 6.3; variable rgdpch).
7. The test statistics will in all cases reject a hypothesis of non-stationarity of the first-differences.
8. All estimations are carried out using the RATS software program with the robust-errors options correcting the standard errors (Wooldridge 2002, p. 57), which in

most cases are consequently larger than the usual standards errors from a pooled OLS estimate with fixed effects – and thus lower the level of significance of the parameters appearing in Table 1.4. Only the standard errors, and not the parameter values, are influenced by this correction.

9. The same conclusion concerning ARCH is reached when testing the (time series) residuals for the respective countries in the panel model estimations.
10. As the structural measure is cosine to the angle between the vectors of alcoholic beverages, cf. Appendix Table A1.2, an increase in AS means a more balanced drinking pattern.

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World Drink Trends (1999) Henley on Thames. NTC.

World Drink Trends (2005) Henley on Thames. NTC.

2
Alcohol Demand, Externalities and Welfare-Maximising Alcohol Taxes

James J. Fogarty

2.1 Introduction

Alcohol production and consumption, starting with beer-type products, has been a feature of human life for at least 8000 years (Poelmans and Swinnen 2011). Production and consumption of wine came after beer, but it is thought that by about 3000 BC winemaking skills were well developed in Egypt (Clark and Rand 2001). Spirit consumption and production came last, and while distillation for consumption may have taken place earlier, it has been a part of human life since at least the first century AD (Forbes 1970). Today, alcohol consumption is widespread, and in a 12-month period just over one half of all men and just under one third of all women will have consumed alcohol (WHO 2011, p. 14). In terms of the importance of alcohol in the consumer budget, there is significant variation, both between and within countries, but Selvanathan and Selvanathan (2005, p. 209) report that on average the people of the world devote approximately 3.2 per cent of their income to alcohol; alcohol is therefore an important global consumption good.

Since the work of St Leger et al. (1979) on cardiovascular disease, the positive health effects of moderate alcohol consumption, and especially red wine consumption, have been widely studied and reported on. Alcohol consumption can prevent heart disease by encouraging the production of high-density lipoprotein cholesterol (HDL), and the work of Volick et al. (2008) confirms that consumption of beer, wine or spirits results in increased levels of HDL. With respect to beverage-specific cardiovascular health effects, the meta-analysis findings reported in Di Castelnuovo et al. (2002) suggest that moderate wine consumption confers greater benefits than moderate beer consumption. Given that the benefits of wine consumption relative to other alcoholic beverages appear to be greater in populations that do not have a diet high in fruit and vegetables, a plausible hypothesis to explain the additional benefit attributable to wine is that it is due to the phenolic acids and polyphenols contained in wine (German and Walzem 2000).

Alcohol consumption is not, however, only associated with positive health outcomes. Not all drinkers consume alcohol in a moderate fashion, and just over 16 per cent of all male drinkers and just over 4 per cent of all female drinkers engage in heavy weekly episodic consumption (WHO 2011, p. 17).[1] This is an important feature of the alcohol market, as high levels of alcohol consumption, and binge drinking in particular, are associated with a range of negative health and social outcomes. High levels of alcohol consumption, and binge drinking in particular may, therefore, result in significant additional costs to government via the health, legal and social security systems. That at least some of these costs are external to the individual consumer means there is a sound case for externality-correcting alcohol-specific taxes, and the remainder of this chapter is concerned with outlining an approach that can be used to calculate welfare-maximising alcohol taxes.

The remainder of the chapter is structured as follows. Section 2.2 provides an overview of the alcohol market, and discusses: global consumption trends; differences in demand responsiveness across countries, beverage categories and consumer types; current alcohol taxation arrangements; and the issue of externality costs. Section 2.3 develops a theoretical model that can be used to calculate welfare-maximising alcohol taxes. Section 2.4 uses Australian data to illustrate the way the model can be used, and explores the impact of different assumptions. Section 2.5 presents concluding comments.

2.2 The alcohol market

Alcohol demand

The World Health Organization provides summary information on per capita alcohol consumption for broadly defined regions through time. Other than for regions with a high Muslim population, where consumption levels are largely unchanged, there was a trend from the 1960s to the 1990s towards convergence in alcohol consumption levels across regions, with consumption falling in high-drinking regions and rising in low-drinking regions (WHO 2004, pp. 9–10). Since then, regional consumption levels appear to have been broadly stable (WHO 2011, p. 8).

At the individual country level, per capita pure alcohol consumption information is available for a number of OECD countries, and this information is shown in Table 2.1. For the countries considered, it can be seen that between 1961 and 1981 per capita alcohol consumption increased on average, but that since 1981 average per capita consumption has been falling. Although this is true on average, there has also been convergence in the level of consumption across countries. Relative to the level of consumption in 1961, alcohol consumption has fallen in countries such as France, where

Table 2.1 Alcohol consumption, per litres of alcohol, population 15+

Country	1961[a]	1971[b]	1981[c]	1991	2001	2009[d]
Australia	9.3	11.6	13.0	10.0	9.6	10.1
Austria	10.0	14.7	14.3	14.9	12.8	12.2
Belgium	9.0	12.0	13.1	11.5	10.3	9.7
Canada	7.1	9.4	10.8	7.3	7.6	8.2
Chile	11.0	11.0	10.3	7.3	6.6	8.6
Denmark	5.8	9.3	12.0	11.6	13.1	10.1
Finland	2.9	6.4	8.0	9.2	9.0	10.0
France	25.1	20.6	18.7	15.8	14.2	12.3
Germany	7.5	13.4	14.2	12.4	10.4	9.7
Greece	7.2	7.0	11.5	10.4	9.4	9.2
Hungary	8.1	11.9	14.8	13.3	13.2	11.8
Iceland	2.5	4.1	4.4	5.1	6.3	7.3
Ireland	5.0	7.3	9.1	11.2	14.4	11.3
Israel	4.2	4.4	2.7	1.7	2.6	2.5
Italy	19.2	19.6	15.1	10.8	8.6	8.0
Japan	5.0	6.1	7.2	8.9	8.6	7.4
Luxembourg	12.6	13.5	12.8	15.1	12.3	11.8
Mexico	2.8	4.1	3.6	4.8	4.8	5.9
Netherlands	3.7	8.5	11.3	10.0	9.9	9.4
New Zealand	5.3	10.4	11.7	10.3	8.8	9.3
Norway	3.5	4.9	5.3	4.9	5.5	6.7
Poland	6.3	8.0	8.7	8.8	7.8	10.2
Portugal	17.2	16.4	15.5	15.8	12.3	12.2
Slovak Republic	7.1	13.6	14.5	13.7	8.7	9.0
Spain	14.6	15.9	17.4	13.2	11.5	10.0
Sweden	5.1	7.0	6.3	6.3	6.5	7.4
Switzerland	12.7	14.2	13.7	12.9	11.1	10.1
Turkey	.9	1.2	1.6	1.4	1.4	1.5
United Kingdom	6.1	7.4	9.1	9.4	10.7	10.2
United States	7.8	9.5	10.4	9.3	8.3	8.8
Mean	8.2	10.1	10.7	9.9	9.2	9.0
Standard Deviation	5.3	4.6	4.3	3.8	3.1	2.5
Standard Deviation / Mean	.65	.46	.40	.38	.34	.28

Notes: (a) Chile 1963, Germany 1960, Japan 1963, Luxembourg 1963, New Zealand 1960, Spain 1962, UK 1965; (b) Germany 1970, Portugal 1972; (c) Germany 1982; (d) Belgium 2006, France 2008, Greece 2008, Hungary 2008, Iceland 2008, Israel 2005, Italy 2006, Luxembourg 2005, Mexico 2008, Portugal 2005, Spain 2006, US 2008.

Source: OECD Health Data 2011 available [www.oecd.org/health/healthdata], accessed 12 March 2012, except France 1961, and Greece 1961 and 1971, which were sourced from AIHW (2003).

per capita alcohol consumption was very high in 1961, and has risen in countries such as Iceland and Finland, where consumption was relatively low in 1961. The coefficient of variation (standard deviation divided by mean) information presented in the bottom row of Table 2.1 shows that for the countries considered the extent of dispersion in per capita alcohol consumption levels fell substantially between 1961 and 2009. This pattern of convergence in consumption is made clear in Figure 2.1. It can also be noted that there is evidence of convergence in consumption shares for individual beverages (Aizenman and Brooks 2008).

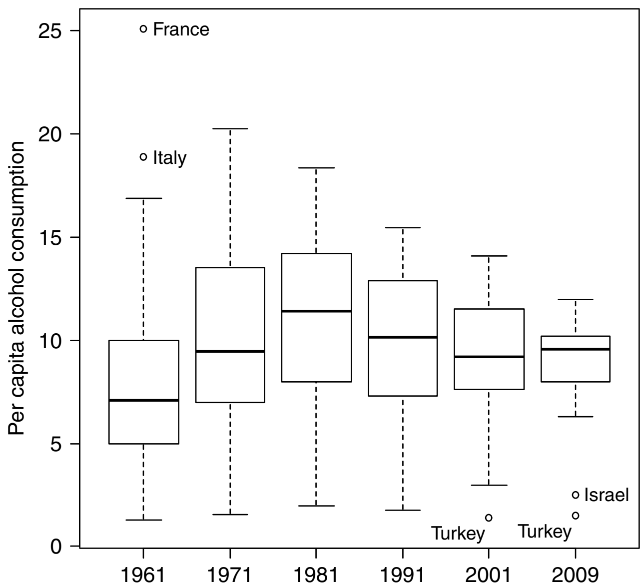

Figure 2.1 OECD alcohol consumption: decreasing dispersion

Source: OECD Health Data 2011 available [www.oecd.org/health/healthdata], accessed 12 March 2012, except France 1961, and Greece 1961 and 1971, which were sourced from AIHW (2003).

While there has been convergence in the average level of alcohol consumption across countries, there remain significant differences in the demand responsiveness of consumers to price changes, in terms of both the average response in different countries and the response of individuals within countries. Summary details on a large number of alcohol consumption studies are reported in Fogarty (2010), and this information has been plotted in the first three panels of Figure 2.2 where, with a view to providing a relatively consistent metric, only Slutsky own-elasticity values have been plotted. In the plots the small squares represent an actual own-price elasticity estimate from one of the studies reported in Table 2.2 of Fogarty (2010), and the large solid dot represents the arithmetic mean estimate. The dashed line represents the arithmetic mean value taken across all observations for each beverage category. At a global level, the mean own-price elasticity estimates across all observations are: beer −.44, wine −.63, and spirits −.69.

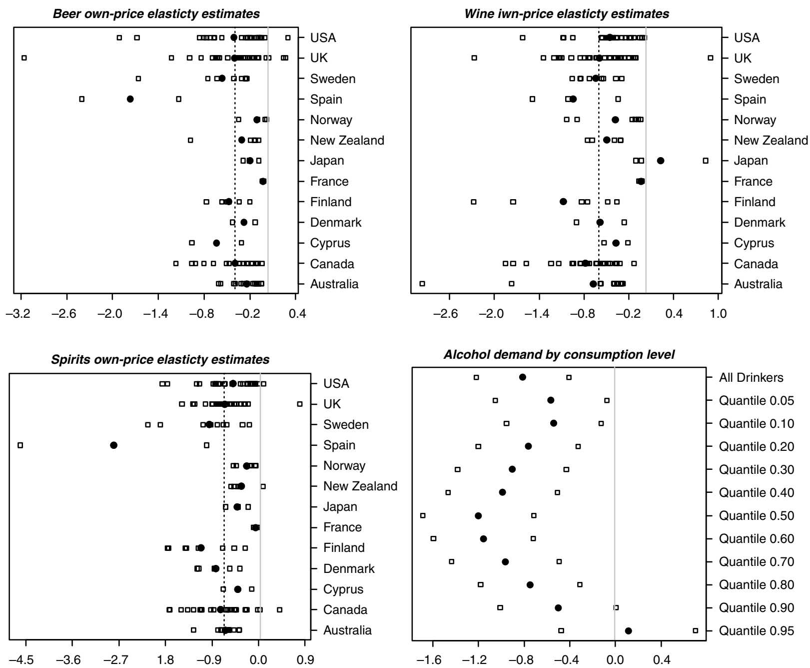

Figure 2.2 Demand for alcohol by country, beverage type, and consumption level
Source: Fogarty (2010); Manning et al. (1995).

The final plot in Figure 2.2 is a plot of the own-price elasticity estimates for alcohol as a composite commodity contained in Manning et al. (1995). In the plot, the solid dot represents the own-price elasticity point estimate for different levels of consumption, and the squares indicate the 95 per cent confidence interval around each point estimate. The plot shows that for low alcohol consumption through to consumption at the median level, demand responds as expected; the higher the budget share, the greater the price responsiveness. However, once consumption moves beyond the median level of consumption, consumers become increasingly unresponsive to price. Consistent with the idea that the heaviest drinkers are addicted to alcohol, the own-price elasticity estimates for the heaviest drinkers are not statistically different from zero. That the demand responsiveness of the heaviest drinkers is lower than that of the median drinker is something that has important implications when considering the effectiveness of alcohol excise taxes as a policy tool.

Alcohol taxation

There are a number of different ways to discuss alcohol tax rates. For example, Cnossen (2007) reports on the average per capita tax paid in different

Table 2.2 Optimal alcohol tax estimates

Scenario	**Beer $/LAL**	**Wine $/LAL**	**Spirits $/LAL**
Reference case	36.83	38.60	32.00
Impact externality costs			
High externality	44.64	47.02	39.13
Low externality	29.02	30.17	24.87
Cross-price elasticity effect			
High substitutability	196.82	138.27	149.80
No substitutability	37.69	37.01	35.19
Abusive consumption share			
Abuser share 50%	41.39	42.97	35.56
Abuser share 30%	33.04	34.95	29.04
No uninformed abusers	32.60	35.09	29.75
Abusers relatively responsive			
Price effect	99.69	85.14	83.66
Price and substitution effect	61.31	64.48	56.66
Abusers relatively unresponsive			
Price effect	12.53	20.28	13.02
Price and substitution effect	26.06	28.03	23.96

European countries in euros, while Fogarty (2012) reports per litre of pure alcohol tax rates for the EU, USA, Australia and Canada in US dollars. Where comparisons of tax rates are to be made across countries, it is helpful for the metric used to be readily comparable. Converting tax rates to a common currency is one possible approach – but which currency should be the numéraire? And which exchange rate should be used for the conversion? An alternative to expressing tax rates in a common currency is to consider for each country and for each beverage type the share of the total beverage price that taxes, on average, represent. Information on the tax share of total price for beer, wine, and spirits in 31 countries is shown in Figure 2.3 and, as can be seen, on average taxes represent about 30 per cent of the purchase price of beer and wine, and about 46 per cent of the purchase price of spirits.

The raw information summarised in Figure 2.3 is calculated by Euromonitor, and it is worth looking at a specific example to understand how the information has been calculated. Euromonitor considers specific representative alcoholic beverage purchases, so in the case of Australia, which is the first entry in each panel of Figure 2.3, Euromonitor calculates the tax rate for the purchase of: a 375 ml bottle of Victoria Bitter beer, abv (alcohol by volume) 4.6 per cent, price $2.65; a 750 ml bottle of Brancott Estate wine, abv 12.5 per cent, price $9.90; and a 700 ml bottle of Johnny Walker Red Label whisky, abv 40 per cent, price $35; these are representative of a typical purchase in each product category.[2] Euromonitor then uses information on the general valued added tax rate, and the alcohol-specific tax rate to calculate the tax share of total price, a process which, for Australia, results in estimates of the

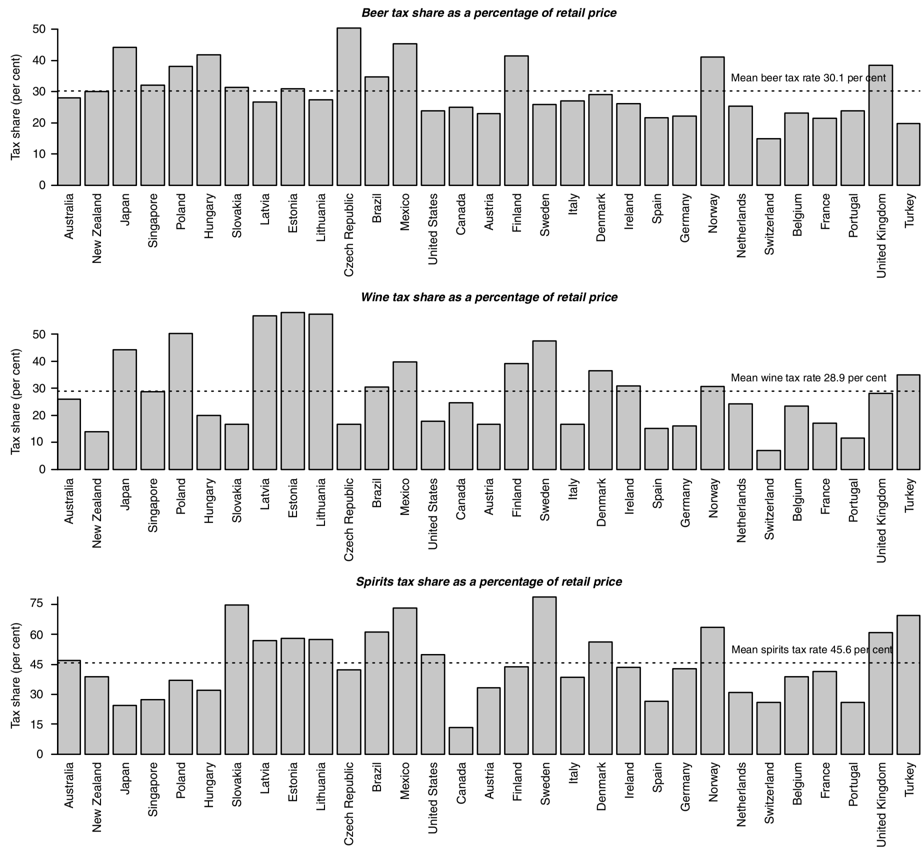

Figure 2.3 Tax as a percentage of total purchase price in 2011

Notes: For Canada and the US there are state specific taxes that complicate the calculation of a reference national tax share for each beverage. Here, for the US, the median state tax rate has been used, and for Canada, the tax rate in British Columbia has been used. For the UK the data is for 2010.

Source: Euromonitor country reports, available GMID Database, accessed 22 March 2012.

tax share of total price of: 27.9 per cent for beer, 26.0 per cent for wine, and 46.9 per cent for spirits.

In summary, the core messages from Figure 2.3 are that: (i) tax is generally a significant component of the total purchase price for alcoholic beverages; (ii) spirits are generally taxed more heavily than beer or wine; (iii) there is significant variation in the tax share of total price across countries and beverage types.

Alcohol externality costs

Alcohol consumption is associated with an elevated health and accident risk. For example, data for 2004 attributes 3.8 per cent of all global deaths and 4.5 per cent of total global disease and injury burden to alcohol (WHO 2011, pp. 29, 54). It is, however, important to distinguish between costs internal to the individual, and externality costs. Unfortunately, determining exactly what constitutes an externality cost is complicated. For example, consider the case of a premature death due to alcohol-induced cirrhosis of the liver. First, consider the total health-related costs; these must be separated into the costs that fall on the individual and the costs that are borne by the publicly funded healthcare system. Next, consider the question of lost earnings. The premature death will have had several impacts:

- First, there is the direct loss of income to the individual. To the extent that the individual has lost income this is not an externality cost, but to the extent that the individual was part of a family unit, and the family unit has lost income, it could be argued that an externality cost has been imposed on the other family members. If a typical family unit consists of four people, it could be argued that up to 75 per cent of the lost disposable income actually represents an externality cost.
- Second, there is lost tax revenue, which is an externality cost. So, if α is the average tax rate on income, the range for the externality cost component of lost income is between α and $[\alpha + (1-\alpha) \times ({}^{n-1}/n)]$, where n is the number of people in the average family. Given typical values for α in high-income countries are around 30 per cent, and assuming $n = 4$, the proportion of total lost income deemed an externality cost could vary between 30 per cent and 82.5 per cent. As such, there can be substantial variation in the proportion of lost income deemed an externality cost.
- A final complication in the externality-cost calculation in this example is that a premature death, while resulting in lost tax revenue to the Department of the Treasury, may also involve some future savings to the Department of the Treasury in terms of reduced pension payments.

The essential point of the above discussion is that determining externality costs is complicated, and reasonable people can legitimately disagree about how externality costs should be determined. As a practical matter, it may therefore be more appropriate to frame externality cost estimates as lying within a range rather than being equal to a specific value.

In terms of the total social cost of alcohol, the representative studies summarised in (WHO 2011, p. 37) suggest that the cost is around 2.5 per cent of GDP in high-income countries, and around 2.1 per cent of GDP in middle-income countries. However, most cost-of-alcohol studies in the literature focus on total alcohol-related costs rather than just externality costs. These studies therefore substantially overstate the costs relevant to calculating externality-correcting tax rates. Anderson and Baumberg (2006, p. 64) reviewed 33 cost-of-alcohol studies and found that for Europe the tangible costs of excessive alcohol consumption were around 1.3 per cent of GDP. There was sufficient information in 15 of the 33 studies reviewed in Anderson and Baumberg for externality costs alone to be identified, and from these studies Cnossen (2007, p. 716) found that the average externality cost was likely to be at least 0.7 per cent of GDP. Fogarty (2012) includes a relatively detailed mapping of the total alcohol cost data contained in Collins and Lapsley (2008) to externality costs, and this mapping implies that the externality cost of alcohol consumption in Australia in 2004/05 was equal to between 0.6 per cent and 0.9 per cent of GDP. So while the externality costs associated with alcohol consumption are substantially less than the total cost of excessive alcohol consumption, the available evidence suggests that the externality costs associated with excessive alcohol consumption are high. The existence of substantial externality costs associated with alcohol consumption means that alcohol-specific excise taxes are a valid government policy option.

2.3 Optimal alcohol tax model

The core elements of the model outlined below were first developed in Pogue and Sgontz (1989), and further developed in both Saffer and Chaloupka (1994) and Kenkel (1996). In terms of notation and approach, the following section extends Fogarty (2012) to allow for substitution between beer, wine and spirits. As shown in the model calibration case study, allowing for substitution between different beverage types has significant implications for the implied optimal tax rates.

The model assumes there are two types of alcohol consumer: moderate drinkers, who impose no externality costs on the community, and abusers, that do impose externality costs on the community. The abuser category is then further divided into two consumer types: informed abusers, who take into consideration the full range of private costs associated with abusive consumption and so make consumption choices that maximise their individual welfare, and uninformed abusers, a category of consumer that fails to recognise some of the private costs of abusive consumption and so consumes at a level beyond their individual welfare-maximising level of consumption. The model further assumes that the beer, wine and spirits markets

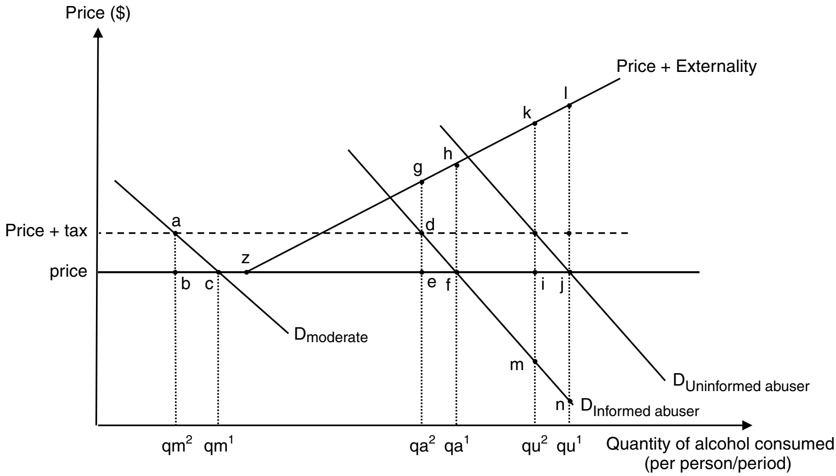

Figure 2.4 Welfare implication of an alcohol tax

Notes: Figure 2.4 has been adapted from Fogarty (2012) which in turn is an amalgam of the representations given in Pogue and Sgontz (1989) and Kenkel (1996).

are competitive, with price equal to long-run marginal cost, and that taxes are fully passed through to the consumer. Finally, the model assumes that alcohol tax revenue can be recycled back to consumers in the form of a lump sum payment.

Although substitution between different beverage categories is allowed for in the model, the intuition of the approach can be best explained by first considering alcohol as a composite commodity. With this initial simplification, the welfare implications of a tax on alcohol can be understood by considering Figure 2.4. First, assume there is no tax on alcohol, so that moderate drinkers consume at q_m^1, informed abusers consume at q_a^1 and uninformed abusers consume at q_u^1. As can be seen from the figure, individual utility maximisation for moderate consumers imposes no externality costs on society. Informed abusers also consume at the utility maximising quantity, but the consumption level that maximises their welfare individually imposes an externality cost on the community equal to the area fhz. The case of the uninformed abuser is, however, more complicated. Assume that if the uninformed abuser does recognise the full range of private costs they face, they will consume at the same level as an informed abuser. This means that for every unit of consumption between q_a^1 and q_u^1 the marginal benefit gained by the uninformed abuser is less than the true marginal cost. So, by consuming at q_u^1, the uninformed abuser not only imposes an externality cost on the community equal to jlz, but they also reduce their welfare below the optimal level by an amount equal to njf.

With the introduction of a tax that is fully passed through to consumers, moderate consumers reduce consumption to q_m^2 and suffer a welfare loss equal to the area abc. With a tax, informed abusers reduce consumption to q_a^2, and this has two effects. First, the informed abuser suffers a welfare loss equal to the area def. Second, the community gains the area efgh due to lower abusive consumption resulting in lower externality costs. For uninformed abusers, the effect of the tax is as follows. First, the uninformed abuser enjoys a welfare gain equal to the area ijmn. This gain is due to the fact that before the tax uninformed abusers are consuming at a level that is greater than their true welfare-maximising level of consumption. Second, society gains the area ijkl from the reduction in externality costs. The optimal tax is one that balances the welfare gains due to lower externality costs and the reduced consumption of uninformed abusers against the welfare losses imposed by the tax on moderate consumers and informed abusers. This is a point of fundamental importance. The argument is often made that alcohol taxes fail to recover externality costs, and hence are too low (Cnossen 2007; Barker 2002; Grossman et al. 1995). This position is incorrect. In setting alcohol taxes it is necessary to consider not only externality costs, but also the welfare loss that alcohol-specific taxes impose on both moderate consumers and abusers.

From Figure 2.4, it is also possible to gain some insight into the main variables that will determine the optimal tax rate for a given level of externality cost. Specifically, higher numbers of moderate consumers, lower price-responsiveness of abusers, higher price-responsiveness of moderate consumers, and lower numbers of uninformed abusers will all lead to lower optimal tax rates. Although it is not clear from the discussion presented, it is also true that the lower the level of substitution between beer, wine, and spirits, the lower the optimal tax.

With this intuitive understanding of the model in place, it is now possible to introduce the formal notation required to derive optimal tax estimates. Let: T_i denote the tax for beverage type i ($i =$ beer, wine, spirits); Δq_i^j denote the change in consumption of consumers of type j ($j =$ moderate, informed abuser, uninformed abusers) in beverage category i; N_i^j denote the number of consumers of type j of beverage type i; E_i^j denote the marginal externality cost associated with consumers of type j of beverage type i, averaged over the relevant range of consumption; and let H_i^j denote the marginal uninternalised private cost for consumer type j of beverage type i, also averaged over the relevant range. With this notation, the change in welfare following the introduction of alcohol taxes can be written as:

$$W = \frac{1}{2} T_b \left(\Delta q_b^m\right) N_b^m + \frac{1}{2} T_b \left(\Delta q_b^a\right) N_b^a - E_b^a \left(\Delta q_b^a\right) N_b^a - E_b^u \left(\Delta q_b^u\right) N_b^u$$
$$- H_b^u \left(\Delta q_b^u\right) N_b^u$$

$$
\begin{aligned}
&+\frac{1}{2}T_w\left(\Delta q_w^m\right)N_w^m+\frac{1}{2}T_b\left(\Delta q_w^a\right)N_w^a-E_w^a\left(\Delta q_w^a\right)N_w^a-E_w^u\left(\Delta q_w^u\right)N_w^u\\
&\quad-H_w^u\left(\Delta q_w^u\right)N_w^u \qquad (1)\\
&+\frac{1}{2}T_s\left(\Delta q_s^m\right)N_s^m+\frac{1}{2}T_s\left(\Delta q_s^a\right)N_s^a-E_s^a\left(\Delta q_s^a\right)N_s^a-E_s^u\left(\Delta q_w^u\right)N_w^u\\
&\quad-H_s^u\left(\Delta q_s^u\right)N_s^u.
\end{aligned}
$$

In equation (1), the $\left(\frac{1}{2}T_i(\Delta q_i^m)N_i^m\right)$ terms and the $\left(\frac{1}{2}T_i(\Delta q_i^a)N_i^a\right)$ terms ($i=$ beer, wine, spirits), capture respectively the fall in the welfare of moderate consumers and informed abusers following the introduction of the tax on beer, wine, and spirits. The $(E_i^a(\Delta q_i^a)N_i^a)$ terms and the $(E_i^u(\Delta q_i^u)N_i^u)$ terms capture respectively the welfare gains due to lower consumption by informed abusers and uninformed abusers. The $(H_i^u(\Delta q_i^u)N_i^u)$ terms capture the private benefits to uninformed abusers of beer, wine and spirits from reducing their consumption.

Let Q_i^j denote the total amount of consumption associated with consumer type j for beverage i, so that $Q_i^j=N_i^j q_i^j$, and let the price elasticity for beverage type i in consumer category j be $\eta_{ik}^j=\Delta Q_i^j/Q_i^j/\Delta P_k/P_k$, where $\Delta P_k=T_k$, and P_k equals the pre-tax price of beverage k. If cross-price effects for beverages are zero, the change in consumption of consumer type j for beverage i can be written as $\Delta Q_i^j=(T_i/P_i)\cdot\eta_{ii}^j\cdot Q_i^j$. If cross-price effects are not zero, the change in consumption of consumer type j for beverage i can be written as $\Delta Q_i^j=(T_i/P_i)\cdot\eta_{ii}^j\cdot Q_i^j+\sum_{k\neq i}(T_k/P_k)\cdot\eta_{ik}^j\cdot Q_i^j$, or if we consider the specific case of beer for illustration purposes $\Delta Q_b^j=(T_b/P_b)\cdot\eta_{bb}^j\cdot Q_b^j+(T_w/P_w)\cdot\eta_{bw}^j\cdot Q_b^j+(T_s/P_s)\cdot\eta_{bs}^j\cdot Q_b^j$. These values can then be substituted into equation (1) to give:

$$
\begin{aligned}
W=\;&\frac{T_b}{2}\left[\frac{T_b\cdot\eta_{bb}^m\cdot Q_b^m}{P_b}+\frac{T_w\cdot\eta_{bw}^m\cdot Q_b^m}{P_w}+\frac{T_b\cdot\eta_{bs}^m\cdot Q_b^m}{P_s}\right]\\
&+\frac{T_b}{2}\left[\frac{T_b\cdot\eta_{bb}^a\cdot Q_b^a}{P_b}+\frac{T_w\cdot\eta_{bw}^a\cdot Q_b^a}{P_w}+\frac{T_b\cdot\eta_{bs}^a\cdot Q_b^a}{P_s}\right]\\
&-E_b^a\left[\frac{T_b\cdot\eta_{bb}^a\cdot Q_b^a}{P_b}+\frac{T_w\cdot\eta_{bw}^a\cdot Q_b^a}{P_w}+\frac{T_b\cdot\eta_{bs}^a\cdot Q_b^a}{P_s}\right]\\
&-\left(E_b^u+H_b^u\right)\left[\frac{T_b\cdot\eta_{bb}^u\cdot Q_b^u}{P_b}+\frac{T_w\cdot\eta_{bw}^u\cdot Q_b^u}{P_w}+\frac{T_s\cdot\eta_{bs}^u\cdot Q_b^u}{P_b}\right]\\
&+\frac{T_w}{2}\left[\frac{T_w\cdot\eta_{ww}^m\cdot Q_w^m}{P_w}+\frac{T_b\cdot\eta_{wb}^m\cdot Q_w^m}{P_b}+\frac{T_s\cdot\eta_{ws}^m\cdot Q_{sw}^m}{P_s}\right]
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{T_w}{2}\left[\frac{T_w \cdot \eta^a_{ww} \cdot Q^a_w}{P_w}+\frac{T_b \cdot \eta^a_{wb} \cdot Q^a_w}{P_b}+\frac{T_s \cdot \eta^a_{ws} \cdot Q^a_{sw}}{P_s}\right]\\
&-E^a_w\left[\frac{T_w \cdot \eta^a_{ww} \cdot Q^a_w}{P_w}+\frac{T_b \cdot \eta^a_{wb} \cdot Q^a_w}{P_b}+\frac{T_s \cdot \eta^a_{ws} \cdot Q^a_w}{P_s}\right]\\
&-\left(E^u_w+H^u_w\right)\left[\frac{T_w \cdot \eta^u_{ww} \cdot Q^u_w}{P_w}+\frac{T_b \cdot \eta^u_{wb} \cdot Q^u_w}{P_b}+\frac{T_s \cdot \eta^u_{ws} \cdot Q^u_w}{P_s}\right]\\
&+\frac{T_s}{2}\left[\frac{T_s \cdot \eta^m_{ss} \cdot Q^m_s}{P_s}+\frac{T_w \cdot \eta^m_{sw} \cdot Q^m_s}{P_w}+\frac{T_b \cdot \eta^m_{sb} \cdot Q^m_s}{P_b}\right]\\
&+\frac{T_s}{2}\left[\frac{T_s \cdot \eta^a_{ss} \cdot Q^a_s}{P_s}+\frac{T_w \cdot \eta^a_{sw} \cdot Q^a_s}{P_w}+\frac{T_b \cdot \eta^a_{sb} \cdot Q^a_s}{P_b}\right]\\
&-E^a_s\left[\frac{T_s \cdot \eta^a_{ss} \cdot Q^a_s}{P_s}+\frac{T_w \cdot \eta^a_{sw} \cdot Q^a_s}{P_w}+\frac{T_b \cdot \eta^a_{sb} \cdot Q^a_s}{P_b}\right]\\
&-\left(E^u_s+H^u_s\right)\left[\frac{T_s \cdot \eta^u_{ss} \cdot Q^u_s}{P_s}+\frac{T_w \cdot \eta^u_{sw} \cdot Q^u_s}{P_w}+\frac{T_b \cdot \eta^u_{sb} \cdot Q^u_s}{P_b}\right] \qquad (2)
\end{aligned}
$$

Although equation (2) can be simplified in a number of ways, writing out the equation in full is helpful as it facilitates subsequent discussion of the drivers of optimal tax rates.

To find the optimal tax for beer, wine, and spirits, equation (2) is differentiated to find $\frac{\partial W}{\partial T_b}$, $\frac{\partial W}{\partial T_w}$, and $\frac{\partial W}{\partial T_s}$. These equations are then set to zero and expressed in terms of T_b, T_w, and T_s, which in turn gives a system of three equations and three unknowns that can be solved simultaneously. As a practical matter, Wolfram's Mathematica program was used to solve the system. An attractive feature of the model is that it can be expanded to a level consistent with data availability. For example, Hausman et al. (1994) estimate brand- and segment-level elasticity information for the US beer market, and the model can be readily expanded to incorporate segment-level information on consumption, price responsiveness and substitution.

2.4 Calibration case study

To calibrate the model, information is needed on: prices, own-price and cross-price elasticities, externality costs, consumption and uninternalised health costs. How the relevant information was obtained for Australia is explained below.

Model data requirements

The first piece of information required to calibrate the model is an estimate of the average pre-tax price for beer, wine, and spirits. Here the approach taken has been to specify the pre-tax price in terms of a litre of pure alcohol (LAL). This has the convenient advantage that subsequent solutions are given in terms of LAL tax rates that can then be compared to actual LAL tax rates. With respect to determining a pre-tax price, a decision must be made regarding whether to deduct from the retail price all taxes or just alcohol-specific taxes. As the main idea is to discuss externality-correcting taxes, only the alcohol-specific excise tax has been deducted from the retail price here. For Australia, using this approach gives an average pre-excise tax LAL price for beer, wine and spirits of, respectively, $111.29, $81.57, and $76.05. In the case of spirits, it is worth noting that in Australia significant quantities of spirits are sold in a pre-mixed format, and the per LAL pre-tax price for spirits sold in standard unmixed form is around $58, while for pre-mixed spirits it is around $95. With respect to the tax on wine, it is worth noting that in Australia the tax is based on value, not alcohol content, and is levied at 29 per cent of the wholesale value of the product. Finally, in the case of beer, it is worth noting that in Australia, the first 1.15 per cent by alcohol volume is exempt from excise tax. In calculating the excise tax component for beer, an adjustment has been made to reflect this when applying the headline excise tax rates published by the Australian tax office.

Total consumption is measured in LAL terms, and the consumption quantities have been derived from the detailed industry database used in Fogarty and Jakeman (2011) to model the impact of shifting from a value-based wine tax to a volumetric wine tax. As there is evidence that official alcohol consumption data for Australia substantially understates actual wine consumption (Chikritzhs et al. 2010), use of a database constructed from industry sources is important. The LAL consumption levels for beer, wine and spirits are taken to be, respectively, 73.89 million litres, 65.01 million litres, and 35.22 million litres. It is then necessary to allocate total consumption to either abusive consumption or moderate consumption. For Australia, Collins and Lapsley (2008) suggest that the abusive consumption share is between 30 per cent and 50 per cent. Here the impact of assuming that the abusive share is 30 per cent, 40 per cent, or 50 per cent is explored, with the base case assumption being an abusive consumption share of 40 per cent. There is little empirical evidence regarding the uninformed abusive consumption share, so here that is set at 20 per cent of abusive consumption: that is 8 per cent of total consumption in the base case. The impact of setting the uniformed abuser share to zero is considered as part of the sensitivity analysis.

In terms of the price elasticity assumption, it is worth recalling the information plotted in Figure 2.2. The figure showed that for Australia the own-price elasticity estimates are similar for beer and wine, but different for spirits; it also showed that the demand responsiveness of the heaviest consumers (abusers) is lower than that of moderate alcohol consumers. The starting point for obtaining an estimate of the own-price elasticity of demand for each beverage was to consider the average of the unconditional compensated own-price elasticity values for Australia, summarised in (Fogarty 2010), which gives the following values: −.37 for beer, −.40 for wine, and −.96 for spirits. Figure 2.2 also reported the results of Manning et al. (1995) where the own-price elasticity ratio between the median drinker and the drinker at the 90th percentile was found to be 2.4. As such, the approach taken to determine appropriate values for abusive and non-abusive own-price elasticities was to move an equal distance from the average own-price elasticity estimate until a ratio of 2.4 was reached. Using this approach gives own-price elasticity estimates of: −.52 for moderate beer consumers and −.22 for abusive beer consumers; −.56 for moderate wine consumers and −.24 for abusive wine consumers; and −1.36 for moderate spirits consumers and −.56 for abusive spirits consumers. The impact of this assumption is then investigated by assuming that the appropriate elasticity ratio between abusers and moderate drinkers is 1.2 and 3.6. The own-price elasticity of demand for informed abusers and uninformed abusers is assumed to be equal.

As discussed above, studies that estimate the cost of alcohol consumption consider a range of costs that would not normally be considered externality costs. Collins and Lapsley (2008) is the most comprehensive cost of alcohol abuse study relevant to Australia, and for 2004/05 the study found that the social cost of excessive alcohol consumption was $15.3 billion (tangible costs $10.8bn and intangible costs $4.5bn). Freebairn (2010) and Fogarty (2012) both use a similar methodology to identify the externality cost component of total social costs and find the externality cost element to be between $5.17bn and $8.25bn, or between 0.6 per cent and 0.9 per cent of GDP. Applying this range of values to Australian GDP for the 2011 calendar year suggests a current value for externality costs of between $8.11bn and $12.94bn, and this is the range of values used to calibrate the model. The midpoint of this range is used in the reference case.

The difference between informed abusers and uninformed abusers is that the latter fail to recognise some of the internal costs of excessive alcohol consumption, and so consume at a level where their true marginal cost is greater than their true marginal benefit. There is little evidence regarding the extent of the costs these consumers fail to recognise. Here it is assumed that across beer, wine and spirits consumption, uninformed abusers consume 10 per cent more than informed abusers. On this assumption, it is then possible to use an approach similar to that in Fogarty (2012) to calculate an implied uninternalised private cost. The specific process used can be explained as follows. First, the relevant own-price elasticity estimate is used to calculate the slope of a linear demand curve around the point of current estimated per capita LAL abusive consumption and the estimated LAL retail price. As the demand profile of informed and uninformed abusers is assumed to be the same, the vertical distance between the uninformed and informed abuser demand curves at this point gives an estimate of the uninternalised private cost. Using this approach, the reference case per LAL uninternalised health costs for beer, wine and spirits, are respectively \$63.45, \$40.31, and \$26.28.

For the purpose of establishing reference cross-price elasticities for beer, wine and spirits, Selvanathan and Selvanathan (2004) is a source of useful information. Specifically, Selvanathan and Selvanathan present information on the conditional own-price and cross-price elasticities for beer, wine and spirits that can be interpreted as suggesting that within the alcohol group: for beer, spirits are a stronger substitute than wine ($\eta_{bw} = .04$, $\eta_{bs} = .12$); for wine, spirits and beer are equally attractive as substitutes ($\eta_{wb} = .16$, $\eta_{ws} = .15$); and that for spirits, beer is a stronger substitute than wine ($\eta_{sb} = .47$, $\eta_{bs} = .15$). The unconditional price elasticity estimates in Selvanathan and Selvanathan could be interpreted as suggesting zero cross-price effects is also a plausible assumption. To calibrate the model, three scenarios are considered for the cross-price elasticity values. The full substitutability scenario imposes demand homogeneity within alcohol, and sets the cross-price elasticities such that the ratio between them reflects the cross-price elasticity ratios reported in Selvanathan and Selvanathan (2004). The moderate substitution scenario – which is the base case – sets the cross-price elasticity values at half this level, and the final scenario considered is no substitution between beer, wine and spirits. It can be noted that for the case of zero cross-price effects, the optimal tax rate formula collapses to:

$$T_i = E_i^a \left(\frac{1}{\dfrac{\eta_{ii}^m \cdot Q_i^m}{\eta_{ii}^a \cdot Q_i^a} + 1} \right) + \left(E_i^u + H_i^u \right) \left(\frac{1}{\dfrac{\eta_{ii}^m \cdot Q_b^m}{\eta_{ii}^u \cdot Q_i^u} + \dfrac{\eta_{ii}^a \cdot Q_i^a}{\eta_{ii}^u \cdot Q_i^u}} \right) \tag{3}$$

for $i =$ beer, wine and spirits.

Model results and discussion

The base case results, along with the results of the sensitivity analysis, are shown in Table 2.2. The first thing to note about the reference case estimates is that across the three beverage classes there is relatively little variation in the level of the optimal tax. This finding suggests that significant differences in the own-price elasticity estimates across beverage types result in relatively modest differences in optimal tax estimates. An intuitive understanding for this result can be gained by considering equation (3), where it can be seen that rather than the own-price elasticity estimate itself, what features in the denominator is the ratio of the moderate to abuser own-price elasticity. This ratio is assumed to be the same for each beverage type.

In terms of comparing current Australian tax rates to the base case optimal tax rates, it is easiest to make a comparison using specific examples. For the beer, wine and spirits products used in Figure 2.3, the current LAL tax rates are around \$32 for beer, \$17 for wine and \$72 for spirits. So the current beer tax rate is broadly consistent with the base case welfare-maximising tax rate; the current wine tax is about half the base case welfare-maximising tax rate; and the current spirits tax is about twice the base case welfare-maximising tax rate.

How externality costs are defined has a relatively significant impact on the implied optimal alcohol tax rates. Relative to the reference case, an inclusive approach to determining externality costs implies optimal alcohol taxes that are around 20 per cent higher. Conversely, a minimalist approach to the determination of externality costs results in optimal tax rates that are around 20 per cent lower than the reference case.

A striking feature of the result is that the optimal tax rates are very sensitive to the assumption about substitutability. If alcoholic beverages are assumed to be relatively strong substitutes compared to the base case, alcohol taxes are on average 4.5 times higher. This is an important finding, as cross-price effects are not generally the focus of applied demand analysis, and are often estimated imprecisely. This finding suggests that before a policy maker could fully embrace the optimal tax model presented, further research on the extent of cross-beverage substitutability is required. It could be argued, however, that optimal alcohol taxes derived under the assumption of no cross-beverage substitution represent lower-bound estimates of optimal taxes. As such, the principles of the optimal tax model could still be adopted by policy makers under conditions of zero cross-price effects, with the true extent of alcoholic beverage substitution left as a matter for further refinement.

The assumption regarding the relative abusive consumption share has a relatively modest impact on the optimal tax estimates. This result is due to the fact that with total externality cost held constant, an increase in the abusive consumption share must also involves a reduction in the implied per LAL externality cost.

From equation (3) it can be seen that the higher the uninternalised health cost, the greater the optimal tax. Setting the uninternalised health cost to zero is the same as setting the uninformed abuser category consumption share to zero. As can be seen from the values reported in Table 2.2, setting the uninformed abuser consumption share to zero implies optimal taxes that are about 9 per cent lower than under the reference case.

As the substitution effect was found to be such a significant factor in determining the optimal tax rates, when considering the impact of the relative demand responsiveness of different consumer types, it was thought appropriate to decompose the total effect into that part attributable to the change in the own-price elasticity values, and that part due to the change in the extent of cross-beverage substitution implied due to the change to the own-price elasticities. When abusers are assumed to be relatively responsive to price changes, the optimal taxes increase substantially. Holding constant the cross-price elasticity values, and just revising the own-price elasticity values so that the own-price elasticity ratio between abusers and moderate consumers is 1.2 rather than 2.4, results in the implied optimal alcohol tax rates increasing by a factor of around 2.5. Once the cross-price elasticity values are adjusted to reflect the same proportional substitution relationship as in the base case, the increase in the optimal tax rates relative to the reference case is around 1.7 times.

The abusers' relatively unresponsive scenario assumes that the own-price elasticity ratio between abusers and moderate consumers is 3.6 rather than 2.4. When the cross-price effects are held constant, under this scenario the optimal tax rates fall on average to 43 per cent of the reference case values. Once the proportional adjustment in the cross-price effects is allowed for, the optimal tax rates are 72 per cent of the reference case tax rates. Again, this is a very important finding; incorrectly assuming that the demand responsiveness of the heaviest drinkers is the same as the average consumer results in a substantial overestimate of the optimal alcohol tax rates.

Potential extensions

In each country's application of the optimal tax formula, it will be necessary to make refinements to the model to reflect local circumstances. For example, it could be argued that in an Australian context, the drink-driving analysis in Gruenewald et al. (1999), and the analysis of Australian National Drug Strategy Household Survey data in Srivastava and Zhao (2010), support allocating a disproportionately large share of traffic-related externality costs to beer consumption. Similarly, the detail on worker absenteeism in Srivastava and Zhao (2010) also suggests that lost productivity costs vary with beverage type. All such country-specific information about difference in the costs associated with consumption of each beverage type can be incorporated into the model.

Developing a country-specific framework also extends to the beverage categories considered. For example, it is possible that the Australian spirits market might be better characterised as consisting of a bottled spirits market and a ready-to-drink spirits market. In the context of optimal alcohol tax estimates, defining market segments is important. Discussions with industry representatives suggest a belief within the industry that there is relatively strong substitution between beer and ready-to-drink spirits, but that this substitution is less pronounced for beer and bottled spirits. As illustrated through the sensitivity analysis findings reported in Table 2.2, if this industry perception is correct, it implies that optimal tax rates for bottled spirits and ready-to-drink spirits could be quite different.

2.5 Conclusion

Alcohol is an important global consumption good, and interestingly over the long run there is evidence of convergence in average per capita alcohol consumption across countries. It remains the case that not all alcohol is consumed in a responsible fashion, and excessive consumption results in externality costs. The existence of such costs provides a sound basis for governments to levy alcohol-specific taxes, but it is not clear that alcohol tax policy is actually developed with these costs in mind. For example, it is difficult to reconcile the fact that most countries with a large wine industry impose relatively low wine-specific taxes with the idea that governments actually use externality cost principles to set alcohol excise taxes.

In terms of general taxation principles, Ramsey (1927, p. 59) proposed that:

> In taxing commodities which are rivals for demand, like wine, beer and spirits, the rule to be observed is that the taxes should be such as to leave unaltered the proportions in which they are consumed.

This idea led to the inverse own-price elasticity rule of taxation where taxes are high on inelastic goods and low on luxury goods. Expanding this approach to the taxation of goods where externality costs are concerned involves in essence replacing the inverse-elasticity rule with the inverse of the moderate-to-abuser-elasticity ratio rule, where taxes are highest on products where this ratio is close to unity.

Notes

1. As the definition of a standard drink varies across countries, the WHO defines heavy episodic drinking (HED) as consuming 60 grams of pure alcohol on at least one occasion in the past seven days. For beer that has an alcohol content of 5 per cent, HED implies drinking around 1.6 litres in a single occasion; for wine with an alcohol content of 12.5 per cent, HED implies drinking around 600 ml in a single sitting; and for spirits with an alcohol content of 37.5 per cent, HED implies drinking around 200 ml in a single sitting.
2. Unless otherwise stated, all dollars are Australian dollars. It can be noted that the average monthly US–Australian exchange rate for the past 10 years has been US$1 = AU$1.26 (range: from US$1 = AU$1.96 to US$1 = AU$0.91).

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3

The Demand for (Non)Alcoholic Beverages in France and the Impact of Advertising

Ruben Hoffmann and Yves Surry

3.1 Introduction

Over the last four to five decades the demand for (non)alcoholic beverages in France has changed dramatically. The total adult per capita consumption of alcohol (in pure alcohol equivalents) has decreased from 24.30 litres in 1963 to 12.30 litres in 2009 (WHO 2012). Furthermore, changing preferences have led to shifts between different kinds of alcoholic beverages, and hence the per capita consumption of beer, spirits and wine to some extent exhibit conflicting trends. An analysis of the per capita consumption (see Figure 3.1) reveals that the demand for beer between 1975 and 2004 decreased by approximately 1 per cent per year, with most of this decline taking place between the early 80s and mid 90s. The per capita consumption of spirits has on the other hand increased steadily, with an average annual rate of 0.5 per cent between 1975 and 2004. It is however in the consumption pattern of the traditional favourite alcoholic beverage in France, wine, that the most dramatic changes can be observed. In the following, a distinction is made between two different categories of wine: sparkling wine (including champagne) and still wine. While the per capita consumption of sparkling wine has increased by on average 2.5 per cent per year, and more than doubled since 1975, the consumption of still wine has declined. With respect to still wine, it should however be noted that there has been a shift in consumer preferences from less expensive table wine, which has declined, towards more expensive high quality wine. Consequently, it is not surprising to observe a decline of the per capita consumption of wine in France (Laporte 2005; Besson 2004).[1]

The radical changes in the drinking habits of French consumers during the last decades are not restricted to alcoholic beverages alone. Per capita

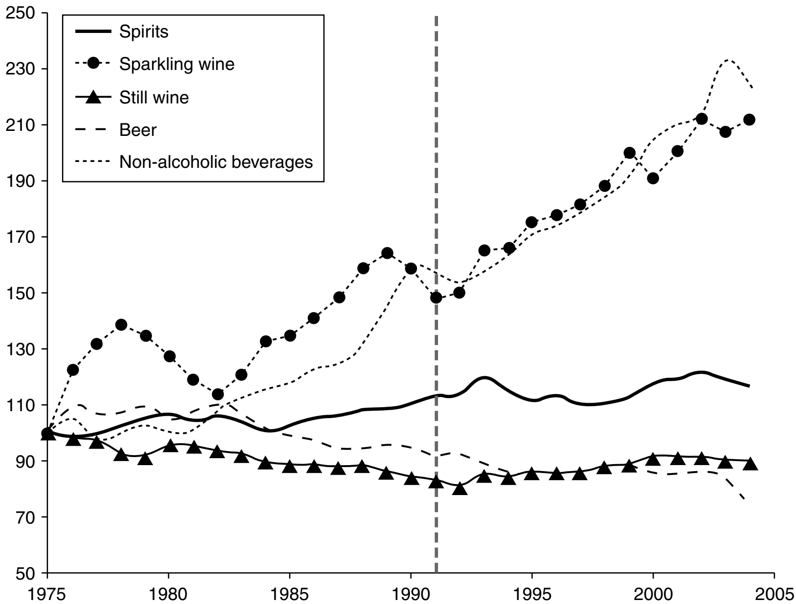

Figure 3.1 Per capita consumption (volume), 1975=100

Notes: The dotted vertical line denotes the time of the introduction of the *Evin law.*

Source: Created by the authors based on data obtained from INSEE, 1975–2004.

consumption of non-alcoholic beverages has soared and, with an annual average increase of more than 2.7 per cent, has increased by 125 per cent between 1975 and 2004. Hence, it is important to include non-alcoholic beverages when analysing the demand for beverages consumed at home.

The changes in consumer preferences for alcoholic and non-alcoholic beverages are also captured by the evolution of per capita expenditures and the corresponding conditional budget shares (Figures 3.2 and 3.3). Given that the prices of beverages have steadily increased over time, and given the changes in the volumes consumed, it is not surprising to observe a seven- to eight-fold increase in per capita expenditures on sparkling wine and non-alcoholic beverages between 1975 and 2004. By contrast, expenses devoted to the purchase of beer, spirits and still wine have risen at annual rates of 4.4 per cent, 4.3 per cent, and 3.5 per cent, respectively. Between 1975 and 2004 the conditional budget shares of beer, spirits and still wine steadily declined, reflecting the substantial reduction in the volumes consumed. During the same period the conditional share of non-alcoholic beverages increased by more than 10 per cent, to approximately 27 per cent in 2004, and the share of sparkling wine almost doubled, to approximately 12 per cent.

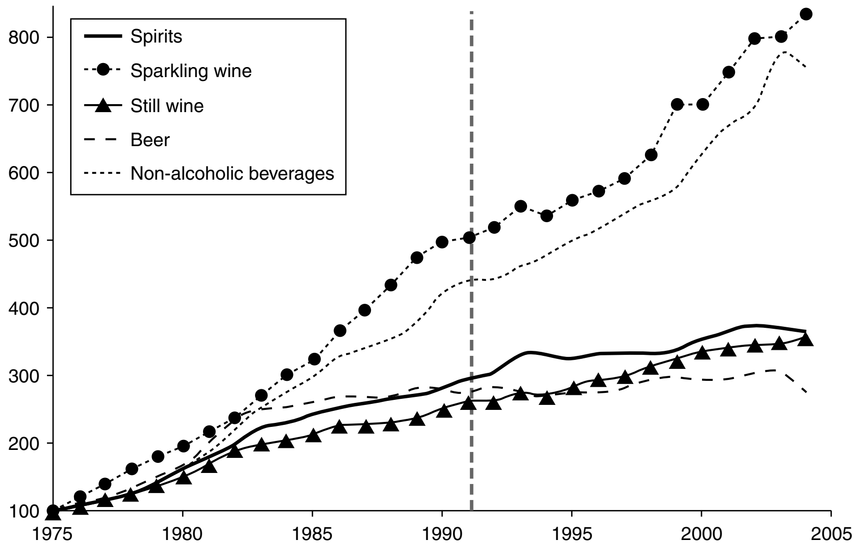

Figure 3.2 Per capita expenditure, 1975=100

Notes: The dotted vertical line denotes the time of the introduction of the *Evin law.*

Source: Created by the authors based on data obtained from INSEE, 1975–2004.

The changes in consumption patterns of alcoholic beverages are not unique to France, and similar trends can be observed in other European countries. With the reduction in the per capita consumption of alcohol being largest in southern European countries, which have historically had comparatively high levels of consumption, the volumes of alcohol consumed in different European countries tend to converge (Bentzen et al. 2001). Explaining the changes observed in consumption patterns in a country such as France constitutes a major challenge given the preceding discussion. Although prices and per capita income obviously play a major role in influencing the demand for alcoholic and non-alcoholic beverages, policy variables such as bans and taxes, and other 'non-price' factors such as availability, cultural factors, shifting tastes, and concerns about the health effects of alcohol (Scheraga and Calfee 1994 and Leppänen et al. 2001), are likely to influence the demand for beverages. Furthermore, advertising is likely to influence the consumer demand for different kinds of beverages.

Over the last 30 years, many econometric studies analysing how advertising affects the demand for total alcohol consumption and/or for alcoholic beverages have been undertaken. This empirical research can be divided into two main streams. The first line of research focuses on how the total volume of alcohol consumed is affected by advertising bans. This has been

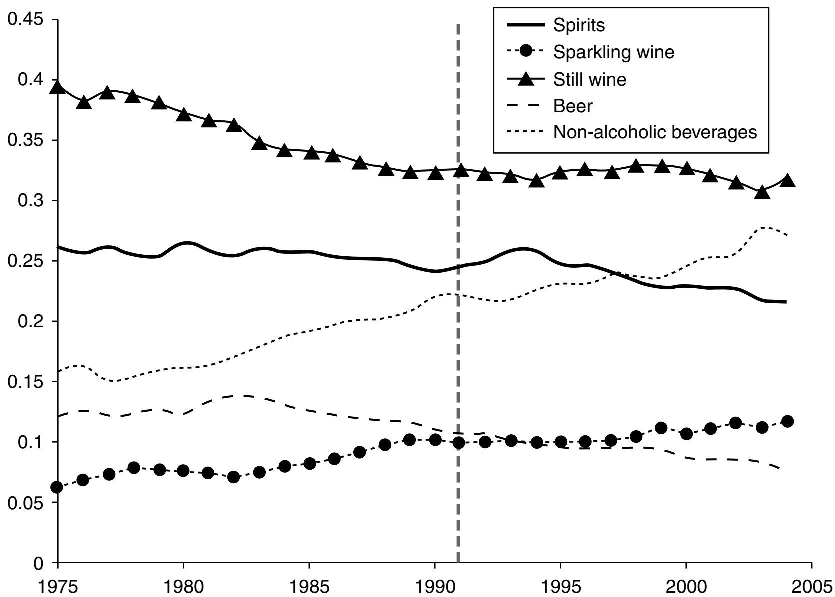

Figure 3.3 Conditional budget shares

Notes: The dotted vertical line denotes the time of the introduction of the *Evin law.*

Source: Created by the authors based on data obtained from INSEE, 1975–2004.

extensively researched for most of the OECD countries (see, for example, Nelson 2010 and Saffer and Dhaval 2002). The second line of research analyses how the consumption of different alcoholic beverages is affected by advertising (expenditure). Most of the latter literature involves specifying and estimating (un)conditional demand systems based on data concerning prices, per capita income and per capita advertising expenditures. Empirical studies of this kind have been conducted for several countries including Australia, Canada, the United States and the United Kingdom (Larivière et al. 2000). Despite the extensive literature concerning the effects of advertising on alcohol consumption, the study by Scheraga and Calfee (1994)[2] is the only empirical study that has analysed how the French demand for alcoholic beverages is affected by advertising expenditure. Specifically, they analysed how advertising influenced total demand for alcohol in four European countries, including France.

The purpose of this chapter is to analyse how advertisement expenditure influences the French demand for (non)alcoholic beverages consumed at home. As opposed to Scheraga and Calfee (1994), in this chapter we examine different types of alcoholic beverages, and we also include non-alcoholic

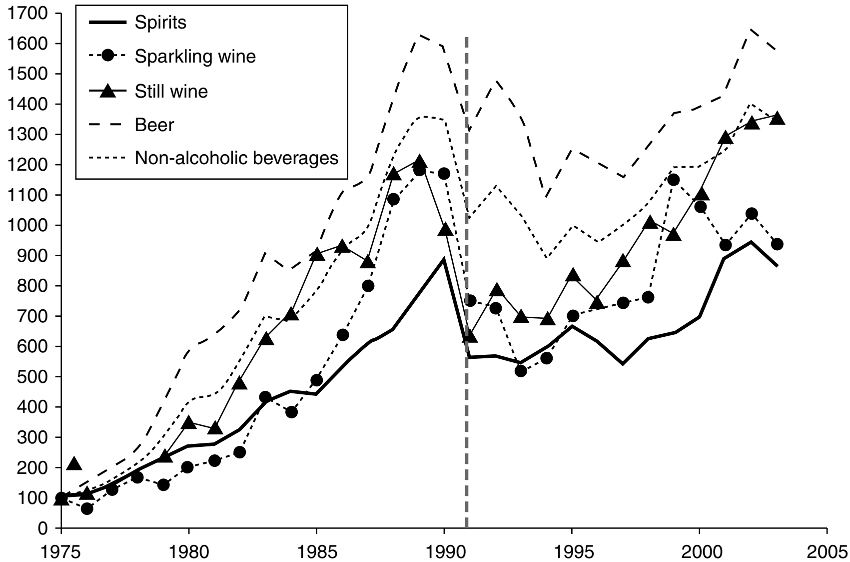

Figure 3.4 Per capita advertising expenditure, 1975=100

Notes: The dotted vertical line denotes the time of the introduction of the *Evin law.*

Source: Created by the authors based on data obtained from several sources, see footnote 8 for details.

beverages in the analysis. Furthermore, special attention is given to the empirically interesting aspect of how the *Loi Evin* (the Evin Law) adopted in France in 1991 has affected the demand for (non)alcoholic beverages. The law banned the use of certain advertising channels for promotion of alcoholic beverages, and where advertising was allowed the law restricted the content permitted in advertisements. When implemented, the Evin Law induced a substantial drop in per capita advertising expenditure related to alcoholic beverages (Figure 3.4). Hence, one may wonder to what extent the Evin Law has influenced the demand for (non)alcoholic beverages in France.

Using annual data for the period 1975 to 2003, a conditional dynamic demand system expressed in first order log-differences based on the theoretically consistent Rotterdam model specification is estimated econometrically for spirits, champagne and sparkling wines, still wine, beer and non-alcoholic beverages. Advertising expenditure is modelled as affecting per capita demand for alcoholic and non-alcoholic beverages through a translation parameter. With the implementation of the Evin Law in 1991, a structural change could have occurred in the demand for (non)alcoholic beverages in France. The hypothesis that the law has affected the demand from 1991 onwards by shifting the demand for each of the beverages is tested.

An important aspect that needs to be captured in the demand model for (non)alcoholic beverages concerns the changes in tastes and habits of French consumers. Several studies (for example, Ayouz et al. 2001; Boizot 1999) have indicated that the consumption patterns of French households are to a large extent formed by long-standing family and cultural traditions, and differ between regions.[3] In order to reflect changes in the tastes and habits of French households, and in order to overcome the problem that tastes and habits are unobservable in annual time series data, a dynamic dimension is, as is common practice in the kind of demand model adopted in this chapter, introduced by incorporating lagged consumption in the model (Pollak and Wales 1992).

The chapter is organised as follows: in the next section the model framework is presented, which is followed by a section presenting data and the estimation procedure. In Section 3.4 the empirical results are presented and discussed; this section includes subsections concerning tests on the dynamic structure, tests on the effects of the Evin Law, the estimation results of the fully dynamic model with intercept, price and expenditure elasticities, and advertising elasticities. The chapter ends with some concluding remarks.

3.2 Model framework

In this study we use the Rotterdam model to estimate a system of conditional demand equations assuming that beverages are weakly separable with other consumer goods. In the following we present the conceptual model which includes short- as well as long-run responses in demand, and draws extensively on Brown and Lee (1992, 1993). The model explicitly takes into account the habits and tastes of French consumers in several ways. The proposed model specifically includes dynamic elements (lagged consumption), the effect of advertising expenditure on the consumption of beverages and, in the empirical model specification, autonomous shifts.

In order to derive the proposed model we start by formally stating the underlying consumer choice problem, as follows:

$$\underset{\left\{q_1^*,\, q_2^*,\, \ldots\ldots,\, q_n^*\right\}}{Max\ U} = \mathrm{U}(q_1^*, q_2^*, \ldots, q_n^*, a_1, \ldots, a_n) \tag{1}$$

$$\text{subject to} \qquad \sum_i p_i q_i^* = R^*$$

where subscript $i = 1,\ldots n$ denotes a particular beverage, $q_i^* = q_i - \lambda_i$ with q_i being the quantity, and λ_i is the translation parameter of beverage i, a_i refers to the level of advertising, p_i denotes the price, and $R^* = R - \sum p_i \lambda_i$ with R representing the total expenditure on beverages where R^* can be viewed as the expenditures on beverages after all minimum needs of beverages are met. Equation (1) differs from the usual consumer choice problem in two respects. First, the levels of advertising, a_i, are assumed to affect consumer's utility (Basmann 1956) and hence the quantities of each beverage chosen. Secondly, translation parameters are incorporated into the consumer choice problem. These parameters refer to fixed levels of quantities of each beverage and can be thought of as minimum subsistence levels. As will be shown later, the effects of lagged consumption on demand can be introduced through this translation parameter.

The Marshallian demand equations corresponding to (1) are given by

$$q_i = \lambda_i + q_i^* \left(p_i, \ldots, p_n, R - \sum_i p_i \lambda_i, a_1, \ldots, a_n \right) \tag{2}$$

Totally differentiating (2) yields:

$$\begin{aligned} dq_i = d\lambda_i + \sum\nolimits_j \frac{\partial q_i^*}{\partial p_j} dp_j + \frac{\partial q_i^*}{\partial R} dR - \frac{\partial q_i^*}{\partial R} \sum\nolimits_j \lambda_j dp_j \\ - \frac{\partial q_i^*}{\partial R} \sum\nolimits_j p_j d\lambda_j + \sum\nolimits_j \frac{\partial q_i^*}{\partial a_j} da_j. \end{aligned} \tag{3}$$

Note that $\frac{\partial q_i}{\partial p_j} = \frac{\partial q_i^*}{\partial p_j} - \frac{\partial q_i^*}{\partial \mathrm{R}} \lambda_j$ and $\frac{\partial q_i^*}{\partial \mathrm{R}} = \frac{\partial q_i}{\partial \mathrm{R}}$. Furthermore, it is in the following assumed that $\frac{\partial q_i^*}{\partial a_j} = \frac{\partial q_i}{\partial a_j}$. In order to obtain the Rotterdam demand model accounting for advertising effects, we take the following steps: (i) multiply $\frac{p_i}{R}$ through equation (3), (ii) substitute $\frac{\partial q_i}{\partial p_j}$ by $s_{ij} - q_j \frac{\partial q_i}{\partial \mathrm{R}}$ (the Slutsky equation) and, (iii) make use of the fact that $dy = y d\log y$. Rearranging and simplifying, we then have:[4]

$$\omega_i d\log q_i = z_i - \mu_i \sum\nolimits_j z_j + \sum\nolimits_j \pi_{ij} d\log p_j + \mu_i d\log Q + \sum\nolimits_j \theta_{ij} d\log a_j \tag{4}$$

where $\omega_i = \frac{p_i q_i}{R}$ is the conditional budget share of beverage i, $z_i = \left(\frac{p_i \lambda_i}{R}\right) d\log \lambda_i$ is the log of change in the translation parameter weighted by the share of total expenditure committed to beverage i, $\mu_i = \frac{\partial p_i q_i}{\partial R}$ is the marginal expenditure share of beverage i, $\pi_{ij} = \left(\frac{p_i p_j}{R}\right) s_{ij}$ is the Slutsky coefficient of the Rotterdam model, $d\log Q = d\log R - \sum_j \omega_j d\log p_j$ is the Divisia volume index in differential form, and $\theta_{ij} = p_i \frac{\partial q_i}{\partial a_j}\left(\frac{a_j}{R}\right) = \left(\frac{p_i q_i}{R}\right)\left(\frac{\partial q_i}{\partial a_j}\frac{a_j}{q_i}\right) = \omega_i \delta_{ij}$ is the budget share of beverage i times the elasticity of demand of beverage i with respect to the advertising of beverage j.

In order to take into account the influence of past consumption on the translation term z_i, we follow Brown and Lee (1992) and assume that the weighted log change in the translation parameter, z_i, is linked to past consumption through the following relationship:

$$z_i = b_i \omega_{i,t-1} d\log q_{i,t-1} \tag{5}$$

The constant b_i is expected to be positive and smaller than one for non-durable consumer goods such as beverages.

Combining equations (4) and (5) and using matrix form, the following dynamic demand model is obtained:

$$\mathbf{Y}_t = \mathbf{L}\,\mathbf{Y}_{t-1} + \mathbf{M}\left(X_t - \mathbf{W}_t'\mathbf{P}_t\right) + \mathbf{\Pi}\,\mathbf{P}_t + \mathbf{\Theta}\,\mathbf{A}_t \tag{6}$$

where $\mathbf{Y}_t = [\omega_{it} d\log q_{it}]$, $\mathbf{M} = [\mu_i]$, $X_t = d\log R_t$, $\mathbf{L}=\hat{\mathbf{B}} - \mathbf{M}\mathbf{B}'$ with $\mathbf{B} = [b_i]$ and $\hat{\mathbf{B}}$ denoting a diagonal matrix of the b_i's, $\mathbf{W}_t = [\omega_{it}]$, $\mathbf{P}_t = [d\log p_{it}]$, $\mathbf{\Pi} = [\pi_{ij}]$, $\mathbf{\Theta} = [\theta_{ij}]$, and $\mathbf{A}_t = [d\log a_{jt}]$. Equation (6) can be viewed as the Rotterdam model for the translation specification of demand (Brown and Lee 1992, p. 2).

The demand responses in the short run are in equation (6) captured by the terms $\mathbf{M}$, $\mathbf{\Pi}$, and $\mathbf{\Theta}$. In the short run, the conditional expenditure elasticity is given by $\eta_i = \frac{\mu_i}{\omega_i}$ while the conditional Hicksian and Marshallian price elasticities are given by $\in_{ij}^* = \frac{\pi_{ij}}{\omega_i}$ and $\in_{ij} = \in_{ij}^* - \omega_j\eta_i = \frac{\pi_{ij}}{\omega_i} - \frac{\omega_j}{\omega_i}\mu_j$, respectively, while the elasticity of the conditional demand of beverage i with respect to the advertising expenditure of beverage j is given by $\delta_{ij} = \frac{\theta_{ij}}{\omega_i}$.

The long-run demand responses are: (i) the expenditure responses corresponding to $(\mathbf{I}-\mathbf{L})^{-1}\mathbf{M}$, (ii) the price responses corresponding to $(\mathbf{I}-\mathbf{L})^{-1}\left(\mathbf{\Pi} - \mathbf{M}\mathbf{W}_t'\right)$, and (iii) the responses to advertising expenditure corresponding to $(\mathbf{I}-\mathbf{L})^{-1}\mathbf{\Theta}$, with $\mathbf{I}$ being an $n \times n$ identity matrix. Briefly, the advertising responses are obtained from equation (6) as follows:[5] for period t, for convenience set $\mathbf{Y}_{t-1}$, $\mathbf{P}_t$ and X_t equal to zero, to obtain $\mathbf{Y}_t = \mathbf{\Theta}\ \mathbf{A}_t$, for all subsequent periods, $g = t+1,\ t+2,\ldots$ set $\mathbf{P}_g$, X_g and $\mathbf{A}_g$ equal to zero to obtain $\mathbf{Y}_{t+1} = \mathbf{L}\ \mathbf{Y}_t = \mathbf{L}\ \mathbf{\Theta}\ \mathbf{A}_t$, $\mathbf{Y}_{t+2} = \mathbf{L}\ \mathbf{Y}_{t+1} = \mathbf{L}^2\ \mathbf{Y}_t = \mathbf{L}^2\ \mathbf{\Theta}\ \mathbf{A}_t$, ..., $\mathbf{Y}_{t+d} = \mathbf{L}^d\ \mathbf{\Theta}\ \mathbf{A}_t$, ... Summing the impacts we obtain $\sum_{k=t}^{\infty} \mathbf{Y}_k = \mathbf{S}\,\mathbf{\Theta}\,\mathbf{A}_t$ where $\mathbf{S}=\mathbf{I}+\mathbf{L}+\mathbf{L}^2+\cdots$ converges to $(\mathbf{I}-\mathbf{L})^{-1}$ if all latent roots of $\mathbf{L}$ are less than one in absolute value.

3.3 Data and estimation procedure

In this study a distinction is made between the following categories of beverages: spirits, sparkling wine (including champagne), still wine, beer and non-alcoholic beverages.[6] Spirits include beverages with an alcohol content of 15 per cent or more,[7] and non-alcoholic beverages include mineral water, juices, coffee, tea and chocolate. Annual data on consumption, prices, and advertising of each of these beverages as well as data on consumer expenditures are required in order to estimate the adopted model. The necessary data concerning consumption, consumer price indices and consumer expenditures is obtained from the national accounts prepared by INSEE (2002). Data on advertising expenditure for each of the beverages is obtained from several different sources.[8] It should be noted that unfortunately it has not been possible to distinguish the advertising expenditures on still wine between quality wine and table wine, and hence still wine is treated as a single category in the analysis. Quantities are expressed on a per capita basis, and all data concerns beverages consumed at home, that is, it does not include consumption away from home. Prices and expenditures are expressed in nominal terms. Annual data (on a calendar year basis) for the period 1975 to 2003 are used in the estimations. While a longer data series would have been desirable, it has not been possible to extend the data since advertising expenditures of the different types of beverages are not available after 2003 and because INSEE since 2005 no longer collect disaggregated data on different types of alcoholic beverages.[9]

The empirical specification of the model presented in equation (6) is modified as follows: (i) an intercept, α_i, is added to each equation in order to account for consumption trends not captured by the translation term, (ii) the model is adjusted to account for finite changes, (iii) dummy variables, DUM_i^{91}, are introduced in order to reflect, and later test, the basic hypothesis that the Evin Law affects the demand response of each beverage to advertising expenditures, and iv) a vector of disturbance terms, ε_t, is added. Given these modifications the Rotterdam model for the translation specification of demand to be estimated is given by:

$$\mathbf{Y}_t = \mathbf{G} + \mathbf{L}\mathbf{Y}_{t-1} + \mathbf{M}\mathrm{X}_t - \left(\mathbf{M}\mathbf{W}_t' - \mathbf{\Pi}\right)\mathbf{P}_t + \left(\mathbf{\Theta} + \mathbf{\Theta}^{91}\mathbf{DUM}\right)\mathrm{A}_t + \boldsymbol{\varepsilon}_t \tag{7}$$

where $\mathbf{Y}_t = \left[\frac{\omega_{i,t}+\omega_{i,t-1}}{2}\log\frac{q_{it}}{q_{it-1}}\right]$, $\mathbf{G} = [\alpha_i]$, $\mathbf{W}_t = \left[\frac{\omega_{i,t}+\omega_{i,t-1}}{2}\right]$, $\mathbf{P}_t = \left[\log\frac{p_{i,t}}{p_{i,t-1}}\right]$, $\mathbf{DUM} = \left[DUM_i^{91}\right]$, $\mathbf{\Theta}^{91} = \left[\theta_{ij}^{91}\right]$, $\mathrm{A}_t = \left[\log\frac{a_{j,t}}{a_{j,t-1}}\right]$, $\varepsilon_t = [\varepsilon_{it}]$, and the other matrices are as previously defined.

In the Rotterdam demand model defined by (7) the following restrictions are imposed on the parameters: $\sum_i \mu_i = 1$, $\sum_i \pi_{ij} = 0$, $\sum_i \alpha_i = 0$, $\sum_i \theta_{ij} = 0$, and $\sum_i \theta_{ij}^{91} = 0$ (adding-up), $\sum_j \pi_{ij} = 0$, $\sum_j \theta_{ij} = 0$, and $\sum_j \theta_{ij}^{91} = 0$ (homogeneity), and $\pi_{ij} = \pi_{ji}$ (symmetry). Furthermore, the negativity condition is imposed by applying the Cholesky decomposition to the Slutsky matrix $\mathbf{\Pi}$ such that $\mathbf{\Pi} = \mathbf{K}'\mathbf{D}\mathbf{K}$ where $\mathbf{D}$ is a diagonal matrix with $d_i \leq 0$ and $\mathbf{K}$ is an upper triangular matrix with unit elements on its diagonal (Barten and Geykens 1975).

The Rotterdam model demand system represented by (7) consists of five equations, $i = 1,\ldots,5$, one for each of the beverages spirits ($i = 1$), sparkling wine ($i = 2$), still wine ($i = 3$), beer ($i = 4$), and non-alcoholic beverages ($i = 5$). All the restrictions of the parameters are maintained throughout the chapter. The demand system is a typical example of a 'seemingly unrelated' regression system which can be estimated by Non-Linear Full Information Maximum Likelihood or, as in this chapter, by adopting the Non-Linear Iterative Zellner procedure, with one of the five beverages (non-alcoholic beverages) dropped

(Barten 1969).[10] The estimates of the excluded equation are subsequently recovered, given the restrictions imposed.

3.4 Empirical results

The empirical results reported in this section are based on a Rotterdam model specification, assuming that all regularity conditions of homogeneity, symmetry and negativity of the Slutsky matrix are satisfied. In the following, specification tests of the dynamic structure of the model and on the impact of the Evin Law are presented. This is followed by a presentation and discussion of the econometric results associated with the adopted demand model specification explaining the conditional demand for (non)alcoholic beverages in France. A brief discussion on price, expenditure and advertising elasticities is then presented.

Testing the dynamic structure

The following alternative dynamic model specifications are estimated and tested:

i) a fully dynamic model in which no restrictions are imposed on the model described in equation (7), implying that $b_i, b_j \neq 0$ and $b_i \neq b_j$,
ii) a partially dynamic model in which the dynamic effects are assumed to be the same across beverages, which implies that the restrictions $b_i = b \neq 0$ are imposed on equation (7), and
iii) a static model assuming no dynamics, implying that the restrictions $b_i = 0$ are imposed on (7).

Each of these three models is estimated with and without intercepts. The six alternative specifications estimated are shown in the table below, along with the associated log-likelihood estimates and the restrictions imposed.

Based on the obtained log-likelihood values, the alternative specifications are analysed based on likelihood ratio tests with degrees of freedom equal

Table 3.1 Alternative model specifications estimated

		Log likelihood	**Restrictions imposed**
Fully dynamic model	– with intercepts	499.532	
	– without intercepts	483.440	$\alpha_i = 0$
Partially dynamic model	– with intercepts	492.925	$b_i = b \neq 0$
	– without intercepts	479.957	$b_i = b \neq 0$ and $\alpha_i = 0$
Static model	– with intercepts	489.299	$b_i = b = 0$
	– without intercepts	476.707	$b_i = b = 0$ and $\alpha_i = 0$

Table 3.2 Hypothesis tested of model specifications

	LR-statistic (restrictions)[a]	**Conclusion[b]**
Testing for exclusion of intercepts:		
H_0: Fully dynamic model *without* intercepts		
H_1: Fully dynamic model *with* intercepts	32.184 (4)	H_0 rejected (1%)
H_0: Partially dynamic model *without* intercepts		
H_1: Partially dynamic model *with* intercepts	25.936 (4)	H_0 rejected (1%)
H_0: Static model *without* intercepts		
H_1: Static model *with* intercepts	25.184 (4)	H_0 rejected (1%)
Testing for partially rather than fully dynamic model:		
H_0: Partially dynamic model with intercepts		
H_1: Fully dynamic model with intercepts	13.214 (4)	H_0 rejected (5%)
Testing for static rather than fully dynamic model:		
H_0: Static model with intercepts		
H_1: Fully dynamic model with intercepts	20.466 (5)	H_0 rejected (1%)

Notes: (a) The number of restrictions equals the degrees of freedom (*df*) and are given within parentheses. (b) The critical chi-squared values are with four restrictions (*df*) 13.28 at 1% level of significance, 9.49 at 5% level of significance and 7.78 at 10% level of significance. With five restrictions they are 15.09 at 1% level of significance, 11.07 at 5% level of significance and 9,24 at 10% level of significance.

to the number of restrictions. In a first step, the null hypothesis of models without intercepts is tested. As shown in Table 3.2, this is rejected for all three models. Focusing on the specifications with intercepts the null hypotheses of a partially dynamic model as well as a static model are rejected in favour of a full dynamic model. Hence, in the following we focus on the full dynamic model, which includes both intercepts and translation terms.

Testing for the effect of the Evin Law

The Evin Law, passed in 1991, forbade certain channels of communication to be used for advertisements of alcoholic beverages and, where they were still allowed, restricted the content. The law thus dramatically changed the rules for advertising, affecting the channels used as well as the content of the advertisements where allowed. Consequently, it seems reasonable to expect that this legislative change may have affected the demand for alcoholic and non-alcoholic beverages. In the model, the effects of the Evin Law are captured by the dummy variables introduced in equation (7), which affect the responses in the demand of each of the beverages to advertising expenditures. Whether the law has had an impact on the consumption can then be tested, based on a likelihood ratio test in which all the coefficients associated with dummy variables are set equal to zero ($\theta_{ij}^{91} = 0\ \forall i, j$) in the restricted model. As

Table 3.3 Testing for the effect of the Evin Law

		Test of Evin Law effect[a]	
	Log likelihood	**LR- statistic**	**Conclusion**
H_0: Evin Law has had no effect on demand ($DUM_i^{91} = 0$)	480.187		
H_1: Evin Law influence demand	499.532	38.690	H_0 rejected (1%)

Notes: (a) There are 16 restrictions (*df*) and hence the critical chi-squared values are 32.00 at 1% level of significance, 26.30 at 5% level of significance and 23.54 at 10% level of significance. The hypothesis that the Evin Law had no effect was also rejected for the partially dynamic model (5%) and the static model (10%).

shown in Table 3.3, the null hypothesis that the Evin Law has had no effect is clearly rejected.

Estimation results of the fully dynamic model with intercepts

In Table 3.4, the parameter estimates of the fully dynamic model with intercepts are shown. Recall that one of the beverages, non-alcoholic beverages, was dropped in the estimation of the demand system. The estimates relating to non-alcoholic beverages were recovered, based on the obtained estimates of the other beverages and the restrictions imposed on the demand system. As a result, a four-equation demand system with 54 free parameters was estimated for the period 1976 to 2003. The application of the Cholesky decomposition to the matrix of the estimated Slutsky coefficients, $\hat{\pi}_{ij}$, initially resulted in the first three estimated $\hat{d}_i$ coefficients being negative and statistically significant while the fourth was positive and close to zero. Consequently, $\hat{d}_4$ was set to zero, and the full dynamic demand model was re-estimated. An inspection of the econometric results in Table 3.4 indicates that 32 out of the 54 estimated free parameters (59%)[11] are statistically different from zero (<10% level of significance).

Although not reported in Table 3.4 due to lack of space, it is worth discussing some indicators summarising the overall econometric performance and quality of the estimated model. A system-R^2 (Berndt 1991) of 0.999 indicates an excellent goodness of fit of the demand for (non)alcoholic beverages.[12] Focusing on the properties of the residuals, Wald tests were conducted on each demand equation in order to check the (first order) autocorrelation of the residuals. The null hypothesis of no significant autocorrelation could not be rejected. Furthermore, the (Breusch–Pagan) Lagrange multiplier test revealed that the residuals are not heteroscedastic. Finally, the long-run stability of the estimated dynamic demand system was examined by computing the latent roots of the matrix **L**. All these latent roots turned out to be positive and smaller than one, confirming that the estimated demand system presented in Table 3.4 is stable from a dynamic standpoint.

The effects of the intercepts and the lagged (translation) variables on the system were previously established in the tests, leading to the choice of the current model. As shown in Table 3.4, the estimates of the intercepts of the individual equations are statistically significant for all beverages. As these parameter estimates capture autonomous shifts in the consumption of each beverage, it is not surprising to find that they are positive for sparkling wine and non-alcoholic beverages (see Figure 3.1). The direct effect of a change in the translation lag variable of a specific beverage is expected to have a positive effect on consumption given that annual data is used and given that beverages are non-durable goods (Brown and Lee 1992). As expected, all the b_i estimates have a positive sign, although not statistically significant for beer and non-alcoholic beverages.

The estimated expenditure and price coefficients reveal that the estimated marginal budget shares are all positive and are statistically significant (1%) for all beverages except beer. The largest impact can be found for still wine, which can partly be explained by the increased consumption of quality wine at the expense of table wine. As expected, the estimates for the own-price Slutsky coefficients ($\hat{\pi}_{ii}$) are all negative, and they are statistically significant for all product categories except beer.[13] The statistically significant estimates of the cross-price effects indicate that there are considerable substitutions between spirits and still wine, between spirits and non-alcoholic beverages and between sparkling wine and non-alcoholic beverages. Similar results were obtained by Boizot (1999).[14] The remaining estimates are not statistically significant.

The effects of advertising prior to the introduction of the Evin Law are captured by the parameter θ_{ij}, and after the introduction of the law by the sum of the parameters θ_{ij} and θ_{ij}^{91}. An inspection of the former estimated parameters ($\hat{\theta}_{ij}$) in Table 3.4 shows that 13 (out of 25) of them are statistically significant, at a 10 per cent level of significance, while for the latter group only 10 of them ($\hat{\theta}_{ij}^{91}$) are statistically significant. *A priori* it was expected that the advertising of a specific type of beverage would positively affect the demand for this type and negatively affect that for other types of beverages. Focusing on the statistically significant effects of own-advertising prior to 1991 the results, as expected, indicate a positive effect for sparkling wine and beer and a negative effect for spirits and still wine. The latter may be explained by the fact that due to data availability still wine is an aggregate of both quality and table wine, and that in the time period examined the consumption of the former has increased substantially while the latter has decreased substantially. An examination of the significant cross-effects (measured by $\hat{\theta}_{ij}$) of advertising – the effect that advertising of one type of beverage has on the demand for

Table 3.4 Parameter estimates

	Spirits	Sparkling wine	Still wine	Beer	Non-alcoholic beverages [a]
$\hat{\alpha}_i$	−0.002***	0.002***	−0.003***	−0.001**	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\hat{b}_i$	0.762***	0.228*	0.681***	0.081	0.186
	(0.141)	(0.128)	(0.122)	(0.100)	(0.174)
$\hat{\mu}_i$	0.260***	0.125***	0.381***	0.020	0.214***
	(0.038)	(0.035)	(0.047)	(0.029)	(0.059)
$\hat{\pi}_{i1}$	−0.100***	−0.001	0.073***	−0.024	0.052*
	(0.026)	(0.017)	(0.020)	(0.016)	(0.031)
$\hat{\pi}_{i2}$	−0.001	−0.078***	−0.004	0.011	0.072***
	(0.017)	(0.020)	(0.020)	(0.016)	(0.024)
$\hat{\pi}_{i3}$	0.073***	−0.004	−0.108***	0.025	0.013
	(0.020)	(0.020)	(0.030)	(0.018)	(0.029)
$\hat{\pi}_{i4}$	−0.024	0.011	0.025	−0.008	−0.004
	(0.016)	(0.016)	(0.018)	(0.007)	(0.022)
$\hat{\pi}_{i5}$	0.052*	0.072***	0.013	−0.004	−0.133**
	(0.031)	(0.024)	(0.029)	(0.022)	(0.053)
$\hat{\theta}_{i1}$	−0.028***	0.024***	−0.035***	0.003	0.036***
	(0.008)	(0.008)	(0.011)	(0.007)	(0.014)
$\hat{\theta}_{i2}$	−0.003	0.025***	−0.018*	0.004	−0.008
	(0.009)	(0.008)	(0.011)	(0.007)	(0.014)
$\hat{\theta}_{i3}$	−0.005	0.023**	−0.041***	0.013	0.010
	(0.012)	(0.012)	(0.015)	(0.026)	(0.021)
$\hat{\theta}_{i4}$	−0.057*	0.071**	−0.060	0.049*	−0.003
	(0.032)	(0.031)	(0.040)	(0.026)	(0.054)
$\hat{\theta}_{i5}$	0.091*	−0.143***	0.155**	−0.068	−0.035
	(0.054)	(0.052)	(0.068)	(0.044)	(0.090)
$\hat{\theta}_{i1}^{91}$	0.034***	−0.021*	0.018	−0.002	−0.030
	(0.011)	(0.011)	(0.015)	(0.009)	(0.019)
$\hat{\theta}_{i2}^{91}$	−0.006	−0.020**	0.011	0.001	0.014
	(0.010)	(0.010)	(0.013)	(0.008)	(0.017)
$\hat{\theta}_{i3}^{91}$	−0.023	−0.041**	0.054***	−0.007	0.017
	(0.016)	(0.016)	(0.021)	(0.014)	(0.028)
$\hat{\theta}_{i4}^{91}$	0.078*	−0.102**	0.096*	−0.038	−0.034
	(0.046)	(0.043)	(0.056)	(0.036)	(0.075)
$\hat{\theta}_{i5}^{91}$	−0.083	0.184***	−0.180**	0.045	0.033
	(0.068)	(0.065)	(0.085)	(0.055)	(0.081)

Notes: Standard errors are given within parenthesis. *, **, and *** denotes that the estimates are significant at 1%, 5% and 10%, respectively. (a) Estimates obtained based on the restrictions put on the demand system as follows; $\sum_i \hat{\alpha}_i = 0$, $\sum_i \hat{\mu}_i = 1$, $\sum_i \hat{\theta}_{ij} = 0$, $\sum_i \hat{\theta}_{ij}^{91} = 0$, $\sum_j \hat{\theta}_{ij} = 0$, $\sum_j \hat{\theta}_{ij}^{91} = 0$, $\sum_i \hat{\pi}_{ij} = 0$, $\sum_j \hat{\pi}_{ij} = 0$, and $\hat{\pi}_{ij} = \hat{\pi}_{ji}$.

other types of beverages – indicates that some of them have the expected signs (for example, the response in the demand for still wine with respect to the advertising of spirits and the response in the demand for sparkling wine with respect to non-alcoholic beverages) while others are counterintuitive and difficult to justify (for example, the response in the demand for sparkling wine with respect to the advertising of spirits, still wine and beer, and the response in the demand for still wine with respect to non-alcoholic beverages).

In order to assess how the demand for each beverage has been affected by the Evin Law, it is necessary to consider the total effect as measured by $\hat{\theta}_{ij} + \hat{\theta}_{ij}^{91}$. An estimation of these total effects (not reported due to lack of space) shows that only three are statistically significant, namely the response in demand for spirits and the demand for sparkling wine with respect to the advertising of still wine, and the response in the demand for still wine with respect to spirits.[15] In all these cases the total cross-effects of advertising have the expected negative signs. How can it be that we find so few statistically significant effects when the statistical specification test conducted earlier clearly rejected the null hypothesis that the Evin Law has no effect on the demand for each beverage? The explanation is that for several beverages the total demand response of a specific beverage with respect to advertising is neutralised by the fact that the estimated coefficients $\hat{\theta}_{ij}$ and $\hat{\theta}_{ij}^{91}$ have opposite signs and the sums are close to zero.[16] This 'neutralising effect' of the Evin Law seems to confirm the findings of Calfee (1996) who concluded that 'advertising has had no discernible effect in increasing total alcohol consumption above what it would otherwise be'. Furthermore, the results presented here for the period prior to the implementation of the Evin Law seem to confirm the (Galbraithian) view that advertising affects the composition of aggregate consumer demand rather than the total consumption of alcohol (Duffy 1991). However, this pattern tends to disappear once the Evin Law was implemented. We come back to this point in the section below where the short- and long-run advertising elasticities are discussed.

Price and expenditure elasticities

As shown in Table 3.5, all the short-run conditional expenditure elasticities are positive, as expected. For all beverages but beer the elasticities are slightly larger than one, with the largest for sparkling wine indicating that this category is more of a luxury good than the other beverages. All the short-run own-price elasticities are negative and indicate inelastic demands. The conditional cross-price elasticities indicate that several beverages are net substitutes, for example spirits and still wine, spirits and non-alcoholic beverages, and sparkling wine and non-alcoholic beverages. There are also some negative short-run cross-price elasticities indicating net complementarities

Table 3.5 Short-run and long-run Hicksian expenditure and Hicksian price elasticities

	Expenditure	Spirits	Sparkling wine	Still Wine	Beer	Non-alcoholic
Short-run elasticities						
Spirits	1.047	−0.402	−0.004	0.295	−0.097	0.208
Sparkling wine	1.342	−0.011	−0.834	−0.041	0.116	0.770
Still wine	1.120	0.215	−0.011	−0.317	0.074	0.039
Beer	0.181	−0.216	0.098	0.228	−0.075	−0.035
Non-alcoholic beverages	1.032	0.249	0.347	0.064	−0.019	−0.641
Long-run elasticities						
Spirits	1.611	−1.841	−0.140	0.686	−0.552	0.243
Sparkling wine	0.636	−0.074	−1.129	−0.273	0.094	0.748
Still wine	1.284	0.553	−0.133	−1.436	0.118	−0.380
Beer	0.072	−0.242	0.101	0.223	−0.088	−0.066
Non-alcoholic beverages	0.464	0.262	0.390	−0.183	−0.064	−0.968

Note: All price and expenditure elasticities are computed at the sample mean.

between beverages, for example between beer and spirits; sparkling wine and still wine; and beer and non-alcoholic beverages.

The long-run expenditure elasticities are all positive. Comparing the short and the long run, it can be noted that the long-run expenditure elasticities are larger for spirits and still wine, but smaller, thereby violating the Chatelier principle, for the other product categories. Examining the long-run price elasticities it can be noted that the diagonal own-price elasticities in absolute values are greater than their short-run counterparts. Furthermore, they are smaller than −1 for spirits, sparkling wine and still wine, while the elasticity for non-alcoholic beverages is close to −1. The long-run conditional own-price elasticity for beer is close to zero, which confirms that beer is highly price inelastic. In most cases, the long-run cross-price elasticities are in absolute values greater than their short-run counterparts in accordance with the Chatelier principle. It is also worth mentioning that the cross-price elasticity of the demand for non-alcoholic drinks with respect to the price of still wine changes sign from the short run to the long run, implying that non-alcoholic beverages and still wine are net substitutes in the short run but net complements in the long run.

How do the price and expenditure elasticities in this study compare to those obtained in other studies applying similar demand model specifications for France (for example, Boizot 1999 and Selvanathan and Selvanathan 2005)? The obtained expenditure and price elasticities are, except for beer, similar to those obtained in Boizot (1999). In a conditional Rotterdam model applied to beer, spirits and wine, Selvanathan and Selvanathan obtained estimates of conditional Hicksian price elasticities for France, which were very small in absolute values. These latter results are in line with our estimates of the price elasticities for beer. However, it should be stressed that caution should be exercised when comparing elasticities obtained in different studies as different model specifications are applied, for example, the studies mentioned above, unlike this study, include neither advertising effects nor dynamics in their models.

Advertising elasticities

Previous empirical studies examining how advertising influences the demand for alcoholic beverages tend to show that the effects are limited. For example, Gallet (2007), in a meta-analysis of elasticities of demand for alcohol, found the following median advertising elasticities for different beverages: 0.02 for beer, 0.07 for spirits, 0.007 for wine and 0.032 for alcohol. Examining the advertising elasticities reported in this study (Table 3.6) it seems that the obtained estimates are considerably larger than what has been reported in previous studies. Specifically, the estimates of the average short-run advertising elasticities for the period 1976 to 1990, which are reported in the top part of Table 3.6, tend to be close to or even greater than 0.1 in absolute values. Even higher estimates are, naturally, observed in the long run. For the period after 1991, when the Evin Law had been implemented, the estimates of the average short-run advertising elasticities tend to be closer to zero and, with a few exceptions, in absolute terms substantially smaller than in previous years. A similar pattern can be observed for many of the long-run advertising elasticities. Hence, the reported advertising elasticities for the period before and after the implementation of the Evin Law confirm the 'neutralising effect' of the law previously mentioned.

Another interesting and somewhat intriguing aspect of the advertising elasticities obtained in this study concerns the signs of the estimates. In several cases, the estimates obtained in fact have the opposite sign to what was expected *a priori*. For example, the direct demand effect of advertising expenditures on a specific beverage (own-advertising elasticities) is expected to be positive. This is not the case, neither in the short nor in the long run, for three out of the five beverages (spirits, still wine and non-alcoholic beverages) in the period 1976 to 1990. Since the Evin Law was implemented, the situation has however, become, quite different, with practically all own-advertising elasticities (the exception, beer, is close to zero) in the short as well as the long run having the expected positive sign.

3.5 Conclusion

In this chapter we have statistically analysed how advertisement expenditures have influenced the demand for (non)alcoholic beverages in France.

Table 3.6 Advertising elasticities

	Spirits	**Sparkling wine**	**Still Wine**	**Beer**	**Non-alcoholic**
Short-run elasticities 1977–1990					
Spirits	–0.109	–0.010	–0.018	–0.221	0.358
Sparkling wine	0.288	0.297	0.282	0.847	–1.715
Still wine	–0.100	–0.051	–0.117	–0.169	0.437
Beer	0.022	0.031	0.101	0.392	–0.546
Non-alcoholic beverages	0.200	–0.045	0.054	–0.018	–0.191
Short-run elasticities 1991–2003					
Spirits	0.028	–0.036	–0.116	0.090	0.034
Sparkling wine	0.026	0.044	–0.169	–0.293	0.391
Still wine	–0.052	–0.021	0.040	0.111	–0.078
Beer	0.012	0.051	0.063	0.120	–0.246
Non-alcoholic beverages	0.027	0.025	0.112	–0.158	–0.006
Long-run elasticities 1977–1990					
Spirits	–0.224	0.022	0.069	–0.485	0.618
Sparkling wine	0.479	0.413	0.431	1.300	–2.624
Still wine	–0.129	–0.108	–0.252	–0.180	0.669
Beer	0.033	0.037	0.116	0.444	–0.630
Non-alcoholic beverages	0.324	–0.035	0.116	0.129	–0.533
Long-run elasticities 1991–2003					
Spirits	0.137	–0.085	–0.386	0.163	0.172
Sparkling wine	0.041	0.078	–0.185	–0.451	0.517
Still wine	–0.147	–0.014	0.206	0.174	–0.219
Beer	0.014	0.059	0.074	0.119	–0.266
Non-alcoholic beverages	0.038	0.046	0.162	–0.246	0.000

Note: The advertising elasticities are computed at the sample mean for the period 1976–1990, prior to the implementation of the Evin Law, and for the period 1991–2003, after the implementation of the law.

Assuming that beverages are weakly separable with other consumer goods, a conditional dynamic demand system expressed in first-order log-differences based on the theoretically consistent Rotterdam model of demand **IS** estimated econometrically for spirits, champagne and sparkling wines, still wine, beer and non-alcoholic beverages. Advertising expenditure is modelled as affecting per capita demand for alcoholic and non-alcoholic beverages through a translation parameter. Special attention is given to the impact of the Evin Law passed in 1991 in France, a law which restricted the use of advertising for alcoholic beverages.

In terms of overall econometric performance, the estimated dynamic demand system performs well and satisfactorily explains the relative annual changes in the demand for (non)alcoholic beverages in France. Furthermore, the underlying dynamic structure yields stable long-term demand patterns converging towards a long-term equilibrium. The results show that the Evin Law has indeed affected consumer demand for alcoholic beverages, implying that some kind of structural change has occurred in the demand for (non)alcoholic beverages in France. The estimates for the own-price Slutsky coefficients are negative for all beverages, while the cross-price effects show mixed results, with substantial substitution between certain beverages.

Prior to 1991 the results as expected indicate positive own-advertising effects for sparkling wine and beer while it has a negative effect for spirits and still wine. The latter may be explained by the fact that still wine, due to the paucity of data availability, is an aggregate of both quality and table wine, and that the consumption of the former has increased substantially while the latter has decreased substantially in the time period examined. The Evin Law was *a priori* expected to have a negative effect on the own-advertising elasticities – but only for sparkling wine and beer is such an effect observed. For all beverages except for non-alcoholic ones, for which the effect is close to zero, the own-advertising effects after 1991 are positive. Given the available data and the type of beverages examined, it is difficult to fully explain the mixed results concerning the cross-advertising effects, of which approximately half of the estimates show the expected negative relationship.

Given the somewhat mixed results found in this study, we envision several ways in which future research can shed more light on the issue of how advertisement expenditures have influenced the demand for (non)alcoholic beverages in France. For example, one could test alternative and more restrictive specifications of the effect of advertising on the demand for beverages. Another refinement of the proposed dynamic demand model would be to pay more attention to how the effect of the Evin Law is incorporated into the model. For instance, instead of assuming a shift, as in this study, it is possible that the effects of the Evin Law are more gradual over time. Yet another alternative way to refine the dynamic demand model would be to test different separability structures of the French consumer preferences for (non)alcoholic beverages. Finally, in this chapter we estimated a conditional demand system for beverages in France by assuming weak separability between the consumption of beverages and other goods. Hence, it may be fruitful to examine whether applying an unconditional demand model, by explicitly adding an additional stage aimed at linking the demand for alcohol in France to prices of other consumer goods and the total disposable income of French households, would help in improving the understanding of the demand for (non)alcoholic beverages and the effects of advertising in France.

Notes

1. This pattern is confirmed by WHO statistics. In 1963, the per capita adult consumption of wine was 18.94 litres of alcohol equivalents, representing 79 per cent of the total per capita consumption of alcohol in France. More than 45 years later, the corresponding figure was 7.10 litres, which represents 58 per cent of the total consumption of alcohol.
2. In this study the influence of advertising was analysed for four European countries – France, the Netherlands, Sweden and the United Kingdom – by regressing the total demand for alcohol on prices, per capita income and per capita advertising expenditure.
3. The drinking patterns of French households differ between regions. It can for example be noted that relatively more (table) wine is purchased in the western and the southern grape-growing regions of France, and consumers in the northern and eastern parts of France favour more beer, while a higher propensity to purchase stronger brandies can be observed in Normandy and Ile-de-France (around Paris) (Boizot 1999).
4. An intermediate step with the terms condensed in equation (4) shown within brackets is $\left(\frac{p_i q_i}{R}\right) d\log q_i = \left(\left(\frac{p_i \lambda_i}{R}\right) d\log\lambda_i\right) - \left(\frac{\partial p_i q_i}{\partial R}\right) \sum_j \left(\left(\frac{p_j \lambda_j}{\mathrm{R}}\right) d\log\lambda_j\right) + \sum_j \left(\left(\frac{p_i p_j}{R}\right) S_{ij}\right) d\log p_j + \left(\frac{\partial p_i q_i}{\partial R}\right) \left(d\log R - \sum_j \left(\frac{p_j q_j}{R}\right) d\log p_j\right) + \sum_j \left(\left(\frac{p_i q_i}{R}\right) \left(\frac{\partial q_i}{\partial a_j} \frac{a_j}{q_i}\right)\right) d\log a_i$.
5. See Theil (1971) and Brown and Lee (1992) for further details on the procedure as such, and for the price and expenditure responses.
6. Cider was excluded from the analysis, as the consumption of this category is relatively marginal in France (less than 1.5% of all beverages consumed). Furthermore, the parameter estimates related to this category was in initial estimations found to be inconsistent with economic theory.
7. More specifically, spirits include the following items (Besson 2004): (i) liquor wine (wine aperitifs such as vermouth, pineau, port etc.), (ii) spirits mixed with water (Pernod, pastis, blackcurrant cream, liquors etc.) and (iii) brandies (whisky, gin, vodka, cognac, Armagnac etc.).
8. One of the authors obtained part of the data on advertising expenditures through personal contacts with Dr. Calfee and SECODIP in 2004. The remaining data on advertising expenditures were obtained from ONIVINS. SECODIP is a market research firm located in Chambourcy (France).
9. A new database for national accounts was established by INSEE in 2005. This has resulted in changes in the collection of household consumption data. For alcoholic beverages this specifically means that it is no longer possible to obtain as disaggregated data as for previous years. Since 2005 INSEE has only published data on the consumption of alcoholic beverages on the three aggregate items spirits, wine and beer (INSEE 2012).
10. The demand system has been estimated using version 5.0 of TSP international (Hall and Cummins 2005).
11. The 54 free parameters of the model are the four intercepts α_i for $i = 1$ to 4, the five coefficients b_i for $i = 1$ to 5, the four marginal budget shares μ_i for $i = 1$ to 4, the nine Slutsky parameters π_{ij} and the 32 advertising expenditures coefficients θ_{ij} and θ_{ij}^{91} for i and $j = 1$ to 4.

12. Although the high value of the system-R^2 looks 'impressive' it is also relevant to refer to the coefficients of determination (R^2) obtained for the demand equation of each estimated beverage, which are 0.818 for spirits, 0.648 for sparkling wine, 0.806 for still wine and 0.446 for beer.
13. That the Slutsky coefficient ($\hat{\pi}_{44}$) associated with the price of beer is not statistically significant is not surprising as it is probably a result of imposing $\hat{d}_4 = 0$.
14. Using a different demand model specification (quadratic almost ideal demand system) Boizot (1999) analysed seven alcoholic and three non-alcoholic beverages based on individual household survey data. Similar to the results obtained in this study, she found statistically significant net substitutability between sparkling wine and non-alcoholic beverages (mineral water) as well as between table wine and spirits with less than 30 per cent alcohol content (*alcool doux*). Furthermore, statistically significant net substitutability was found between still wine (both table and high quality) and non-alcoholic beverages (mineral water and fruit juice). In contrast to the results in this study she also found statistically significant relationships between beer and brandies, and between beer and non-alcoholic beverages (mineral water and fruit juice).
15. The total response in the demand for spirits with respect to the advertising of still wine (measured by $\hat{\theta}_{13} + \hat{\theta}_{13}^{91}$) equals −0.277 with a standard error of 0.108. The total response in the demand for sparkling wine with respect to the advertising of still wine (measured by $\hat{\theta}_{23} + \hat{\theta}_{23}^{91}$) equals −0.018 with a standard error of 0.110, and the total response in the demand for still wine with respect to the advertising of spirits (measured by $\hat{\theta}_{31} + \hat{\theta}_{31}^{91}$) equals −0.017 with a standard error of 0.010.
16. Let us as an example look at the total response in demand for sparkling wine with respect to the advertising of this type of beverage (measured by $\hat{\theta}_{22} + \hat{\theta}_{22}^{91}$). As shown in Table 3.4, both estimated coefficients are statistically significant and have the expected signs. The combined effect, which equals 0.005, is, however, not at all statistically significant (standard error of 0.006). The explanation is a high negative correlation coefficient between the two coefficients (−0.795), which means that the covariance between the two estimated coefficients offsets the two respective variances in the calculation of the variance of the total effect. This example clearly shows that the Evin Law mitigates the direct effect that advertising has on the demand for sparkling wine.

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Part II

Consumer Behaviour and Prices

4
The Economic Value of Wine Names That Reference Place in the US Market: Analysis of 'Champagne' and Sparkling Wine

Hyunok Lee and Daniel A. Sumner

4.1 Introduction

Place names or geographic indicators used to identify wines (or other products) have long been raised as major marketing and policy issues, but these have become even more important and more complex with increased globalisation. The issues arise especially for food and beverage products where characteristics of particular regions are most likely to imbue products with special characteristics that are difficult or impossible to duplicate outside the region of origin. With the spread of people and product styles, however, some place names have become used without clear association with geographic regions of origin. So, for example, one sees apartment buildings in Beijing, China, with the names Sonoma or Seville and one sees mustards with the name Dijon, even though neither the apartments nor the mustard has any connection to a place other than, perhaps, an approximation of a broad style.

All wines marketed in the United States are required to state on the label where the grapes were grown. The place of origin, usually appearing just above the varietal designation on the label, must be a region with official government-sanctioned boundaries that indicates the origin of the grapes that were used to make the wine. The use of place names has long been vital to identify the origin of wines, and important place names such as Napa Valley, Champagne, Port and Sherry convey valuable information to US consumers about where grapes are grown that are used in making wines with these place names. Some place names, such as California or Italy, represent large areas or political jurisdictions that do not convey any particular style of or any particular distinctive characteristics to a product.

Given its relatively short history and the cultural ties of its many immigrants with their homeland, in the United States (and some other places) European place names, such as Champagne, have been used even when the grapes have no connection to the place names on the wine label. In some cases such names have been used for several decades or more, and some would argue that the use of such designations do not convey a place but rather, simply, a broad style.

Nonetheless, the use of place names for products not of the place named does raise significant concerns. A few of these might be mentioned for context. First, if consumers are misled, and believe that the product is from the named place, this can reduce the value of the place name as a brand conveying information. This is especially a concern if the products using the place names are inferior, but is a concern even if the characteristics are simply different. Products that do not represent well the characteristics of the products from the original place reduce the value of the place name or, at least, dilute the meaning of the term. This is true even if consumers are not confused by believing that the use of the place name means that the product is from that place. The broad sense of the name, as a brand, is diluted when it is used for products that do not have the key characteristics of the place. Further, products using the place name that are not from the place named may avoid contributions (such as to promotion programmes) and restrictions (such as to improve product quality and reputation) which will place them at a competitive cost advantage relative to the legitimate products from the place.

This chapter investigates the econometrics of the place name 'Champagne' in the sparkling wine market in the United States. (See Sumner et al. [2004] for description of the wine market in North America.) We measure the price effects of use of the place name Champagne by wines from US grapes relative to other US sparkling wines that do not use the term Champagne. We go on to consider statistical analysis of the prices in the US market of wines from Champagne relative to other French sparkling wines that do not claim the place name Champagne.

There are many studies that consider and evaluate the value of wine appellations and other geographic indicators for food and beverage products. For example Josling (2006) considers legal and policy issues, while Kwon, Lee and Sumner (2008) develop an econometric measures of price effects of US place designations. However, we have found no prior literature that specifically assesses the value of a geographic place name that is used to refer to a place that is not the origin of the good labelled. Here we are breaking new ground, measuring the contribution to price of the use of a place name such as Champagne for wines that are not from Champagne.

To examine this issue quantitatively, this chapter explores an econometric approach within a hedonic price framework using data on sparkling wines collected from the *Wine Spectator*. We first review the previous empirical studies on the general theme of the value of a place name in wine markets. Next, we provide the data and data description, and then proceed to presenting our econometric estimation and results. The chapter closes with conclusions.

4.2 Previous econometric research on wine place names

Wine is highly differentiated; prices widely available in a typical retail outlet in the United States differ by a factor of 100 or more. To evaluate the impact of wine characteristics and grape attributes on price, numerous studies have applied a hedonic pricing model of Rosen (1974) based on observable attributes of wine, such as information on the label, as explanatory variables.

For about 20 years, studies have included appellations (or micro grape region) in wine price equations. Examples include Combris et al. (1997 and 2000), Costanigro et al. (2007), Lecocq and Visser (2006), Nerlove (1995), Schamel and Anderson (2003), Landon and Smith (1997), and Oczkowski (1994). Lecocq and Visser (2006) and Landon and Smith (1997) incorporated appellations in their analyses of Bordeaux wine, and Costanigro, McCluskey and Mittelhammer (2007) considered seven California wine regions in their segmented wine market study for the period 1991 to 2000.

Unwin (1999) critiqued use of hedonic econometrics applied to wine prices. He identified several concerns, including difficulties in identifying the most appropriate variables, ambiguous interpretations, and problems in the definitions of wine quality. Thrane (2004) responded, showing how hedonic econometric studies could avoid the problems identified. Using the hedonic approach, Angulo et al. (2000) found that variations in Spanish red wine prices were associated mainly with region of production and vintage, while the grape variety and the alcohol were found statistically significant.

Findings of these studies indicate that grape regions are generally important in explaining wine prices. Costanigro, McCluskey and Mittelhammer (2007), however, indicate that grape region becomes less significant as the wine market becomes more exclusive. A more comprehensive treatment of appellations can be found in Schamel and Anderson (2003) and Oczkowski (1994). Schamel and Anderson (2003) estimated hedonic price functions for premium wines from Australia and New Zealand, incorporating up to 34 different grape regions along with other variables. They found that over the period 1994 to 1999, there was a clear trend towards greater regional differentiation, particularly in Australia. Oczkowski (1994), who also studied Australian and New Zealand wines using 1991 to 1992 data, found mixed results, with 14 out of 24 Australian grape regions having significant price effects (New Zealand was aggregated into a single region).

Bombrun and Sumner (2003), using California wine data collected from the *Wine Spectator*, established that recognised California place names, such as Napa Valley or Sonoma, as well as specific local appellations, commanded substantial premiums, holding constant such other factors as variety, expert score, vintage and age of the wine. Kwon et al. (2008) provide in-depth analysis of wine appellations specific to grape variety using the Bombrun and Sumner data. Within the hedonic framework, they investigate the price effects of 63 appellations separately for each of five major grape varieties.

Finally, Gustafson et al. (2012) generated data from an economic field experiment using customers shopping for US wine in a market with a large wine selection. They show that careful econometric modelling of the controlled experimental data allows identification of willingness to pay for wine characteristics such as grape variety and appellation separate from cost-side differences and consumer sorting. Their approach allows a more precise interpretation of estimated parameters of a price equation than is available using market data such as we employ in this chapter.

4.3 Data source and data description

The data for our analysis was obtained from the *Wine Spectator* database. Each wine reviewed in the *Wine Spectator* is accompanied by information on the tasting score, the region of origin, grape variety, price per 750 ml bottle and vintage year. Tasting scores are provided based on a 100-point scale. Wine tastings are carried out by the editors of *Wine Spectator* with the labels covered but with knowledge of the general type of wine and the vintage (*Wine Spectator*).

For the purpose of this study, sparkling wines that can be found in the US market are grouped into three categories: sparkling wines from Champagne, US-produced sparkling wines that do not misuse the name Champagne, and some sparkling wines labelled 'Champagne' that misuse the name. Our *Wine Spectator* sample includes 1352 US-produced sparkling wines and 3418 French sparkling wines. We will first provide the data description of the sparkling wines of US origin, then those of French origin.

Of the sample of more than 1300 US-produced sparkling wines, 27 are mislabelled as Champagne. Of these 27 wines, 20 are from California (more than half of these California wines use the brand name Korbel). Table 4.1 provides the mean real prices per bottle (deflated by the consumer price index (CPI)) by broadly defined US region of origin. For the wines misusing the Champagne place name, the prices range from \$4.30 to \$51.90 when deflated by the CPI. For the non-Champagne sparkling wines, the prices range from \$4.30 per bottle to \$620 per bottle. The mean price for sparkling wines misusing the Champagne name is about \$9 per bottle lower than the price for other sparkling wines. Even for the California origin, which commonly carries a premium over other US origins, the mean price of mislabelled sparkling wines is much lower than the mean price of sparkling wines originating from a place other than California.

Table 4.1 Mean price of US Sparkling wine and wine mislabelled as US Champagne by broad US region

Type		**Obs**	**Mean price ($)**	**Std Dev ($)**	**Minimum ($)**	**Maximum ($)**
Mislabelled as Champagne		27	14.90	9.9	4.30	51.90
All other Sparkling		1325	24.20	20.8	4.30	620.20
	US region				**Mean score**	**Std Dev. of score**
Mislabelled as Champagne	California	20	15.4	10.9	80.9	5.4
	NY&other*	5	14.4	7.5	78.4	5.2
	Washington	2	11.6	2.1	78	2.8
Sparkling	California	989	26	23.5	85.5	4.2
	NY&other*	181	19.4	8.2	80.5	4.6
	Wash/Oregon	155	18.8	7.1	86	3.6

Notes: * 'NY&other' includes New York and other states. Prices are deflated by CPI, 2000 is the base year.

Table 4.1 also shows that there are substantial differences in the range of rating scores across US regions and label names. Washington State wine mislabelled as Champagne has the lowest average rating, 78, while the Washington and Oregon region has the highest rating for sparkling wine, 86. California wines mislabelled as Champagnes have a mean score of about 81, and the California sparkling wines have a score of 85.5 for a differential of 4.5 points. The five wines from New York and elsewhere in the United States that are mislabelled as Champagne have an average score of 78.4 compared to an average score of 80.5 for sparkling wines from the same region.

Table 4.2 begins to explore in more detail the 20 California mislabelled wines whose region is shown on the label. About 24 per cent of the sparkling wines and 65 per cent of the wines labelled Champagne wines are from the 'other California' region. The rest of the wines are from various costal districts. Thus the Champagne name is misused for wines from the region that typically has the lowest-priced California grapes and wines. Most of the wines in our sample were released after 1995 (with a few released in the 1980s). For age and vintage information, we have only limited information. While most of the sparkling wines have vintage information, only six of the sparkling wines mislabelled as Champagne (from California) have vintage information. This lack of data limits us from fully utilising vintage information in our econometric model and estimation.

Table 4.2 Mean price of California sparkling wine and wine mislabelled as US Champagne by detailed California region

	CA Region	Obs	Mean price	Std Dev.
Mislabelled as Champagne	Carneros	1	51.9	.
	Napa	3	26.4	7.9
	Other California	13	10.4	3.1
	Sonoma	3	13.8	0.9
Sparkling	Bay/central	51	20.2	10.8
	Carneros	99	28.5	13
	Mendocino/ Lake	117	23.8	7.4
	Napa	195	30.9	17
	Other California	240	21.8	15.4
	Sonoma	253	27.9	39.2
	South Coast	34	22	5.4

Notes: Prices are deflated by CPI.

Table 4.3 Descriptive statistics on score and price for French sparkling wines

Country/region	Obs.	Sample share	Variable	Mean	Std Dev.
All France	3418	100%	Score	88	4
			Real price	50	36
Alsace	52	1.5%	Score	83	4
			Real price	16	3
Burgundy	23	0.7%	Score	83	4
			Real price	15	2
Champagne	3077	90.0%	Score	88	4
			Real price	54	36
Jura/Savoie	12	0.4%	Score	83	3
			Real price	15	2
Languedoc-Roussillon	28	0.8%	Score	82	4
			Real price	14	3
Loire	129	3.8%	Score	83	3
			Real price	17	7
Other France	97	2.8%	Score	80	5
			Real price	11	3

Notes: Prices are deflated by CPI.

Table 4.3 provides descriptive statistics for the tasting score and price for the French sparkling wines. (Wilson 1999, describes French wine regions.) There are in total 3418 observations of French sparkling wines from seven French regions, including 'other France'. About 90 per cent of the French sparkling wine sample is from the Champagne region and is, of course, labelled Champagne. The wines from Champagne have a mean *Wine Spectator* score of 88 and a price of $54 per bottle. Sparkling wines from Champagne command the highest price and score of the sparkling wines from all French regions. Alsace, Burgundy, Jura/Savoie and Loire all have a mean score of 83 and a mean price that ranges from $15 to $17 per bottle; sparkling wines from Languedoc-Roussillon and the other French regions have slightly lower scores and prices. The mean price of the sparkling wines from Champagne is more than triple the mean price of the sparkling wines from other regions of France.

Figure 4.1 provides the price distribution. Only 1.4 per cent of the wines sold for less than $10 per bottle and about 1.0 per cent sold for a price over $200 per bottle. About 70 per cent of the wines are sold at prices between $20 per bottle and $60 per bottle, and about half sold for prices between $30 and $50.

4.4 Econometric estimation of the hedonic price equations with market data

To elicit the price relationships of using the Champagne label for US wines, we develop a hedonic model for wine price as a function of wine characteristics including the label name, region, score, vintage, and release year. To aid the interpretation of the estimation results as relative effects, we use a logarithmic transformation of the price as the dependent variable. Using the ordinary least squares method, we estimate three versions of regression equations. The first two models are estimated using only the US data, and the two equations specified include one without the vintage variables and the other with them. The third model is estimated using the combined data of the US and French samples without vintage information.

As developed in detail in Gustafson et al. (2012), using market data necessarily means that our coefficient estimates include both supply side and demand side influences. Designating a place where the grapes are grown often directly reflects the cost of production of a wine, and in equilibrium the observed market price will not be below the market price. The demand side, or willingness to pay, affects market price, but only to the extent that the wine is offered on the market at a given price, which is determined on the supply side. Moreover, given heterogeneity and sorting across consumers, the position of the willingness-to-pay function and its slope may determine how much wine is produced and sold from a region as well as market price. Some of these considerations may also influence the magnitude of other coefficients in the hedonic price equation. Some label designations may reflect

Real price range ($)	French sparkling wine including Champagne	
	Obs.	%
<10	48	1.4
<20	283	8.4
<30	357	10.6
<40	929	27.6
<50	701	20.8
<60	410	12.2
<70	164	4.9
<80	102	3.0
<90	63	1.9
<100	56	1.7
<110	41	1.2
<120	45	1.3
<130	33	1.0
<140	23	0.7
<150	18	0.5
<160	14	0.4
<170	17	0.5
<180	13	0.4
<190	8	0.2
<200	10	0.3
<250	21	0.6
>250	14	0.4

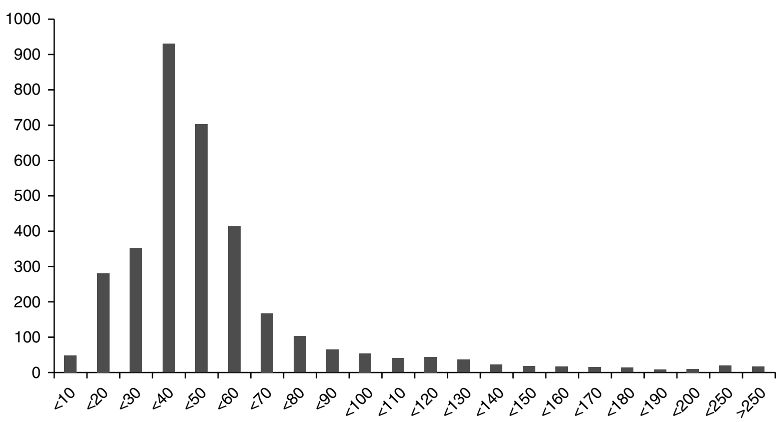

Figure 4.1 Distribution of real price for French sparkling wines

lower costs of production, as they also signal a lower consumer willingness to pay. Because of the identification issues, one must exercise caution in interpreting the coefficients in estimated price equations.

4.5 Econometric results and interpretations of the price equation for sparkling wine sold in the United States

Our estimation strategy is to examine several specifications and data sets to assess consistency of the estimates of the key parameters of interest. We examine two models with US sparkling wines only – with and without vintage dummy variables. We then consider a specification that includes US and French wines in the specification. Each specifically provides new estimates of a series of variables of interest including tasting score and region. However, in each case we are particularly interested in the coefficient for the variable of representing use of the name Champagne for wines not from Champagne.

Table 4.4 reports the estimation results obtained from the model using only US data. Overall, the model explains about 26 per cent of the variation in the data. Significant explanatory variables include tasting score, several US region dummies, and labelling having significant impacts. The variable indicating a US wine that uses the term Champagne on the label has a significantly lower price, after controlling for tasting score and region.

Our results indicate that one unit of score increase is associated with a 3.3 per cent increase in price. Our estimation uses non-California as the regional base, so the coefficients of included regional dummy variables are interpreted as the change in log price of sparkling wines compared to those for non-California US wines. The Napa regional dummy variable commands the highest region effect (0.35), and is followed by Carneros (0.25) and Sonoma

Table 4.4 Log price regressions for US sparkling wine including US wine labelled as Champagne, without Vintage

Variable	**Parameter estimate**	**t Value**	**Pr >|t|**
Intercept	0.0963	0.42	0.6733
Score	0.0335	11.72	<.0001
Labelled as Champagne	−0.280	−3.42	0.0006
Time (release year)	−0.000456	−0.21	0.84
Bay-Central	0.0911	1.44	0.151
Carneros	0.2483	5.1	<.0001
Mendocino-Lake	0.1429	3.13	0.0018
Napa	0.3508	9.01	<.0001
Sonoma	0.2243	6.29	<.0001
South Coast	0.1408	1.89	0.059
Other California	−0.0348	−1.01	0.313
R-sq=0.259	Adj R-sq=0.254	Obs=1352	

Notes: Excluded region is the rest of the United States outside California. Dependent variable=log (Price). Price is deflated by CPI, 2000 is the base year.

(0.22). All region effects are significant at conventional levels except for two regions, Bay Central and Other California. Importantly, we find that labelling a US wine as Champagne lowers the log price by 0.28, holding the other variables constant. This is a strong and statistically significant impact of about 28 per cent.

In Table 4.5 we report on results of estimating a hedonic price equation that includes vintage dummy variables. We include dummy variables for each vintage with non-vintage wines as the control group or left-out category. We include a release year in the regression as well. Of course, because they are linearly related, it is impossible to identify separately, vintage, year and aging effects on the price of wine. Holding the vintage of the grapes constant, the release year now has a small positive impact on wine price. As expected, the inclusion of vintage information in the regression enhances the explanatory power of the equation. Now the regression explains more than 40 per cent of the price variation with the explanatory variables, including vintage years, mostly significant at high levels. Including the vintage dummy variable had little effect on the tasting score effect or those for the regional dummy variables. In this specification, the misuse of the Champagne designation reduces price by about 20 per cent and, once again, the effect is strongly significant.

The overall summary of these results shows that the use of the Champagne name for US wine is associated with much lower market prices, holding constant a whole host of explanatory variables including region, vintage and rating score that themselves have significant positive impacts relative to the categories left out.

In the regression results presented in Table 4.6, we combined the sample of French wines with the sample of US sparkling wines, including those US wines using the place name Champagne when it cannot designate the place in France. In addition to a much larger sample size, this dataset and specification allow us to investigate the impact of the name Champagne on the label in a sample that includes wines where the name Champagne on the label correctly reflects a place name and wines where the name Champagne on the label cannot correctly reflect a place because the wines are from a variety of regions in the United States. Once again, the main purpose of the regression analysis is to assess the effects of place names on price, including the misuse of the place name Champagne on wines from the United States.

Table 4.6 presents the regression results estimated using all 4770 observations in a dataset. The dependent variable is the log of the wine price deflated by the US CPI. In addition to the expanded region variables, we also include a variable to control for bottle size, because a few of the wines were sold in 1.5 litre bottles. These oversize bottles are represented by the variable Dsize in Table 4.6. The basis for bottle size is the usual 750 ml, and the variable Dsize measures the price effect of an oversize bottle relative to the 750 ml bottle.

Table 4.5 Log price regressions for US sparkling wine including US wine labelled as Champagne, with Vintage

Variable	Parameter estimate	t Value	Pr >|t|
Intercept	0.664	3.15	0.0017
Score	0.0223	8.38	<.0001
Mislabelled as Champagne	−0.207	−2.82	0.0048
Time (release year)	0.0067	2.26	0.0243
Region, base=non-California			
Bay-Central	0.0203	0.35	0.725
Carneros	0.2044	4.64	<.0001
Mendocino-Lake	0.1750	4.26	<.0001
Napa	0.3209	9.1	<.0001
Sonoma	0.1553	4.76	<.0001
South Coast	0.1236	1.84	0.066
Other California	0.0732	2.31	0.021
Vintage, base=no vintage			
1981	0.542	3.92	<.0001
1982	0.442	4.25	<.0001
1983	0.522	5.8	<.0001
1984	0.409	5.24	<.0001
1985	0.476	7.01	<.0001
1986	0.365	5.38	<.0001
1987	0.409	7.05	<.0001
1988	0.359	5.86	<.0001
1989	0.337	5.62	<.0001
1990	0.416	6.52	<.0001
1991	0.439	8.09	<.0001
1992	0.435	7.55	<.0001
1993	0.379	5.83	<.0001
1994	0.578	9.49	<.0001
1995	0.529	8.69	<.0001
1996	0.510	8.5	<.0001
1997	0.460	8.15	<.0001
1998	0.422	7.76	<.0001
1999	0.520	7.48	<.0001
2000	0.420	6.2	<.0001
2001	0.408	5.36	<.0001
2002	0.367	4.39	<.0001
2003	0.236	2.55	0.0109
2004	0.396	3.47	0.0005
2005	0.356	2.13	0.0331
R-sq=0.425	Adj R-sq=0.410	Obs=1352	

Notes: Dependent variable=log (Price). Price is deflated by CPI, 2000 is the base year.

Table 4.6 Regression analysis for US and French sparkling wine prices using specific place name and designation for use of name Champagne for American wines

Variable	Parameter estimate	t value	$P_r > \|t\|$
Intercept	−0.76	−5.46	<.0001
Score	0.040	23.34	<.0001
Year	−0.0063	−5.54	<.0001
Dsize	1.160	9.92	<.0001
US wine labelled Champagne	−0.24	−2.93	0.0034
Region in United States			
Bay-Central	0.46	6.48	<.0001
Carneros	0.60	10.26	<.0001
Mendocino-Lake	0.51	9.01	<.0001
Napa	0.68	13.39	<.0001
Sonoma	0.56	11.57	<.0001
South coast	0.52	6.33	<.0001
Other CA	0.36	7.37	<.0001
Other US	0.40	8.59	<.0001
Region in France			
Champagne	1.18	27.69	<.0001
Alsace	0.29	4.09	<.0001
Burgundy	0.22	2.26	0.024
Languedoc-Roussillon	0.14	1.55	0.1218
Loire	0.28	5.15	<.0001
Total obs.	4770	R-sq=0.58	Adj R-sq=0.57

Notes: Dependent variable= log (Price). Price is deflated by CPI, 2000 is the base year. Definition: Dsize = 1 if bottle size=1.5l, otherwise 750 ml. Left out region=Other France.

In Table 4.6, all coefficients are significant except for the value of the Languedoc regions relative to the rest of France. We find that the *Wine Spectator* tasting score is highly significant, with a coefficient of 0.04 meaning that each added point – from, say, 86 to 87 – adds 4 per cent to the price of the wine. The real price of these wines trended down gradually over time. This does not necessarily reflect the trend in the overall price of sparkling wines, because the coverage is not identical each year. It could be that some of the highest-priced Champagnes were included in the earlier issue dates and not in later ones. As can be expected, the price effect of the oversize bottle is positive – slightly more than double the 750 ml bottle.

The regional dummy variables tell an interesting story. Holding other factors constant, including use of the name Champagne on some US wines, the lowest price region is the left-out category 'Other France'. Other regions in California and the United States have a positive price relative to Other France region, once we have controlled for score, year, and bottle size. As expected, the dummy variable designating the French region Champagne has by far the largest coefficient. Among the US regions, Napa exhibits the highest price, followed by Carneros and Sonoma. Napa has a high price relative to the specific regions of France except Champagne. As expected, the dummy variable designating the French region Champagne has by far the largest coefficient; Champagne commands a price almost double that of Napa, holding other variables constant. Thus as a regional designation, Champagne commands a very high price relative to any other region, even after the tasting score is accounted for.

The use of the name 'Champagne' by US wines, where it cannot be a place name, is associated with a significantly lower price, by about 24 per cent compared to the base case which is simply using the 'sparkling wine' designation for US wines. Remember that these effects are measured holding everything constant. In other words, even when the measured quality rating of the wine is held constant (the *Wine Spectator* score), the price of US wine mislabelled Champagne is 24 per cent lower. The bottom line is that when Champagne designates the place name it adds hugely to the price of the wine, but when it does not designate a place name the price of the wine is lower.

4.6 Conclusion

We have estimated a series of specifications of price equations for sparkling wine sold in the United States. The estimated coefficients are consistent and robust across data and specification differences. A higher *Wine Spectator* tasting score is associated with significantly higher prices in every case. This is true holding region constant for US wines, in the specification with vintage dummies included, and especially in the sample that includes wine from France. The regional variables had the expected signs and relative magnitudes. Within the United States, sparkling wines from the north coast regions of Napa, Sonoma and the Carneros region that spans southern Napa and Sonoma counties command higher prices. Within the wines from France the place name Champagne translates into much higher prices. As expected Champagne has much higher prices than any other region, with the north coast regions noted above slowing significantly behind. Other regions of the US also have higher prices than the non-Champagne regions of France. Using the word 'Champagne' on the label of US wine where it cannot be a place name reduced the price in every specification. The negative coefficient is significantly negative and consistent across the Tables 4.4, 4.5 and 4.6.

It is possible that the price of US wine labelled 'Champagne' would be even lower if such wine did not benefit from some association, even if mistaken, with the region in France. It is also possible that sparkling wines from the Champagne region in France would be even higher if no US wine also carried this word on the label. However, the most compelling evidence is that the label term has two strongly opposite and highly significant implications on wine labels in the United States. When the term Champagne on the wine label in the United States designates the region in France, the price is much higher than other wines in the category, holding other factors constant. And when 'Champagne' is used for a US wine without reflecting a region in France, the price is much lower than other comparable wines. More detailed and perhaps experimental data will be required to sort out the causations more specifically.

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5
The Price of Wine: Does the Bottle Size Matter?

Jean-François Outreville

5.1 Introduction

What's behind the bottle price? Weather, vintage, geographic area, bottling, marketing and recipe are all important factors in the cost of the wine. Many papers look at the determinants of prices by using hedonic price functions. Wine prices are determined by climate influences and by their reputation, their perceived quality or sensorial characteristics. Most of the recent literature (Combris et al. 1997 and 2000; Landon and Smith 1998; Oczkowski 2001; Jones and Storchmann 2001; Horowitz and Lockshin 2002; Schamel and Anderson 2003; Benfratello et al. 2004; Cardebat and Figuet 2004; Lecocq and Visser 2006) demonstrates the importance of considering all these factors to explain the formation of a price on the market.[1]

There is more than the price of just the wine in a bottle. When it comes to calculate a wine's final price, there are certain concrete costs that go into every bottle. Production costs vary enormously based on the type of wine, the size of the winery and its location. There are important economies of scale, since new vineyards may have major start-up costs while a big player sees the cost per bottle go down as production goes up.

Wineries may use many tools to convince consumers that their wines are worth more – fancy bottles, designer labels, sophisticated advertising (Boudreaux and Palmer 2007; De Mello and Gonccalves de Borochia 2008). Several other factors intervene at the intersection of image and pricing. Scarcity, or the perceived rarity of a wine, can be one, because motivated consumers are willing to pay for the prestige associated with small-production bottling from renowned appellations. The decision to market wine in a different bottle size is considered to have more to do with the judgement of taste and the feeling of pleasure than other factors.

To our knowledge, investigation of the possible effects of bottle size on supply or demand of liquid products has received little attention in the literature, with the exception of Di Vittorio and Ginsburgh (1996) and Brunke et al. (2009). The latter, in their empirical analysis based on wines offered at auction markets in Germany, find a negative correlation between price and bottle size. When controlling for vintage and quality, they find that the bottle size generally has very little or no effect on the price sold at auction. However the sample of prices in their dataset is mainly relevant for 1.5 litres (magnum) but very limited for bigger sizes (only nine cases for 3.0 litres and one case for a 6.0-litre bottle). The purpose of this chapter is to investigate the price effect with bigger bottles for Champagne and Bordeaux wines.

The results of our investigation show a major difference between prices posted for bottles of Champagne and auction prices for Bordeaux wines. In the case of Champagne, the price of wine increases more than proportionally with the size of the bottle. We show that the relative scaled price of the marketed bottle may vary from 1.0 for a standard bottle (0.75l) to a factor of 2.1 when the size of the bottle increases, whatever the type of wine or region of production. However, this result does not fully hold for Bordeaux wines when we consider auction prices for large bottles.

The chapter is organised as follows. First we provide some background on bottle sizes. In the next section, we suggest a measure of the relative scaled price index to compare the price of different bottle sizes on the same scale, that is a standard bottle of 0.75l, and then we show that its value is an increasing function of the size of bottles. We suggest that the hypothesis of scarcity, defined by Walras, may explain this non-linear relationship; consumers are willing to pay for the prestige associated with small-production bottling, but the demand curve may simply be the result of segmented markets. This issue is examined through a regression analysis with dummy variables to pick up for the bottle size. In the following section we verify this hypothesis with a sample of wines for which auction 'hammer prices' are available. The last section discusses the results and concludes the chapter.

5.2 Does the bottle matter?

While it is not really necessary to have any knowledge of wine bottles in order to appreciate wine, the bottles are nevertheless vitally important. A glass bottle, sealed with a cork or other device, is preferable for the storage and transport of wine. The size and the colour of the bottle may also have important implications. The shapes of bottles also evolved according to traditions and customs of the people who made them, and they have proved to be a reliable container, including other essential environmental factors, ideal for the keeping and the ageing of wine.[2]

As well as the traditional (in many cases, legally required) 750-ml bottle (the standard size), and the useful half-bottle (containing 375 ml of wine), there are a number of legally permitted 'large-format' bottles. Bottle sizes permitted by the EU, but applying only to still wine, range from 0.1 litre to 10 litres (Robinson 2006).

Magnums, the next size up from the standard bottle, are probably the most popular choice. Wine bottles, however, come in many different sizes, and all of them serve a purpose. The list of all formats is presented in Table 5.1 below.

Single-serve bottles (187.5) or *piccolo* in Italian, are great for picnics.

- Half bottles (375 ml) are often reserved for restaurants and dessert wines.
- The everyday bottle is the 750 ml.
- Moving up, next is the Magnum (1.5-litre bottle). This size is very good for serving wine by the glass at gatherings such as family reunions. Champagne is also commonly packaged in Magnums.
- Marie-Jeannes (three bottles) and double magnums for Bordeaux wines are less popular.
- Next come the big bottles. Many of these bear biblical names; Jeroboam, Rehoboam, Methusalem (or Methusalah), Salmanazar, Balthazar, Nebuchadnezzar and Melchior are the most famous.

There are a few other bottle sizes permitted in certain regions, such as the Clavelin (620 ml) in the Jura, or in certain countries, like the commonly encountered 500-ml bottle used for some Ports designed for drinking young, and Tokay, the famous sweet wine of Hungary.

The price of an empty bottle (whether or not including label and cork) should be almost identical between providers in a specific region, or even in different regions, whatever the quality of the wine inside the bottle. It is usually estimated that the price of the bottle itself is less than 10 per cent of the final price of a standard bottle of wine and may significantly decrease when the number of bottles produced increases.

More expensive wines tend to have more expensive packaging. A flat-bottom, generic Burgundy-style bottle (at 50 cents per item) may do just fine for a less expensive wine, but if a producer wants to target a different market with higher-priced wines, he or she may select a more expensive bottle style. Although the notion that high prices may convey quality is well established in the behavioural marketing literature (Rao and Monroe 1989), the signalling effect of a high price related to the size of a bottle is less clear.

Wineries produce very few large-format bottles because these require manual processing. Once a winery chooses to release a bottling that is larger than a magnum, it no longer fits on a standard bottling line. Each step means higher labour costs and higher risk of poor closure. Nevertheless, large-format bottles are popular, and limited supply may put a premium on large formats.[3]

The scarcity of supply has been shown to affect product attractiveness and desirability (Brock 1968; Lynn 1991) which, in turn, affect purchasing decisions (Lynn and Bogert 1996) and product diffusion patterns (Swami and

Table 5.1 Wine bottle size

Bottle name	Volume (in litres)	Equivalent standard bottles	Names's Origin	Comment
Mignonette	0.05 to 0.15	..		Used as a sample
Piccolo	0.1875	¼	’Small’ in Italian	
No name	0.200	..		Used frequently for Ice-wine in Québec
Chopine	0.250	1/3	Traditional French unit	Known as Quarter bottle
Demi	0.375	½	’Half’ in French	’Fillette’ in Loire Valley
Jennie	0.5	2/3	50 cl bottle ’White spirit’ in Welch	Used in Tokay, and several sweet wines
Clavelin	0.620	..	Jura ’Vin Jaune’	Exist also a half-clavelin
Bottle	0.750	1	Standard bottle	
Fifth	0.757	..	One-fifth of a US gallon	In 1979, the US adopted the metric
Litre	1.0	..		Used for low-quality wine
Magnum	1.5	2		
Marie-Jeanne	2.25	3		Tregnum for Port Wine
Double-Magnum	3.0	4		
Jeroboam	3.0 / 4.5	4/6	Biblical, first king of Israel	3.0 l in Champagne and Burgundy
Franzia	5.0	..		4.5 l in Bordeaux
Rehoboam	4.5	6	Biblical, first king of Judea	
Imperial	6.0	8		In Bordeaux
Methusalem	6.0	8	Biblical, oldest man	Or Methuselah
Salmanazar	9.0	12	Biblical, Assyrian king	
Balthazar	12.0	16	Biblical, one of the wise	
Nebuchodonosor	15.0	20	Biblical, king of Babylon	Or Nebuchadnezzar
Melchior	18.0	24	Biblical, one of the wise	
Solomon	20.0	26 2/3	Biblical, king of Israel	
Sovereign	25.0	33 1/3		
Primat	27.0	36		
Melchizedek	30.0	40	Biblical, middle-east religions	

Khairnar 2003).[4] This would certainly also apply to wine because consumers are willing to pay for the prestige associated with small-production bottling from renowned appellations. In reality, there is a high correlation (a non-linear relationship) between value and scarcity (see Appendix 5.1). Research in marketing and psychology has shown that consumers usually apply this correlation in their value judgments; they judge what is scarcer as more valuable (Lynn 1992; Verhallen and Robben 1994).

5.3 A measure of the relative scaled price index

The value of the wine is hypothesised to be the same whatever the quantity sold. The basis for the observed price of wine is the standard bottle (750 ml). Everything else being equal, then, the price of a larger bottle of wine should be a simple multiplier of the quantity of wine in the bottle. The relative scaled price index is the ratio of the observed price of the bottle to the normalised price relative to the price of the standard bottle for the same wine. We assume there are no economies of scale.[5]

For example, if the price of a standard bottle is \$15 then the normalised price of a magnum should be \$30 (15×2) or the price of a Methusalem \$120 (15×8). The ratio of the real price of the Methusalem bottle (\$216 for example) to the normalised price (\$120), gives an index equal to 1.8 (the index is always equal to 1.0 for the standard bottle).

The data for Champagne comes from the prices posted on company websites. To avoid bias related to the vintage, the dataset for each producer is limited to prices available for the same vintage and the same wine for the full range of bottle sizes. Only seven producers have posted the relevant prices.

Is price is a function of perceived quality (producer, vintage)?

Figure 5.1 presents the relationship between the sizes of the bottles measured in litres and the price index. The relationship is calculated for the seven producers. For a single producer the price is for the same vintage whatever the size of the bottle, but the vintage may differ among producers. We observe that the curve looks similar whatever the perceived quality of the producer. The index also increases for smaller bottles (375 ml) to a value of 1.2, and the larger the size of the bottle the higher the index, up to a value of 2.1.

Is this relationship related to other factors?

Bigger bottles are also supposed to be the ideal medium for ageing wine. The larger the bottle the less air space per millilitre of wine, resulting in better storage conditions. Collectors attracted by the rarity of such bottles are also attracted by the fact that wine ages much more slowly and gracefully in larger bottles. Unfortunately this hypothesis does not hold for large-format bottles

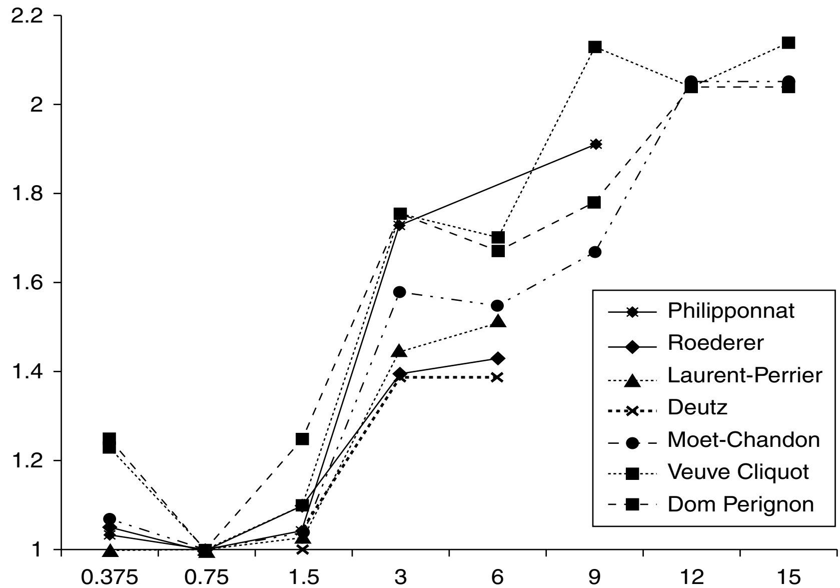


Figure 5.1 Relationship between bottle size (number of litres) and the scaled price index for seven Champagne producers

if, as it is often the case with Champagne, they are filled using wine poured from single 750-ml bottles prior to sale.

The shape of the relationship may be a regional phenomenon. Some data for Bordeaux and Burgundy have been collected on company websites and averaged by region when possible.[6] Figure 5.2 presents the average price index for three regions in France; the relationship exhibits the same curve whatever the region of production.

What about the price of empty bottles?

It could be also argued that the higher index may only reflect the higher cost of producing bigger bottles. The price of the empty bottle may also explain this relationship. We collected the prices, excluding taxes, of empty bottles of Champagne. Whereas a standard 0.75-litre Champagne bottle costs €0.53, a magnum bottle is sold for €1.60, a 3-litre bottle for €10.00, a Methusalem (6.0 litres) for €42 and up to the Nebuchadnezzar (15.0 litres) which fetches €305.[7]

For all bottle sizes we calculated an adjusted price index taking into account the price of the empty bottle. It is clear from Figure 5.3 that the relationship remains the same, with the exception of the largest bottle (a Nebuchadnezzar) whose price is so high that it has a significant effect on the index.

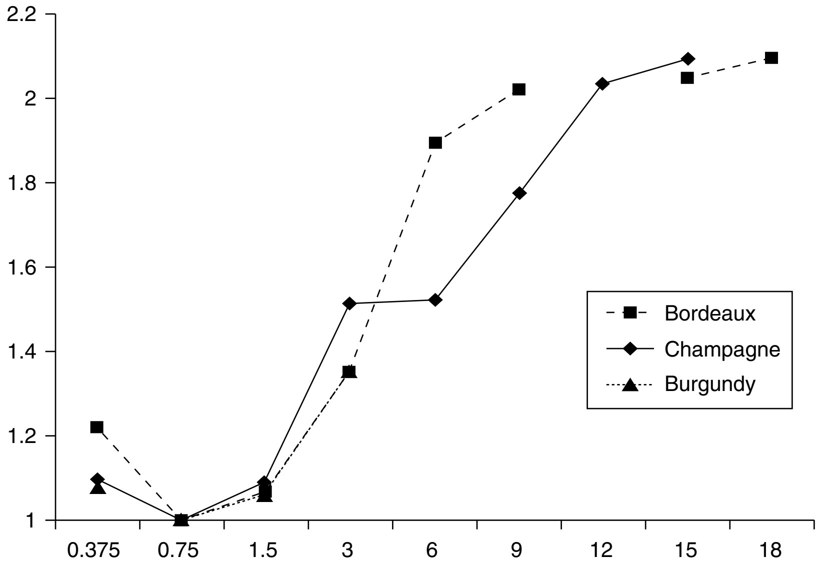


Figure 5.2 Relationship between bottle size (number of litres) and the average price index by region of production

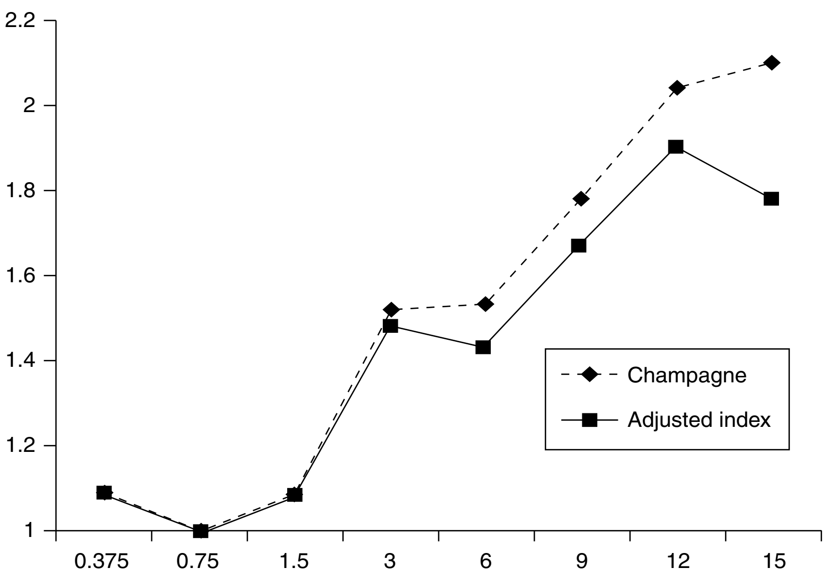


Figure 5.3 Relationship between bottle size and the adjusted price index for Champagne compared to the non-adjusted price index

Is this relationship an illustration of scarcity?

According to Walras, value is an increasing function of scarcity. This hypothesis of scarcity may explain the increasing relationship between the price and the size of a bottle independently of the perceived quality of the wine or the region of production. However, posted prices may not reflect actual transactions and may not represent the actual willingness to pay. Actually, it could also be suggested that these bottles are not physically for sale and may only be in the catalogue of the producers for prestige or marketing purpose.[8] Unfortunately this kind of information is not readily available.

To verify the non-linearity of the relationship, it is hypothesised that the price index is a log function of a known measure of the unavailability (see Appendix 5.1). The price of empty bottles is supposed to be a good proxy for scarcity and therefore we could test directly the following relationship: Price Index = a + b.Log (price of empty bottles). The results are estimated for the index prices of Champagne, and show a highly significant relationship as in Table 5.2 below.

However, it could be argued that this relationship is only an illustration of scarcity and reflects the particular situation of supply and demand on segmented markets, that is, the demand for regular bottles is not related to the demand for other sizes. This would be the case of, for example, half-bottles supplied for restaurants or Methusalem bottles, very popular for special events.

To test for the existence of segmented markets we used dummy variables to pick up for the size of the bottle in the relationship. To solve the estimation problem, dummies were tested one by one. The existence of a significant dummy variable would demonstrate the existence of a particular market for the relative bottle size. If none of the variables is significant it means that there are no segmented markets and that the price is only a reflection of scarcity.

Estimations of the dummy variables are presented in Table 5.3 and show that two types of bottles, that is the half-bottle and the Methusalem, exhibit prices significantly different from the log-relationship. This possibly gives a confirmation of specific markets for these bottle sizes.

Table 5.2 Relationships between the price index and the price of the empty bottle

Variable	Coefficient	Std Error	t-statistic
C	1.112455	0.061701	18.02972
Log(emptyprice)	0.164964	0.018037	9.145777
Adjusted R-sq	0.921914		

Table 5.3 Test of segmented markets

Dummy 0.375	0.187	*
Dummy magnum	–0.127	ns
Dummy double magnum	0.032	ns
Dummy Methusalem	–0.237	***
Dummy Salmanazar	–0.0232	ns
Dummy Balthazar	0.187	ns
Dummy Nebuchodonosor	0.068	ns

Notes: ns – non significant, * significant at the 10% level, *** significant at the 1% level.

5.4 The market price of large bottles at auctions

Further investigation of the possible effects of bottle size on the price of wine products needs to be performed, using prices resulting from real transactions at auction markets. Most wines are traded on the basis of posted prices or according to private terms and conditions. Auctions are, however, used for buying and selling certain high quality or rare wines.[9] The prices used in our sample are obtained from a one-year period of monthly auction hammer price data (from July 2009 to June 2010) from The Chicago Wine Company (TCWC).[10] TCWC represents one of the largest trading markets for wine, and conducts one live auction per month.[11]

Of all the transactions reported over a one-year period only a few are relevant to our analysis. The transactions should be realised for a single producer, for the same vintage, during the same month and for bottles ranging from 0.375l to 6.0 litres (some transactions for smaller sizes (0.375 ml) are missing in our sample and there is no single transaction for sizes larger than 6.0 litres). Transactions reflect only Bordeaux wines (no transactions in any other region) and eight producers, corresponding to 12 sets of transactions for vintages 1999 to 2006 (Table 5.4).

For each producer and set of transactions the relative scales price index (relative to 0.751) has been calculated. The average value is presented in Figure 5.4, as well as the maximum and minimum values, for each bottle size. On average, larger bottles fetched a higher price than regular bottles for the same wine. However, this is also true for half-bottles, and therefore it is difficult to conclude that bottle size could capture wine quality. It is true that the effect is small compared to posted prices for bottles of Champagne, but this result is nevertheless very different to the results of Brunke et al. (2009) for German wines that show no effect of size on price.

Analysing Bordeaux wines in the Médoc region priced at Christie's auctions, Di Vittorio and Ginsburgh (1996) found that wines sold in bottles larger than magnums tend to be more expensive than those in regular bottles, reflecting the effect of scarcity, for which collectors are willing to pay

Table 5.4 Sample of companies, transactions realised during July 2009 to June 2010

Producer	**July–December 2009 Vintages**	**January–June 2010 Vintages**
Château Quinault L'enclos	1999, 2001	
Château Monbousquet	2001	2006
Château Pavie	2004, 2005	2005
La Mission Haut-Brion	2005	
Château Pape-Clément	2005	
Château Branaire-Ducru	2006	
Cos d'Estournel		2005
Château Ducru-Beaucaillou		2005

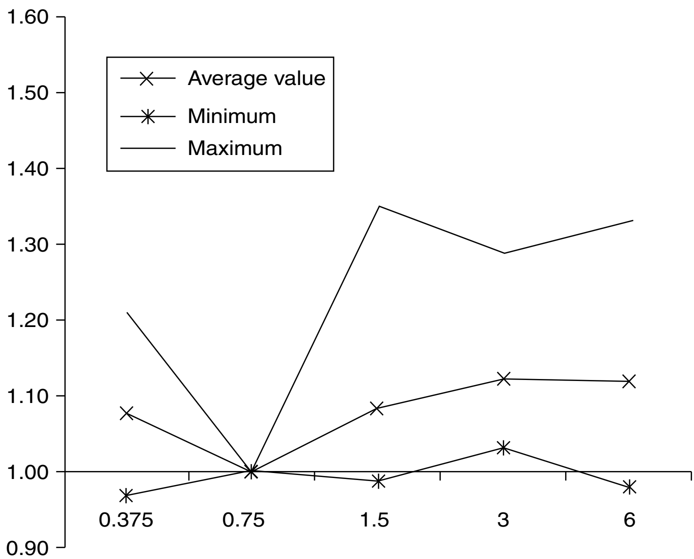


Figure 5.4 Relationship between bottle size and the adjusted price index for Bordeaux wines at auctions

more. They calculate a price increase as large as 42 per cent for imperials (6 litres), compared to the maximum value of 33 per cent in our study.

5.5 Conclusion and suggestions for further research

According to Walras, value is an increasing function of scarcity. We have shown in this chapter that this hypothesis of scarcity may explain the non-linear relationship between the posted prices of larger bottles of Champagne and the size of a bottle independently of the perceived quality of the wine or the region of production. However, further investigation based on prices determined at auctions for Bordeaux wines mitigates these results, as at auction the premium for larger bottles is much smaller than that for posted prices.

Further investigation of the possible effects of bottle size on supply or demand of wine products would require access to larger databases on this subject. Does this relationship vary significantly with more expensive wines or wines perceived as being of long-standing high quality? Also, quantities supplied are well known when a wine is sold for the first time, but over the years quantities are likely to decrease with consumption. If quantities available on the market over time become a matter of scarcity, then the relative price should increase. But unfortunately, information on quantities is not available and the effect on price could eventually be tested only if data for the same wine were to be available over a long period of time.

Appendix

Appendix 5.1 Price or Value as a Function of Scarcity

Walras argued that value is a function of scarcity. It is generally agreed that the value of any product satisfies the following properties (Chen 2005):

(a) The value of two products should be higher than the value of each of them.
(b) If two products are independent, that is if the two products are not substitutes or partial substitutes for each other, then the total value of the two products should be the sum of two products.
(c) The value of any product is non-negative.

The only mathematical functions that satisfy all of the above properties are of the form

$$V(P) = -\log_b P \tag{1}$$

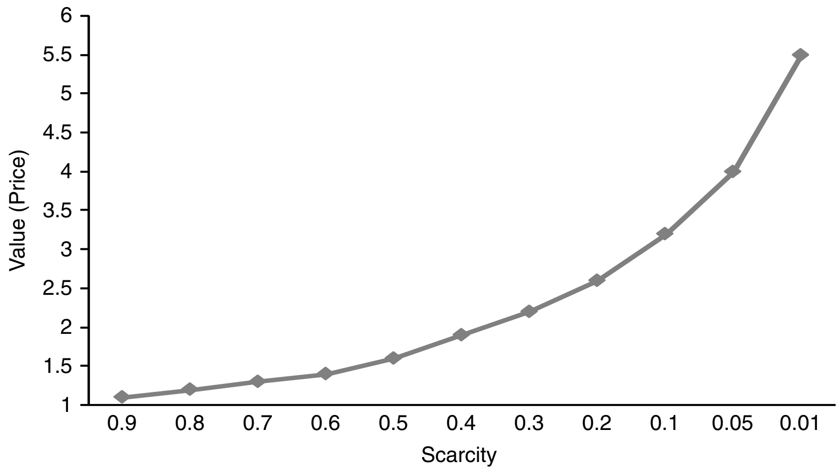
where b is a positive constant. The base b can be understood as the number of units produced.

In general, if the scarcity of a service or product X can be estimated by the probability measure $\{p_1, p_2, \ldots p_n\}$, the expected value or price of this product is the average of the value of each possibility, that is

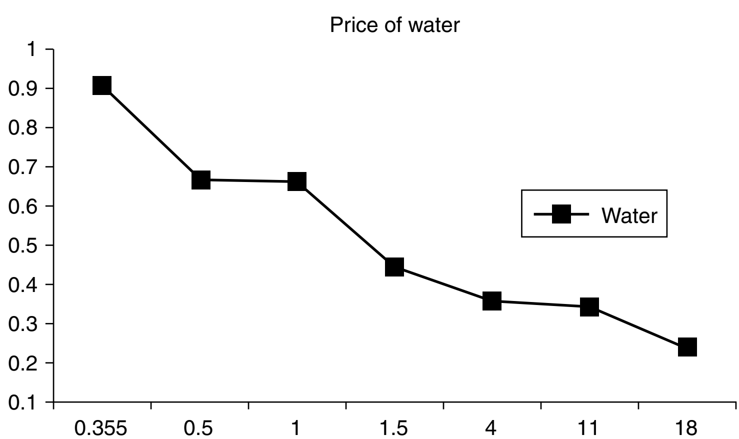
$$V(X) = \sum_{i=1}^{n} p_i(-\log_b p_i) \tag{2}$$

Therefore, value, just as information, in its general form can be defined as entropy, a measure of the unavailability. The concept was introduced by Claude E. Shannon (1948). The figure below is a graph of equation (1), which shows that value (price) is an increasing function of scarcity measured by the decreasing probability of availability.

Value (Price) and scarcity



Appendix 5.2: Relationship between Price and Size of the Bottle of Water



Source: www.amaro.ca/

Notes

1. See also Outreville (2010).
2. See Brunke et al. (2009) for a short historical background.
3. At this stage it could be useful to distinguish between the tangible value of a bottle, which refers to the fact that wines in larger formats mature more slowly, and the intangible value, which refers to the collector's value of the bottle.
4. It must be noted that whether consumers overestimate or underestimate the levels of supply is actually a very difficult question to tackle, since the quantities produced are usually unknown.
5. This hypothesis is not true for water, as shown in Appendix 5.2.
6. Only one producer in Bordeaux (Château Le Puy) and three producers in Burgundy. Data is available from the author.
7. Prices were provided by Champagne Emballage, Reims.
8. Research in information economics has focused on signals as mechanisms to solve problems that arise under asymmetric information (see a review of the literature on signalling by Karmini and Rao 2000). This hypothesis is not considered in this chapter.
9. On auctions for wine, see Ashenfelter (1989).
10. Data available at www.tcwc.com.
11. See Sanning et al. (2008) for more details.

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6
Wine Judging and Tasting

Matteo M. Galizzi

6.1 Introduction

Professional tasters, experts and judges are key actors in the wine sector. In fact, they play a pivotal role at the interface between the supply and the demand sides of the market. On the supply side, wine judges and professional wine tasters exert a profound impact on winemakers' oenological choices as well as their commercial and marketing strategies. In addition, by affecting producers' reputations and pricing strategies, experts may directly affect producers' sales volumes and margins, and therefore, ultimately, their profits and economic performance.

On the demand side, the key role attributed to wine experts, tasters and judges is justified mainly by the very nature of wine as a specific consumption good. It is very difficult to assess the quality of a wine before its consumption (in economist jargon it is thus an 'experience good'), and very often not even afterwards either (a 'credence good'), and for most consumers wine is indeed an experience or even a credence good. For most non-educated consumers, the purchase of wine can actually be a very challenging task due to the huge number and dispersion of countries, regions, producers, grape varieties and wine typologies. Moreover, the tasting and full enjoyment of a glass of wine is inherently not a straightforward task for physiological reasons, as it requires overall multi-sensorial examination crucially involving olfaction, a subtle and under-used sense in modern societies.

The experience and credence nature of the wine goods is why consumers typically rely either on extrinsic information – such as pricing, labels and other external cues that are believed to convey information about the intrinsic quality of the wine – or on judges' opinions and wine-tasters' notes.

The opinions of experts, professional tasters and judges may affect the interface of the demand and the supply sides of the wine sector through two main channels. First, by providing the consumer with a direct appraisal and signal of the intrinsic quality of a bottle of wine, judges and experts can affect the likelihood of the consumer purchasing that bottle, and enhance their willingness to pay (WTP) for it. Second, by providing producers and winemakers with a signal of the relative quality and ranking of their own wine compared to those of competitors, tasters and experts can indirectly inform the pricing and marketing strategies of the producers, thus indirectly affecting the response to demand. As we will argue below, the wine-tasting panels in Italy may in many senses be seen as the true market-makers in the wine sector, as they offer their assessment and awarding services to both consumers and producers of wine; in the jargon of industrial economics this is a 'two-sided platform market'.

The profound effect that expert opinion has on the market sector and the extensive respect assigned to wine judges ultimately depend on the widely held recognition that experts are able to capture 'objective' indicators of the intrinsic quality of a wine, which are much harder for less educated consumers to identify and perceive.

Economists, in fact, would probably argue that an optimal assessment process should be based on the evaluation and categorisation of a range of objective signals of quality, such as the oenological process, freshness or acidity, olfaction intensity and persistence, structure of tannins and so on

If so, economists would probably argue that, like all other experts – who, as postulated by the traditional economics textbooks, are assumed to be able to process all available information rationally and to employ it for perfectly rational decision-making – wine experts should also be able to condense and aggregate these objective signals into an overall judgement, and thus to come up with a quality ranking towards which all the judgements tend to converge. That means, it can be argued, that the experts' quality ranking should be substantially proof against individual idiosyncratic preferences.

Fast-growing evidence from the behavioural sciences has contributed to showing how often human decisions and behaviours, far from being fully rational, are mistaken and distorted by biases and cues. It is difficult to see why wine experts, often being perceived as an exception to this documented evidence, should escape from this tendency. In fact, the same applies to them as to all other human beings, and decisions by wine judges and tasters are indeed likely to be affected by and prey to a wide range of biases.

In this work we argue in particular that, even though professional (blind) wine tasting and judging is usually done by panels of experts who evaluate objective signals, the outcome of the assessment process is likely to be affected by the experts' personal backgrounds, attitudes, histories and tastes. The work tests and assesses the existence of any bias in the professional wine experts' evaluations. By 'bias', we mean any distortion in a direction which cannot be plausibly due to different valuations of signals of the wines' objective oenological characteristics and intrinsic sensorial quality.

In particular, we focus on the Italian wines. Using an original dataset, we explore whether the three most renowned experts' guides, edited by the three main professional wine-tasting panels in Italy, do indeed show any type of consensus as to which wines are truly the best Italian wines, and to what extent the guides' quality rankings actually converge onto the same pool of wines. In particular, we empirically test one of the most heatedly debated, but as yet unproven, claim about professional guides in Italy, namely that they may be affected by some form of regional bias, possibly being keener to award higher scores to wines coming from particular Italian regions.

The rest of the work is organised as follows. Section 6.2 reviews some of the recent literature in the area of wine tasting and judging. Section 6.3 discusses the system of professional wine judging in Italy, and discusses a possible price formation model for Italian wines. Section 6.4 presents the three professional guides used in the empirical analysis, and describes their award system, as well as all data on the characteristics of the wines used to construct our dataset. Section 6.5 reports the empirical analysis and the results. Finally, Section 6.6 briefly concludes.

6.2 Literature review

In experimental economics and psychology, consumer studies and sensorial analysis, a wide literature has explored the process of tasting and judging. One of the key aspects that have been thoroughly explored in marketing studies, for instance, concerns the distinction between extrinsic (top-down) and intrinsic (bottom-up) information and its effects on consumer evaluations and purchasing decisions. Extrinsic information about a product is constituted by all features due to, or related with, the firm's marketing effort and strategies, while intrinsic information constitutes the physical and sensorial characteristics of the product as directly perceived by the consumer.

The seminal paper by Allison and Uhl (1964) reports that consumers are unable to recognise their preferred brand of beer in a blind taste and that the perceived characteristics of different beers are related more to firms' marketing information (extrinsic information) rather than to perceived physical differences (intrinsic information).

Several subsequent studies examined the effects of intrinsic and extrinsic information in food and drinks products. Makens (1965) finds that turkey meat was appreciated more if thought to be from a popular brand than from an unpopular one. Nevid (1981) finds that Perrier was preferred by consumers to standard sparkling mineral water when consumed with labels, but not otherwise. Olson and Dover (1978) find that consumers perceived coffee as being less bitter when repeatedly exposed to that idea. Bowen et al. (1992) and Wardle and Solomons (1994) observed differences in the stated liking of dairy products depending on whether they were labelled as high or low fat.

Concerning, in particular, economic experiments on food and wines, Fevrier and Visser (2004) asked a sample of subjects to evaluate six orange juices. Subjects were presented each of the six juices in a random order, in two phases: first some characteristics of the product were shown to the subjects via an image; then the juice was tasted. Subjects evaluated each juice and were then told that they could buy the orange juices they had just evaluated. Fevrier and Visser (2004) checked the consistency of the product choices with the Generalised Axiom of Revealed Preferences (GARP) and found that almost one-third of the subjects were GARP-inconsistent. Lange et al. (2000) and Combris et al. (2007) asked a sample of subjects to evaluate six orange juices and complete a demand schedule with different budget/price situations. In one group, subjects chose after looking at the packaging. In the other group, they could also taste the products. Their results show that subjects who chose without tasting made quicker decisions, selected a larger set of varieties and were more influenced by price than those who could taste the products. Galizzi et al. (2008) asked a sample of subjects to taste three wines and three hams of the same category (Dolcetto d'Alba, and *prosciutto crudo*) under three conditions: a control group, and two treatment groups where subjects were given information about their peers' and an expert's opinion. Galizzi et al. (2008) found that peer pressure affected individual preferences expressed for foods to some extent, while expert opinions significantly affected the wine-tasting evaluations.

Moving to experiments explicitly focusing on wine tasting, Combris et al. (2006) performed two series of Vickrey auctions to assess the effect of packaging information (bottle and label) on the reservation prices of non-expert consumers for five brut non-vintage Champagne sparkling wines. Packaging information was found to explain much more of the variation in willingness to pay (WTP) than was sensory information; subjects were unable to evaluate the wines differently after blind tasting, but they expressed significantly different WTP when labels were disclosed. Vigne and Gergaud (2007) found that consumer preferences for Champagne differed significantly when preferences were stated based on extrinsic information only rather than on intrinsic only. Gustafson (2008) found that expectations induced by reputational information affected consumers' experienced utility and subsequent purchasing decisions. Galizzi and Reiley (2012) reported a field experiment in which almost two-thirds of a hundred economists tasting three glasses of wines were unable to identify the two glasses containing exactly the same wine, even though the wines were sold for twice or even three times the price of that in the third glass.

Concerning the related case of beer tasting, some studies (Guinard et al. 1998, 2001; Bushnell et al. 2003; Foster et al. 2001) were carried out on the characteristics of beers and the perception of a trained panel of consumers to identify the relationship between the chemical compounds in beer and the perception of consumers. Guinard et al. (2001), for instance, found in an experiment that consumers' hedonic ratings changed considerably between blind and informed tasting conditions, thus confirming the important role of non-sensory variables in formulating hedonic judgements. Following the seminal paper by Allison and Uhl (1964), Caporale and Monteleone (2004) illustrated how information regarding manufacturing technology was able to alter consumers' liking for beer. Lee et al. (2006) found that consumers' evaluation of beer versus the same beer spiked with balsamic vinegar depended significantly on the order in which consumers received sensory information and information on the ingredients. Porretta and Donadini (2008) report that packaging is the most important attribute that influences consumers' attitude towards alcohol-free beer. Galizzi and Garavaglia (2012) explored the interaction between intrinsic and extrinsic information on beer tasting and willingness to pay (WTP) for bottles of beer, and found that exposure to any type of brand raised evaluations and enhanced subjects' sensorial perceptions.

An extension of this literature has used functional magnetic resonance imaging (fMRI) to examine brain activity by subjects exposed to different stimuli. McClure et al. (2004) found in an fMRI study that providing information about brand of cola (either Coke or Pepsi) affected more areas of participants' brains than when the cola was blind tasted. In the blind-tasting condition, preferences were predicted by relative activity in the ventromedial prefrontal cortex (VMPFC); in the informed condition, the hippocampus, the dorsolateral prefrontal cortex (DLPFC) and the midbrain were also active, particularly when the brand was revealed to be Coca-Cola. The authors interpreted these results as suggesting that the VMPFC functioned independently from the hippocampus, DLPFC and midbrain, and that the two systems represent different processes affecting a subject's preferences for the product. Plassmann et al. (2008) found that the sensation of pleasantness that people experience when tasting wine is directly linked to its price: with the higher priced wine, more blood and oxygen was sent to an area of the brain (medial orbitofrontal cortex), which is thought to be responsible for encoding pleasure during experiential tasks.

The issue of wine judging and tasting has also been investigated in non-experimental settings, using secondary data. For instance, Galizzi and Miniaci (2012) explore the competing strategies and the determinants of the selling prices by the two main traditional method Italian sparkling wines (Franciacorta and Trento) and found evidence of a significant, but asymmetric, price premium associated to a past award by a professional guide. Finally, in a study related to the present work, Caggiano et al. (2012) use an original panel dataset with the characteristics of about 25,000 Italian wines in the years 2007 to 2012 to look at the determinants of the awards by three professional guides, and report weak convergence and consensus of scores and ratings, as well as significant differences in preferences across guides. We will refer to some of their findings later on.

6.3 The wine judging system and expert panels in Italy: a price formation model?

The system of professional wine judging in Italy is highly decentralised and dynamic, in the sense that many professional wine-tasting panels operate in the Italian wine sector.

The first layer is at a provincial level, represented by boards of wine-tasting experts within the local Chambers of Commerce. This national network, which is funded partly by local public authorities and partly by the local professional organisations, serves mainly as a system of quality assessment, and monitors wines and wine-making. Although this system represents the closest approximation to an official body, the Chamber of Commerce wine-tasting panels do not issue comparative rankings, and do not publish or distribute any assessment or judging notes which can be used by the general public and wine consumers. More often than not, they simply limit their evaluations to checking that the wine-making process has adhered to all the legal minimum quality requirements as well as to the guidelines issued by the local wine-producing consortia and the regional monitoring and regulatory bodies.

In addition to this more or less official tier, a plethora of competing privately-funded wine-tasting bodies operates in Italy. Very few of these, however, go beyond a merely local dimension to reach a national audience with their rankings and wine-tasting notes. Even fewer publish yearly editions of systematic professional guides to be sold to the general public nationwide in bookshops, wine cellars and specialised shops. Arguably the three traditionally most popular and influential panels which edit professional guides are the Associazione Italiana Sommelier (AIS), the Seminario Permanente Luigi Veronelli (VER), and the Slow Food-Gambero Rosso (SF-GR). This does not mean that they are the only guides worth consulting: quite the contrary, many newer and competing guides are gaining credit, but they are either editorial initiatives accompanying national magazines or newspapers (for example the well-known *L'Espresso* guide), or the as yet not well established or structured guides edited by individual experts or wine-tasters (such as the sommelier Luca Maroni). For the purpose of gathering data for an empirical work such as this one, the above-mentioned guides by AIS, VER, and SF-GR are particularly attractive as they report quantitative and qualitative data on each wine which neatly integrate and complement each other.

Briefly, the AIS is the most renowned and structured society of professional sommeliers in Italy. With a local branch in every Italian province, it runs three-year specialisation courses (actually a kind of PhD) as exam preparation for a diploma to qualify officially as professional sommelier in Italy. Whilst this first level of qualification provides immediate entitlement to work as a sommelier in any restaurant or wine cellar, AIS also runs higher-level courses for more advanced qualifications as professional wine taster, judge, expert, and writer, recently including Master of Wine, which is intended to be the highest qualification in wine studies achievable in Italy. AIS is founding partner of the World Sommelier Association. It is reckoned by most international sommelier associations to be their partner and counterpart in Italy. AIS is also present with its own branches and activities in many cities outside Italy, for instance in Switzerland, Austria, France, Germany, and the UK.

Over the last 12 years AIS has edited its own professional guide, *Duemilavini AIS*, which is widely employed by professional sommeliers and buyers in the hospitality sector. The guide started in 2000, providing a qualitative description of 2000 wines, and currently assesses around 8–9,000 wines every year, giving some technical information on the wines, the producers and the oenologists.

The Seminario Permanente Luigi Veronelli (VER) was founded in Bergamo by Luigi Veronelli, undoubtedly the most famous and influential Italian sommelier and wine expert of all time. In the spirit of Luigi Veronelli – who was at the same time sommelier and oenologist – the Seminario has always emphasised the importance of traditional and correct practices and techniques in viticulture and oenology, together with the valorisation of the typicality of local wine-producing traditions. The best wine was thus intended not in absolute terms, but as the most faithful representation of that specific typology of wine. Rather than a generally applied grid against which to value the characteristics of a wine, the Veronelli wine-tasting panel has always emphasised the sensorial characteristics of the wine, together with the interpretation of its specificity. Since Luigi Veronelli passed away, the Seminario has been successfully directed by Gigi Brozzoni.

For more than 25 years now, the Seminario Veronelli has been promoting courses as professional wine-taster, and also specialisation courses in viticulture and oenology. It has also edited a guide, *I Vini di Veronelli*, which assesses more than 10,000 wines a year, and which, also due to its detailed information on wine-making techniques, is quite influential, and popular among wine-producers and oenologists.

Originally born in the nineties in Bra, in Piedmont, the Slow Food movement is now a worldwide phenomenon. Inspired by its founder, Carlin Petrini, and still guided by him, Slow Food considers the wine sector as just part of a much wider agenda aiming to actively promote the tangible and intangible values of local agriculture and oenogastronomic products. Slow Food has made the valorisation of the traditional local products one of its flagships by, for instance, emphasising the importance of the local autochthonous grapes, seeing them as an antidote to the homogenisation of tastes and flavours worldwide.

As for its wine guide, Slow Food joined forces with Gambero Rosso, a former independent wine-tasting guide associated with an homonymous magazine, and for 20 years, the *Slow Food – Gambero Rosso* (SF-GR) guide was a highly influential bestseller among wine lovers and the general public in Italy, due also to its ease of consultation and the avoidance of technicalities in favour of informal and qualitative description of the background and history of the wine-producers.[1] In its last four years, the guide was also translated into English and sold worldwide.

The three guides have been generally well accepted by the public, as witnessed by the sales volumes, by far the highest in the Italian wine guide market. While raw figures for the copies sold gave the leadership unambiguously to the SF-GR guide, followed by the AIS and the VER guide by a few thousand copies, it is also fair to say that over the years the three guides focused on three rather different segments of the demand. While the SF-GR guide broadly targeted generic wine consumers, AIS has mostly been intended for wine purchasers and sommeliers within the hospitality sector, whereas VER mainly targets fairly educated wine lovers and, consistent with Veronelli's spirit and experience, oenologists and wine-makers as well.

While the general public and consumers have obviously shown an interest in these guides, Italian wine producers have also been actively engaging with these wine-tasting panels and guides' awards. In fact from an industrial organisation perspective, the wine-judging panels in Italy can be seen as the pivotal interface of a two-sided market. On the one hand, the SF-GR sold, and the AIS and VER wine-tasting panels still sell, their edited guides to the general public and the various professionals within the wine sector. On the other hand, however, they offer their wine-tasting assessment and awarding services to the wine producers. From this perspective, the wine-tasting panels and expert judges act as the true market-makers in the Italian wine sector.

The wine producers, in fact, have also a strong incentive to seek the assessment services of these wine-judging panels. Expert opinions combined with the author's own experience suggest that an interesting economic model of price formation may be in place for many wines in the mid–high quality segment of the Italian market.[2] These wines are those whose selling prices lie roughly within the bracket €5–€25. Unlike the wines priced at or below €5, which can rarely be considered quality wines and are mainly sold through the supermarket channel using price as a key competitive factor, or the wines priced above €25, which are generally regarded as price-insensitive top-segment quality wines, the demand for wines priced between €5 and €25 is indeed highly elastic to selling prices, even whilst characterised as a demand for good-quality products.

In this price range, it can be argued that the wine producers have a particularly strong interest in obtaining feedback and awards from wine-tasting panels prior to setting their selling prices and putting their wines on the market. In fact, the higher the awards and more positive the feedback obtained by the panels, and thus the better the intrinsic quality perceived by professional wine-tasters, the higher the prices that can be charged to consumers.

For these reasons in Italy the same wine-producers often invite experts to taste their wines, and usually send samples of bottles to one or more qualified panels of experts (such as the AIS, Seminario Veronelli, Slow Food, Gambero Rosso and similar), at for instance, public events, wine-tasting sessions, or proper horizontal judging sessions (where a number of wines from same wine region and vintage are blind tasted and assessed by panels of professional experts). In those sessions, wines are given qualitative and quantitative evaluations (according to the scoring system adopted by the panel; see below for more details). Furthermore, an average evaluation by the wine-tasting panel is typically calculated and a brief assessment consensus report is drafted and sent to producers as feedback.

The wine producers can thus look at the average evaluations obtained by their own wine, and, perhaps most important, at their position relative to closely competing products in that segment, and use these as a guidance in their decision to set up their own pricing strategies within the €5–€25 range. If this price formation model indeed holds for some of the wines in the mid–high segment of the demand, the wine producers can set their selling prices on the basis of the relative ratings scored by the professional wine-tasting panels, so that selling prices, together with professional awards and ratings, can be used by final consumers and purchasers as signals reflecting the intrinsic quality of the wine as perceived by experts.[3]

6.4 The three main professional guides in Italy, and their data on wines and awards

Each of the three professional guides edited by the above wine-judging panels in Italy rates each of the wines assessed according to its own scoring scheme. Furthermore, at least two of those guides (produced by AIS and VER) also contain much quantitative information on the technical characteristics of the wine and the wine-making process, which can usefully be collected and combined to populate an original dataset for the Italian wines.

In particular, the AIS guide rates all the assessed wines within a five-grade system, based on a number of 'grapes' from zero to five; wines awarded five grapes are considered the best Italian wines and reported in the opening pages of the relevant edition.

The AIS guide also contains other information for each wine assessed. In particular it contains specific information on the selling price of the wine (at the cellar) which, unlike other guides, is precisely stated rather than included in brackets or classes. The AIS guide also contains other important information on the wines, and especially indicates the grape (in a varietal wine) or the proportion of the different grapes (in a blend) which compose each wine. In our empirical analysis we use this information to control the type and the mixture of the grapes employed in the wine, to see whether the wine is varietal or not and whether the grape is international or local (see below).

The real attraction of the AIS guide lies in the fact that it is the only professional guide which contains a brief description of the qualitative aromas as perceived in the sensorial tasting by the professional sommelier in the tasting panel. The aromatic and sensorial descriptions are quite detailed, and include the specific aromas of single components rather than categories: for instance the description of the aromas in, for example, a Chardonnay from Sicily, does not limit itself to generic terms such as 'fruity', but rather lists specific flavours perceived in, and evoked by, the wine tasting, such as 'peach', 'apricot', or 'passion fruit'.

In our empirical analysis, we process this qualitative information only in quantitative terms. Notably we count how many specific flavours and aromas have been perceived and described by the AIS guide, and we encode this information as the numerical variable *Aromas*. While this does not allow us to fully account for the qualitative differences in the aromas, this variable can be considered a reliable proxy for the intrinsic sensorial complexity of the wine. Professional sommeliers, in fact, tend to attach a higher sensorial value for a wine that presents a wider aromatic spectrum and richer complexity. Therefore the variable *Aromas* can be seen from this perspective as a close approximation to the objective sensorial quality of a wine.

The VER guide scores the wines from 0 to 100. In addition, stars are awarded for wines above 84, and it awards wines scoring 91 or more a maximum rating, the so-called three superstars.

The VER guide is the ideal companion guide to the AIS guide, integrating and complementing the information in it. While VER does not contain a qualitative description of the wines, it provides detailed information on the oenological techniques employed by the wine producers, coherently with the twofold expertise of Veronelli himself as sommelier and oenologist. For instance, the VER guide is the only one that provides full information on the vintage of each wine sold into the market (codified in our dataset as a set of vintage dummies); on the nature of the container where the fermentation has taken place (inox steel containers, wooden barrels, or small French oak barriques, which we codified as the categorical variable *Wood*, increasing, in precisely that order, with the extent of contact of the wine with the wood); on the number of months during which the fermentation took place;[4] and, also uniquely, on the number of produced bottles (*Bottles*); as well as the size (in hectares) of the area cultivated in vineyards by the wine producer (*Hectares*).

Finally, while providing little information on the characteristics of the wines and wine-making, the SF-GR guide gave qualitative information on the year in which the wine-producing cellar was founded. The SF-GR scoring system for the wines assessed was based on the famous 'glasses' scores, from 0 to 3 glasses, the latter being awarded to the very best wines.

Combining the information contained in the three professional guides – and the AIS and VER in particular – thus allows the construction of a quite rich and detailed dataset with many control variables on the characteristics of the wines and the viticulture and oenological techniques, in addition to the scores and ratings awarded to the wines by each guide.

6.5 Empirical analysis and results: the awards by the professional guides in 2008

In this section we inspect the ratings and scores awarded by the AIS, VER, and SF guides in 2008 in order to assess whether there may exist any systematic bias in the evaluations and judgements expressed. As discussed above, by the latter we mean any bias not explained by the wines' characteristics which are not necessarily indicators of, or correlated with, the intrinsic quality of the wine as should be perceived and evaluated by professional wine-tasters.

Here in particular, we refer to the regional origin of the wine as the main source of potential bias. In Italy, in fact, not only there is a well-known rivalry between the two main historical wine-producing regions, Tuscany and Piedmont (similar, perhaps to Bordeaux and Burgundy in France, or the Douro and the Alentejo in Portugal), but also recent rivalry and competition between those historical wine-producing regions and other regions with more recent oenological traditions, such as Friuli-Venezia Giulia, Alto Adige, Sicily, Campania and Basilicata.

Other potential sources of bias which are not necessarily related to the intrinsic quality of wines relate to the producers' experience. These include tension between older and more established producers and younger, more innovative producers; type of grape and wine, with the obvious distinction between red and white wines; and provenance of the grape employed in the wine-making process, with the oft-debated dualism between international grapes (for example Cabernet, Chardonnay) versus local grapes (Sangiovese, Trebbiano).

To explore the issue of possible bias, we used the 2008 edition of the AIS, VER and SF guides, and gathered information from each of those three guides to construct a dataset combining all data available for each wine awarded or assessed by the guides.

In particular, for each wine we collected data on the following characteristics: (i) type of wine, with a series of dummies *RedD, WhiteD,* and *SweetD* for red, white, and sweet wines respectively; (ii) official classification of the wine in terms of the regulated categories *IGT, DOC,* and *DOCG*, (*Indicazione Geografica Tipica, Denominazione di Origine Controllata, Denominazione di Origine Controllata e Garantita*); (iii) region of provenance, with a set of dummy variables, one for each producing region (for example *TuscanyD*); (iv) typology of the grape, with a dummy *LocalD* for the autochthonous grapes (for example Sangiovese, Trebbiano); (v) the distinction between varietal wines or wines blending more than one type of grape, with the dummy variable *VarietalD*; (vi) the above-mentioned number of sensorial aromas perceived in wine-tasting by the experts in the AIS guide (*Aromas*); (vii) the year of harvest (but of course in any year producers may decide to sell wines from very different years); (viii) the historical experience of the wine-producer, measured by the number years since the foundation of the cellar (*Experience*); (ix) the number of bottles produced (*Bottles*); and finally (x) the size in hectares of the area cultivated as a vineyard by the wine producer (*Hectares*).

In the following analysis, we focus on detecting any sign of regional bias in the scores and awards given by the guides. In particular, we look at how many wines of any particular region received the top quality awards – five grapes by AIS, three superstars by VER, and three glasses by SF. We then look at which wines received the top awards in more than one guide in order to test to what extent the scores and evaluations by the guides do indeed converge, thus selecting a sub-sample of truly best Italian wines.

The initial look at the data should start by considering some basic descriptive statistics. The first observation is that the odds of a wine being awarded the top score by a guide are extremely low. In 2008, the SF-GR guide, for instance, assessed 10,489 wines, and gave out only 305 three glasses, corresponding to 2.91 per cent of all the wines assessed. In the VER guide, the odds of receiving the maximum score were only marginally higher; it assessed as many as 15,463 wines, and gave out 489 three superstars, which despite being the highest absolute number of awards out of the three guides corresponded merely to 3.16 per cent of all wines assessed. Slightly higher odds hold for the AIS guides, which assessed 8735 wines and awarded 309 of them five grapes, corresponding to 3.54 per cent of the total. This first observation suggests that the selection process by each wine-tasting panel is extremely competitive.

The second observation refers to the high absolute number of Italian wines which are annually assessed by at least one guide. The three guides together, in fact, annually review nearly 35,000 wines, from thousands of producers. Some of the wines, however, obviously overlap, as the most renowned wines (and in fact all those which are awarded the maximum score by at least one guide) are indeed included in all three guides. Taking double or triple entries into account, the total number of wines assessed goes down to a figure fluctuating between 22,000 and 28,000 per year (Caggiano et al. 2012).

The third observation is that besides potential guide-specific regional biases, all three guides seem to share at least one easily perceived bias, namely for red wines. It is in fact fair to say that in general red wines are much more likely to be allocated the highest possible scores by any guide. Among all the wines awarded by the SF-GR guide, 82 per cent were red wines, and only 17 per cent white (with the remaining 1% sweet wines). Similar figures hold for the AIS guide, in which 81 per cent of the award-winning wines were red and 17 per cent white. The VER guide seemed to have an even higher preference for red wines, 94 per cent of all its three-superstar wines being red.

Another look at the data should take into account the empirical distribution by region of the wines assessed by each guide, and compare the latter to the regional distribution of the wines which have been given awards by that guide. The strategy here is basically to compare the empirical frequencies of wines along the dimension of the Italian regions of interest in the overall sample of wines assessed by each guide and in the resulting sub-sample of the wines given awards by that guide, and then to ask questions such as How many wines from Tuscany have been assessed and awarded compared to the total wines assessed /awarded?

Comparing the two empirical frequencies can provide preliminary insights into the selection criteria adopted by each guide in order to award the top scores to a wine coming from a particular region. In particular, the observation of a higher frequency of a region in the distribution of the awarded wines compared to the distribution of assessed wines may signal the existence of a possible bias in the experts' guide for wines from that region.

It is worth emphasising, however, that observing a higher frequency of a region in the distribution of the wines awarded than in the distribution of wines assessed may support two alternative interpretations of the bias thus observed. The first is that wines from that region are much more likely to be given awards by that guide, and are thus perceived as being of better quality. Alternatively, or possibly concurrently, the second interpretation is that one guide was particularly keen on including and assessing wines from that specific region, despite those wines indeed being relatively less promising than expected in achieving awards. Now while in principle the separation of these two sources of bias is intriguing, from an empirical perspective identifying and disentangling one from the other is practically impossible given the very nature of our data. In fact, no dataset at all is available for the almost limitless range of wines (estimates come to around 200,000) produced in Italy every year, so that we can only observe the characteristics of a wine when it is included in at least one guide, making the empirical test of a selection bias impossible.

Nevertheless, some interesting findings seem to emerge by the comparison of the empirical frequencies of the assessed and awarded wines by each guide.

Starting from the SF-GR guide, it can be noticed from Figures 6.1 and 6.2 that about one-fifth (19.98%) of all the wines assessed come from Piedmont, the region where the Slow Food movement originally developed. The share of wines assessed from Piedmont is larger than that of those from Tuscany, the competing historical region. It can be noticed, however, that the proportion of Piedmont wines assessed to the total produced is virtually identical to that of the awarded wines (20%), so that, in contrast to what is sometimes claimed, the Slow Food guide does not show any particular bias in favour of the wines from the Piedmont region. If anything, the SF-GR guide seems to have perhaps a particular attraction towards the wines from Tuscany, which, despite representing a significantly lower proportion of the total of wines assessed (14.52%), wins a proportion of the top score by the SF-GR guide; this is even higher (21.31%) than the Piedmont wines, which were originally represented more highly.

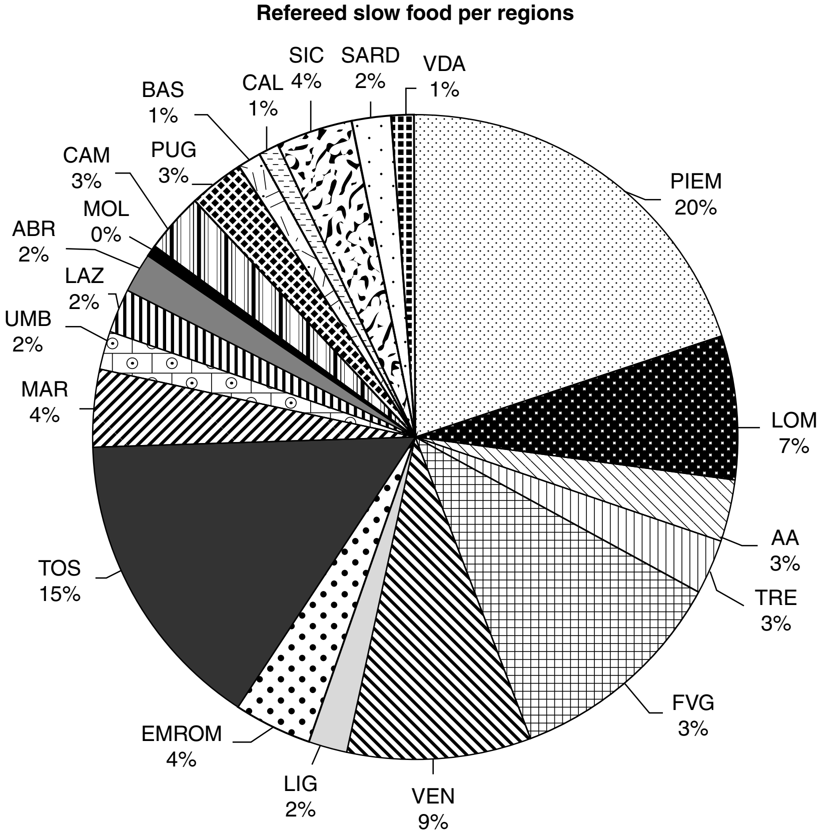

Figure 6.1 The wines refereed by the SF-GR guide per region

Turning to the AIS guide, from Figures 6.3 and 6.4 it can be seen that the proportion of Tuscan wines to the total of wines awarded is only marginally higher (15.68%) than the share of Tuscan wines to the entire sample of wines assessed (14.63%). The case of wines from Piedmont is different, however, as these wines represented 23.3 per cent of all the awards given out by the AIS guide but only 17.32 per cent of the wines assessed, indicating a preference in the AIS panels for wines from this region.

Finally quite the opposite story holds for the VER guide. As can be immediately noticed from Figures 6.5 and 6.6, the Tuscan wines represented by far the highest share (37.83%) of the awards by the VER guide in 2008 whilst accounting for only 17.65 per cent of the wines assessed by that edition. Interestingly, the latter figure was significantly lower than the corresponding share of the Piedmont wines assessed (24.28%), which nevertheless manage

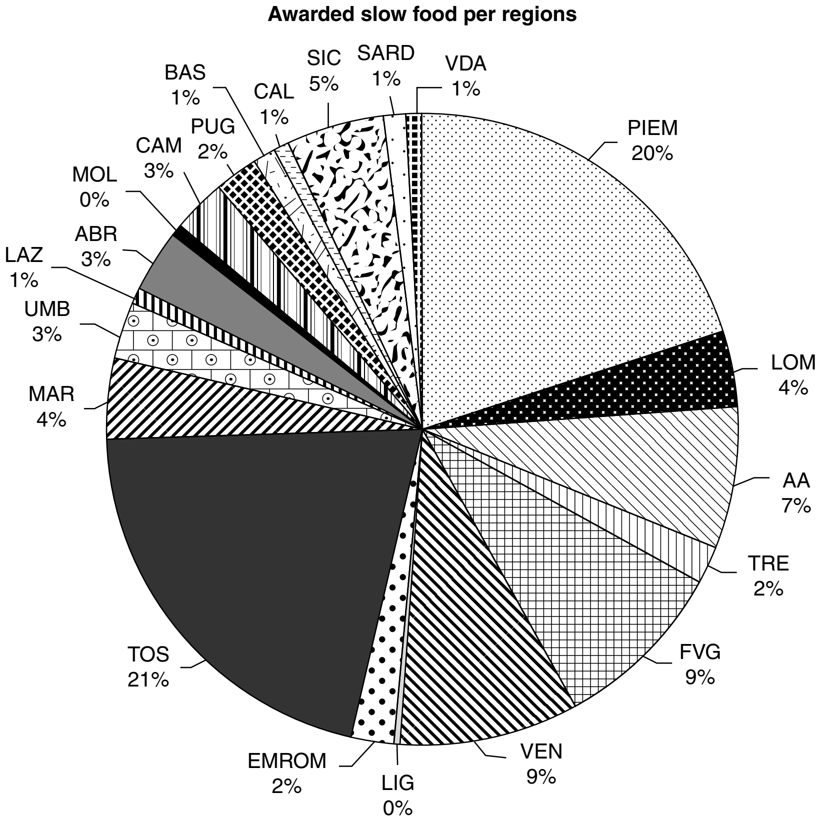

Figure 6.2 The wines awarded by the SF-GR guide per region

to represent a share of the total awards that is not only much smaller than that from Tuscany, but also lower than the proportion of the total of assessed wines (22.7%). All this indicates a fairly macroscopic attraction of the VER wine-tasting panel for wines from Tuscany at the expense of other regions such as Piedmont – but also, for instance, Friuli-Venezia Giulia, whose wines represent 10.04 per cent of the sample assessed, but only 3.68 per cent of the awards.

From this perspective, it may also be interesting to have a look at the assessed and awarded data at a more general level. One way is to calculate for each region a ratio between the total number of wines assessed from that region and the number of wines scoring highest in each of the three expert guides. This indicator can in fact be used to represent visually the objective odds of a wine from a specific Italian region being given an award by each guide provided that it has been considered for assessment by that guide.

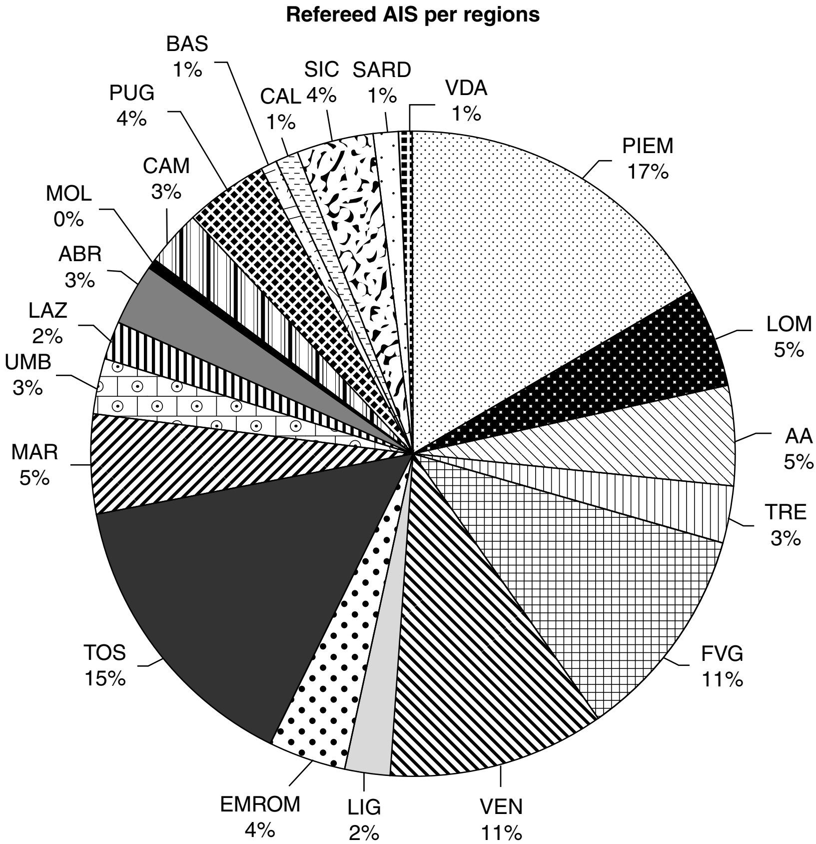

Figure 6.3 The wines assessed by the AIS guide per region

As can be seen from Figure 6.7, this analysis confirms the previously discussed findings on guide-specific biases. For instance, Tuscan wines seem to be particularly favoured by the VER guide, as well as wines from Marche, Umbria, Sardinia and Campania. The AIS guide seems to have a particular fondness for wines from Piedmont and Valle D'Aosta, as well as from Marche, Umbria and Sardinia, while the SF-GR seems particularly keen on wines from Alto Adige. Similar patterns of regional preference by professional guides have also been documented by Galizzi and Miniaci (2012) for the sub-sample of traditional method sparkling wines, in particular from Franciacorta (in Lombardy) and Trento (in Trentino).

As a third level of the empirical analysis, we turn to a more structured estimation of the likelihood of a wine receiving the top scores in the expert guides, in order to test the convergence of the scores and evaluations awarded

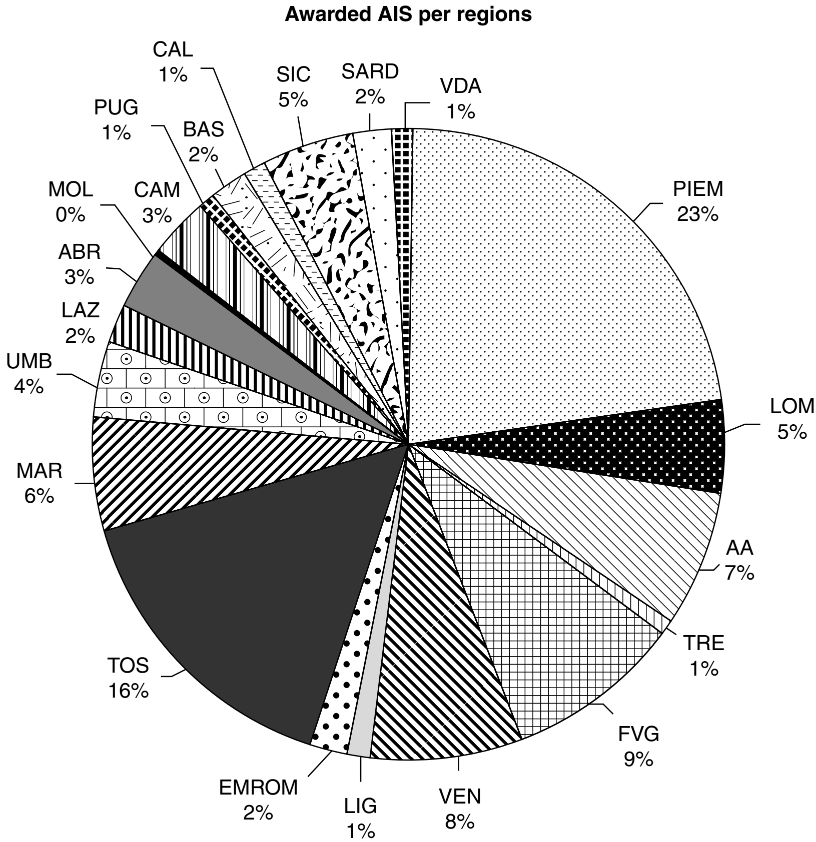

Figure 6.4 The wines awarded by the AIS guide per region

by the three guides. Our empirical strategy is as follows. We consider the subset of the wines that were in the 2008 edition awarded with a top score by *at least* one professional guide – either five grapes by AIS, or three superstars by VER, or three glasses by SF-GR. Pooling all the data from the three guides shows that a total of 1103 wines achieved a top score in at least one guide in 2008.

We then estimate the probability that the wines have been awarded top scores by two or three of these guides simultaneously. Specifically, we use an ordered probit model where the dependent variable of gaining awards from the guides takes values from 1 (top score in one guide only) to 3 (highest award by all three guides), and the explanatory variables are all the wines' and wine-producers' characteristics described above, collected from the three guides.[5]

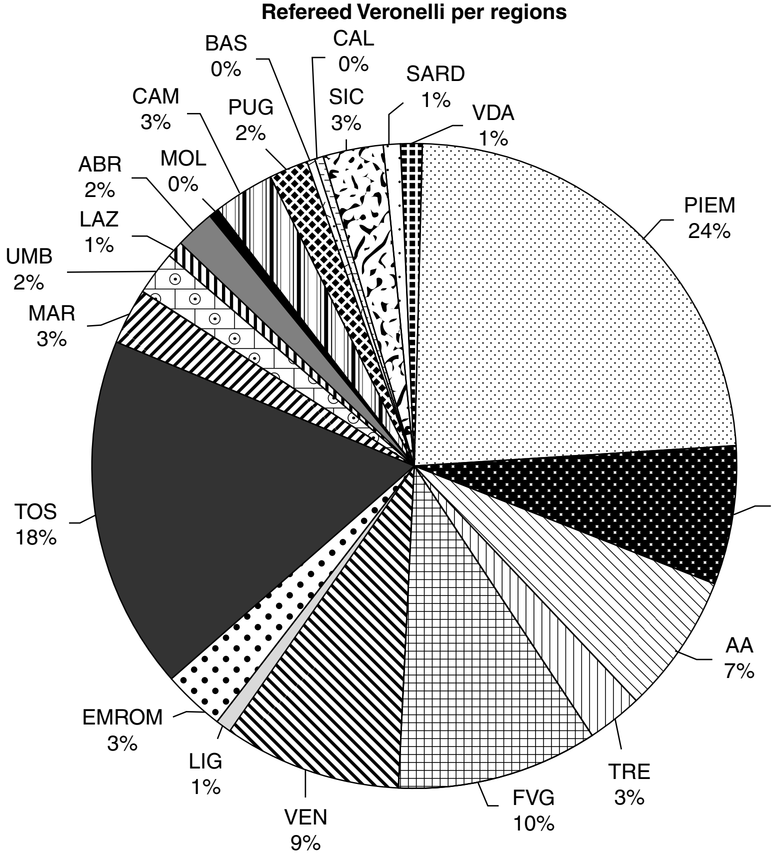

Figure 6.5 The wines assessed by the VER guide per region

Briefly, the main idea beyond an ordered probit regression is that the likelihood of observing a wine which has been awarded a top score by, say, two professional guides, $(Y = 2)$ can be modelled as:

$$\Pr(Y = 2|X_1, X_2, X_3, \cdots, X_k) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k) \qquad (1)$$

Where Φ is the cumulative standard normal distribution function, $X_1, X_2, \ldots X_k$ are the above wines' and cellars' characteristics used as explanatory variables, and $\beta_0, \beta_1, \beta_2, \ldots \beta_k$ are the coefficients of the explanatory variables to be estimated. The latter sign can be immediately interpreted as determining whether the likelihood of receiving more awards increases or decreases with the corresponding explanatory variable. In the case of the

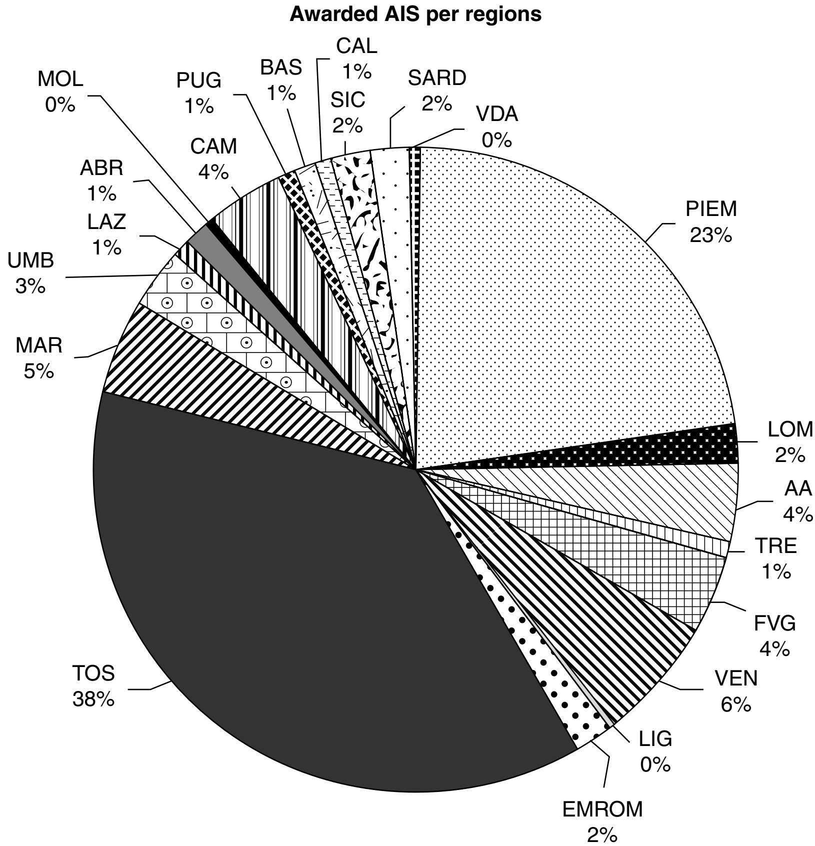

Figure 6.6 The wines awarded by the VER guide per region

ordinary probit model, the ancillary threshold parameters describing the cut-points between the three outcomes are estimated together with the regression coefficients, and help to match the probabilities associated with the outcome (Cameron and Trivedi 2006).

The results of the ordered probit model are presented in Table 6.1. We present three of the several specifications we have run. *Model I* includes in the explanatory variables the characteristics of the grape, the experience of the producer, the regional dummies, and the indicator for the sensorial aromas of the wine. *Model II* also includes in the controls the variables on the number of bottles and the extension of the area cultivated as vineyard, to test whether awards by the guide can be affected by the dimension and sales volumes of the wine producers. Finally, *Model III* also includes in the explanatory variables the oenological characteristics. The results presented

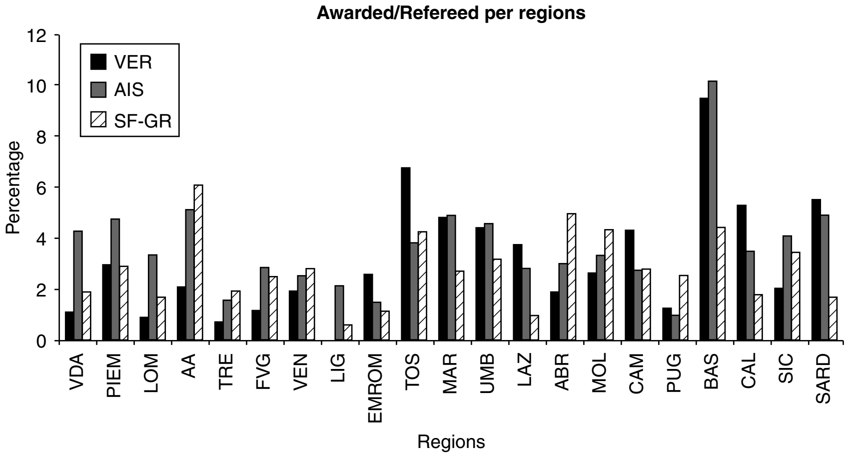

Figure 6.7 The awarded/assessed wines ratio per region and per guide

Table 6.1 The determinants of higher number of awards by professional guides

Probability of Awards	**Model (I)**	**Model (II)**	**Model (III)**
Local grape	0.349(0.196)	0.313(0.217)	0.358(0.216)
Varietal	0.073(0.054)	0.061(0.092)	0.045(0.103)
Red	0.431***(0.074)	0.407***(0.071)	0.416***(0.088)
Wood			0.094(0.077)
Fermentation			0.073(0.054)
Aromas	0.257(0.181)	0.250(0.288)	0.151(0.129)
DOCGDum	0.184(0.123)	0.172(0.151)	0.191(0.131)
TuscanyDum	0.284***(0.115)	0.233**(0.087)	0.267**(0.054)
PiedmontDum	−0.194	−0.116	−0.232
Bottles		−0.157	−0.251
Hectares		0.037(0.028)	0.041(0.039)
Experience	−0.165**	−0.143**	−0.112**
Cut 1	*0.294 (0.082)*	*0.284 (0.095)*	*0.259 (0.087)*
Cut 2	*0.764 (0.216)*	*0.731 (0.315)*	*0.733 (0.286)*
Observations	*1103*	*1103*	*1103*

Note: Standard errors in parentheses. *$p < .10$, **$p < .05$, ***$p < .01$.

remained qualitative, unaltered across many alternative empirical specifications and robustness checks in terms of the explanatory and control variables included.

As can be seen, and consistently with the above descriptive statistics, the fact of its being red is a powerful help to a wine in being given more than one maximum score by these guides. Interestingly, the fact that the wine incorporates one or more grapes, or local vs international grapes, does not significantly explain the likelihood of getting more than one award, and neither does the official classification of the wine in terms of DOC or DOCG. Also the oenological characteristics of the wines, such as the container in which the fermentation took place, or the duration of the fermentation itself, turned out not to be significant in predicting the likelihood of obtaining more awards.

In addition, the estimates show a strongly significant effect related to the regional origin of the wines: in particular those from Tuscany are more likely to receive a higher number of awards, while this premium effect does not apply to other historical wine-producing regions, nor for emerging regions with relatively younger wine-producing tradition (all other regional dummies are omitted as non-significant).

A seemingly counterintuitive result relates to the experience of the wine producers, which shows a negative and significant sign, as if the guides were less likely to converge in a consensus on the awards as far as well-established and long-serving wine producers are concerned. The dimension and sales volumes of the wine-producers turned out to be not significant, an indication contradicting the hypothesis that these guides may favour wine-makers with higher market shares.

The most interesting finding, however, is perhaps the fact that the only variable which can arguably be considered a close proxy for the intrinsic, objective sensorial quality of the wine – namely the number of aromas perceived by the professional sommelier in their tasting – is not significantly associated with the likelihood of winning more awards.

An analogous pattern of results emerged from the analysis of all other editions between 2007 and 2012, the only remarkable difference being that in some years other regional dummies also turned out to be statistically significant (Caggiano et al. 2012). All in all, these results suggest that some evaluation biases may exist in the process of awarding scores and ratings by the three main wine-tasting guides in Italy: while objective indicators of the intrinsic sensorial quality of the wines are not significantly associated with a higher likelihood of receiving better scores and more awards, such scores and awards are significantly associated with variables which do not necessarily correlate with higher intrinsic quality, such the region of provenance, the colour of the wine and the experience of the producers.

As such a weak form of convergence on the objective indicators of the quality of the wine seems to have emerged from this analysis, one might also wonder how strong the general consensus by the three competing panels was on the identification of which wines should be considered the truly best Italian wines in 2008.

As discussed above, the three guides altogether considered and assessed about 25,000 Italian wines in the 2008 edition. Out of this considerable pool, the three guides together awarded 1,103 top scores, namely 489 three superstars by VER, 309 five grapes by AIS, and 305 three glasses by SF-GR. This figure amounts to saying that less than about 4.5 per cent of the wines assessed every year by at least one guide manage to receive a top score in at least one guide. For a crude measure of convergence between the expert ratings and awards, the most natural candidate to consider is the number of wines awarded top scores by any one of the three guides.

On this point, we find quite a striking result; it turns out that as few as 36 wines were given top scores by the three guides! This figure – which clearly corresponds to the number of observations for which the dependent variable in our ordered probit model above took the value $Y = 3$ – leads us to conclude that only 3.49 per cent of the wines given an award by at least one guide in 2008 managed to earn top scores from all three panels. Together with the figure discussed above, this leads us to infer that only a tiny proportion, corresponding to about 0.15 per cent, of the wines considered for wine-tasting and assessment by at least one guide can be awarded top scores by all the three guides.

The fact that only 36 wines out of about 25,000 are considered unanimously the truly best Italian wines does not exactly point to the direction of a strong convergence and consensus among different wine experts and competing wine-tasting panels. This surprising result is not limited to 2008 as further confirmed by the findings by Caggiano et al. (2012) on the analogous figures for the subsequent 2009 to 2012 editions of the three guides, when at most 50 wines were awarded top scores by all the three guides.

It is then interesting to have a closer look at these truly 'best' Italian wines in 2008. For instance, it turned out that, coherently with the figures discussed above, they are mainly red: 86 per cent are in fact red wines, compared to 11 per cent white wines, and 3 per cent sweet wines. It may be also interesting to notice that about two-thirds of the truly best Italian wines were made employing exclusively local or autochthonous grapes (64%), compared to 22 per cent which used international grapes, and 14 per cent which mix local and international grapes, which further suggests that the profiles of winners emerging for the case of Italy are unlikely to be fully comparable with the ones in other countries.

Finally, and going back to the main focus of our analysis insofar, the data on the 36 truly best wines clearly indicates that, in line with what documented above, Tuscany clearly beats Piedmont in terms of total awarded wines: 38.9 per cent of the wines that were considered best by all the three professional guides were from Tuscany, against the 16.7 per cent of Piedmont wines. This is a really remarkable and striking result in light of the facts that, among the assessed wines, the share of Piedmont wines was roughly similar, if not significantly higher, than that of Tuscan wines across the three guides, and that, when the awards by the guides were considered in isolation, the difference in the shares of top scores for Piedmont and Tuscany was much less considerable (with the sole exception of the VER guide).

Finally, perhaps the most attractive aspect of making research on wine econometrics is that one has the opportunity to get closer to a very special product, the wine, which is hard not to love. Talking about wine without drinking it is, as we see it, unnatural, and so the final words of this work should try to reassure the reader that we are fully aware that actual wine-tasting is much more worthwhile than consulting assessor descriptions and expert tasting notes. So as a useful corollary to the present work, we have retained the names of the 36 Italian wines adjudged best in the 2008 edition: for the interested reader and wine-lover, Appendix 6.1 contains a shopping list – just six cases of the truly best Italian wines. We hope you will be able to enjoy them!

6.6 Conclusion

The aim of the present chapter was to explore whether the three mostly renowned experts' guides edited by the three main professional wine-tasting panels in Italy show any type of consensus on which wines are truly the best Italian wines, and at which extent their quality rankings indeed converge to the same pool of wines. In particular, we have empirically tested whether the guides may be affected by any form of regional bias, that is, may be keener of awarding higher scores to wines coming from a particular Italian region.

Our analysis has found that there is extremely weak convergence of the professional guides on the identification of the same set of best Italian wines. Out of more than 25,000 wines assessed in the 2008 edition, only 36 received the top awards in all the three professional guides, a figure roughly corresponding to the 0.15 per cent of the sample of wines assessed. We have also found that the convergence and consensus among competing wine-tasting panels is more likely to occur relating to red wines, especially from Tuscany. Moreover, and interestingly, we also found that no variable from a set of indicators capturing the oenological and sensorial characteristics of the wines was significantly associated with the likelihood of a wine being given a higher number of awards by the guides.

Furthermore we have also found that all the three guides have some favoured wines in terms of region of provenance, in the sense that they are keener on awarding top scores to wines produced in particular regions, and that each professional guide has its own range of preferred regions.

All in all, our results confirmed that, at least in the case of Italian wines, the wine judging and tasting process and, in particular, the guides reporting the scores given by professional panels of wine experts, are likely to be affected by factors such as the regional provenance of the wine, which are not necessarily correlated with the intrinsic oenological characteristics and sensorial quality of the wines. This suggests a touch of caution when interpreting the rankings and scores given by wine experts.

Appendix

Appendix 6.1 The Shopping List: The 36 Truly Best Italian Wines of 2008

Valle d'Aosta Chardonnay Cuvée Frissonnière Les Cretes,
Barbaresco 2004 Gaja,
Barbaresco Coparossa 2004,
Barbaresco Valeriano La Spinetta,
Barolo Percristina Clerico,
Langhe Nebbiolo Costa Russi,
Roero Rocche d'Ampsey,
Valtellina Sfursat 2004 Nino Negri,
San Leonardo 2003 Tenuta San Leonardo,
Alto Adige Gewürtztraminer Nussbaumer,
Alto Adige Lagrein Abtei,
Bolgheri Rosso Superiore Grattamarco,
Bolgheri Sassicaia Tenuta San Guido,
Brunello Cerretalto Casanova,
Brunello di Montalcino Poggio al vento Col d'Orcia,
Brunello di Montalcino Poggio Antico,
Brunello di Montalcino Vigna del Paretaio,
Camartina Querciabella,
Chianti Classico La Casuccia Castelli di Ama,
Cortona Il Bosco,
Galatrona Petrolo,
Le Pergole Torte Montevertine,
Masseto Ornellaia,
Saffredi Le Pupille,
Tignanello Antinori,
Rosso Piceno Sup. Roggio del Filare,
Cervaro della Sala,
Costa d'Amalfi Bianco fior d'uva Cuomo,
Montevetrano 2005,
Taurasi Radici,
Taurasi Antonio Caggiano,
Terra di Lavoro Galardi,
Aglianico del Vulture Basilisco,
Litra Sant'Anastasia,
Passito di Pantelleria Ben Ryé,
Carignano del Sulcis Cantina Santadi.

Notes

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The author gratefully acknowledges discussions with Tatiana Bouzdine-Chameeva, Gigi Brozzoni, Pierre Combris, Olivier Gergaud, Aziza Laguecir, Giovanni Malzanni, Franco Peracchi, Michael Visser, and the participants at the VDQS-EuAWE conference in Collioure, the AAWE conferences in Reims and Bozen, and the Wine and Spirits Markets Seminar at BEM Bordeaux Management School.

1. Interestingly, and for reasons which have not been fully explained publicly, the seemingly successful marriage between the Slow Food and Gambero Rosso partners ended suddenly in a divorce in 2011, when two separate and competing guides, one by SF and the other by GR, were released. See Caggiano et al. (2012) for more on the effects of that divorce.
2. A disclosure and a disclaimer are in order here. The author trained as professional wine-taster and has long served as a wine judge on panels organised by the Seminario Permanente Luigi Veronelli, the Associazione Italiana Sommelier, and the World Sommelier Association, from which he also obtained official qualifications as professional sommelier and wine-taster at both national and international level. These engagements, however, in no way influenced the works discussed in the present work. In addition, and perhaps needless to say, these engagements neither implied the involvement by any of these organisations in this work, nor their sharing of any of the views expressed here.
3. While this model also implies that wine experts should be able to perceive differences in wine quality which justify differences (at least partially) in price, this still leaves wide open the key question as to whether this holds for the vast majority of consumers.
4. In the case of classical method sparkling wines, the VER guide also reports the number of months during which the wine interacts with the yeasts along the second fermentation in the bottle (see Galizzi and Miniaci 2012).
5. In honour of the wine dataset, with the co-authors of a related work (Caggiano et al. 2012), we used to refer to the ordered probit model as the ordered prosit.

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7

Willingness to Pay for Appellation of Origin: Results of an Experiment with Pinot Noir Wines in France and Germany

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7.1 Introduction

Ever-increasing international competition in the wine sector has sharpened the controversy among economists who are in charge of analysing the agricultural sector and regional development. The growth of exports from the so-called New World countries (Australia, South Africa, Chile, Argentina, United States) questions rural concepts of wine-growing economy and makes it necessary to reconsider consumers' expectations and the whole economic organisation and marketing strategies of the wine sector.

Indeed, more than other food markets, the wine market is highly segmented with many differentiation criteria. Consumers have to choose in extended product lines with a host of objective and subjective characteristics (grape variety, certification, brand etc.). As a quality signal, the French certification Appellation d'Origine Contrôlée (AOC) is often criticised because of lack of readability. Irregularity in quality and too many different appellations are often used as arguments against this collective certification system. The classic opposition between Appellations of Origin and pure brand-named wines is often perceived as a confrontation between, on the one hand, a worthy collective system based on a common investment in quality and, on the other hand, a commercial system characteristic of industrial economy and which would have as its sole objective the advancement of the private interests of the firm. However, on the consumer's side, the actual trade-off between wine characteristics is not well understood. The relative impact of brand names, Appellations of Origin, and other items of information on labels, as well as their interactions with sensory characteristics, are matters still in need of clarification.

This chapter is an attempt to contribute to the debate by studying how wine consumers value these different characteristics, with a special focus on Protected Designation of Origin and private brands. We also investigate the impact of alternative front label designs and information.

Our interest is in the impact of quality signals on the lower-middle-range market, where competition is very tough. Therefore, our experiment was conducted with low- and mid-price wines and ordinary consumers (as opposed to experts or connoisseurs). Red Burgundy wines have been chosen as a model, because in spite of the indisputable reputation of great Burgundies, mid-range wines benefiting from the Protection of Designation of Origin nevertheless experience hard times on the international market. In order to control for grape variety, all the wines tested are from the same grape, namely Pinot Noir, which is the variety used in red Burgundy wines. In order to assess the impact of the Protected Designation of Origin information outside the country from which it originates, the valuation task was conducted jointly in France and Germany.

To avoid hypothetical bias in consumers' evaluation of the wines, we used an incentive compatible elicitation method, the Becker, DeGroot, Marschak (BDM) mechanism (Becker et al. 1964), based on real sales with a random selling price.[1]

After a brief review of previous work on willingness to pay for Protected Designation of Origin and other wine characteristics, Section 7.3 presents the experiment design and method, and Section 7.4 analyses the results.

7.2 Willingness to Pay (WTP) for Protected Designation of Origin and other wine characteristics

Willingness to Pay for wine characteristics is a widely studied subject. Much research has been conducted on this issue, using different methods and various kinds of data. Many papers also address the issue of identifying the determinants of wine prices.

Using a hedonic pricing framework, Combris, Lecocq and Visser (1997, 2000) and Lecocq and Visser (2006), consider objective and sensory characteristics. Objective cues are defined by the information provided by inspection of the bottle and its label (including Protected Designation of Origin, vintage, and grape). The results show that price differences are widely explained by objective characteristics, and that expert grading has little positive impact on wine prices. Following the same conventional hedonic model, using data from Australia and New Zealand, Schamel and Anderson (2003) show that regional reputations have become increasingly differentiated through time. They also find that vintage ratings by independent critics have a significant positive impact on the prices that consumers are willing to pay for premium wines. This result is consistent with the findings of Oczkowski (1994) and Schamel (2000) and with the effect of Robert Parker's opinion as assessed by Ali et al. (2008).

Several papers focus on consumers' valuation of Country of Origin certification, using contingent valuation surveys, choice experiments and experimental markets. Loureiro (2003) uses contingent valuation to estimate consumers' WTP for geographical and environmental labels. Based on survey data for Colorado (USA) wines, the main finding is that environmental labels are worthless with what are perceived as poor quality wines. Skuras and Vakrou (2002) also employ the contingent valuation method with Greek wine drinkers; applying a choice model, they find that specific origin increases consumers' WTP. Brooks (2003) uses data from *The Wine Advocate* to measure Country of Origin bias in US wine imports; the author assesses the valuation of wines according to objective and subjective cues, to find that Country of Origin bias does significantly affect the prices of US wine imports, the premium being particularly high for France and Italy. Unfortunately, however, the data does not indicate region of origin, so the author was unable to isolate regional effects from country effects.

When market data on specific characteristics are not available, use of a controlled laboratory environment is an efficient way of recreating a simplified market where these specific aspects are easily identifiable. Lecocq et al. (2005) used an experimental wine auction, aiming to assess the impact of product information on WTP. They compared three groups of participants. In the first group, participants evaluated four wines by examining labels and reading extracts from wine guides and technical details about each wine; they also tasted them. In a second group, participants had the same information but they could not taste the wines. In the third group, they only tasted the wines without being given any added information. The authors show that WTP for wine is less related to the sensory attributes than to the information reported on the label and expert guidance. The authors also find that several socio-economic characteristics have significant effects on WTP (women have a lower WTP than men, and regular drinkers have a higher WTP than occasional drinkers).

Lange et al. (2002) and Combris et al. (2001, 2006) performed hedonic tests and experimental auctions to assess the weights of sensory characteristics and reputation on the willingness to pay for Champagnes. They compared Vickrey auction, BDM mechanism and hedonic test. Their results show an extreme heterogeneity of preferences after blind tasting, and concordance between the hierarchy of market prices and mean participant rankings appears only when labels are disclosed; so brand and reputation have significant and large impacts on WTP. Nevertheless, detailed analysis of individual rankings reveals that preference heterogeneity remains significant even when participants are fully informed of product characteristics and brands. A study by d'Hauteville, Fornerino and Perrouty (2007) measures the impact of the region of origin, using the relation between expected and perceived quality. The experiments suggest that disconfirmation of expected quality may be used to measure region of origin equity on a behavioural basis.

7.3 Experiment design and method

The experiment is based on the protocol developed by Lange et al. (2002) and Combris et al. (2001, 2006). Experiments were conducted in Paris (France) and Munich (Germany).

Recruitment of participants

A total of 119 participants were recruited by market research companies (60 participants in Paris and 59 in Munich). The individuals selected had to meet three criteria:[2] (i) being wine drinkers (drinking wine at least once a week for French participants, and once every two weeks for German participants), (ii) being involved in their household wine purchases, (iii) not having taken part in a marketing or consumer study in the previous three months. Subjects were offered a monetary compensation to participate in a study which was at first loosely defined as a ‘preference experiment’.

Each eligible participant was sent (by email or postal mail) information about how the experiment would be conducted. The objective was to get participants to fully understand the revelation mechanism and to give them time to become familiar with it. Instructions were nominal and contained an example with actual figures to ensure the revelation mechanism had been properly understood. To control for any potential anchoring bias, different examples were used for each participant.

Choice of wines

Four wines from Pinot Noir grapes were selected for the experiments after a tasting session conducted by experts and professionals of the wine sector in Dijon. These wines were chosen in order to be relatively close substitutes, each one with a typical set of characteristics:

1) ‘Bourgogne, Appellation Bourgogne Contrôlée’, represents the well-known French certification of origin from the Burgundy region. Red wines from this Protected Designation of Origin are made only from Pinot Noir grapes. The market price of the wine used for the experiment was €7.00 per bottle.
2) ‘Bourgogne, Appellation Bourgogne Contrôlée, Passe-tout-Grains’, is another Protected Designation of Origin from the Burgundy region. Red wines from this Protected Designation of Origin are made from Pinot Noir and Gamay grapes. These wines are rather on the low-price side of the market. The price of the Passe-tout-Grains used for the experiment was €3.20 per bottle.

3) 'Ernest & Julio Gallo, Turning Leaf, Pinot Noir' represents the pure brand-named wine. Gallo's brand is famous, and Gallo is one of the biggest companies in the wine industry. Gallo's Pinot Noir price was €6.80 per bottle.
4) 'Pinot noir' represents the grape variety Pinot Noir, without any other indication. This wine actually came from the south of France (Pays d'Oc) but this origin was not mentioned on the label we used for the experiment. The market price of this wine was €5.60 per bottle.

In the sequel to the chapter, and in the tables and figures, these four wines are denoted respectively: Burgundy, PTG, Gallo and Pinot.

Sessions

Sessions were held in Munich and Paris, taking place in tasting rooms, with the aforementioned 20 participants per session in Munich and 11 participants per session in Paris. The four wines were first evaluated after blind tasting, then after examination of the bottle with no tasting, and finally after examination of the bottle and tasting.

For label examination, four additional labels were included: the label from a German wine (Spätburgunder), a label where the name of the grape variety (Pinot Noir) was added to the Protected Designation of Origin, a label with a traditional design (parchment), and a label with a modern design.[3]

The session began with a presentation of the experiment and a detailed explanation of the BDM procedure. To ensure that the revelation mechanism and the selling procedure were properly understood, a fictive sale was conducted with almonds and cashews. Then, participants were seated in a sensory analysis room in such a way that they could not communicate with each other. They each had a glass of water and some bread to take away the taste of the wines between each tasting.

The participants had to evaluate the wines in three informational situations:

- First, each participant valued the four wines in turn (sequential monadic design) in a blind tasting. They could taste each wine but had no other indication beyond sensory information. After tasting each wine, participants wrote their maximum buying price for the wine on a form. They were told to do it carefully, imagining that this wine could be the one sold at the end of the experiment. They could indicate that they did not want to buy the wine by ticking a box. Forms were collected by the experimenter after each individual evaluation.
- In the second situation, participants examined the labels of eight wines in turn but without tasting them. Again participants wrote down their maximum buying price for each of the wines.

- In the third situation, participants valued the initial four wines in turn. They tasted each wine, examining the corresponding label at the same time. After each tasting, participants wrote down their maximum buying price for each wine.

It should also be noted that the participants were never told that the wines presented in the three situations were actually the same wines. Participants tasted or visually assessed each wine sequentially. Each wine was served in a glass (20 ml per glass) at a temperature of 15 ± 2°C. The wines were presented to each participant in a different sequence. So participants did not taste the same wine as their neighbours at any one time, and the impact of tasting a wine after or before another could be tested. After each tasting and each valuation, the wines (or labels) were taken away from the participants and their valuations were recorded. Participants could not revise their valuations with hindsight after experiencing the other wines or situations.

To avoid endowment effects and strategic behaviours, participants were informed at the beginning of the session that after they had completed the evaluation task, only one wine evaluated in one of the three situations would be randomly selected to be actually sold.

At the end of the session, each participant drew a token from a bag to select one situation and one wine. Then they individually drew a token from another bag containing selling prices. When a participant drew a selling price equal to or lower than the maximum buying price they had indicated for that wine, they had to buy the wine at the randomly drawn selling price. If, however, the random selling price was higher than their maximum buying price, they did not buy. So participants had an incentive to indicate a maximum price they would not come to regret, whatever the actual selling price.

To avoid anchoring effects, the range of the selling price distribution was not indicated precisely. Participants were told that the price distribution reflected that of the tested wines, with a wider spread, and that they could ask to check the bag with the price tokens at the end of the experiment.

7.4 Data and results

The data analysed in this chapter was collected during experiments conducted in April 2007 (German data) and September 2007 (French data). Table 7.1 reports the main characteristics of each sample. The first session was conducted in Germany, in which the 59 consumers from Munich participated. The second experimental session took place in France, in which the 60 consumers from Paris participated.

Each of the 119 participants submitted 16 bids, which results in a total of 1904 observations. Age, gender, household income and size were collected (Table 7.1). The mean values of the different characteristics do not differ

Table 7.1 Characteristics of the two samples of participants

	Germany (Munich) (59 participants)				France (Paris) (60 participants)			
	Mean	**Std Dev.**	**Min.**	**Max.**	**Mean**	**Std Dev.**	**Min.**	**Max.**
Age	40.81	11.46	20	65	41.19	11.75	24	60
Gender (= 1 if male)	0.51	0.50	0	1	0.55	0.50	0	1
Household Size	2.39	1.06	1	5	2.41	0.99	1	6
Per capita income (€/month)	1240.96	705.72	133	3500	1558.47	865.02	100	5500
Usual price paid for wine	5.42	3.12	2.25	20	4.83	2.03	2	11

significantly between the two samples, except for per capita income which is higher in the French than in the German sample.

Analysing the choice of a product as a two-step process (see for instance Haines et al. 1988) allows the identification of differences that may appear between factors influencing a consumer's decision to buy or not to buy a given product (the first step) and the amount they are willing to pay for it once they have decided to buy it (the second step). Unlike market data which do not always permit identification of the reasons why consumers do not purchase a product (preference or price), experiments provide clear information on this issue by eliciting refusals to buy and reservation prices. Participants who refuse to buy a product whatever its price unambiguously reveal that they do not like it. This justifies separate analysis of each step of the decision-making process. So in a first sub-section, we discuss the factors influencing the decision whether or not to buy. In a second sub-section, we focus on factors explaining non-zero WTP.

Factors influencing the decision to buy

For the four wines (Burgundy, PTG, Gallo and Pinot) which were presented in each of the three situations, we obtain a total of 1428 prices (119 participants giving four prices in three situations). Out of this total, 279 bids (19.5%) are zero and represent refusals to purchase. This percentage is higher in the German than in the French sample (23% vs. 16.1%). The largest proportion of refusals to buy is observed for the Burgundy (29.4%) in Munich, and for the Gallo (22.8%) in Paris.

Figure 7.1 shows means and 95 per cent confidence intervals of the proportion of participants refusing to purchase according to wine and situation in Paris and in Munich. After blind tasting (situation 1), French participants display no significant difference between the four wines. On the other hand,

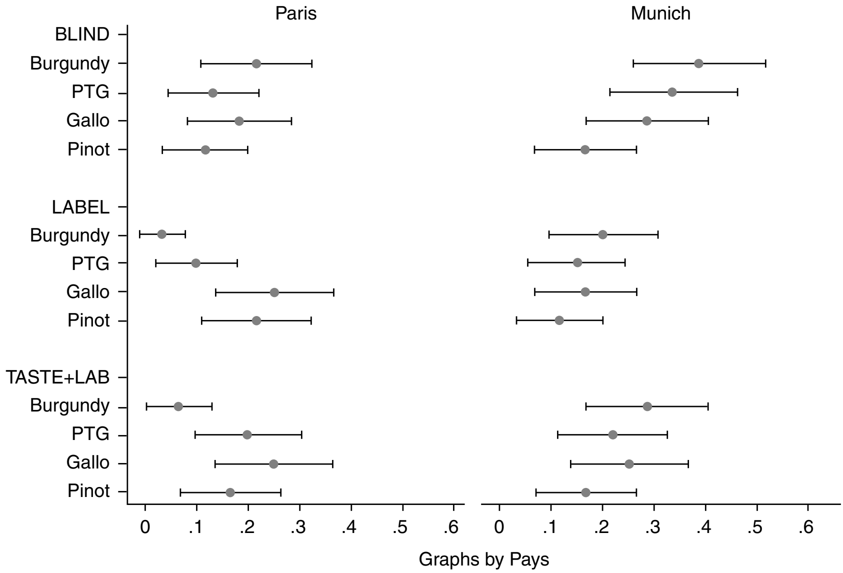

Figure 7.1 Means and 95% confidence intervals of the proportion of participants refusing to buy

German consumers show a clear preference for the Pinot Noir, which is significantly less rejected than the other three wines. After examination of the labels (situation 2), French participants reject the Gallo and the Pinot Noir significantly more than the Burgundy and the Passe-tout-Grains (PTG). German participants, however, show no significant differences in their preferences based on examination of the different labels. In the last situation, where participants had full information, the Burgundy is less rejected than the other three wines by French participants, but no significant differences appear in the German sample.

Wilcoxon matched-pairs signed-ranks tests on purchase refusals confirm these results. In the German sample, significant differences appear only after blind tasting and show that Pinot Noir is preferred to Burgundy ($P<0.01$), PTG ($P<0.05$), and almost significantly so to Gallo ($P=0.11$). After examination of the labels, French participants display a clear preference for Burgundy relative to Gallo ($P<0.001$), Pinot Noir ($P<0.01$) and PTG ($P<0.05$), and also a preference for Passe-tout-Grains relative to Gallo ($P<0.05$) and Pinot Noir ($P<0.10$). In the last situation, after tasting, preference for PTG is no longer significant and the Burgundy emerges as the preferred wine.

To quantify more precisely the probability that participants would indicate a positive price, a probit model is estimated on the whole sample, and separately on the French and the German samples. The specification allows for interactions between situations and wines, and controls for participant socio-demographic characteristics. Table 7.2 reports marginal effects on probability of buying, which are in line with the preceding comments.

Table 7.2 Probit marginal probabilities of factors affecting participants' decision to buy

	Full sample	**France**	**Germany**
Blind	Reference	Reference	Reference
Label	0.164***	0.226***	0.117**
Full Info	0.105***	0.153***	0.067
Blind X Bourg	Reference	Reference	Reference
X PTG	0.049	0.070	0.027
X Gallo	0.028	0.026	0.032
X Pinot	0.119***	0.081	0.151***
Label X Bourg	Reference	Reference	Reference
X PTG	−0.0003	−0.156**	0.083**
X Gallo	−0.131**	−0.400***	0.057
X Pinot	−0.069	−0.332***	0.105**
Full Info X Bourg	Reference	Reference	Reference
X PTG	−0.091	−0.274***	0.041**
X Gallo	−0.053	−0.200**	0.045
X Pinot	0.009	−0.151	0.114*
Country (ref = France)	−0.050		
Usual price	0.023***	0.016	0.028**
Woman	−0.066*	−0.005	−0.151***
Household size	0.016	0.021	−0.003
Income	−0.023	−0.026	−0.006
Age	−0.0003	0.001	−0.002
Order	−0.006	−0.009	−0.0004
Predicted purchase probability	0.825	0.848	0.825
Observed purchase probability	0.812	0.828	0.792
Observations	1247	671	576

Notes: Probit models with robust standard errors accounting for within subject correlation between observations. Marginal effects are evaluated at the means of the independent variables. Number of observations as less than 1428 due to introduction of socio-economic variables with missing values. * significant at 10%; ** significant at 5%; *** significant at 1%.

The results show very clearly that compared to blind tasting, label examination has a positive and significant impact on the probability of purchasing in both France and Germany.

Interactions between wines and situation show that label is a rejection factor for PTG, Gallo and Pinot in France, but not in Germany; this confirms that the Burgundy designation has a high and systematic impact in France but not in Germany.

Only two participant characteristics have an impact on the probability of purchase: gender, and the price usually paid when purchasing wine. The price usually paid for wine increases the probability of purchase, but is significant only in Germany and not in France. In this study, being a woman decreases the probability of buying and this difference, too, appears to be significant only in the German sample.

Factors influencing positive WTP

Table 7.3 reports price means and standard deviations for positive prices proposed by participants when they decide to buy; it gives an overview of the average bids for each of the four products in each situation. After the blind tasting, it appears that average prices are slightly higher for Burgundy than for the other wines, suggesting clear-cut preference for this wine, which tends to be either rejected (highest refusal rates after blind tasting) or liked (highest price after blind tasting for those participants who agree to buy it). However, as Figure 7.2 shows, positive WTP are not significantly different between the wines within each situation and country.

Comparing situations rather than wines shows that labels globally increase the WTP relative to blind tasting. Comparing countries shows that participants proposed higher prices in Germany than in France. This is in contrast with purchase probabilities, which were lower in the German sample. This point probably deserves more attention, because increasing the probability to purchase does not require the same strategy as increasing the WTP of consumers who agree to buy.

A regression of positive prices on all the explanatory variables confirms these results (see Appendix, Table A7.1). Compared to the blind-tasting situation, prices are higher in situation 2 (label) in both samples, and in situation 3 (full information) in France only. Again, this illustrates the positive influence of labels on WTP.

Interactions between wines and situations show no further influence, except a negative one for Pinot in the French sample. When analysing positive prices, the differentiation among wines thus appears less significant than when focusing on the decision to buy. This means that for the middle-range wines tested in these experiments, market shares resulting from consumers' choices are not due to the amount consumers are ready to pay but are mainly the result of their decision to buy or not to do so.

An important factor that has to be taken into account at this stage is the usual price paid for wine. This variable is always significant and has more impact on the WTP than on the probability of buying. This could mean that once consumers have decided to buy a wine, they evaluate their WTP for this wine using the price they are used to paying as a reference.

Table 7.3 Mean positive bids and standard deviations according to product and condition

	Total sample				French sample				German sample			
	Blind	**Label**	**B+Lab**	**Total**	**Blind**	**Label**	**B+Lab**	**Total**	**Blind**	**Label**	**B+Lab**	**Total**
Burgundy	3.12	3.90	3.90	3.67	2.74	3.56	3.59	3.33	3.61	4.32	4.31	4.11
	(2.56)	(2.56)	(2.53)	(2.57)	(1.92)	(1.93)	(1.99)	(1.97)	(3.18)	(3.14)	(3.09)	(3.13)
PTG	2.73	3.92	3.78	3.50	2.47	3.56	3.67	3.23	3.07	4.30	3.90	3.81
	(1.78)	(2.56)	(2.33)	(2.32)	(1.66)	(2.41)	(2.48)	(2.26)	(1.90)	(2.69)	(2.18)	(2.35)
Gallo	2.85	3.86	3.90	3.54	2.41	3.11	3.36	2.95	3.36	4.56	4.45	4.15
	(1.93)	(3.40)	(3.13)	(2.92)	(1.63)	(2.02)	(2.03)	(1.93)	(2.13)	(4.19)	(3.90)	(3.58)
Pinot	2.91	3.70	3.84	3.48	2.61	3.21	3.63	3.14	3.24	4.14	4.06	3.82
	(2.11)	(2.46)	(2.45)	(2.38)	(1.97)	(2.01)	(2.25)	(2.11)	(2.23)	(2.76)	(2.65)	(2.58)
All	2.89	3.86	3.86	3.63	2.56	3.36	3.57	3.21	3.31	4.38	4.17	4.08
	(2.11)	(2.77)	(2.61)	(2.61)	(1.79)	(2.06)	(2.18)	(2.06)	(2.36)	(3.27)	(2.98)	(3.04)

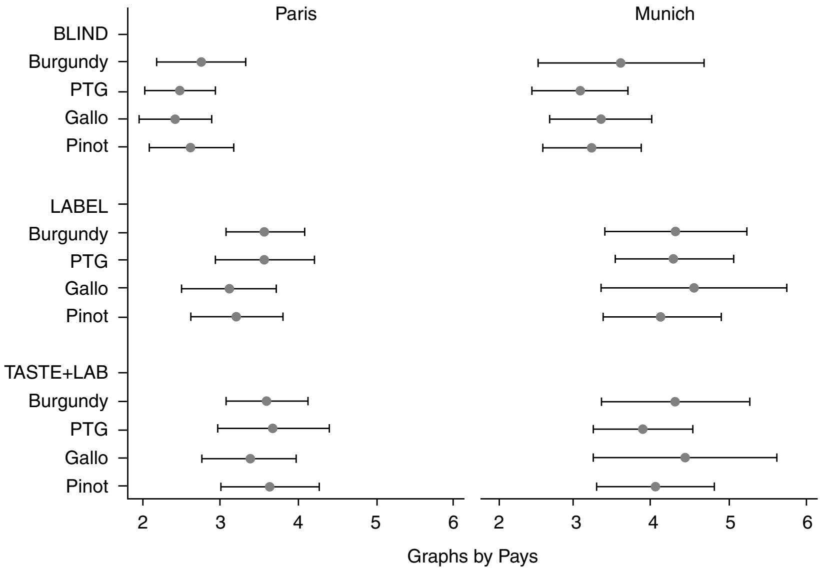

Figure 7.2 Means and 95% confidence intervals of positive WTP (in Euros per bottle) Proportion refusing to purchase WTP>0

Willingness to pay according to preferences

The previous analysis of buying decision and WTP has shown small differences among the wines that have been tested in this study. These small differences can result from almost identical evaluation of the wines by participants (due to close objective characteristics of the wines or to participants' lack of discriminating ability) or they can be the outcome of an aggregation of preferences. In this case, participants discriminate among wines, but their preferences are very heterogeneous and aggregations cancel out the differences. These two alternatives have totally different implications in terms of industrial strategies.

To know whether participants have actually discriminated among wines during the experiments, their individual WTP are ranked in each situation, the highest WTP corresponding to the preferred wine. The wine with the highest WTP is ranked 1, and so on. No correction is made for ties, which means that the rank of a given wine is 1 plus the number of wines that have a higher WTP.

Figure 7.3 shows mean purchase refusals and mean positive WTP computed according to rank. Both graphs suggest that preferences are actually strong.

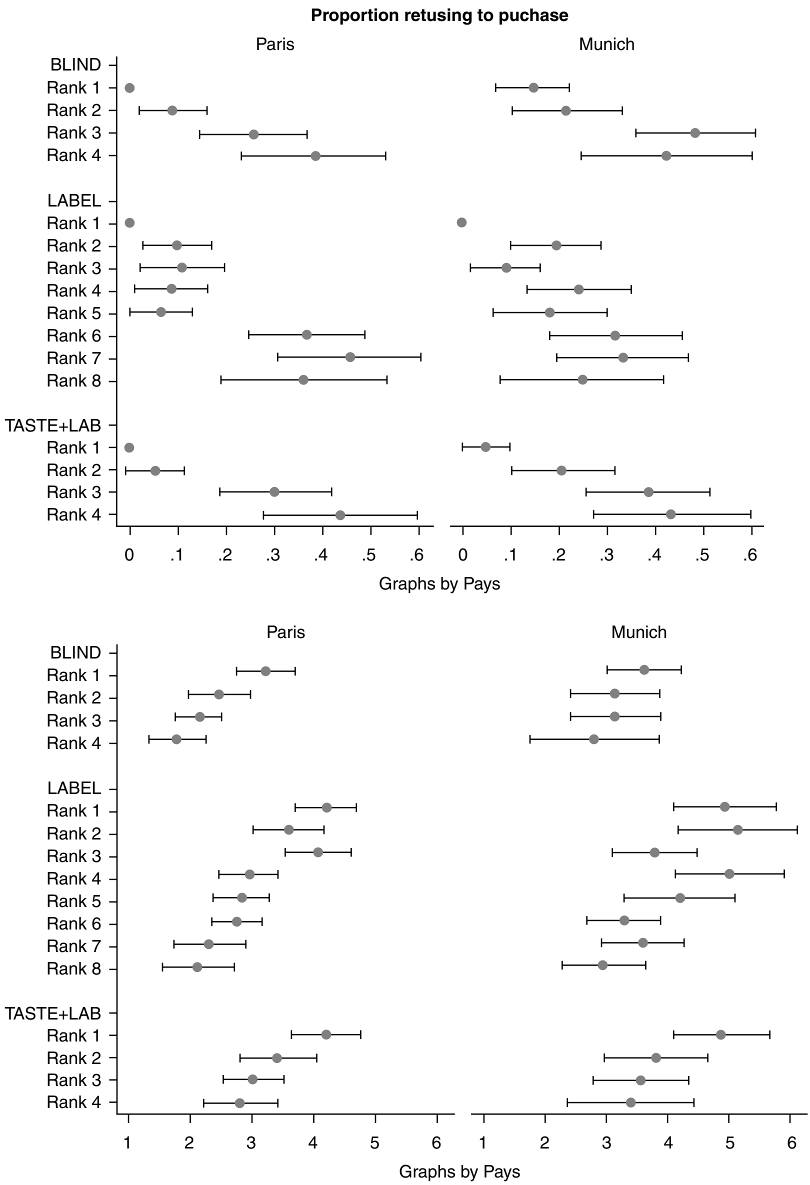

Figure 7.3 Mean and 95% confidence intervals according to wine ranking in each situation

The left part of Figure 7.3 shows that whatever the situation, French participants never refuse to purchase their favourite wine. In the blind-tasting situation, refusal rates for the three favourite wines are significantly different ($P < 0.02$ for comparison between ranks 1 and 2, and between ranks 2 and 3). On the contrary, for the two least appreciated wines, refusal rates are not significantly different. In the label-examination situation, three clear groups appear: the favourite label, then the next four labels, and finally the last three. In the full-information situation, we find the same configuration as in the blind situation, but with a more significant gap between the two favourite wines and the two least appreciated.

In the blind-tasting situation, German participants' preferences are structured in two groups of two wines. In the label-examination situation, the refusal rate is 0 for the favourite wine, but no further significant differences appear between the other wines. This seems to confirm that in the German consumers there is no clear differentiation based on labels. In full-information situation, a three-group classification appears, as with the French participants.

The right part of Figure 7.3 displays non-zero WTP according to preference. In contrast to the outcome of the analysis by wine, which showed very little difference between positive WTP within each situation, the analysis by rank reveals that once the purchase decision has been taken, the WTP can still vary considerably according to the preferences of the individual consumer.

In the Paris blind tasting, the price offered for the favourite wine is significantly higher than for the other wines ($P<0.04$). In the label-examination situation, three groups of wines can be distinguished: the first three, then the next three, and finally the last two. In the full-information condition, only the price of the favourite wine is significantly higher than the prices of the others. This last result also applies to the German sample, whereas it is more difficult to bring to the foreground a relevant classification in the other conditions (blind tasting and visual examination).

7.5 Conclusion

Based on real sales in three different information conditions, this study provides a number of results on consumer willingness to pay for middle-range Pinot Noir wines, according to their sensory and label characteristics. To assess the market value of the Burgundy Protected Designation relative to other indicators of quality, French and German consumers were compared in order to control for a Country of Origin effect.

Results show that sensory characteristics and label information influence French and German consumers differently. The results also show that for middle-range wines information on Protected Designation of Origin does not confer a decisive advantage outside the country of origin. Comparisons of individual valuations reveal that the small differences observed in mean WTP for each wine in each country and information condition do not result from consumers' lack of discrimination. Participants in both samples display strong individual preferences; however these preferences, being very heterogeneous, tend to cancel out when individual WTP figures are aggregated.

Appendix

Table A7.1 Factors influencing the level of positive reservation prices

	Full sample	**France**	**Germany**
Blind	Reference	Reference	Reference
Label	0.834***	0.885***	0.821***
Full Info	0.869***	0.942***	0.789
Blind X Bourg	Reference	Reference	Reference
X PTG	–0.320	–0.198	–0.485
X Gallo	–0.212	–0.132	–0.276
X Pinot	–0.109	0.028	–0.224
Label X Bourg	Reference	Reference	Reference
X PTG	–0.068	–0.053	–0.141
X Gallo	–0.090	–0.359	0.136
X Pinot	–0.349	–0.461**	–0.276
Full Info X Bourg	Reference	Reference	Reference
X PTG	–0.146	–0.006	–0.294
X Gallo	–0.014	–0.141	0.124
X Pinot	0.081	–0.039	–0.159
Country (ref = France)	0.424		
Usual price	0.500***	0.542***	0.450***
Woman (ref = men)	–0.320	–0.381	–0.346
Household size	–0.099	–0.187	–0.037
Income	–0.156	–0.506**	0.327
Age	–0.006	0.010	–0.007
Order	–0.041	–0.038	–0.045
Constant	0.426	1.084	0.477
Observations	1012	556	456

Notes: OLS with Robust standard errors accounting for within subject correlation between observations. * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.

Notes

1. See Lusk and Shogren (2007) for a detailed presentation of experimental auctions as a tool to elicit consumers' willingness to pay.
2. The recruitment questionnaire is available on demand from the authors.
3. The analysis of these additional labels is the subject of another study.

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Part III

Wine Ranking and Financial Issues

8
How Best to Rank Wines: Majority Judgment

Michel Balinski and Rida Laraki

8.1 Introduction

Classifying and ranking wines has been a favourite activity of men and women since time immemorial. Gaius Plinius Secundus (Pliny the Elder) who died in the year 79 AD wrote in his treatise *The Natural History* (Pliny the Elder, circa AD 77–79):

> Who can entertain a doubt that some kinds of wine are more agreeable to the palate than others, or that even out of the very same vat there are occasionally produced wines that are by no means of equal goodness, the one being much superior to the other, whether it is that it is owing to the cask, or to some other fortuitous circumstance … The late Emperor Augustus preferred the Setinum to all others, and nearly all the emperors that have succeeded him have followed his example … The second rank belonged to the wine of the Falernian territory, of which the Faustianum was the most choice variety; the result of the care and skill employed upon its cultivation … To the third rank belonged the various wines of Alba … I am by no means unaware that most of my readers will be of opinion that I have omitted a vast number of wines, seeing that every one has his own peculiar choice … Indeed I have no wish to deny that there may be other wines deserving of a very high reputation, but those which I have already enumerated are the varieties upon the excellence of which the world is at present agreed.

And yet, although today there seems to be a large consensus about the physical conditions that should attend a serious tasting whose objective is to classify and to rank wine, how to express and then how to amalgamate the various opinions of individual judges into a collective assessment of all continues to defy description and bedevil decisions.

The intent of this chapter is to explain how and why the traditional methods for amalgamating the grades fail and how and why a new approach – *majority judgment* – does the job best.

8.2 Traditional amalgamation schemes and the 'Judgment of Paris'

The famous – or infamous, depending perhaps on which side of the Atlantic your heart resides – wine tasting organised by the well-known English wine-expert Steven Spurrier in Paris on 22 May 1976 pitted vintage Cabernet Sauvignon wines of Bordeaux against those of California. Eleven judges participated: Spurrier, an American lady, Patricia Gallagher, and nine respected French connoisseurs. The tasting was blind, the judges graded each wine on a 0–20 scale, and the wines' average scores determined the order-of-finish. *Time* magazine wrote on 7 June 1976, 'The unthinkable happened: California defeated Gaul.'

We believe the facts show that this was patently false: California did not defeat Gaul. California only defeated Gaul because of the method used to amalgamate the judges' opinions. Ranking the wines in accordance with their average grades is a very bad idea, as will soon be apparent.

There were 10 wines, 4 French and 6 Californian:

A. Stag's Leap 1973 (Californian)
B. Château Mouton Rothschild 1970 (French)
C. Château Montrose 1970 (French)
D. Château Haut-Brion 1970 (French)
E. Ridge Monte Bello 1971 (Californian)
F. Château Léoville-Las Cases 1971 (French)
G. Heitz Martha's Vineyard 1971 (Californian)
H. Clos du Val 1972 (Californian)
I. Mayacamas 1971 (Californian)
J. Freemark Abbey 1969 (Californian)

Judges were asked to grade the wines on a scale going from 0 (worst) to 20 (best), the traditional scale used in French schools and universities. No absolute meaning was given to the grades, leaving individual judges to use their own criteria. The tasting was blind: judges only knew they tasted all of the ten designated wines; they had no information concerning which specific ones.

The judges' grades[1] are given in Table 8.1 where, as subsequently, a* denotes French wines.

How is one to deduce the collective opinion of the jury? An infinite number of methods exist, though attention has typically been confined to very few.

Table 8.1 Judges' grades

	A	*B**	*C**	*D**	*E*	*F**	*G*	*H*	*I*	*J*
P. Brejoux	14.0	16.0	12.0	17.0	13.0	10.0	12.0	14.0	5.0	7.0
A. de Villaine	15.0	14.0	16.0	15.0	9.0	10.0	7.0	5.0	12.0	7.0
M. Dovaz	10.0	15.0	11.0	12.0	12.0	10.0	11.5	11.0	8.0	15.0
P. Gallagher	14.0	15.0	14.0	12.0	16.0	14.0	17.0	13.0	9.0	15.0
O. Kahn	15.0	12.0	12.0	12.0	7.0	12.0	2.0	2.0	13.0	5.0
C. Dubois-Millot	16.0	16.0	17.0	13.5	7.0	11.0	8.0	9.0	9.5	9.0
R. Olivier	14.0	12.0	14.0	10.0	12.0	12.0	10.0	10.0	14.0	8.0
S. Spurrier	14.0	14.0	14.0	8.0	14.0	12.0	13.0	11.0	9.0	13.0
P. Tari	13.0	11.0	14.0	14.0	17.0	12.0	15.0	13.0	12.0	14.0
C. Vanneque	16.5	16.0	11.0	17.0	15.5	8.0	10.0	16.5	3.0	6.0
J.-C. Vrinat	14.0	14.0	15.0	15.0	11.0	12.0	9.0	7.0	13.0	7.0

Point-summing

The 'obvious' method is to add the points given each wine – or equivalently, compute their average – then rank them in accordance with their sums or averages. This is what was done in the Judgment of Paris, giving the result:

Point-summing	*A*	*B**	*C**	*D**	*E*	*F**	*G*	*H*	*I*	*J*
Sum	155.5	155.0	150.0	145.5	133.5	123.0	114.5	111.5	107.5	106.0
Average	14.14	14.09	13.64	13.23	12.14	11.18	10.41	10.14	9.77	9.64
Rank	1	2	3	4	5	6	7	8	9	10

By this method 'the golden state' defeated Gaul in that one of its wines finished first, though the four wines ranked last were all Californian whereas the four French wines were all in the first six places.

But is this outcome *reasonable*? Was Gaul *really* defeated in 1976? Or was the ranking simply a roll of the dice that depended on the use of this particular method for amalgamating the various individual opinions? What might other methods have proposed?

Truncated point-summing

When a point-summing method is used it is sometimes modified by first eliminating a competitor's highest and lowest grades in order to dampen the influence of exaggerated grades. For example, in figure skating competitions the top two and bottom two grades are dropped. In the Judgment of Paris dropping each wine's top and bottom grades does not change the order; however, dropping their two top and bottom grades does:

Truncated point-summing	*A*	*B**	*C**	*D**	*E*	*F**	*G*	*H*	*I*	*J*
Sum	99.0	100.0	97.0	93.5	86.5	79.0	73.5	71.0	72.5	65.0
Average (7 grades)	14.14	14.29	13.86	13.36	12.38	11.29	10.50	10.14	10.38	9.29
Rank	2	1	3	4	5	6	7	9	8	10

Quandt's method

'Grading wines consists of assigning "grades" to each wine, with no restrictions on whether ties are permitted to occur. While the resulting scale is not a cardinal scale, some meaning does attach to the level of the numbers assigned to each wine. Thus, if on a 20-point scale, one judge assigns to three wines the grades 3, 4, 5, while another judge assigns the grades 18, 19, 20, and a third judge assigns 3, 12, 20, they appear to be in complete harmony concerning the ranking of wines, but have serious differences of opinion with respect to absolute quality. I am somewhat skeptical about the value of the information contained in such differences. But we always have the option of translating grades into ranks and then analyzing the ranks … ' (Quandt 2006, p. 15).

Since a judge may give two or more wines the same grade, each is assigned the average of their possible places in the judge's ranking (e.g., three wines with the second highest grade – occupying places 2, 3 and 4 in the ranking – are each ranked 3). Thus with Quandt's method Table 8.2 gives the relevant input data.

Table 8.2 Judges' ranks

	A	*B**	*C**	*D**	*E*	*F**	*G*	*H*	*I*	*J*
P. Brejoux	3.5	2.0	6.5	1.0	5.0	8.0	6.5	3.5	10.0	9.0
A. de Villaine	2.5	4.0	1.0	2.5	7.0	6.0	8.5	10.0	5.0	8.5
M. Dovaz	8.5	1.5	6.5	3.5	3.5	8.5	5.0	6.5	10.0	1.5
P. Gallagher	6.0	3.5	6.0	9.0	2.0	6.0	1.0	8.0	10.0	3.5
O. Kahn	1.0	4.5	4.5	4.5	7.0	4.5	9.5	9.5	2.0	8.0
C. Dubois-Millot	2.5	2.5	1.0	4.0	10.0	5.0	9.0	7.5	6.0	7.5
R. Olivier	2.0	5.0	2.0	8.0	5.0	5.0	8.0	8.0	2.0	10.0
S. Spurrier	2.5	2.5	2.5	10.0	2.5	7.0	5.5	8.0	9.0	5.5
P. Tari	6.5	10.0	4.0	4.0	1.0	8.5	2.0	6.5	8.5	4.0
C. Vanneque	2.5	4.0	6.0	1.0	5.0	8.0	7.0	2.5	10.0	9.0
J.-C. Vrinat	3.5	3.5	1.5	1.5	7.0	6.0	8.0	9.5	5.0	9.5

The method treats the judges' individual ranks as points and ranks the wines according to their sums (or, equivalently, their averages). This gives the final ranking:

Quandt	***A***	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
Sum	41.0	43.0	41.5	49.0	55.0	72.5	70.0	79.5	77.5	76.0
Average	3.73	3.91	3.77	4.45	5.00	6.59	6.36	7.23	7.05	6.91
Rank	1	3	2	4	5	7	6	10	9	8

or,

$$A \succ C^* \succ B^* \succ D^* \succ E \succ G \succ F^* \succ J \succ I \succ H$$

If comparisons are the key a host of other methods immediately suggest themselves.

Majority vote

For Condorcet (1785) each judge should express his opinion by giving a comparative judgment among all the wines taken pair-by-pair. This amounts to ranking all the wines yet allowing ties among them. Condorcet's basic idea was that there should be a vote among each pair of wines. For example, what is the jury's decision between the two wines A and C^*? Condorcet says the majority decides: A is ranked above C^* by 3 judges, below C^* by 5 judges, and equal by 3 judges, so C^* should be ranked above A with 6.5 votes to A's 4.5. His hope was that there would be a wine – the *Condorcet-winner* – that defeats all others in a direct vote.

The numbers of votes for every possible confrontation is given in Table 8.3 (e.g., B^* wins 4.5 votes against A and 8.0 against E). 5.5 votes implies a tie between the wines of its row and column (indicated by $\approx$ below), any number above 5.5 indicates that the wine in its row wins by a majority against the wine in its column (indicated by $\succ$ below).

Table 8.3 Majority votes pair-by-pair

	A	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
A	–	6.5	4.5	5.5	7.5	10.0	8.0	8.5	10.5	8.0
B*	4.5	–	5.0	5.5	8.0	9.0	9.0	9.0	8.0	9.0
C*	6.5	6.0	–	6.5	5.5	10.0	7.5	8.5	9.5	8.5
D*	5.5	5.5	4.5	–	6.5	7.5	7.5	8.5	8.0	7.5
E	3.5	3.0	5.5	4.5	–	6.5	9.0	8.0	6.0	9.0
F*	1.0	2.0	1.0	3.5	4.5	–	5.0	7.0	6.5	7.0
G	3.0	2.0	3.5	3.5	2.0	6.0	–	7.0	6.0	7.0
H	2.5	2.0	2.5	2.5	3.0	4.0	4.0	–	6.0	4.0
I	0.5	3.0	1.5	3.0	5.0	4.5	5.0	5.0	–	5.0
J	3.0	2.0	2.5	3.5	2.0	4.0	4.0	7.0	6.0	–

The famous *Paradox of Condorcet* is that majority vote may lead to no winner and no ranking. The Judgment of Paris is a striking example of its occurrence:

$$\{A \succ B^* \succ E \approx C^* \succ D^* \approx A\} \succ G \succ F^* \succ J \succ H \succ I$$

There is no Condorcet-winner – no first in the ranking – but there is a *Condorcet-loser* – a wine that is last in the ranking. Each of the five wines in the first group (A, B^*, C^*, D^*, E) defeats all the others; for the others a wine to the left defeats a wine to the right. The first five wines are in a *Condorcet-cycle*. Or, by ignoring a good deal of information, it might be said that there is a five-way tie for first place, the others occupying second through sixth places.

Condorcet	***A***	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
Rank	1	1	1	1	1	3	2	5	6	4

Three French wines are in first place, only two California wines. Three California wines are in the last places.

Borda's method

Borda (1781) agreed with Condorcet: every judge should evaluate the merits of each wine compared successively to the merits of each of its competitors. But he advocated amalgamating the opinions by summing each wine's votes against all of the others (sums of the numbers in their rows in Table 8.3). The idea is in spirit very similar to Quandt's yet different. It happens to give the same result in this case.

Borda	***A***	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
Sum	69	67	68.5	62	55	37.5	40	30.5	32.5	34
Average	6.9	6.7	6.85	6.2	5.5	3.75	4.0	3.05	3.25	3.4
Rank	1	3	2	4	5	7	6	10	9	8

This method should actually be known under another name since it was recently discovered that Cusanus (see Hägele and Pukelsheim 2008) had proposed it in 1433.

Black's method

Duncan Black (1958) suggested that the Condorcet majority-criterion should be used and where it fails the wines in a Condorcet-cycle should be ranked according to Borda's method. This gives the ranking

$$A \succ C^* \succ B^* \succ D^* \succ E \succ G \succ F^* \succ J \succ H \succ I$$

Llull's method

In 1299 Ramon Llull advanced what seems to be the first formal presentation of a rule of voting (see Hägele and Pukelsheim 2001). It is a generalisation of the idea of a Condorcet-winner. He proposed that the wines be ranked according to its sum of wins against all competitors (a tie counting as a win), instead of its sum of votes against all competitors, as does Borda. This means that if there is a Condorcet-winner, then that wine must necessarily be the winner. This method is known in the modern literature as Copeland's method (Copeland 1951). It yields:

Llull	*A*	*B**	*C**	*D**	*E*	*F**	*G*	*H*	*I*	*J*
Wins	8	7	9	8	6	3	4	1	0	2
Rank	2	3	1	2	4	6	5	8	9	7

or

$$C^* \succ A \approx D^* \succ B^* \succ E \succ G \succ F^* \succ J \succ H \succ I$$

In first place is a French wine, in the first four places three French wines.

Dasgupta-Maskin's method

'If no [wine] obtains a majority against all [others], then among those [which] defeat the most opponents in head-to-head comparisons, select as winner the one with the highest [Borda-score]' (Dasgupta and Maskin 2004, p. 97). So if there are ties in the number of wins or Llull's method they are resolved with Borda's method.

According to Llull wines A and D^* are tied. A has the Borda-score 69 and D^* 62, so this method gives the ranking:

$$C^* \succ A \succ D^* \succ B^* \succ E \succ G \succ F^* \succ J \succ H \succ I$$

or

Dasgupta-Maskin	*A*	*B**	*C**	*D**	*E*	*F**	*G*	*H*	*I*	*J*
Rank	2	4	1	3	5	7	6	10	9	8

Eight methods give seven (that magical number!) different rank-orderings of the wines.

8.3 Why the traditional amalgamation schemes fail

Meaningfulness

There is no cardinal measure with which to rate wines (as Quandt quite correctly observes). He goes on to state,

> 'Two scales for rating are in common use: (1) the well-known ordinal rank-scale by which wines are assigned ranks…, and (2) a "grade"-scale, such as the well-publicised ratings by Robert Parker based on 100 points. The grade scale has some of the aspects of a cardinal scale, in that intervals are interpreted to have meaning, but is not an [interval measure]' (Quandt 2006, p. 2).

These statements raise the important question of 'meaningfulness' and require clarification and elaboration.

How to construct a scale for measuring something is a science in itself (see e.g. Krantz et al. 1971). The types of scales have been classified in various ways (of which one follows Stevens 1946). When numbers, names or labels indicate categories (blood type, bus number, telephone code), the scale is a *nominal measure*. When they indicate order (pain, mineral hardness, destructive power of earthquakes), it is an *ordinal measure*. Pain, for example, is usually measured on a scale from 0 to 10. The Mankowski scale defines a 2 by 'Minor annoyance – occasional strong twinges. No medication needed'; a 3 by 'Annoying enough to be distracting. Mild painkillers take care of it'; a 9 by 'Unable to speak. Crying out or moaning uncontrollably – near delirium'; and a 10 by 'Unconscious. Pain makes you pass out' (WEMSI 1998). When in addition to order, equal intervals have the same significance (days of calendars, degrees Celsius and Fahrenheit), it is an *interval measure*. Finally, when in addition to qualifying as an interval measure, zero has an absolute meaning (dollars, grams, degrees Kelvin), it is a *ratio measure*.

Two key problems present themselves. How to assign scale values to empirical observations is the 'representation problem'. What analyses of observations are valid as a function of the type of scale is the 'meaningfulness problem'. It is obviously meaningless to add numbers that are nominal measures: the sum or average of two telephone codes bears no earthly meaning. It is also meaningless to add numbers that are ordinal measures: an increase in pain from 2 to 3 cannot be compared with an increase from 9 to 10 let alone have the same significance. For sums or averages to be meaningful the numbers must come from interval measures such as calendars – an additional day has the same significance whenever it is added in the Gregorian, Hebrew or Moslem calendars – or such as weight, distance or money – one more carries the same meaning to whatever it is added (the last three examples are ratio measures so multiplication makes sense too).

The official results of the Judgment of Paris depend on adding or averaging numbers ranging from 0 to 20. For them to make any sense at all those numbers must be chosen from an interval measure. But that is obviously false.

First, no common definitions were given to the numbers on the scale, so each judge gave his own interpretation of their meanings. Nonetheless, it is reasonable to assume that each judge had his own benchmark wines acquired in years of experience and some absolute sense of what it means to give a 7 or a 17 to a wine; moreover, it is not unreasonable to assume that these benchmarks were fairly similar (the 0–20 scale is the standard of French schools instead of the 50–100 scale of American schools used by Robert M. Parker, Jr.; Parker 2002).

Second, as is so often true when a numerical scale is used, the higher the grade the more difficult it is to raise it: there seems to be a human reluctance to give very high grades. That is certainly the case here although these were a very fine set of wines: of 110 grades none were above 17 and only four reached that level. The scale was not an interval measure, because increasing the grade of a wine from (say) 17 to 18 was much more difficult for a judge to do than increasing a grade from an 11 to a 12. But this immediately implies that the sums and averages of such grades are meaningless, so point-summing fails.

When judges compare wines and the comparisons are amalgamated, as is done in all the methods described above except point-summing, the same difficulties arise. Every one of those methods involves using Borda's basic idea that treats a place in the order as though it were an interval measure. But it is certainly not an interval measure since these methods treat the very different judges' inputs of (3, 4, 5), (18,19, 20) and (3, 12, 20) as exactly the same, which they are not: the first judge believes the wines are all bad and differ little, the second that all are excellent and differ little, the last that there is a huge difference among the quality of all three. Indeed, one cannot but question whether statistical analyses based on 'places in the order' are meaningful.

Manipulability

There is also a second major reason that point-summing methods fail in competitions. They are among the most highly manipulable of all methods. As Sir Francis Galton so aptly remarked:

> 'Each voter [of the jury] has equal authority with each of his colleagues. How can the right [collective] conclusion be reached, considering that there may be as many different [grades] as there are members? That conclusion is clearly not the average of all the [grades], which would give a voting power to "cranks" in proportion to their crankiness. One absurdly large or small [grade] would leave a greater impress on the result than one of reasonable amount, and the more a [grade] diverges from the bulk of the rest, the more influence would it exert' (Galton 1907).

A 'cranky' wine judge may be one who errs from lack of judgment or finesse; she may also be a judge who 'cheats' wilfully either because she has some predefined agenda (e.g., a high place for friends' wines and a low one for enemies' wines that she believes she can identify) or simply because she wishes to impose her superior will on the collective jury decision. The director of a wine competition complained that in Australia – where typically juries consist of three judges who assign points from a 0 to 20 scale that are averaged to determine decisions – two judges may both give gold medal scores of 18.5 but a cranky third judge can completely thwart the majority opinion by giving a low score.

A glance at the grades given cannot but make one wonder whether the 2s, 3s and 5s were cranky grades. But put that question aside and assume the grades were 'honest' evaluations. How might a judge have manipulated and what success might he have had?

Since no judge gave either a 0 (the minimum) or a 20 (the maximum) to any wine, *every* judge can manipulate the final score of *every* wine either up or down. Take, for example, C. Dubois-Millot. He could achieve the final order he prefers among A, B^*, C^*, D^*, and E as well as the order he prefers among F^*, G, H, I, and J by changing the grades he assigns as follows:

Point-summing	***A***	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
Dubois-Millot (actual)	16.0	16.0	17.0	13.5	7.0	11.0	8.0	9.0	9.5	9.0
Sum (actual)	155.5	155.0	150.0	145.5	133.5	123.0	114.5	111.5	107.5	106.0
Dubois-Millot (new)	13.0	13.5	20.0	13.5	7.0	0.0	4.0	8.5	13.5	14.0
Sum (new)	152.5	152.5	153.0	145.5	133.5	112.0	110.5	111.0	111.5	111.0
Rank (new)	2	2	1	3	4	5	8	7	6	7

Manipulation enables him to obtain *exactly* the order he wishes except that E is not last.

C. Vanneque's preferred order-of-finish is very different than that given by point-summing:

$$D^* \succ A \approx H \succ B^* \succ E \succ C^* \succ G \succ F^* \succ J \succ I$$

Manipulation enables him to obtain the order he wishes except for H and a near miss in the order of C^* and E.

Point-summing	***A***	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
Vanneque (actual)	16.5	16.0	11.0	17.0	15.5	8.0	10.0	16.5	3.0	6.0
Sum (actual)	155.5	155.0	150.0	145.5	133.5	123.0	114.5	111.5	107.5	106.0
Vanneque (new)	9.0	8.5	0.0	20.0	20.0	0	11.0	20.0	3.0	8.0
Sum (new)	148.0	147.5	139.0	148.5	138.0	115.0	115.5	115.0	107.5	108.0
Rank (new)	2	3	4	1	5	7	6	7	9	8

When 'places in the order' are inputs there are again wide-open opportunities for judges to manipulate. If, for example, a judge is intent on wishing one wine V to lead over another W it suffices to place V first (or high) and W last (or low). Dubois-Millot could again achieve the order among A, B^*, C^*, D^*, and E he prefers (as well as A, B^*, C^*, D^*, and F^* in that order above H, I and J) as follows:

Quandt	***A***	***B****	***C****	***D****	***E***	***F****	***G***	***H***	***I***	***J***
Dubois-Millot (actual)	2.5	2.5	1.0	4.0	10.0	5.0	9.0	7.5	6.0	7.5
Sum (actual)	41.0	43.0	41.5	49.0	55.0	72.5	70.0	79.5	77.5	76.0
Dubois-Millot (new)	4.0	2.0	1.0	3.0	7.0	5.0	10.0	8.0	6.0	9.0
Sum (new)	42.5	42.5	41.5	48.0	52.0	72.5	71.0	80.0	77.5	77.5
Rank (new)	2	2	1	3	4	6	5	8	7	7

There is ample experimental evidence showing Borda's method is highly manipulable, as are point-summing methods (truncated or not) (Balinski and Laraki 2010). They are also, as was seen, meaningless.

Point-summing methods have one redeeming property that the others do not: they are 'coherent' in that the final order between any two wines does not depend on whether other wines are competing (they avoid 'Arrow's Paradox').

Coherence

A method of amalgamation is *coherent* if it ranks one wine X above another Y whatever other wines participate or do not participate in the competition. Theorem: *Every method based on comparisons is incoherent.*

Take either Borda's or Quandt's method. When used to rank-order all the wines they yield

$$A \succ C^* \succ B^* \succ D^* \succ E \succ G \succ F^* \succ J \succ I \succ H$$

However, when used to rank-order A, B^*, C^*, and D^* alone they yield $C^* \succ A \succ D^* \succ B^*$ when used to rank-order A, $B*$ and $C*$ alone they give $C^* \succ B^* \succ A$; and when A and C^* alone they conclude $C^* \succ A$.

Llull's and Dasgupta-Maskin's methods are also incoherent. Llull's order among all is

$$C^* \succ A \approx D^* \succ B^* \succ E \succ G \succ F^* \succ J \succ H \succ I$$

and since A's Borda-score is 69 and D^*'s 62, Dasgupta-Maskin's order is

$$C^* \succ A \succ D^* \succ B^* \succ E \succ G \succ F^* \succ J \succ H \succ I.$$

But among only the wines B^*, C^*, and D^* Llull yields

Llull	B^*	C^*	D^*
Wins	1	2	1
Rank	2	1	2

or

$$C^* \succ D^* \approx B^*,$$

which is incoherent with the Llull order among all. Since among the three wines B^*'s Borda-score is 10.5 and D^*'s 10, Dasgupta-Maskin's order among the three is

$$C^* \succ B^* \succ D^*,$$

incoherent with the Dasgupta-Maskin order among all.

These are all occurrences of Arrow's Paradox: depending upon the presence or absence of other wines the order between two (or more) may change. It is quite clearly an unacceptable property. But Arrow's impossibility theorem shows: *No method that depends on comparisons alone avoids it* (Arrow 1951).

8.4 Majority judgment

The U.I.Œ. (*Union Internationale des Œnologues*) is an international federation of national œnological associations. Until 2009 they advocated the use of a standard tasting sheet for each wine of a competition (see Table 8.4). Each attribute of a wine is evaluated in a language of seven grades: *Excellent, Very Good, Good, Passable, Inadequate, Mediocre, Bad*. This is an important improvement over assigning undefined points or relying on orders since these evaluations have meaning that are by and large shared by judges (who can refer to the shared benchmarks of years of experience). To each evaluation of every attribute is associated a number of points. Their total points determine the wines' awards and their rank-order. To be awarded a 'Grand Gold' a wine must have a total score of 90 or above; a 'Gold' a score below 90 but at least 85; a 'Silver' below 85 but at least 80; and a 'Bronze' below 80 but at least 75. This is a point-summing method where meaning is given to the points accorded, which is essential. Nevertheless, these points do not constitute an interval measure, so their sums remain meaningless.

All of the methods based on comparisons depart from the primitive idea that when the majority of a jury prefers Wine A to Wine B then that should be the jury's decision. One difficulty with this is that Condorcet's Paradox may occur so there is no rank-order and no winner. But there is a deeper, much less appreciated difficulty: there is no real justification for accepting

Table 8.4 U.I.Œ. 'Sensorial Analysis Tasting Sheet for Wine Judging Competitions', still wines, 2006. A judge circles her evaluations in each row

	Excellent	***Very Good***	***Good***	***Passable***	***Inadequate***	***Mediocre***	***Bad***
Aspect							
Limpidity	6	5	4	3	2	1	0
Nuance	6	5	4	3	2	1	0
Intensity	6	5	4	3	2	1	0
Aroma							
Frankness	6	5	4	3	2	1	0
Intensity	8	7	6	5	4	2	0
Finesse	8	7	6	5	4	2	0
Harmony	8	7	6	5	4	2	0
Taste, flavour							
Frankness	6	5	4	3	2	1	0
Intensity	8	7	6	5	4	2	0
Body	8	7	6	5	4	2	0
Harmony	8	7	6	5	4	2	0
Persistence	8	7	6	5	4	2	0
After-taste	8	7	6	5	4	2	0
Global opinion	8	7	6	5	4	2	0

a majority preference *even between two wines alone*. For suppose – using the U.I.Œ. grades – eleven judges gave two wines, *A* and *B*, the following grades:

	Excellent	***Good***	***Mediocre***	***Bad***
A:	4	3	2	2
B:	3	2	2	4

Since *A*'s high grades dominate *B*'s there is little doubt that the jury's collective opinion is A >B. But what would ordinary majority voting say? That would depend on the comparisons of the judges. If their evaluations were

	2 judges	**2 judges**	**3 judges**	**1 judge**	**1 judge**	**2 judges**
A:	*Excellent*	*Excellent*	*Good*	*Mediocre*	*Mediocre*	*Bad*
B:	*Good*	*Mediocre*	*Bad*	*Bad*	*Excellent*	*Excellent*

(each wine has the distribution of grades given above) then the majority vote would yield A >B by a vote of 8 to 3. If, however, their evaluations were

	3 judges	4 judges	2 judges	2 judges
A:	*Good*	*Excellent*	*Mediocre*	*Bad*
B:	*Excellent*	*Bad*	*Good*	*Mediocre*

(the same distribution of grades again) then the majority vote would yield B >A by a vote of 7 to 4. *Simple majority voting between two can make the wrong decision!* With more information, using a generally accepted scale of grades, such anomalous results may be avoided.

The key fact is summarised in the Theorem: *A method of amalgamation is coherent and avoids the Condorcet Paradox if and only if a wine's place in the ranking depends only on the grades it receives* (see Balinski and Laraki 2010). Thus the only way to make coherent decisions and be certain to avoid cyclic jury decisions is precisely *to ignore each judge's implicit comparisons* and pay attention only to the grades she gives.

Point-summing methods heed this injunction: it is coherent and there is no ambiguity in the rank-orders it determines. It fails because it gives meaningless results and is highly manipulable. What then is to be done?

Majority-grade and majority-ranking

First, a common-language of grades must be defined. The U.I.Œ.'s terminology – *Excellent, Very Good, Good, Passable, Inadequate, Mediocre, Bad* – is an excellent choice. More or fewer grades may be chosen. They must be well defined and understood by all the judges.

Let us assume that the number grades of the Judgment of Paris constituted an acceptable common-language of grades. Which judge gave which grades cannot be taken into account, so each wine's grades may be arranged from highest to lowest (as in Table 8.5). A wine's *majority-grade* is the grade supported by a majority against any other grade. Wine *C**'s majority-grade is 14.0 because it obtains a majority of at least 7 to 4 against any lower grade and it obtains a majority of at least 8 to 3 against any higher grade. Using

Table 8.5 Judgment of Paris: grades given wines, their majority-grades italicised

A	16.5	16.0	15.0	15.0	14.0	*14.0*	14.0	14.0	14.0	13.0	10.0
B*	16.0	16.0	16.0	15.0	15.0	*14.0*	14.0	14.0	12.0	12.0	11.0
C*	17.0	16.0	15.0	14.0	14.0	*14.0*	14.0	12.0	12.0	11.0	11.0
D*	17.0	17.0	15.0	15.0	14.0	*13.5*	12.0	12.0	12.0	10.0	8.0
E	17.0	16.0	15.5	14.0	13.0	*12.0*	12.0	11.0	9.0	7.0	7.0
F*	14.0	12.0	12.0	12.0	12.0	*12.0*	11.0	10.0	10.0	10.0	8.0
G	17.0	15.0	13.0	12.0	11.5	*10.0*	10.0	9.0	8.0	7.0	2.0
H	16.5	14.0	13.0	13.0	11.0	*11.0*	10.0	9.0	7.0	5.0	2.0
I	14.0	13.0	13.0	12.0	12.0	*9.5*	9.0	9.0	8.0	5.0	3.0
J	15.0	15.0	14.0	13.0	9.0	*8.0*	7.0	7.0	7.0	6.0	5.0

statistical jargon a wine's majority-grade is the median or middlemost of its grades. Had the grades been words or letters this definition is valid (so number grades are not necessary). The grades – in this case numbers – are never added or averaged (since sums are meaningless), their only significance is ordinal, a higher number means a higher grade or better evaluation.

The majority-grades are used to obtain the *majority-ranking* of the wines, but – as here – there may be ties that need to be resolved. The rationale for resolving them is simple. Consider wines A and B^*. A majority decided each should have the grade 14, so a majority should again decide which should be classed ahead among the remaining grades (when that one 14 is dropped from each). Wine A's second majority-grade is 14 (with at least 8 against a lower grade and at least 6 against a higher grade). Now, however, there is a difficulty because with an even number of grades a tie may occur, as happens here for B^*: 5 are for 15 or higher, 5 against.

A	16.5	16.0	15.0	15.0	14.0	$\cancel{14.0_1}$	14.0_2	14.0	14.0	13.0	10.0
B^*	16.0	16.0	16.0	15.0	15.0	$\cancel{14.0_1}$	14.0_2	14.0	12.0	12.0	11.0

When there is an even number of grades the theory dictates (Balinski and Laraki 2010) there must be an absolute majority for the higher grade and only a relative majority for the lower grade, so B^*'s second majority-grade is 14 (this means taking the 'lower middlemost'). Again a tie, so the procedure is repeated. Wine A's third majority-grade is 14, Wine B's third majority-grade is 15: therefore, B^* must be ranked ahead of A, or B^* >A.

A	16.5	16.0	15.0	15.0	14.0_3	$\cancel{14.0_1}$	$\cancel{14.0_2}$	14.0	14.0	13.0	10.0
B^*	16.0	16.0	16.0	15.0	15.0_3	$\cancel{14.0_1}$	$\cancel{14.0_2}$	14.0	12.0	12.0	11.0

The majority-ranking for the wines of the Judgment of Paris is:

$$B^* \succ A \succ C^* \succ D^* \succ E \succ F^* \succ H \succ G \succ I \succ J.$$

The majority-ranking can contain a tie *only* if two wines have exactly the same set of grades.

Majority judgment ranks the ten wines differently than any of the other methods previously considered. With what we believe is the only valid method of amalgamating judges' evaluations, the thinkable happened, Gaul defeated California: Château Mouton Rothschild 1970 is first, all of the four French wines are among the first six; none of the French wines are among the last four.

Why majority judgment

Majority judgment is meaningful. There are two scales for rating in common use, an ordinal scale where wines are assigned ranks and an interval scale where wines are assigned cardinal numbers. But there is also a middle ground that asks for more than ranks but less than an interval scale: an ordinal scale of merit. The U.I.Œ.'s word grades and the Mankowski pain scale are examples. Piano, figure skating, gymnastics, diving and many other competitions use number scales whose meanings are carefully defined and/or come to have very definite meanings much as the measurements of length and weight. So long as they are treated as ordinal and not assumed to constitute interval scales the approach is perfectly valid. The very notion of determining a consensual jury decision implies some commonality in a language of absolute grades, determined by widely shared benchmarks. As Wittgenstein so aptly said, 'the meaning of a word is its use in the language.' Otherwise, meaningful decisions cannot be made.

Majority judgment is the least manipulable. Both theory and experiments show that among the widely known and recommended methods of amalgamation majority judgment is the least subject to strategic manipulation.

It is *strategy-proof-in-grading* meaning that if a judge's objective is that a particular wine should be evaluated (say) *Very Good* then honesty is her optimal strategy: to assign *Very Good*. Consider, for example, Wine *A* of the Judgment of Paris, with a majority-grade of 14 but which C. Dubois-Millot evaluated as 16. Disappointed, could he have upped the grade he assigned to 20 and thereby raised *A*'s majority-grade?

A	16.5	16.0	15.0	15.0	14.0	*14.0*	14.0	14.0	14.0	13.0	10.0

The answer is no because that would change nothing in the majority opinion. Symmetrically, P. Tari gave 13 to *A*, so he too was disappointed but could do nothing to lower *A*'s majority-grade even by changing the 13 to 0 because, again, majority opinion remains the same. This is an important property for it allows the judge whose primary wish is for the jury decision to assign the grade he believes is merited to forget about strategising and concentrate on making the correct evaluation.

A judge, however, may have a different agenda in mind: to assign his grades so as to realise the majority-ranking – the final order-of-finish – that he believes in rather than to determine the 'correct' majority-grades – the final grades of the wines. One would wish for a method that is *strategy-proof-in-ranking,* meaning that each judge's optimal strategy when she has the final rankings in mind is again to give her honest evaluations of each wine. Regrettably, Theorem: *No method of amalgamation is strategy-proof-in-ranking* (Balinski and Laraki 2010).

Since perfection cannot be achieved one must accept the best possible. Suppose the final order placed *A* above *B* and some judge preferred *B* to *A*, so wished to reverse that ranking. That judge would be tempted to increase *A*'s grade and decrease *B*'s. With majority judgment if the judge is able to increase$A$'s grade she cannot decrease B's, and if she can decrease B's she cannot increase A's – the method is *partially strategy-proof-in-ranking*. In fact, Theorem: *Majority judgment is the only method that is partially strategy-proof-in-ranking* (Balinski and Laraki 2010).

To see what all of this means in practice consider, first, the judge Dubois-Millot (who could so easily have manipulated the order-of-finish were either point-summing or Quandt's method used). Contrast the majority-ranking with Dubois-Millot's preferences,

Majority ranking:	$B^* \succ A \succ C^* \succ D^* \succ E \succ F^* \succ H \succ G \succ I \succ J$
Dubois-Millot's preferences:	$C^* \succ A \approx B^* \succ D^* \succ F^* \succ I \succ H \approx J \succ G \succ E$

Dubois-Millot cannot raise C^* in the majority-ranking. Lowering B^*'s grade is not sufficient to place B^* below C^* but puts B^* below A, not his intention. He cannot lower E in the majority-ranking, nor can he raise F^*. He can raise I (by changing the 9.5 to 12) above H, but cannot raise J nor lower G. All he is able to do is move I up above H.

C. Vanneque's wishes diverge more from the majority-ranking:

Majority ranking:	$B^* \succ A \succ C^* \succ D^* \succ E \succ F^* \succ H \succ G \succ I \succ J$
Vanneque's preferences:	$D^* \succ A \approx H \succ B^* \succ E \succ C^* \succ G \succ F^* \succ J \succ I$

He can do nothing to push D^* above $B*, A$, or C^*; nor can he push either B^*, A, or C^* below D^*. He cannot push A above B^*, but he can push B^* below A (by lowering its grade from 16 to 12). He cannot place either H or G above F^*, nor can he place J above I. Thus Vanneque, who can easily manipulate the outcome with point-summing (putting D^* first, A second and B^* third), can at most change the majority-ranking to

$$A \succ B^* \succ C^* \succ D^* \succ E \succ F^* \succ H \succ G \succ I \succ J$$

Majority judgment is coherent. Of crucial importance, majority judgment is necessarily coherent because wines are assigned individual grades by judges instead of being compared (the root of all the evils!).

To finish the case for 'why' it should be said that all of the assertions made in the above rest on formal proof. Indeed, majority judgment is characterised mathematically as the only method for amalgamating judges' opinions that is coherent and meaningful, does the best in combating manipulation, and heeds the majority opinion (in particular, cranky judges cannot counter the majority will).

8.5 Majority judgment in use

'To give a global grade to a wine, one should not immediately think in terms of a numerical value, but rather classify its quality; the grade, in the chosen scale, will follow automatically.' So said the great œnologist Émile Peynaud in his classic treatise (Peynaud and Blouin 2006, p. 104). Indeed, insiders say that professional judges often work backward: they first decide on a wine's quality and then they assign numerical grades to the various attributes so that their sums give the desired outcome. Grading a wine strictly on the basis of the quality of its individual characteristics may miss the point for it 'has difficulty in detecting exceptional wines by overly favouring wines that are "taste-wise correct"' (Peynaud and Blouin 1999, p. 109). A wine that is truly outstanding in some one attribute yet has clear flaws in others may well classify as sublime, well above all the other competing wines, yet lag the others when the evaluations are based on attributes.

The previous discussion has shown that the use of numbers without specific meanings gives meaningless results; moreover, the very use of numbers suggests that they will be summed to determine final decisions (though summing is meaningless since they do not constitute interval measures), so they induce strategic behaviour, the attribution of points that may not be honest. For these reasons, a set of grades such as the seven given by the U.I.Œ., should be used, though six may be sufficient (in most competitions *Bad* is not used at all).

Experts of great taste and experience will integrate for themselves the importance of the various attributes, so should simply be asked to assign one of the six or seven grades. However, juries composed of judges of limited experience and tasting ability should be asked to assign one of the six or seven grades to each of the attributes. They may not be able to integrate the relative importance of the attributes, they may overlook some of them in their evaluations, and they are undoubtedly more at ease when faced with the more specific task of addressing specific qualities. This means that majority judgment must be extended to ranking wines that are given a grade for each of several attributes.

The U.I.Œ. revised its scoring sheets in 2009 (Table 8.6). The two lowest grades were dropped probably because they were little used. Regrettably the word descriptions were dropped except for *Excellent* and *Inadequate*, thereby emphasising the comparative aspects rather than the absolute nature of the evaluations. However, an additional row was adjoined below the score sheet, 'Eliminated due to a major defect': a wine with two such mentions cannot be awarded a medal. The former scoring sheet (Table 8.4) contained 14 attributes to be evaluated individually, all of approximately the same numerical weight or importance, the new one (Table 8.6) contains 10 attributes, but the total importance of *Visual* (= *Aspect*), *Nose* (= *Aroma*), *Taste* and *Overall* (= *Global*) is about the same as before.

Table 8.6 UIŒ 'Score Sheet', still wines, 2009.
A judge circles her evaluations in each row

	Excellent				**Inadequate**
	+	→	→	→	−
Visual					
Limpidity (VL)	5	4	3	2	1
Aspect other than limpidity (VA)	10	8	6	4	2
Nose					
Genuineness (NG)	6	5	4	3	2
Positive intensity (NI)	8	7	6	4	2
Quality (NQ)	16	14	12	10	8
Taste					
Genuineness (TG)	6	5	4	3	2
Positive intensity (TI)	8	7	6	4	2
Harmonious persistence (TP)	8	7	6	5	4
Quality (TQ)	22	19	16	13	10
***Harmony – Overall judgment* (HO)**	11	10	9	8	7

We advocate restoring words as grades, eliminating numbers altogether, and using an even number of grades – for example,*Excellent, Very Good, Good, Passable, Inadequate, Bad* – so as to bar the possibility of 'opting for the middle.'

Les Citadelles du Vin

The *Citadelles du Vin* is an annual wine competition held in the Bordeaux area every June that is organised by the well-known œnologist Jacques Blouin. In 2006 some sixty judges organised into twelve juries of five judges classified 1,247 wines. Two methods were used to amalgamate judges' opinions, the official U.I.Œ. point-summing method and majority judgment with a single global criterion and five grades, *Excellent, Very Good, Good, Fair*, and *Mediocre*. These words appeared on the scoring sheets (*Very Good, Good*, and *Fair* replacing in that order the three →'s).[2]

The responses of one jury on three white wines, A, B, and C are given in Table 8.7. The numbers that correspond to the word grades are given in keeping with practice. Thus, for example, Judge 1 evaluated Wine *A*'s 'Visual limpidity (VL)' as 5 or *Excellent* for the U.I.Œ. method, and *Very Good* (at the right) for majority judgment.

Table 8.7 A jury's grades for three white wines, *Les Citadelles du Vin*, 2006

Attribute →	**VL**	**VA**	**NG**	**NI**	**NQ**	**TG**	**TI**	**TP**	**TQ**	**HO**	**Maj. Jdg. Grade**
Judge ↓						Wine *A* :					
1	5	8	7	5	14	7	5	7	19	10	*Very Good*
2	5	10	6	5	12	6	5	7	16	9	*Good*
3	5	10	8	5	14	7	5	8	16	10	*Very Good*
4	5	10	8	6	16	8	6	8	22	11	*Excellent*
5	5	8	7	5	14	6	4	6	16	9	*Fair*
						Wine *B* :					
1	5	8	7	5	14	7	5	7	16	9	*Very Good*
2	5	10	6	5	12	6	5	7	16	9	*Good*
3	5	10	7	5	14	7	4	7	16	9	*Good*
4	5	10	7	5	12	7	5	6	19	10	*Very Good*
5	5	10	7	5	12	6	4	6	13	8	*Fair*
						Wine *C* :					
1	5	10	7	5	14	7	4	7	16	10	*Very Good*
2	5	8	7	5	14	7	5	6	16	9	*Good*
3	5	10	7	4	12	7	5	7	16	10	*Good*
4	5	10	7	4	12	7	4	6	19	10	*Very Good*
5	5	8	7	5	14	7	5	7	16	10	*Good*

Majority judgment for expert juries

We believe (as has already been said) that truly expert juries should give their global evaluations in a single scale preferably of six grades (instead of the five used here).

The *majority judgment procedure* is simple. List the grades of each from highest to lowest:

Wine *A*:	*Excellent*	*Very Good*	*Very Good*	*Good*	*Fair*
Wine *B*:	*Very Good*	*Very Good*	*Good*	*Good*	*Fair*
Wine *C*:	*Very Good*	*Very Good*	*Good*	*Good*	*Good*

The *majority-grade* is the middlemost grade. *A*'s majority-grade is *Very Good*, *B*'s and *C*'s *Good*. Thus *A* is judged the best of the three. To decide on the order between *B* and *C*, the remaining grades must decide, so drop the 'first' (equal) majority-grades (see below). When there is an even number of grades the *majority-grade* is the lower middlemost grade.

Wine *B*:	*Very Good*	*Very Good*	~~*Good*~~$_1$	*Good*$_2$	*Fair*
Wine *C*:	*Very Good*	*Very Good*	~~*Good*~~$_1$	*Good*$_2$	*Good*

The second majority-grades of *B* and *C* are *Good,* again equal. So drop them:

Wine *B*:	*Very Good*	*Very Good*$_3$	~~*Good*~~$_1$	~~*Good*~~$_2$	*Fair*
Wine *C*:	*Very Good*	*Very Good*$_3$	~~*Good*~~$_1$	~~*Good*~~$_2$	*Good*

The third majority-grades are again the same, *Very Good*. So repeat:

Wine *B*:	*Very Good*	~~*Very Good*~~$_3$	~~*Good*~~$_1$	~~*Good*~~$_2$	*Fair*$_4$
Wine *C*:	*Very Good*	~~*Very Good*~~$_3$	~~*Good*~~$_1$	~~*Good*~~$_2$	*Good*$_4$

B's fourth majority-grade is *Fair*, *C*'s is *Good*, so *C* is judged better than *B*, giving the majority-ranking:

$$A \succ C \succ B.$$

This is the general procedure, though in this case it is immediately evident that *C* is judged better than *B* since they only differ in one grade.

This order happens to agree with the usual U.I.Œ. point-summing method determined by the respective wines' averages of the total points over all attributes given by the judges,*A* obtaining an average of 87.2, *B* of 82.0 and *C* of 83.6.

Multi-criteria majority judgment for ordinary juries

Evaluating several attributes independently has the advantages and disadvantages already discussed. The several – in this case 10 – independent evaluations of a wine by 3 judges may be thought of as 30 independent judges evaluating the merits of different aspects of the wine. If the different aspects bear the same importance then majority judgment may be applied as though there were one global evaluation of each wine by 30 judges. We believe that when possible it is best for the attributes to be defined so that they do bear the same importance (as is suggested by the points accorded in the 2006 version of the U.I.Œ.'s scoring sheet).

In the 2009 version, however, the attributes have differing importance or weights. One approximation of the relative weights of importance of the attributes is to simply add the points used for each criterion (given at the top of Table 8.8).

The *multi-criteria majority judgment procedure* replicates the grades of each criterion according to its weight and applies majority judgment to this extended set of grades. The data is exactly the same but in Table 8.8 the word grades are inserted rather than their corresponding points.

The procedure is explained for Wine *A*. Every grade assigned to the three wines is either *Excellent*, *Very Good*, *Good* or *Fair*. Letting the 4-tuples below be the numbers of *Excellent*, *Very Good*, *Good* and *Fair* attached to each attribute, the assignment of weighted grades is

VL (75,0,0,0)	VA (90,60,0,0)	NG (54,54,27,0)	NI (20,80,0,0)	NQ (20,180,60,0)
TG (27,54,54,0)	TI (20,60,20,0)	TP (60,60,30,0)	TQ (80,80,240,0)	HO (45,90,90,0)

This data allows the majority-grades of each attribute of the wines to be calculated as well, which is useful information (they are given in Table 8.8).

Table 8.8 A jury's grades for three white wines, *Les Citadelles du Vin*, 2006 (verbal grades)

Attribute →	**VL**	**VA**	**NG**	**NI**	**NQ**	**TG**	**TI**	**TP**	**TQ**	**HO**
Weight	**15**	**30**	**27**	**20**	**60**	**27**	**20**	**30**	**80**	**45**
					Wine *A* :					
Judge 1	*Exc*	*VG*	*VG*	*VG*	*VG*	*VG*	*VG*	*VG*	*VG*	*VG*
Judge 2	*Exc*	*Exc*	*G*	*VG*	*G*	*G*	*VG*	*VG*	*G*	*G*
Judge 3	*Exc*	*Exc*	*Exc*	*VG*	*VG*	*VG*	*VG*	*Exc*	*G*	*VG*
Judge 4	*Exc*	*Exc*	*Exc*	*Exc*	*Exc*	*Exc*	*Exc*	*Exc*	*Exc*	*Exc*
Judge 5	*Exc*	*VG*	*VG*	*VG*	*VG*	*G*	*G*	*G*	*G*	*G*
					Wine *A* :					
Majority-grade	*Exc*	*Exc*	*VG*	*VG*	*VG*	*VG*	*VG*	*VG*	*G*	*VG*
					Wine *B* :					
Majority-grade	*Exc*	*Exc*	*VG*	*VG*	*G*	*VG*	*VG*	*VG*	*G*	*G*
					Wine *C* :					
Majority-grade	*Exc*	*Exc*	*VG*	*VG*	*VG*	*VG*	*VG*	*VG*	*G*	*VG*

Note that the weighted majority-grade of a wine's attribute is necessarily the same as the majority-grade (without replication) of that wine's attribute.

The total count of grades for Wine *A* is (531,778,521,0) or 531 *Excellent*, 778 *Very Good,* 521 *Good* and 0 *Fair*. *B*'s total count is (195,714,736,125) and *C*'s (165,980,625,0).

It would be laborious, to say the least, to write down in order 1,830 grades. There is a simpler procedure. An absolute majority is 916 or more. Therefore, *A*'s *majority-grade* is *Very Good* since there is less than a majority for *Excellent* and an absolute majority for at least *Very Good*.

A wine's *majority-gauge* is a triplet (p, majority-grade $\pm$, q), where p is the number of grades above the majority-grade and q is the number of grades below the majority-grade. A '+' is adjoined if there are more grades above the majority-grade than there are grades below it (if $p > q$), and a '−' otherwise. Thus the three wines' majority-gauges are

A: (531, *Very Good* $^+$, 521) *B*: (195, *Very Good* , 861) *C*: (165, *Very Good*$^-$, 625)

Each of the wines is *Very Good*. The following rule determines the *majority-ranking*:

- When wine*X*'s majority-grade is above *Y*'s, X >Y;
- When they have the same majority-grade, *X*'s with a + and *Y*'s with a −, X >Y;
- When they have the same majority-grade and both are + or both are −, the biggest of the four associated numbers of grades decide: if it is one of

X's and it is the number of grades above the majority-grade, X >Y, whereas if it is one of *X*'s and it is the number of grades below the majority-grade, X <Y.

This rule gives exactly the majority-ranking obtained by the laborious procedure unless it produces a tie in the ranking (unlikely when there are many grades). If this occurs and there is a need to resolve the tie the laborious procedure may be used (which guarantees there can be no tie unless both wines have exactly the same numbers of each grade).

8.6 Conclusion

The foremost reasons why majority judgment should be used to amalgamate the opinions of judges to make jury decisions – to reach a jury consensus on the value of each wine and on how they should be ranked – have been presented. A much more complete and detailed theoretical argument together with proofs is presented in the book (Balinski and Laraki 2010), where experimental evidence in diverse uses including the award of prizes and elections is described as well.

Notes

1. There are some very small discrepancies in the grades assigned the wines in the available sources. We follow those given by R.E. Quandt (2006). They are slightly different than those given in our book (Balinski and Laraki 2010); thankfully those discrepancies are small enough that they do not appreciably change the analysis.
2. We are indebted to Jacques Blouin for giving us access to the data of the results in 2006.

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9
Wine as an Alternative Asset Class

Philippe Masset and Jean-Philippe Weisskopf

9.1 Introduction

Investors have never faced as many investment choices as they do today. Not only have markets become more integrated and international investments facilitated but also the number of available asset classes has grown more important during the last decade. This has also led to an increase in complex financial products. As a counterbalance, demand for basic or physical products has increased equally. These products should ideally be tangible, their characteristics quite easily understandable, rather uncorrelated with other assets which would allow for diversification benefits of an investment portfolio and yield good returns. At the same time a new class of investors is actively seeking possibilities to convey a certain lifestyle, social status and passion for aesthetic goods.

Collectibles and especially fine wine constitute products that can cover this demand. Wine has a long-standing history that is not only linked to ancient civilisations such as the Greeks and Romans but is also representative of culinary refinement. As such, it is a product that has enough availability to be easily purchased but is also scarce enough to offer an image of refinement, lifestyle and social status to its owner. At the same time, wine also seems to cover the characteristics of a good investment opportunity, with a minimum market depth, good returns and low risk. The market for fine wine has therefore been widely promoted as an interesting choice due to its remarkable risk–return profile and its image as status symbol. The *Wall Street Journal* (2008) recently described how in times of economic crises investors tend to turn to real physical products that will not vanish; Champagne or wine is considered as one of these hard assets. At the end of 2009, just after the financial crisis, the *Financial Times* (2010) looked at the best-performing investments over the preceding decade. It turned out that a 1982 Château Lafite would have taken first place, with a total return of 857 per cent over the period (an annual compounded return of 26%). Consequently, wine should be viewed not only as a pure consumption good any more, but also as an interesting investment opportunity by many an investor.

The market for fine wine and the offer side have also moved to cater for the growing demand. In the last decade a small but steadily growing marketplace has established itself. In particular, trading through auction houses has expanded, and wine auctions now not only span classic wine regions like Europe and the United States but are also reaching new customers, especially in Asia. At the same time, the number of wine auctions conducted throughout the world has increased. The rise in worldwide turnover from some US$90 million in 2003 to more than US$478 million in 2011 at major auction houses as noted by *Wine Spectator* (Meltzer 2005 and 2012) provides proof of the growing popularity of this market. At the same time, investment in bottles of wine has become possible through wine funds (such as Elite Advisers' Nobles Crus). Simultaneously, wine indices (for example Liv-ex in the UK or Idealwine in France) have emerged to cater for this new demand from investors. The resulting improvement in transparency and liquidity has rendered this market even more accessible to investors.

Although wine investments are often associated with the trading of bottles of wine, they should not be restricted to it. Opportunities to take part in this thriving new market are multiple. They range from expensive, time-consuming and difficult projects such as the purchase of a whole domain or château to the inexpensive, straightforward purchase of a bottle of fine wine. In the following we will take a closer look at these two and other possibilities that are offered to investors interested in the wine market. We will, further, look in more detail at the best known and most used investment vehicle on the market for fine wine, namely the trade in bottles of wine.

In general, wine investments, especially through bottles, show different benefits. As wine production cannot be increased drastically over the short to medium term, the offer is quite rigid. Facing an ever-growing demand not only from developed countries but mostly from emerging markets, this naturally leads to increasing prices for fine wine. This effect becomes even more pronounced as wine consumption of a specific vintage across time enhances its scarcity. The best fine wines are drinkable for at least 40 to 50 years. This means that investments do not have to be short-term but are feasible over a longer time horizon. However, even after maturity old bottles of wine stay an interesting choice on the collectible market. This longevity and the fact that wine, like other collectibles, is a physical good makes it an option as inflation hedge. Wine is also interesting from a tax point of view. Many countries, most notably Hong Kong, have lowered their duties on wine. Moreover, returns on wine investments are normally not taxable, which can represent a considerable gain as opposed to classic assets. Regarding pure speculation the wine market stays fragmented, which may allow for arbitrage opportunities across markets, wines and vintages; while from a non-pecuniary point of view, wine equally offers advantages. Not only is it a status symbol, representing a certain lifestyle and refinement by its owner, but it can also trigger positive emotions. Even if it is intended as an investment, some wine amateurs may end up drinking their investment. This gives not only a pecuniary value to wine but also an emotional one that might be as important.

Wine investment, however, also displays some inconveniences. First, several costs are associated with it. To be able to resell wine at a good price it should be stored in the best possible conditions. This can involve the purchase of equipment such as wine cellars and wine fridges or the renting of a climate-controlled box in a warehouse facility. Next to these storage costs insurance may be a further expense. Finally, the trading of wine in auctions is accompanied by trading costs. Typical buyer's premium varies between 15 and 25 per cent. Another major problem is liquidity which, although increasing with time, remains quite low compared to classic assets. Other, smaller, problems that also affect wine as a financial asset include change in tastes and trends, market timing difficulties, counterparty risk (including fraud) and the arrival of new information that will impact wine prices (mostly reviews of wine ratings).

In a nutshell, investment possibilities in the market for fine wine are numerous and although small in size can cater for many different investment styles and wishes. Also, wine seems to bring with it several interesting benefits but also problems. It is therefore of the utmost importance to review these different investment possibilities and to understand what they imply in terms of opportunities and threats.

This chapter is organised as follows. In the next section, we present various approaches to investing in wine. Section 9.3 reviews the existing academic literature on wine investments. In Section 9.4, we report empirical results on the financial performance of fine wine, while Section 9.5 concludes.

9.2 Investment opportunities on the market for fine wine

In this section, we describe various approaches to investing in wine and profiting from its supposedly attractive financial performance. There are several ways to do this, ranging from the purchase of an existing *Château* to investment in a single bottle of *Grand Cru Classé*, but only very few really enable investors to gain a genuine exposure to the price evolution of fine wine.

We first discuss investments in *companies* active in the wine market (wineries, merchants etc.). In the following section we present ways of investing in *bottles* of fine wines. We first define what can be considered as an investment-grade wine before examining important specificities and potential problems associated with this very particular market (for example costs, risk of counterfeit). A closely related approach is to invest in a wine fund that trades in bottles of wine. Finally, we analyse this category of investment vehicles.

Investing in a company active on the wine market

An important distinction should be made between wine-*producing* companies (for example wineries and cooperatives) and companies bridging the gap between the wineries and the customers (for example, merchants, wholesalers and restaurants). Such companies can at best be considered as an indirect way to invest in wine; their profits do not necessarily originate from wine price appreciation but rather from the margin made by the seller multiplied by the number of bottles sold (which may both be related, either positively or negatively, to wine price changes). We have therefore focused the following discussion on investments in wine-producing companies.

One can purchase an estate (a *Château*) or invest in a company that produces wine. If the company is listed, one may simply invest in its stock. In some European countries there exist some further alternatives such as sharing the ownership of a wine estate through a collective ownership scheme (known as *Groupement Foncier Viticole* in France, GFV henceforth) or even sponsoring a vine stock (*Parrainage de ceps de vignes* in France, PCV). Theoretically, all these approaches could qualify as ways to invest in the fine wine market. However in practice it turns out that few of these approaches are actually feasible. For instance, except in Champagne,[1] the number of listed companies active in the fine wine world is extremely limited.[2] Similarly, while GFV and PCV might appear to be of interest at first due to the modest initial outlay required, they are generally set up by small estates that lack the necessary sources of financing to survive or expand. Hence, they are definitely not of interest to someone wishing to invest in the world of fine wine.

The only viable option is, therefore, to invest directly in a wine-producing company. This approach has some appealing features. First the investor/owner captures the full upside potential in case the wine becomes more sought-after and more expensive. Moreover, it enables the investor to have a direct influence on the marketing strategy of the winery. It can also actively manage the inventories and thereby potentially help creating rarity and supporting higher prices. For instance, most estates in Bordeaux market their wines during the *en primeur* period; they determine the number of bottles from their first and second labels that they want to put on the market. In a year of strong demand, they may release more bottles from their first wine. In a depressed year, they may decide to retain part of the production or to reduce the percentage of the first wine as compared to the second label. For instance, Château Latour (first growth from Pauillac, Bordeaux) produces a first wine (Château Latour), a second wine (Les Forts de Latour) and even a third wine (Pauillac de Latour, created in 1973) whose production has increased significantly over the last two decades. Clearly having three labels enables the estate to manage its inventories more efficiently and to potentially increase its brand power by affecting the availability of the first wine. Château Latour has indeed significantly reduced the number of bottles from the first wine put on the market over the last decade.[3] This has helped support the dramatic appreciation of all vintages available on the market.

Nevertheless, investing in a wine company has also its drawbacks. First and foremost, the number of attractive investment opportunities (that is, of investment-grade wine estates) available on the market is extremely low. Over the last decade, very few key estates have changed hands:

- The Agnelli family sold its 75 per cent stake in Château Margaux (first growth from Margaux) to Corinne Mentzelopoulos in 2003.[4] The selling price of €350 million valued the overall property at close to €470 million, or €6 million per hectare. This price also corresponded to a capitalisation rate of about 5 per cent to 6 per cent (at that time).[5]
- Another, slightly earlier, example is the purchase of Château Latour by Franccois Pinault in 1994 for Frs 650 million. This corresponds to about €100 million, or slightly more than €2 million per hectare. Assuming a capitalisation rate of 6 per cent or even 7 per cent, the current value would certainly be higher than €1500 million. Taking into account the profits accumulated over the period, this implies a rate of return well above 15 per cent p.a.
- Colony Capital acquired Château Lascombes (second growth from Margaux) in 2001 for about €50 million and resold it in 2011 to the Mutuelle d'Assurance du Corps de Santé Franccais (MACSF) for €200 million. Taking into account about €35 million of investments to modernise and improve property facilities, this implies a capital appreciation of close to 9 per cent p.a. This recent transaction also translates in a capitalisation rate of about 7 per cent to 8 per cent.
- Other significant transactions include the Frey family (winemakers in Champagne and owner of Château La Lagune, Haut-Médoc) who acquired the Maison Paul Jaboulet Ainé (winemaker of Hermitage La Chapelle, one of the most prestigious wines of the Rhône Valley) in 2006. The Rouzaud family purchased Pichon Comtesse (second growth from Pauillac) from May-Eliane de Lencquesaing in 2006, and the Barton family (owner of Léoville-Barton and Langoa-Barton in St-Julien) took over Château Mauvesin (Moulis) in late 2011. (Undisclosed transaction prices.)

Of the other first and second growths, none has changed hands in the last decade. Most have been owned by the same family since the nineteenth century (for example, Château Mouton Rothschild and Château Lafite Rothschild have been owned by two different branches of the Rothschild family since 1853 and 1868 respectively). The situation is similar for other renowned wine regions (for example Burgundy, the Rhône Valley, Piedmont, Tuscany), where most estates are not available for sale. In Burgundy the last significant transaction was the takeover of Bouchard Père & Fils by the Henriot family in 1995. Of the other top estates from Burgundy, all are family-owned and none has been sold for decades.

In addition to this obvious lack of liquidity, it should also be noted that investing in a wine-producing company typically involves large amounts of money and lacks flexibility. In particular, in the case of a major crisis (like that of 1973–1974) an investor is likely to be very seriously affected indeed. Moreover, most estates produce not only a 'flagship wine' but also several less renowned, non-investment grade wines – for instance, the Delon family owns Léoville-Las Cases, which produces not just its *grand vin* but also Clos du Marquis and Petit Lion, and the family also produces wines from Potensac and Nénin. While the *grand vin* from Léoville-Las Cases can clearly be considered as a speculative wine, the other wines produced by the estate are not in the same league. When purchasing a wine company, one actually acquires the full line-up of the company, not just the flagship wine. Though providing some form of diversification, this also implies that the possibility to benefit fully from a price increase is limited.

In fact, investing in wine-producing companies requires patience, a long time horizon, knowledge and a strong financial situation. As such, this constitutes a strategy more for pension funds and insurance companies than for individual investors. For instance, Axa Millésimes owns several properties in Burgundy and Bordeaux, including Château Pichon-Longueville Baron, the well-known second-growth from Pauillac. Some private equity funds are also active in this market (for example Colony Capital). For private investors, however, the easiest approach is to purchase bottles or even cases of fine wine. This also allows the investor to select specific wines that are likely to appreciate in the future.

Trading in bottles of wine

A very diverse range of wines can be bought by a variety of economic actors, from a small winery to a large wholesaler. However, only a very small subset of all those wines can be considered as investment-grade. We hereafter first clarify the type of wines that can be considered as potentially attractive from an investor's viewpoint. We then discuss some important features of wine trading, including transaction costs and risks of counterfeit.

What is an investment-grade or a speculative wine?

An investment-grade wine is one for which an active secondary market exists. These are wines that can not only be purchased but also sold quite easily and frequently, and for which the spread between the purchasing and selling prices is not too wide. Based on experience and observation of the wines that are actively traded at auctions, five criteria that a wine should ideally fulfil in order to qualify as investment-grade can be identified: ageing potential; scarcity; reputation; quality and brand/trendiness.

- The ageing potential is a discriminant criterion: while wine that is short-lived has almost no chance of becoming speculative, there also is no guarantee that a wine with a huge ageing potential will be speculative. The ageing potential heavily depends on the grape variety and the region of origin of the wine.
- Scarcity is relative. With the emergence of new customers on the market, more wines are likely to become rare – as compared to the number of potential buyers. All the first growths from Bordeaux (150,000 to 300,000 bottles per year), which used to be widely available in French supermarkets are now becoming increasingly rare. Of course, a Romanée-Conti (slightly more than 5,000 bottles produced every year, on average) will certainly always remain more valuable than a Mouton Rothschild (close to 300,000 bottles per year). Hence, while scarcity definitely has an impact on wine prices, it is not necessarily a discriminant criterion.
- Reputation and history constitute another key criterion: collectors and investors are looking for wines that have a long-standing history and a strong reputation. From this perspective, wines from France (especially from Bordeaux and Burgundy) and Italy (Piedmont) have a clear advantage over wines from Australia, Chile or even the United States or Spain. In particular, Bordeaux and Burgundy both benefit from a great heritage. Bordeaux is the only wine region that has an official classification that dates back to 1855; meanwhile in Burgundy, monks started setting out vineyards and examining the specificities of each *terroir* during the Middle Ages.
- Quality is a subjective but nevertheless crucial investment criterion; a bad wine will never be a good investment. In the long run, only good wines can durably increase in value. The quality of a wine has to be uniformly recognised; this recognition may take time before it materialises in higher prices. In some regions, such as Bordeaux and to a lesser extent the Rhône Valley, ratings from certain wine gurus may be used as a quality proxy – Robert Parker, in particular, is known as having an important influence on Bordeaux prices. The existence of an official classification, as in Bordeaux, may also help in ranking the wines. Notably, the five wines ranked as first growth in 1855 are still by far the most expensive wines from the Médoc.[6]
- With the arrival of new customers, wine and the image associated with it has evolved quite dramatically over the last few years. As a consequence, some wines have become trendier than others. In particular, the second labels of some classified growths from Bordeaux enjoyed a spectacular increase in price between 2005 and 2010.[7] For instance, most vintages of Carruades de Lafite increased in price by more than 500 per cent over that time – and then saw it drop by 30 per cent to 40 per cent in just 18 months. This implies that one can no longer invest blindly in the wines that used to be speculative – one has to look at the psychology of wine buyers in order to make wise investment decisions.

A list of investment-grade wines

Table 9.1 below presents a list of investment-grade wines classified by regions. Whatever the region considered, only wines from great vintages and some wines from (very) good vintages can qualify as investment-grade. In the table, we distinguish between speculative and investment-grade wines. The first are the most expensive and most appealing for investors. The second can also be interesting from an investor's perspective, but they require a deeper analysis (for example taking into account the specificities of the vintage, looking for ratings).

The very best red wines from Bordeaux and Burgundy are by far the most appealing from an investor viewpoint. In Bordeaux, the Médoc is certainly the region of greatest interest to investors, as it offers many investment-grade wines that enjoy a genuine market depth. In the Libournais (St-Emilion and Pomerol), there is only a handful of true investment-grade wines, many of these only in particular vintages. In general, sweet wines are of more interest to collectors than to investors as they can be very long-lived but their prices are more stagnant; the only true exception is Yquem, whose price can be very high for some excellent old vintages. Certain wines from other French regions (the Rhône Valley, Champagne), Italy (Barolo and, to a lesser extent, Tuscany), and the USA (Californian Cabernets) can also be of interest from an investment perspective; however, caution is needed, as only a small fraction of these wines (basically, the best *cuvées* from the best producers in the best vintages) display an upside potential.

Trading wine: primary and secondary markets

As in conventional financial markets, a distinction can be made between the primary and the secondary market. Depending on the region and the type of wine considered, primary and secondary markets can be organised rather differently.

a) Primary market The primary market refers to the market in which a wine is offered for sale to the customer for the first time. Most of the wines are first sold by merchants and/or supermarkets. But, when it comes to fine wines, many are sold through two specific channels: (i) *en primeur* (also known as wine futures) and (ii) by allocation.

En primeur is a method of purchasing a wine that is still in the barrel and receiving it about 12 to 18 months later, once it has been bottled. This system used to be beneficial for both producers and customers. On the one hand, the producer collects the payments from its customers earlier and can thereby more easily finance its working capital needs. On the other hand, *en primeur* gives customers the opportunity to acquire rare wines, often at a significant discount. Wine futures are especially popular for Bordeaux wines, and more and more for wines from Burgundy (for example Bouchard Père & Fils), the Rhône Valley (for example Chapoutier) and southern France (for example

Table 9.1 Investment-grade wines

	Speculative wines	Other investment grade wines
Bordeaux – Médoc (left bank)	First growths: Lafite-Rothschild, Latour, Margaux, Mouton-Rothschild, Haut-Brion; plus Mission Haut-Brion (that is assimilated into a first growth). Second wines from some of the first growths: Carruades de Lafite, Forts de Latour and, to a lesser extent, Pavillon Rouge de Margaux.	The so-called 'super seconds' from St-Estèphe (Cos d'Estournel, Montrose), Pauillac (Pichon Baron, Pichon Comtesse, Lynch-Bages and, in recent vintages, Pontet Canet), St-Julien (Léoville Las Cases, Léoville Poyferré, Léoville Barton, Ducru Beaucaillou) and Margaux (Palmer). Plus (in great vintages): Gruaud Larose, Calon Ségur and Grand-Puy Lacoste.
Bordeaux – Libournais (right bank)	First growths 'A' from Saint-Emilion: Ausone (since 1995) and Cheval Blanc. In Pomerol: Pétrus, Lafleur, Le Pin, and Latour-à-Pomerol (some vintages between 1945 and 1961 only).	Some first growths 'B' from Saint-Emilion: Angélus, Pavie; and in some great vintages only, Beauséjour-Duffau, Troplong-Mondot and Clos Fourtet. In Pomerol: Eglise-Clinet, Vieux-Château Certan, Trotanoy, Clinet, La Fleur-Pétrus.
Sweet and white Bordeaux	Sauternes (sweet): Yquem. Whites: Haut-Brion blanc, and, to a lesser extent, Mission Haut-Brion blanc (formerly known as Laville Haut-Brion).	Some other Sauternes, but only in great vintages: Climens, Rieussec, Suduiraut.
Burgundy	The *grands crus* (e.g. Musigny, Chambertin, Richebourg) and some *premiers crus* (e.g. Les Amoureuses in Chambolle, Les Perrières in Meursault) from the best wine producers: Domaine de la Romanée-Conti, Henri Jayer, Méo-Camuzet, Comte de Vogüé, Domaine Leflaive, Jean-Franccois Coche-Dury, Comtes Lafon, Georges Roumier, Lalou Bize-Leroy, Armand Rousseau, etc.	*Premiers crus* from the best producers. *Grands crus* from other renowned producers, like: Jean Grivot, Anne Gros, Jean Trapet, Perrot Minot, Robert Groffier, Bruno Clair, etc.

Continued

Table 9.1 Continued

	Speculative wines	Other investment grade wines
Rest of France	Rhône Valley (North): the best *cuvées* from Guigal, Chave, Chapoutier (in recent vintages) and Jaboulet (La Chapelle). Rhône Valley (South): Rayas (Châteauneuf). Champagne: Krug (Clos du Mesnil) and Salon.	Some other excellent producers from Hermitage and Côte Rôtie (e.g. Rostaing) and the best *cuvées* from several producers from Châteauneuf-du-Pape, like Beaucastel, La Janasse, Pégaü, Clos des Papes, etc. Some specific wines from Champagne (Dom Pérignon, Roederer Cristal), the Loire Valley (Huët) and Alsace (Zind-Humbrecht).
Italy	Some rare *cuvées* from the Piedmont (Barolo and Barbaresco) from top producers like Giacomo Conterno, Angelo Gaja, Bruno Giacosa.	Piedmont: some *cuvées* from other excellent producers (e.g. Voerzio, Mascarello, Vietti). So-called Super Tuscan wines such as Sassicaia and Ornellaia.
Rest of the world	In the rest of Europe, only few wines can qualify as investment grade. Examples include Spanish wines like Pingus, Vega Sicilia Unico Riserva, L'Ermita and the very rare Trockenbeerenauslese (TBA) and ice wines from Germany, in particular those by Hermann Dönnhoff and Fritz Haag. The USA nowadays produce many cult wines. They include the best Californian cabernets and Bordeaux blends (e.g. Abreu, Colgin, Harlan, Screaming Eagle, Shafer, Vérité, Sloan) and some Rhône rangers (e.g. Sine Qua Non, Alban Vineyards). In Australia, the only really speculative wine is Penfolds Grange. Among other new world wines, some have become very popular but none can really be considered as speculative.	

Clos des Fées or Montus). Wineries generally retain a limited number of bottles that they can sell later through the trade (*négoce*). Over the last decade, with the ever stronger demand for great Bordeaux, this system has evolved from its commercial win–win spirit to a more speculative one. For the producers, the goal is now to release their wines as close as possible to their fundamental value, thereby leading to a severe reduction in the potential discount. For the customers, the issue is to find and invest in (potentially) underpriced wines. As a consequence, the difference between the futures price and the price once the bottle hits the shelves has decreased on average, but its variability has widened with some spectacular increases (for example Montrose 2003; Pavie Macquin 2005; Clinet 2009).

The allocation system is based on a completely different paradigm. To some extent, this system can be considered as a long-term win–win commercial relation between producer and customer. On the one hand, the customer agrees to purchase a sample of the wines produced at the estate year in, year out. If the customer decides to decline his allocation for a year, he will typically be replaced by another customer (from a waiting list). In general, prices remain very similar or increase slightly from one vintage to another, whatever its supposed quality. The advantages for the producer are obvious: he does not have to find new customers every year and he can easily forecast his revenues. The advantage for the customer is that he is certain of having a sample of wines from those great estates where he has an allocation. Moreover, in exchange for his loyalty, the customer generally benefits from highly competitive release prices. In very good vintages, the winner is clearly the customer, while in lesser vintages the producer saves time and resources by not having to market his vintage (but the customer is not necessarily the loser, thanks to the relatively low release prices). This system is very popular in Burgundy and the Rhône Valley.

Between these types of primary market, there exist some intermediate systems based on recourse to wholesalers, merchants or even supermarkets. For instance, some large French supermarkets quite often purchase Bordeaux wines *en primeur* and sell them to their customers once they are physically available.

b) Secondary market The secondary market refers to the market on which it is possible to trade (purchase and to sell) wine. First and foremost, one must note that a secondary market only exists for investment-grade wines. Contrary to stocks and bonds that are traded on a centralised secondary market, there is no such unique market place to trade wine; there are actually several secondary markets set up by various economic agents: traditional auction houses (for example Sotheby's, Christies, The Chicago Wine Company or Acker Merral & Condit), online auction houses (for example winebid, ebay, ricardo), and some large merchants (such as Farrvintners or Arvi) that both sell and purchase fine wine. Over the last decade, the secondary market has dramatically increased in terms of size and trading activity, and within a few years, marketplaces trying to replicate the functioning of other financial markets have started to emerge. A good example is Liv-ex that aims at creating a genuine order book for each wine, with bid and ask prices.

Specificities and potential issues associated with wine investments

Fine wine possesses some key features that distinguish them from other asset classes. First, like other collectibles, it does not pay dividends. This implies that its value cannot be derived from a stream of cash flows as with stocks or bonds. Prices are fully determined by the equilibrium between supply and demand at a given moment. But supply is difficult to estimate, as producers may, in case of adverse economic conditions, retain part of their inventories for better times or simply be affected by the weather. Moreover, the world of fine wine is not static: just a few years ago, Bordeaux had a clear lead over other wine-producing regions; but, since the beginning of 2011, Burgundy has bounced back with rapidly increasing prices, while Bordeaux prices have stagnated or even declined. Demand is also becoming trickier to estimate, with the arrival of new customers from all over the world and with the increasing number of investors active on the market. Hence it is very difficult to establish the fundamental value of a bottle of wine; to a certain extent, almost any price level can be justified.

An additional issue is the absence of a central marketplace and the consequent aggregation of unique wine prices. Nevertheless, the situation has started to improve in recent years with the inception of websites that comprehensively report current hammer prices from several auction houses (for example wineauctionprices.com), current merchant prices (for example wine-searcher.com) and data about the evolution of the market as a whole (for example Liv-ex). Even so, the market remains fairly inefficient and illiquid. The inefficiency constitutes both a major drawback for most people and a potentially attractive feature for the few informed investors active on this market, as they can take advantage of those inefficiencies. The lack of liquidity makes it very difficult to take large positions in investment-grade wines without affecting market prices, a problem that is accentuated when trying to exit these positions. This implies that investors willing to unload positions may rapidly trigger severe price declines, especially in a downward market.

Another drawback with wine investment appears in the form of the physical fragility of the asset: it can break and deteriorate, and its holding period is limited, as it remains a perishable product; most wines cannot be kept for a prolonged period of time. Storage conditions are vital for an old vintage, as with improperly stored bottles the chances are the wine has turned bad and the bottle becomes almost worthless, at least from a consumption point of view.

A related issue is the risk of buying a counterfeit. While it is impossible to copy a wine (the content), it remains quite easy to replicate the bottle and its label (the container). Unfortunately, it turns out to be extremely difficult for the buyer to determine with any exactitude whether the bottle is original or not. The story of Rudy Kurniawan illustrates this situation. Mr. Kurniawan has rapidly acquired the reputation of being one of the most influential wine collectors in the world. For instance, the *Los Angeles Times* wrote in a 2006 article that he had 'amassed one of the world's premier wine collections, estimated at its peak to be more than 50,000 bottles of the most celebrated Bordeaux and Burgundy wines of the last century'. Mr. Kurniawan justified his many expensive purchases by passion: 'I'm not a collector. I'm a drinker' (Brown 2006). However he was arrested in early March 2012 and charged with the sale of fraudulent wines for about $1.3 million.[8] So far, only one way exists to reduce the risk of purchasing a counterfeit or improperly stored bottle: one must track down all the owners of the bottle since the first time it was sold on the market. As Farr Vintners state on their website, 'provenance is king'.

Finally, it must be stated that trading and storing wine is costly. Trading costs depend on how and where the wine is traded. For instance, merchants typically take a margin of 20 per cent when purchasing a wine that is in strong demand; for a wine that is less sought after, the margin can be as much as 35 per cent.[9] Auction houses typically charge both a buyer's premium and a seller's commission, but it is sometimes difficult to compare between auction houses as fee structures vary. In particular, the seller's commission differs widely (but normally remains below 5%) and is typically negotiable – meanwhile Acker, Merrall and Condit do not charge any seller's premium. The buyer's premium is typically between 15 per cent and 25 per cent (with the exception of The Chicago Wine Company, which does not charge a buyer's premium). As another example, Sotheby's charges a seller's commission of 2 per cent to 10 per cent and a buyer's premium of 17.5 per cent in London and 22.5 per cent in New York. This discussion shows that the bid–ask spread is close to 20 per cent to 30 per cent on the wine market, which is very large in comparison to other asset classes (including gold and commodities). Cheaper alternatives to traditional auction houses include trading through non-specialised online auction houses (ebay or ricardo) and direct transactions between sellers and buyers, omitting a middleman. The first solution is especially appropriate for young wines, while the second requires a network of contacts, which can be rather costly to build. In addition to direct transaction costs, other indirect expenses related to holding and trading wine must be taken into account: shipping, insurance and storage. They can easily amount to 5 per cent of the value of wine, and cannot be reduced or eliminated.

It is often claimed that wine has at least one significant advantage compared to other asset categories: their tax treatment. In the UK, for instance, wine is considered a 'wasting asset' and as such is exempt from income and capital gains tax. Fogarty (2007) shows its large impact on the net expenses rate of return to wine: the advantageous tax treatment almost completely offsets the trading and holding costs incurred by wine investors. This statement holds for the UK and Australia,[10] but not for other countries, where profits on wine are treated similarly to capital gains.

To sum up, investing in wine directly requires a deep knowledge of this very specific market due to: the difficulty of establishing a fair value (increasing the risk of creating a bubble), a lack of a centralised market place (leading to low liquidity and contributes to the lack of information on wine prices), the fragility and the risk of counterfeit (difficult to assess properly without opening the bottle), and the high transaction and holding costs. All these difficulties explain why more and more people turn to wine investment funds.

Wine funds

Even though the fine wine market may suffer from several pitfalls, the high returns it promises have led to the creation of various funds that invest exclusively in wine. One can broadly classify those funds into two categories according to their structure. The first category contains funds that have a fixed term (typically five years) and are therefore comparable to private equity funds. The second category contains funds that do not have a fixed term but impose some restrictions in terms of redemption and charge relatively high fees; as such they resemble hedge funds. Management fees are usually between 1.5 per cent and 2.5 per cent, and performance fees can be as high as 20 per cent (with a high watermark). Sometimes, they also include a subscription fee of up to 5 per cent. Minimum investments of between US$100,000 (for private investors) and US$500,000 (for institutional investors) are most common, although they vary considerably.

These funds typically invest a large share in Bordeaux (for example the Wine Growth Fund, The Fine Wine Fund, The Wine Investment Fund) but some of them allocate a significant proportion to Burgundy (like Nobles Crus), or the Rhône Valley and Italy (for example The Bottled Asset Fund). It is less common for them to invest in wines from other regions, even though some funds, such as the Vintage Wine Fund or the Elevation Wine Fund, claim to invest in wines from Spain, California and Australia. Moreover, most funds do not invest in *all* Bordeaux, not even in *all* classified growths, but rather in the five first growths from the Médoc (Latour, Mouton Rothschild, Lafite Rothschild, Haut-Brion and Margaux) plus Pétrus and some other Pomerols (for example Lafleur, Trotanoy, Eglise-Clinet), and St-Emilions (for example Ausone, Cheval Blanc and to a lesser extent Pavie and Angélus). Furthermore, they focus essentially on the best vintages, and tend to weight recent vintages, such as 1982, 1990, 2000, 2005, 2009 and 2010,[11] overmuch (it being far easier to acquire wines from those vintages than from older ones). The fact that most of those funds invest in the same, limited, universe of fine wine is *interesting*. It is interesting because the added value provided by some of these fund managers – who charge (very) high fees and who simply buy high-end Bordeaux wines – can be questioned. It is also interesting because this suggests that a potentially large share of recent vintages from top Bordeaux wines is owned by about 25 to 30 investment funds.

According to Chris Smith of the Wine Investment Fund, 'total holdings in formal funds ... and quasi-managed funds (like Berry Bros) are around USD 1,200 million'.[12] Chris Smith further estimates that 'for the wines he looks at the total stock of wine left is around USD 10 billion' (Rose 2011). This means that about 12 per cent of the fine wine market is in the hands of just a few actors. This figure of 12 per cent is probably slightly underestimated, as prices have declined over the last year or so and new funds have been created in the same period. For instance, China's first government-approved wine fund, Dinghong Fund (Dinghong means 'in red', and while this relates of course to wine, to the Chinese red is an auspicious colour) was launched in late 2011 and is expected (according to its founder, Ling Zhijun) to raise up to ¥1 billion (about €120 million) in the next five years. This situation is obviously a source of risk as this speculative demand pressure may well drive prices away from their fundamentals and, in the event of a liquidity shock (like in late 2008) might lead to severe price declines. Andrew Davison, manager of the Vintage Wine Fund, states that only a few collectors and traders wanting to sell at the same time are sufficient to affect adversely wine prices: 'Selling two to three million Euro worth of wine in a month is not that hard. Selling 10 million is. You have to bring prices way down to make the wine attractive' (Kevany 2011). 'Spreads vary between merchants and can be quite large. You don't want to have to liquidate your portfolio if you get a redemption request, because you may not get the best prices for the wines,' according to Michel Tamisier, managing partner and co-founder of Elite Advisers. That is the reason why his fund, Nobles Crus, always holds at least 10 per cent of its assets in cash, with no client accounting for more than 10 per cent of the fund (de Sa'Pinto 2009).

As mentioned above, wine funds often claim that they can achieve returns in the mid-teens or above (for example The Wine Source Fund targets a return of 20% p.a.). The Wine Investment Fund has achieved a return of 13.25 per cent p.a. for its 2005 Tranche (period 2005–2010), but since then its returns have fallen substantially, with the 2006 Tranche reaching a lower 10.94 per cent p.a. and the subsequent 2007 Tranches failing to reach 5 per cent p.a. The Vintage Wine Fund ordinary share is up 31.48 per cent for the period spanning 2003 to March 2012; this amounts to less than 3 per cent p.a. Both 2008 (−33.37%) and 2011 (−22.43%) were particularly poor for the fund. Before the credit crisis, this fund had more than €100 million assets under its management, until institutional investors pulled out massively in September 2008 (Lister 2011). The Fine Wine Investment Fund, launched in early 2008, lost since its inception about 2 per cent by March 2012. The Fine Wine Fund, launched just one year before (January 2007) was, by March

2012, up by about 40 per cent since its launch. These numbers illustrate the fact that investors have to be careful when choosing a wine fund and, above all, require a long-term horizon.

Another issue, which has not yet been addressed, is linked to pricing. How do these funds price their wines and calculate their Net Asset Value (NAV)? Fine wines are not always traded regularly, and there is no unique marketplace for each wine. This makes pricing a very difficult task. Some funds rely on Liv-ex quotes, while others use their own estimations. There are indeed no international standards. Michel Tamisier considers using the market price to calculate the NAV to be best practice. For every bottle in the fund, the team collects two prices from auction houses and two quotes from wine traders that have sold the wine in question in the month under review, and average them out to get the fund's NAV (Picard 2010). The failure of Vinum Fine Wine Fund in 2010 illustrates the risk of mispricing, as it was found that the fund had overestimated its NAV.

The point is that there is a general lack of regulation of wine investment companies. In the UK, for instance, the FSA does not regulate wine investment funds but just the marketing by those funds (Rose 2011). Moreover, many funds are located in low-regulation, tax-friendly jurisdictions (for example Cayman Islands, Delaware, St. Kitts and Nevis). In a 2001 article from the *New York Times*, de Aenlle argues that the world's first mutual wine fund, AWM Fine Wine Fund Ltd, grew by 25 per cent p.a. on average during its first two years (de Aenlle 2001). As true as that may be, the fund went bankrupt in 2006, due to the fact that only a very small fraction of its positions were in investment-grade wines (Arnold 2008).

9.3 Academic literature

In response to the growing interest in fine wine as an investment vehicle from investors since the 1970s and renewed interest from the 2000s onwards, academic research has been conducted on financial characteristics of the market for fine wine. A common perception by investors and academics nowadays shows that wine not only yields higher returns but is primarily useful due to its diversification benefits.

However, one of the earliest available articles on the subject is less positive on wine returns. In a study of red Bordeaux wines and Californian Cabernet Sauvignons, Krasker (1979) finds that wine does not perform significantly better than a riskless asset. These results are often criticised, mostly because Krasker assumes high storage costs of US$1.4 per bottle, and bases his research on very few data points spanning a short period of time (1973–1977). Although wine does not seem to yield good returns, Krasker still finds two potential benefits to investing in wine: 1) by purchasing early at a known price, real risk is reduced and 2) returns are not taxable.

Since this initial article by Krasker, consequent studies all seem to confirm that wine is indeed a good investment. Jaeger (1981) extends Krasker's sample to encompass data from 1969 to 1977. She further reduces the yearly storage costs to a more plausible US$0.499 per bottle and observes that wine yields an average premium of 16.6 per cent over US Treasury bills.

Covering the period from 1980 to 1992 for Médoc wines, Di Vittorio and Ginsburgh (1996) take a closer look at the evolution of wine prices and the characteristics that drive wine prices at auctions. These prices include a quantity discount (a negative relation between price and number of bottles in a lot) while premiums can be observed for larger bottles (magnums, jeroboams, imperials etc.), for wines in original cases, and for aged wine (3.7% per year). The more important characteristics are, however, linked to weather conditions during the vintage, and to wine ratings by experts. All in all, Di Vittorio and Ginsburgh find that between 1981 and 1985 wine prices increased by 75 per cent but decreased by 15 per cent at the end of the sample period. These results are confirmed by Jones and Storchmann (2001) who find that climate, Parker ratings, ageing of wine and scarcity all have an impact on quality and thus on the prices of Bordeaux wines.

For the period covering 1986 to 1996, Burton and Jacobsen (2001) construct a wine index on red Bordeaux vintages of 1960 and younger which yields the poor nominal returns of 7.9 per cent p.a. over the period as opposed to 13.5 per cent for stocks and 5.8 per cent for T-bonds. This negative finding is accentuated when insurance and storage costs, liquidity issues and the difficulty of obtaining wine are taken into account. The authors, however, also argue that single vintages, single investment years or investors capable of market timing can make a profit. The 1982 vintage, which is seen as one of only two exceptional vintages since World War II, is the only one that outperformed the Dow Jones Industrial Average (DJIA).

Bentzen et al. (2002) analyse returns on the top 11 Bordeaux wines sold at Copenhagen's Bruun Rasmunsen auctions over the period 1988 to 2002 and find prices that increase markedly until 1996 and then stagnate between 1997 and 2002. Looking at determinants of these wine prices, the authors find that Danish stock prices do not significantly affect wine prices. The best indicator stems from changes in the Danish consumer confidence indicator, which gives a good indication of the consumer outlook on the economy.

While returns are an important part of the reflection on wine investments they should not be considered on their own. Therefore more recent studies broaden the scope to include not only the higher moments of the distribution, such as volatility, skewness or kurtosis, but also to look in general at the benefits of including wine as part of a regular financial portfolio.

Fogarty (2006) not only takes these issues into account but also broadens the scope from French wines to an Australian perspective. He finds that Australian wine had a comparable risk–return profile to Australian equity, with slightly higher returns for equities but paired with a slightly higher volatility over the period 1989 to 2000. In a second step, Fogarty compares returns from Australian and Bordeaux wines[13] over the period 1990 to 1996, and observes that Australian wines are yielding higher returns for lower risk. His results are in line with those obtained by Byron and Ashenfelter (1995) who find the annual real rate of return to storing Penfolds Grange, the best known and most traded Australian wine, to be 3.9 per cent over the period 1952 to 1980. Unadjusted, this would reflect a nominal rate of return of around 12 to 13 per cent.

In a further article, Fogarty (2007) argues that wine returns have been understated in previous papers. His argumentation focuses on three main aspects. First, investors can identify quality wines and vintages in advance and thus will not invest in poor wines to start with (these are, however, included in most studies). This corroborates evidence on the impact of climate and ratings on wine prices as described above. Second, investors will be interested in after-tax and not pre-tax profits. In this case wine becomes interesting, as in many countries investing in wine is tax-free as long as it is not done professionally. For classic financial assets such as bonds and stocks, taxation should not be neglected, as dividend and interest payments – and in some countries capital gains as well – are taxable, which can considerably reduce the returns on such assets. Third, risk–return profiles should not be compared pairwise but in a larger framework, as for example that proposed by *portfolio theory* (Markowitz 1952). As most investors hold many different assets, the only interesting point to analyse is the benefits of adding wine to such a portfolio and its impact on portfolio risk and return.

The first evidence on the benefits of adding wine into a portfolio was published by Weil (1993) who followed the portfolio of a single wine investor over the mid 1970s to 1990s. This investor fared quite well, with an average return of 9.9 per cent with highest returns (11%) and lowest risk (3.7%) on Bordeaux wines. Sanning et al. (2008) study in more detail the risk–return relation of Bordeaux wine from 90 producers and of equity. In line with other studies, they find that investment-grade wines outperform stocks, but also observe that fine wine has only a low exposure to market risk factors, which is beneficial in terms of portfolio diversification and hedging. Using both the CAPM and Fama–French (1993) three-factor model, they find a 7.5–9.5 per cent excess return of wine (alpha) while exposure to market risk (beta) is not significantly different from zero. This is especially remarkable, as the sample period, 1996 to 2003, covers an important economic boom market.

Masset and Henderson (2010) extend the scope of previous papers by looking at a longer time period (1996–2007), and find that average returns and volatility are attractive for Bordeaux wines. However, the results heavily depend on vintage, rating and ranking of the wine. Considering portfolio theory, evidence suggests that Bordeaux wines are relatively uncorrelated with equity markets, and should therefore be included in an optimal portfolio, which will move the efficient frontier in a positive north-westerly direction.

This result also holds when higher moments (skewness and kurtosis) are taken into account. While the inclusion of wine significantly increases portfolio skewness, equities are favourable in terms of kurtosis. Even taking different costs into account, the addition of wine to an equity portfolio stays positive. Masset and Weisskopf (2010) give evidence that over the period 1996 to 2009 an index including wine from different French, Italian and US wine regions outperformed the US stock market while having a lower volatility. At the same time, wine seems to generate positive alphas and lower betas in a classic CAPM framework. Focusing on the 2001 to 2003 economic crisis and the 2007 to 2009 financial crisis, the results are even more pronounced. Wine experiences higher returns and lower risk; this especially when other asset prices tend to fall. Looking at the drivers of wine returns in a conditional CAPM framework, it becomes apparent that alphas and betas are time-varying. Although wine is not correlated to equity markets, it is affected by the state of the economy. In a final step, Masset and Weisskopf analyse the performance of typical financial portfolios with and without wine; the inclusion of wine increases returns, reduces risk and improves skewness and kurtosis of a financial portfolio, and once again this is the most pronounced during crises.

9.4 Empirical study of the market for fine wine

In this section, we study the performance of an investment in fine wine. We use two datasets to conduct our inferences. The first contains all hammer prices from The Chicago Wine Company (TCWC) over the period 1996 to 2009. The second dataset comes from the Swiss auction house Steinfels Weinauktionen and covers the period 2002 to 2011. We use the repeat-sales regression approach to calculate a variety of fine wine indices on the basis of the hammer prices. So far, studies on wine investment performance have mostly used US data (with the exception of Fogarty, who uses Australian data in his articles). The use of two distinct datasets allows us to analyse if the results found in the USA are country-specific or if they show similar trends in other countries.

The main purpose of this section is to test whether the main premises of wine as an investment hold. That is, we want to determine if investing in fine wine not only generates a better performance than traditional assets but also improves portfolio diversification. We therefore analyse fine wine returns, risk and correlation with other asset classes.

9.5 The case of the US wine market

Both academics and practitioners seem to find that fine wine does indeed constitute a good investment in terms of returns and/or portfolio diversification on the US market. Using data from TCWC, we can examine empirically if this holds true over a longer period of time. We analyse returns, risk and correlations for different wine indices[14] and other financial assets over the period 1996 to 2009.

In a first step, we control if the said low correlation of wine with other financial assets holds. Table 9.2 shows correlations between two wine indices and different financial indices. Results confirm that fine wine does indeed display very low positive correlations with bond markets, and a negative correlation with all other assets. This is particularly interesting from a portfolio diversification point of view, as it allows investors to hedge part of their portfolio against adverse market movements. Considering that data spans 13 years during which two heavy market downturns occurred (internet bubble and financial crisis) the numbers are robust to market conditions as they also cover periods of potential correlation breakdown. It is also interesting to notice that investing in a US beverage stock index does not allow reducing correlation; only commodities seem to yield somewhat similarly low correlations with the S&P 500. Investing in wine therefore helps to diversify risks which cannot be achieved by taking proxies for the beverage market in general.

In a second step, we analyse the performance of an investment in fine wine using different financial criteria. The results are reported in Table 9.3. Although wine fares quite differently across regions and countries, it constitutes a good investment as compared to classic financial assets. On a yearly basis, all wine indices perform better than stocks and commodities. In particular, French wines from Bordeaux and Burgundy and the top wine index seem to vastly outperform with returns two to three times higher than for the S&P 500. Wine, moreover, is less risky than stocks, as shown by lower volatility and beta not significantly different from zero. Only bonds from the US Treasury show even less risk. Looking at risk-adjusted performance, wine also beats stock markets with higher Sharpe ratios. This, however, is a bit dampened by Jensen's alphas that do not indicate a statistically significant over-performance – even though all alphas but one are positive.

9.6 The case of the Swiss wine market

In this section, we use hammer prices from a Swiss auction house over the period 2002 to 2011 to create wine indices.[15] Table 9.4 reports a set of statistics for the different indices. All prices are in Swiss Francs (SFr). The impact of quoting prices in SFr is marginal on all statistics but the returns as the SFr has quite dramatically appreciated over the last five years. Average yearly returns in SFr are about 1.5 per cent lower than in euros.

The returns on the general wine index have been only slightly positive, but the first growths have achieved a better performance. These returns, however, still beat those on the reference stock market index (the Euro Stoxx 50). Volatility ranges between 11 per cent (general wine index) and 18 per cent

Table 9.2 Correlation between wine and classic asset classes

	Top wine	S&P500	Commodities	Agricultural commodities	US Beverage	US T-bonds	US corporate bonds	MSCI World (Ex-US)
GWI	0.72	–0.13	0.05	–0.05	–0.12	0.17	0.17	–0.10
Top wine		–0.13	–0.07	–0.01	–0.05	0.06	0.12	–0.15
S&P500			0.18	0.17	0.55	0.06	–0.08	0.86
Commodities				0.41	–0.02	0.24	0.17	0.36
Agricultural commodities					0.10	0.12	0.05	0.24
US Beverage						0.01	–0.08	0.46
US T-bonds							0.84	0.06
US corporate bonds								–0.07

Notes: GWI denotes a general Wine Index representing all wines traded at TCWC while Top Wine refers to the Best Bordeaux wines from excellent vintages. S&P500 is a US stock index. Commodities denote the S&P GSCI Commodities Index while agricultural commodities represent the S&P GSCI Agricultural Index and US beverage is a stock index of US beverage companies. US T-bonds represent US Government bonds with a 30-year maturity while US corporate bonds are bonds from AAA US companies. MSCI World ex-US is a stock index encompassing the world's largest companies that are not based in the US.

Table 9.3 Wine and financial asset statistics in the US

	GWI	Bordeaux	Burgundy	Italy	USA	Top wine	Bonds	S&P 500	Commodities	MSCI world (ex-US)
Yearly return	7.27%	8.77%	8.56%	6.46%	3.84%	13.98%	6.41%	2.63%	2.97%	0.24%
Min.	−10.45%	−10.64%	−10.69%	−12.42%	−14.98%	−13.01%	−2.55%	−29.94%	−42.35%	−38.37%
Max.	9.89%	10.41%	28.33%	7.89%	16.49%	24.87%	4.64%	13.83%	14.18%	14.57%
Volatility	8.23%	10.33%	14.71%	9.09%	12.73%	18.72%	3.75%	17.45%	24.60%	19.54%
Sharpe ratio	0.28	0.36	0.24	0.16	−0.09	0.48	0.38	−0.14	−0.08	−0.24
Alpha	0.19%	0.27%	0.35%	0.14%	−0.06%	0.69%	0.17%*	−0.01%	0.04%	−0.26%
	(0.95)	(1.05)	(1.00)	(0.63)	(−0.19)	(1.50)	(1.87)	(−0.29)	(0.08)	(−1.18)
Beta	−0.08**	−0.07	0.05	0.01	0.02	−0.14	−0.03*	0.97***	0.46***	0.97***
	(−2.04)	(−1.47)	(0.80)	(0.23)	(0.27)	(−1.62)	(−1.71)	(118.7)	(4.28)	(22.40)

Notes: All statistics cover the period 1996–2009. GWI denotes an index including all wines traded at TCWC, Bordeaux and Burgundy wines from these two regions; Italy and USA wines from these two countries. Top wine includes the best Bordeaux wines from excellent vintages. S&P 500 is a US stock index, MSCI world (ex-US) covers the largest companies in the world outside the US, commodities is the S&P GSCI Commodities index while bonds is the City fixed income index named CGBI USBIG AAA. *, **, *** denote statistical significance at the 10%, 5% and 1% level.

Table 9.4 Wine and financial asset statistics in Switzerland

	GWI	**First Growths**	**Bonds**	**Euro STOXX 50**
Yearly return	0.33%	5.05%	−4.64%	−0.28%
Volatility	11.03%	17.41%	20.57%	4.27%
correlation	0.61	0.46	−0.38	1.00
Sharpe ratio	−0.07	0.23	−0.38	−0.73
Alpha	0.09%	4.98%	−3.98%	0.00%
Beta	0.34	0.41	0.02	1.00

Notes: GWI denotes an index including all wines traded at the auction house; First Growths includes the first growths from Bordeaux only; Euro STOXX 50 is a pan-European stock index and Bonds the iBoxx Eurozone sovereign bond index.

(first growths); these numbers are slightly lower than those observed for the Euro Stoxx 50. On the other hand, a comparison with bonds is less to wine's advantage. On several dimensions, bonds are more appealing than wine: they have a lower volatility and maintain a negative correlation with stock market indices, but also have smaller returns than wine. The two wine indices display a significantly positive correlation with the stock market index. Concentrating on performance measures, only the very best wines have a positive Sharpe ratio over the period studied, and all other asset classes have a much poorer performance. The alphas of the wine indices are all positive.

On the whole, it seems that the US and Swiss markets for wine are similar. Both outperformed their respective stock benchmarks and show low risk, but do not fare as well as bonds. In both cases correlation seems to be low, which allows for diversification benefits.

9.7 Conclusion

A recent article by Ella Lister (2012) raises the question where the boundary between a wine enthusiast/amateur and an investor can be set. For a private person the boundary is very vague, as an enthusiast might trade wine to finance their own consumption and an investor will probably drink wine. It may seem paradoxical, but in the wine fund industry the same dichotomy can be found. On the one side, London-based funds in particular see wine as a purely financial investment and look for wine with ideal financial characteristics (high returns and liquidity, low risk and correlation). These often turn to Bordeaux wine exclusively. On the other hand, some funds, such as Nobles Crus, have a mixed approach, between financial characteristics and passion. These funds defend the position that one must understand the wine market (that is, be passionate about wine) to be able to make wise investments.

This leads to fund positions covering several wine-growing regions and very specific wines, which allows for a broader diversification.

Media attention on fine wine has steadily grown over the last couple of years. This is not so much due to a sudden discovery of epicurean pleasure by consumers as to the investors who have discovered wine as an alternative asset class. Talk on wine is no longer associated solely with *terroir*, climate and taste, but also with high returns, low risk and diversification benefits. With the financial and debt crisis still looming, and the ensuing low returns and high correlation of traditional asset classes, interest in wine has further grown. But as shown above, wine from the major wine-growing regions around the world has yielded 6 to 10 per cent return per year over the period 1996 to 2009. This is high compared to stocks, which yielded no more than 3 per cent. Correlations of wine with traditional assets are also low over this period, highlighting the large diversification benefits that can be gained from an investment in fine wine. However, the wine market is currently facing an unprecedented wave of vitality that leads to an increased professionalisation. It has evolved from a market in which amateurs bought and sold bottles to finance their own consumption to one in which more and more professionals and funds intervene. This should lead to an increased risk and maybe even instability of the market, and returns can no longer be generated across the board. It seems that the importance of wine picking has grown, as investors have to choose wisely the wines that they believe will appreciate with time. Simply buying Bordeaux *en primeur* and waiting in the expectation that prices will automatically rise has become an obsolete investment style.

Investors should be cautious, as wine is not a panacea that will always yield superb investments. By the 1960s wine was already considered an asset. An article from a *New York* magazine from 1972 shows the magic of an investment in Bordeaux first growths that went up 25 times between 1948 and 1969, or an increase of 200 per cent in an *en primeur* Léoville Las Cases 1970 over the year 1971/72 (Geracimos 1972). But only a year after the publication of the article, the reckless behaviour was brought to an abrupt halt with the 1973 oil crisis. Wine prices significantly dropped and brought down the wine industry which only recovered 10 years later with the outstanding 1982 vintage. Although the latest debt crisis has affected wine prices, especially in Bordeaux, the effect has been more moderate (−25% according to the Liv-ex 100). It remains, however, important to follow the market closely, to avoid the pitfalls of an investment; in the end, the best advice is to become passionate, and hence knowledgeable, about wine, which helps wise and considerate decisions to be taken.

Notes

1. In Champagne, there are four major listed companies: Lanson-BCC, Vranken-Pommery Monopole (which also has some holdings in Provence and Portugal),

Laurent-Perrier Group and LVMH (owner of Moët & Chandon in Champagne, plus Yquem and Cheval Blanc in Bordeaux, though most of its revenues do not actually derive from wine).

2. Some examples include Cottin Frères in Burgundy (owner of Labouré-Roi and Nicolas Potel), Viña Concha y Toro in Chile (producer of Don Melchor) and Constellation Brands in the USA (owner of Mondavi, Clos du Bois and many other brands active in several segments of the beverage industry).
3. For instance, Château Latour released about 35 per cent less wine in 2010 than in 2009 (according to Anson and Lechmere 2011). In April 2012, the estate also announced its decision to abandon the *en primeur* market and to sell each vintage once it reaches its drinking plateau (i.e. when it hits its maximal price) (Anson 2012).
4. It must however be noted that the Mentzelopoulos family has been involved in the estate from 1976 onwards and was indeed its sole owner between 1976 and the early nineties.
5. Estimate based on the following assumptions: 150,000 bottles of the first wine sold at an average price of €140; 200,000 bottles of the second wine (Pavillon rouge) sold at an average price of €40; and 35,000 bottles of the white (Pavillon blanc) sold at an average price of €50. We further assume the production costs amount to about €20 for the first wine and €10 for the other two wines. As such, we obtain a Net Operating Income of about €25 million.
6. There were only four first growths in 1855: Château Latour, Château Margaux, Château Haut-Brion and Château Lafite Rothschild. Château Mouton Rothschild was granted an upgrade from second to first growth status in 1973.
7. James Miles, director of Liv-ex, refers to this as the 'China effect'.
8. See Asimov (2012) and Lechmere (2012) for more information.
9. These rates are essentially based on discussions with wine specialists. Only very few merchants publish these rates on their websites. Farr Vintners is one of them: they apply a 20 per cent discount to the value of the wine they purchase; alternatively, they may also list the wine and take a commission of 10 per cent if it is sold.
10. This is only true of individuals. Professional wine traders are taxed on their profits, like any other investor.
11. For instance, Dinghong Fund aims at investing 90 per cent of its assets in Bordeaux and the remaining 10 per cent in Burgundy. Two-thirds of the wines bought will be *en primeur*.
12. According to Lister (2011), 'at a conservative estimate, wine funds globally are worth a modest £150–200 million, which represents about 3 per cent of total investment-grade stock'.
13. Fogarty uses the results obtained in Burton and Jacobsen (2001) for returns on Bordeaux wines.
14. The various indices are calculated as in Masset and Weisskopf (2010).
15. The various indices are calculated as in Masset et al. (2012).

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10

Financial Reaction to the Business Cycle in Periods of Difficulties: The Case of French Wine Companies

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10.1 Introduction

From the beginning of this century, French wine companies are said to have been in a state of crisis … Over the last 20 years, major studies have been commissioned: Booz-Allen and Hamilton (1993), ONIVINS and Ernst & Young (1999), the Ministry of Agriculture (Berthomeau 2002). As a whole, France lost its world export leadership in 2005 (by 2010 the French export market share was just 3.8%, against 6% in 1982),[1] as well as losing its position of first world consumer in 2007 and leading wine producer in 2008. The French wine industry is struggling to maintain its commercial position.

The notion of crisis is elusive, and it is difficult to understand the consequences of the crisis for each company. Duquesnois et al. (2010) try to define crisis at an industry level and find three aspects: industry has reached a declining stage; industry enters a deregulation period; and industry enters into hypercompetition. Following Gamble and Taddei (2007) the roots of the problem for the French wine sector are an inadequate marketing and promotion system relying on the regulatory system of Appellations d'Origine Contrôlée (AOC), an over-complex packaging and labelling system with inadequate production and channel management.

Whatever the qualitative characteristics of crisis, crisis in the economic environment (demand reduction or stagnation, or changes in the niche shape) takes the following forms for the French wine industry. French wine exports (Figure 10.1) have since 1999 been following a steep downward trend in volume, and the 1999 peak in value has never been reached since. Prices stayed stagnant. National wine consumption dropped by 5.5 million hectolitres during the ten-year period, equivalent to about 10 litres per head, from 60 l in 1999 to 48 l in 2009 (France Agrimer Statistics 2010) and

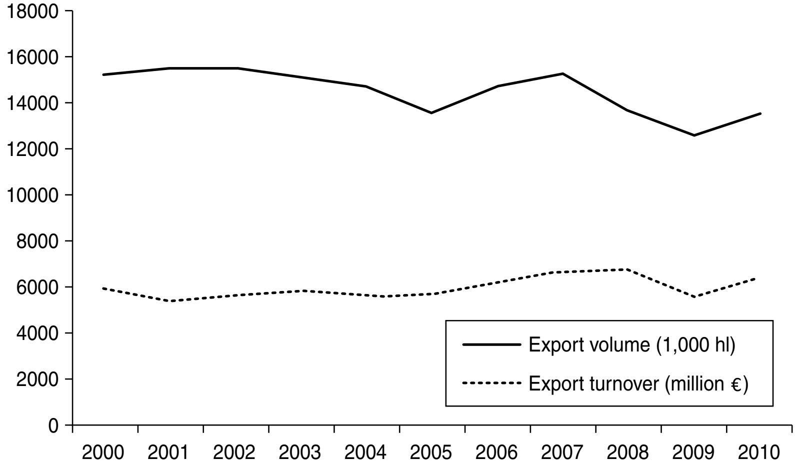

Figure 10.1 French wine exports in volume and value (thousand of hectolitres, million €).

Source: French Customs and FranceAgrimer

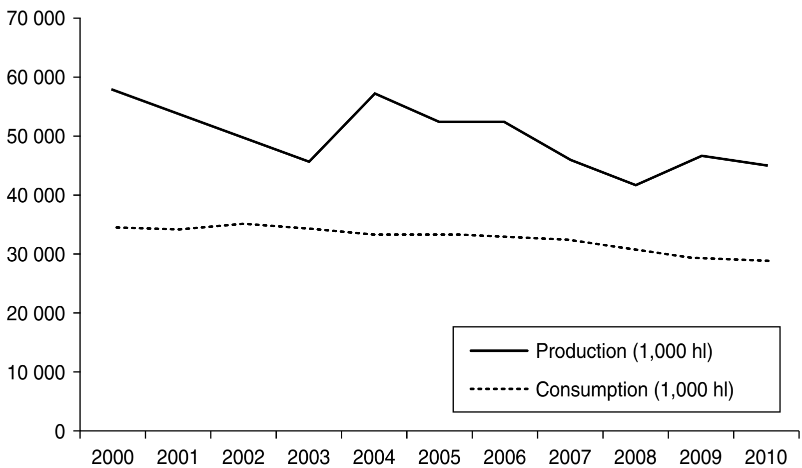

Figure 10.2 French wine production and consumption (thousand of hectolitres)

Source: FranceAgrimer

production decreased even more (Figure 10.2). There is no global price index available at production level in France, but various regional price indicators show a drop in the market price per hectolitre in 2000 to 2002, a recovery in 2003 to 2004, and a further collapse from 2005 to 2009.

These evolutions generate scarcity for the companies and a decrease of financial resources (Cameron et al. 1987a; Cameron et al. 1987b). 'Its impacts are translated to and are reflected in the financial statements' (Smart and Vertinsky 1984). More specifically, the financial consequence is a fall in margin, and so productivity declines (Perry et al. 1993; Domowitz et al. 1987). During a crisis, companies have an interest in disconnecting their financial performance as far as possible from the business crisis, and the objective of this chapter is to study the various strategies used by French wine companies to cushion the effects of business cycles on their financial performance. In effect, financial performance appears to be very sensitive to the business cycle. Longstaff and Piazzesi (2004) show that earnings are correlated with aggregate consumption and considerably amplify (sevenfold) the movements of this last variable.

The wine sector is worth investigating because wines and spirits continue to be the leading agrifood category, generating the largest agrifood export balance. But sales slumped in 2009 to just €7.9 billion from €9.5 billion the preceding year, giving a net balance of €6.5 billion, a figure down by €1.6 billion. Moreover since 2007 the whole French economy has entered into a period of turbulence and difficulties, justifying this study on the wine sector to understand how companies react in such a situation.

In this chapter we argue that the French wine trade is subject to firms' business cycle exposure, measured by the sensitivity of their financial performance to macroeconomic variables, and that (1) the firms composing this cyclical industry are affected by various factors at the firm level and (2) the financial policy of the companies significantly affects the sensitivity of their financial performance to the business cycle. The chapter is organised as follows: in Section 10.2 we describe the channel through which economic fluctuations affect firm performance and the hypotheses derived from it. Section 10.3 presents data, variables and method, Section 10.4 presents the results (national and regional analyses) and Section 10.5 concludes.

10.2 Theoretical foundations of hypotheses

Companies' reactions to this crisis can be categorised as 'strategic' or 'operating' (Bibeault 1982; Hambrick 1985; Hofer 1980; Schendel et al. 1976). Strategic actions are the grand, long-term initiatives such as diversification (geographic, exports (Porter 1993), markets, industries: towards non-cyclical industries), private labelling (Pearce and Michael 2006), vertical integration, new market share thrusts, and divestment. Note that, except for the last one, these strategies are hard to implement by SMEs (Small and Medium Enterprises) (Chowdhury and Lang 1996). The purposes of operating actions are immediate revenue generation, cost-cutting or asset reduction. Empirically, a reduction in expenditure (costs) and assets are often observed during the year following the greatest performance decrease (Robbins and Pearce 1992), in order to preserve cash flow.

The literature (Grinyer and McKiernan 1990; Pearce and Robbins 1994 a, b; Robbins and Pearce 1992; Barker et al. 2001) shows that turnaround requires both retrenchment and recovery. In retrenchment, the firm reduces costs and assets to conserve cash flow. Following retrenchment, successful turnaround firms initiate recovery strategies designed to redirect their remaining resources toward more promising strategies. Parker and Keon (1994) found that small firms utilised efficiency strategies (costs reduction) in order to recover. Three aspects of this strategy can be underlined: increased employee productivity, investment in more efficient assets, and control of discretionary expenses. The first of these is pre-eminent in small companies.

The chapter aims to test empirically the two main following hypotheses.

H1: Companies react differently to aggregate shocks depending on:
- their activities (producer or wine merchant),
- their legal structure (corporation or cooperative).

Producers and wine merchants do not have the same degree of integration and are not positioned at the same stage of the supply chain. Producers could have a higher sensitivity to the business cycle because they have a higher operational leverage. On the other hand, a major objective of wine merchants is to partially absorb fluctuations in demand, therefore reducing the impact of the business cycle on producers.

Cooperatives, due to their weak governance system (Cook 1995), react slowly to changes in their environment. Cooperatives members lack incentives to invest because of free rider, horizon and portfolio constraints (Knoeber and Baumer 1983; Cook and Iliopoulos 2000). Finally, cooperatives have limited access to outside sources of equity capital because of restrictions on residual claims (Hart and Moore 1996). Therefore their performance should be quite sensitive to the business cycle. But they can transfer the environment fluctuations to their suppliers (members).

H2: The companies' operational and financial policies influence the sensitivity of these companies to the business cycle.

Concerning H2, five specific aspects of the companies' management are examined in relation with the sensitivity to the business cycle: working capital management (inventory management, financial relationship with suppliers (accounts payable) and customers (accounts receivable)), human resources management, financing policy, and investment policy.

Working capital management

Working capital management is particularly important for French wine companies for two reasons: most of them are SMEs (potentially suffering from financial constraint so that accounts payable are an important source of financing), and inventories are quite important in the wine sector. In a period of economic difficulties, cash supply is relatively tight. Moreover companies encounter more difficulties in collecting receivable accounts and possibly also with inflated inventories resulting from a decline in sales. We should thus observe a natural trend for working capital to amplify the impact of business cycle on financial performance. Clearly, in a recession period, companies should implement more efficient working capital management in order to strive for and attain a positive effect on financial performance (Deloof 2003; Wang 2002). Samiloglu and Demirgunes (2008) and Lazaridis and Tryfonidis (2006) find a negative relationship between working capital or the cash conversion cycle and profitability. This relationship is even more important for SMEs (Teruel-Garcia and Solano 2007).

Human resource management

Due to the importance that companies (essentially those with firm-specific capital) lay on retaining skilled workers and to the high cost of dismissal (and more generally adjustment costs) in France, French wine companies should respond to negative demand shocks by maintaining their workforce. A consequence is that labour productivity is pro-cyclical (Rotemberg and Summers 1990). We thus expect that human resource management amplifies the impact of the business cycle on financial performance. However, following Parker and Keon (1994), in order to recover, companies should increase employee productivity.

Financing decisions

In periods of difficulties, companies lack internal financial resources and must seek external ones. The margin between cash flow and debt services is narrowed, so highly leveraged firms are more affected by fluctuations in economic conditions. Following the Pecking Order Theory, POT, (Myers 1984; Myers and Majluf 1984), they must privilege new debt (even more so for SMEs (Small and Medium Enterprises) suffering from a higher information asymmetry). On the other hand, the business cycle is an important determinant of default risk (Fama 1986; Duffie and Singleton 2003). In periods of difficulties the expected interest tax shield is lower and the expected cost of bankruptcy is higher, so that, following the Trade of Theory, TOT (Modigliani and Miller 1958; Myers 1984), companies must reduce their leverage measured through accounting values[2] (Hackbarth et al. 2006). As we only deal with the accounting value of debt and equity, we should observe that leverage either increases or reduces the impact of business cycle on asset turnover, depending on the relevant theory (POT or TOT) for French wine companies. In effect, the business cycle leads to a negative effect on debt and asset turnover. But debt reduction has a positive effect on turnover, reducing the sensitivity of asset turnover to the business cycle.

Table 10.1 Expected impact of companies' characteristics and management policies on the sensitivity to business cycle

	Expected impact	
Wine merchants versus producers	Theoretically effects can be in both directions so the net effect must be empirically determined	
Cooperatives versus corporation	Theoretically effects can be in both directions so the net effect must be empirically determined	
	Natural impact	**Corrected impact**
Working capital management	+	−
Human resources management	+	−
Financing policy	+/−	?
Investment policy	+	+

Investment policy

Many investment projects are not feasible when only small amounts are spent. Moreover the costs of adjusting capital stock may not be convex. These characteristics imply that investment policy amplifies the impact of the business cycle on financial performance.

Table 10.1 presents a synthesis of the expected impact of companies' characteristics and management on performance sensitivity to the business cycle. Note that 'natural impact' means the effect of the business cycle in the absence of corrective measures undertaken by the management.

We will address H1 and H2 measuring the impacts of companies' characteristics and management on the sensitivity of the operating profitability to the business cycle.

10.3 Data, variables and method

Next, we present a sample construction and a description of the independent and dependent variables used in the empirical study.

Sample

The identification of wine companies is not an easy task. Our sample is constructed via a collaborative project financed by Crédit Agricole SA (the largest agricultural French bank), and has been undertaken since 1998 in partnership with the Confederation of the French Wine Cooperatives (CCVF), the General Association of the French wine firms (AGEVE), and the patronage of France Agrimer (representing the Ministry of Agriculture).

The main steps in our methodology are the following. First, French companies (producers, wine merchants, *négociants* and cooperatives) with a turnover above €2 million, and which sell bulk or packaged wine to the wine and food wholesalers and distributors in France and in the rest of the World, are selected in the Diane SCRL commercial data base). Four different categories of the companies' statistical figures and financial accounts relating to their European activities have been collected for this purpose: Champagne and sparkling producers (European activity number 11.02A), Wine producers (Ean 11.02B), Wine wholesalers (Ean 46.34Z), Grape wine growers with a bulk or packaged commercial activity (Ean 01.21Z).

Second, we resolve the main difficulty connected with the wine wholesalers. Companies in this category can either buy and sell packaged wines, or blend and package bulk wine that they have bought. Only this last category is defined as the wine trade, as wholesalers pure and simple obviously belong to the distribution sphere. It is therefore only through an expert opinion in each producing region in France that a final selection has been validated. This expertise was obtained through the national or regional headquarters of the partners of this collaborative project.

Finally, the sums of these ca. 1000 selected firms' export turnover have been compared to the French Customs wine exports statistics, in order to control whether this selection is exhaustive (as presented in Appendix, Table A10.1). As a result, it can be considered that the sample is representative of the entire wine sector.

From this process we have obtained a sample of 962 companies. Financial statements are extracted from the Diane database over nine years during the period 2002 to 2010.

Description of variables[3]

For dependent variables, we have chosen three measures of financial performance: ROA (return on asset; EBIT[4]/Economic asset), ATO (asset turnover; Sales/Economic asset), and OPM (operating profit margin; EBIT/Sales). These measures are linked by the well known formula: ROA = ATO*OPM. As wine industry is cyclical, the business cycle indicator should have a noticeable impact on these performance measures.

We have constructed two business cycle indicators: (1) National Sales Growth (NSG) is the variation of the sum of turnovers of companies belonging to our sample, and (2) Regional Sales Growth (RSG) uses the same methodology for companies grouped by region. To obtain sensitivity to the regional business cycle, we regress companies' performance indicators on the relevant RSG.

Descriptive statistics of the other independent variables are presented in Table 10.2. For the great majority of variables, wine merchants, producers, cooperatives and corporations are statistically different justifying a specific treatment for each of the four groups.

Table 10.2 Descriptive statistics of independent variables

	Global sample		**Corporation**	**Cooperatives**	**t-test**	**Merchants**	**Producers**	**t-test**
Number of companies	**Mean 962**	**SD**	**Mean 592**	**Mean 370**	**difference**	**Mean 505**	**Mean 456**	**difference**
Companies characteristics								
Number of employees	23.96	33.44	26.59	18.04	0.0001	23.65	24.37	0.3893
Turnover (M€)	11.99	18.94	14.39	8.20	0.0000	13.09	10.79	0.0322
Export intensity	0.27	0.26	0.33	0.11	0.0000	0.33	0.18	0.0000
Economic asset (M€)	9.41	18.94	10.28	8.04	0.0262	7.63	11.37	0.0015
Financial performance indicators								
Return on assets	0.092	0.13	0.13	0.03	0.0000	0.13	0.049	0.0000
Asset turnover	3.81	7.60	5.09	1.82	0.0000	5.99	1.47	0.0000
Operating profit margin	0.042	0.061	0.054	0.022	0.0000	0.041	0.042	0.4525
Management Indicators								
General								
Asset variation	0.17	0.41	0.19	0.13	0.0160	0.21	0.11	0.0001
Added Value(AV)/ Sales	0.17	0.10	0.18	0.16	0.0029	0.15	0.19	0.0000
(Cash-flow + interest expenses)/VA	0.29	0.37	0.24	0.37	0.0000	0.22	0.37	0.0000
Long-term assets management :								
Long-term assets/asset	0.35	0.23	0.28	0.45	0.0000	0.28	0.41	0.0000
Original value variation	0.15	0.37	0.19	0.07	0.0000	0.20	0.08	0.0000
Balance sheet value variation	0.25	0.83	0.33	0.09	0.0000	0.38	0.09	0.0000
Depreciation/Original value	0.55	0.19	0.48	0.64	0.0000	0.49	0.61	0.0000
Sale of fixed assets/fixed assets	0.034	0.088	0.047	0.011	0.0000	0.05	0.017	0.0000

Continued

Table 10.2 Continued

	Global sample		**Corporation**	**Cooperatives**	**t-test**	**Merchants**	**Producers**	**t-test**
Working capital management								
Inventories/Sales	0.41	0.40	0.42	0.40	0.2191	0.31	0.52	0.0000
Receivables/Sales	0.24	0.11	0.22	0.29	0.0000	0.22	0.27	0.0000
Operating liabilities/Sales	0.27	0.17	0.31	0.21	0.0000	0.29	0.24	0.0000
Financial policy								
Leverage (financial debt / equity)	1.63	2.78	1.96	1.11	0.0000	1.96	1.29	0.0001
Financial debt/Cash flow	18.95	37.59	20.28	16.82	0.0752	20.21	17.63	0.1516
Employees management								
Sales/Labour costs	21.15	41.43	22.88	18.35	0.0354	25.15	16.72	0.0007
VA/Labour costs	2.26	2.09	2.42	2.00	0.0002	2.23	2.29	0.3286

Notes: Mean is computed for each company for the period 2002–2010. Variables are winsorised at the 1% level (we remove 1% highest and lowest values). t-test is unilateral for sample with different variances (heteroscedasticity), we only reported the probability that mean of the two subsamples are identical.

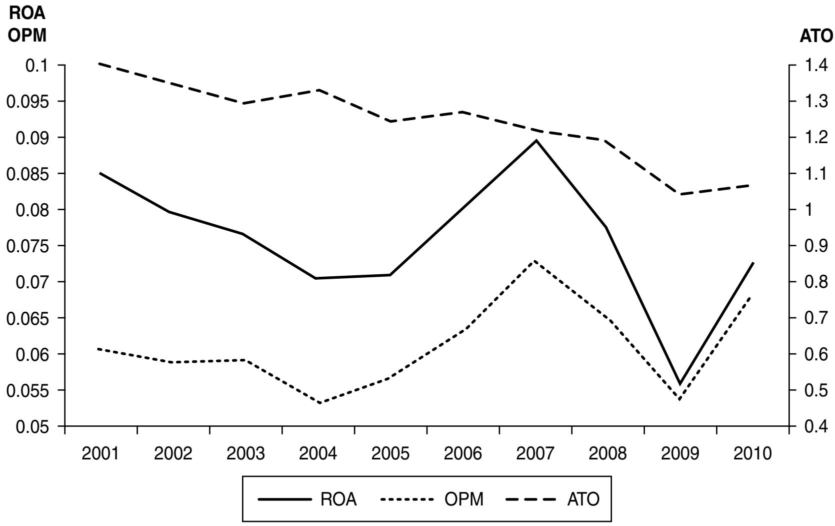

Figure 10.3 Evolution of the global performance of the wine trade in France

Aggregating the data of our population, we compute the evolutions for the global performance of the wine trade in France during the last decade (Figure 10.3). During this period, the cyclical property of ROA with decreasing trend is easily observable. This evolution is a consequence of two underlying dynamics: cyclical dynamic of margin (OPM) and decreasing trend of asset turnover (from 1.4 to 1.05). This last evolution means that French wine companies need more and more capital to reach the same level of sales.

The same computations for corporations versus cooperatives and for producers versus wine merchants are illustrated in Figures 10.4 and 10.5. Corporations encountered a larger decrease in ATO than cooperatives, but they compensated for the negative effect on ROA by setting a larger margin than cooperatives. Moreover, during that period, the margins of corporations and cooperatives evolved in different directions; cooperatives' margins decreased dramatically, reaching a very low level.

As expected, producers had higher margins and lower turnover. Wine merchants had more volatile performance than producers (Figure 10.5).

Estimation method

We estimate three simple models in which we regress the three variables measuring financial performance, ROA, ATO and OPM, on:

- Indicators of the business cycle,
- Measures of the companies' managerial and financial policy: working capital policy, human resource management, financing policy and investment policy,

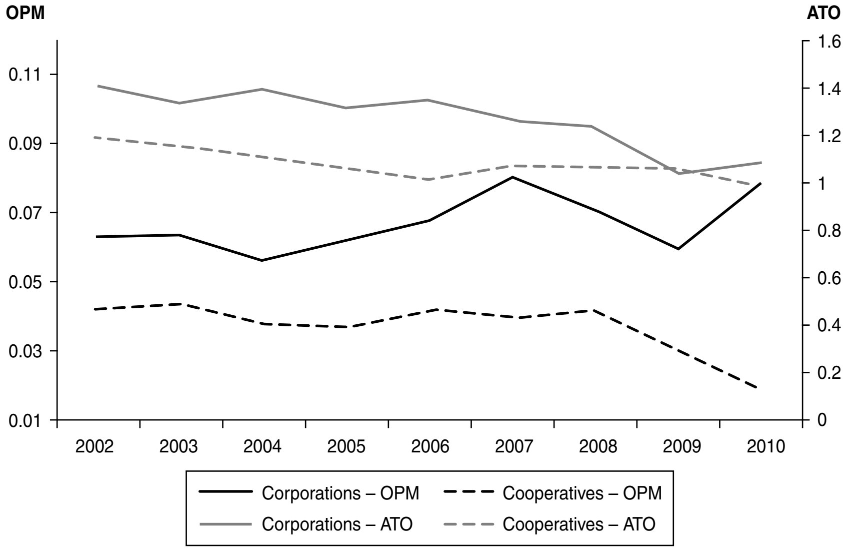

Figure 10.4 Evolution of the global performance – corporations *vs*. cooperatives

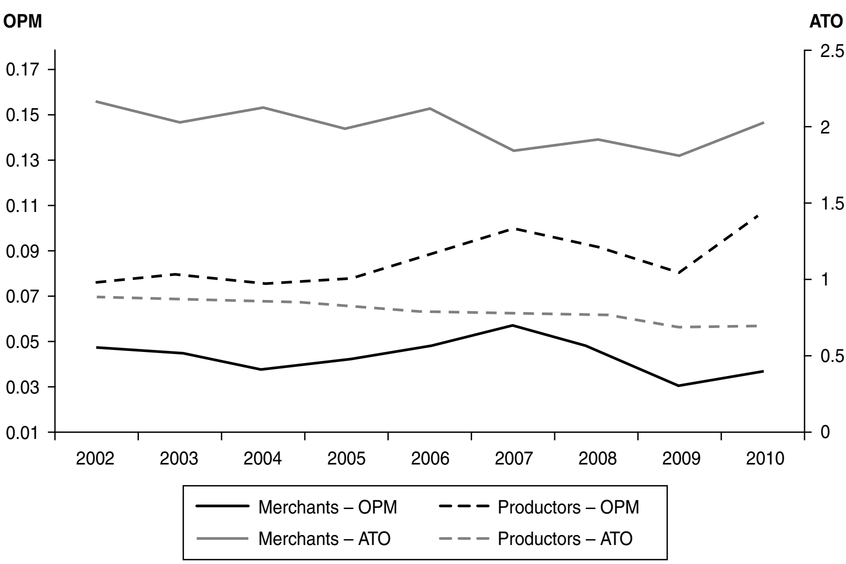

Figure 10.5 Evolution of the global performance – producers *vs*. wine merchants

- Firm controls: investment , capital intensity and output quality, lagged one year to control for the previous year's profitability level,
- Linear trend: to capture the change in the average profitability in the cross-section of listed firms.

We estimate the following equation using a fixed firm effect estimator with robust standard errors:

$$FPM_{it} = \alpha + \sum \beta_j BC_{jt} + \sum \gamma_k FC_{kit-1} + \mathrm{trend_t} + \varepsilon_{it} \tag{1}$$

where FPM_{it} is Financial Performance Measure (ROA or ATO or OPM) for company i at time t; BC_{jt} is j business cycle indicators at time t; and FC_{kit-1}: is k financial characteristics of company i at time t−1.

This equation serves as a baseline; in a subsequent analysis we interact the business cycle indicators with measures of firms' characteristics and the financial policy of the companies.

We modify equation (1) to investigate what kind of company characteristics help them resist business fluctuations and if financial policy is used to attenuate the impact of business fluctuations on companies' financial performance.

$$FPM_{it} = \alpha + \sum \beta_j BC_{jt} + \sum \delta_j \times FP_{it} \times BC_{jt} + \sum \gamma_k FC_{kit-1} + \mathrm{trend_t} + \varepsilon_{it} \tag{2}$$

where FP_{it} is indicator of the financial policy of company i at time t; we will use one indicator for each regression.

10.4 Results

We first studied the impact of companies' characteristics (producer/wine merchant and corporation/cooperative) and of companies' management decisions (working capital, human resources, financing, and investing) on the sensitivity of financial performance to the business cycle for the whole sample. An investigation of the difference in behaviour in the best-performing and worst-performing companies is presented in a subsequent part.

Global study

The steps of the empirical studies are: measuring the impact of companies' characteristics on the sensitivity of their financial performance to the business cycle; we then investigate the impact on the sensitivity to business cycle of each policy (working capital, human resources, financing, investing) separately; and finally we retain the most significant aspects of characteristics and policies in a global model.

Table 10.3 presents the effect of the business cycle on the financial performance of French wine companies and the impact of companies' characteristics on their sensitivity to the business cycle. To capture the influence

Table 10.3 The impact of companies' characteristics on sensitivity to the business cycle

Dependent variables	Base line			Producer/wine merchant			Cooperatives/Corporation		
	ROA	ATO	OPM	ROA	ATO	OPM	ROA	ATO	OPM
Regional Sales Growth (RSG)	0.09***	0.39	0.04***	0.20***	1.00	0.06***	0.11***	0.05	0.04**
	(3.02)	(0.51)	(2.74)	(3.63)	(0.68)	(3.42)	(3.17)	(0.05)	(2.55)
National Sales Growth (NSG)	0.13***	1.05	0.07***	0.13*	1.95	0.04*	0.17***	1.91	0.09***
	(2.80)	(1.03)	(3.80)	(1.74)	(1.10)	(1.89)	(2.93)	(1.41)	(4.22)
Producer*RSG				−0.23***	−0.96	−0.05*			
				(−4.20)	(−0.66)	(−1.70)			
Cooperatives*RSG							−0.09*	1.32	−0.02
							(−1.73)	(1.28)	(−0.63)
Producer*NSG				−0.01	−1.97	0.06			
				(−0.10)	(−1.10)	(1.60)			
Cooperatives*NSG							−0.14**	−3.08**	−0.09**
							(−1.96)	(−2.17)	(−2.44)
L.(Original value variation)	−0.004		−0.0001	−0.004		−0.0003	−0.004		−0.0001
	(−0.39)		(−0.03)	(−0.04)		(−0.09)	(−0.42)		(−0.04)
L((Cash-flow + Interest expenses)/AV)		−0.28			−0.27			−0.28	
		(−1.48)			(−1.39)			(−1.45)	

L(Long terms assets/asset)		−0.87**			−0.83**			−0.86***	
		(−2.59)			(−2.52)			(−2.57)	
L(Added Value, AV/ Sales)	0.17***	−2.12**		0.16***	−2.18**		0.17***	−2.13**	
	(4.06)	(−2.14)		(3.95)	(−2.20)		(4.11)	(−2.15)	
L(Eco. Asset/Sales)	−0.03***		−0.005	−0.03***		−0.005	−0.03***		−0.005
	(−5.77)		(−0.87)	(−5.77)		(−0.89)	(−5.70)		(−0.87)
L.(AV/Labor costs)			0.005***			0.005			0.005***
			(4.28)			(4.25)			(4.39)
Trend	−0.003***	−0.06***	−0.001**	−0.003***	−0.06***	−0.001***	−0.003***	−0.06***	−0.001***
	(−3.45)	(−2.87)	(−2.55)	(−4.05)	(−3.05)	(−2.86)	(−3.67)	(−2.82)	(−2.66)
Constant	0.094***	4.15***	0.05***	0.99***	4.15***	0.05***	0.09***	4.13***	0.05***
	(9.52)	(14.93)	(7.74)	(10.05)	(14.81)	(7.84)	(9.62)	(14.80)	(7.77)
Observations	3023	3356	2997	3022	3354	2996	3023	3356	2997
Adj. R^2 (within)	0.043	0.011	0.046	0.05	0.012	0.048	0.048	(0.012)	0.051

Notes: Method: panel data with fixed effect and robust standard error.
t-statistics are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
L.() is for lagged value.

of past variables on financial performances, we introduce lagged variables representing three important determinants of financial performance:

– Investment,
– Capital intensity: Economic Asset/Sales, but to avoid problems we choose (Cash flow + Interest expenses)/ Added Value for ATO,
– Global value created (which depends on the degree of integration of the company and the level of quality of the output): (Added Value, VA/Sales), but to avoid problems we choose (VA/Labour costs) for OPM.

The baseline model (Table 10.3) shows that, as expected, the business cycle has a noticeable effect on financial performance: regional and national sales have a positive coefficient (significant for ROA and OPM).

Hence the French wine industry appears to be a cyclical industry with a financial performance increase/decrease during boom/recessionary periods (Domowitz et al. 1987). Its financial performance has significantly decreased during the period (coefficients of the trend are negative and significant) providing confirmation of the financial difficulties of French wine companies during the last decade. Past output quality has a positive and significant impact on ROA and OPM and, as expected, a negative impact on ATO. Past employees' productivity (VA/Labour costs), which can also be seen as a measure of output quality, also has a significant impact on OPM. Past capital intensity has a negative impact on the three performance measures (but is significant only for ROA). Finally, and surprisingly, past investments have a negative (although insignificant) impact on ROA and OPM. French wine companies seem to have difficulty in finding a relevant investment strategy during this period of deep qualitative changes in their environment.

The effect of companies' characteristics on their sensitivity to the business cycle is significant for ROA. Producers are less affected by the business cycle than are wine merchants, whatever the measure of financial performance used (coefficient of the interaction with regional sales is highly significant for ROA; the effect is mitigated for OPM). Cooperatives are significantly less sensitive to the business cycle than are corporations, whatever the measure of financial performance used, and the effect is particularly significant for the interaction with national sales. One possible explanation is that cooperatives, acting as the commercial arm of their owner-suppliers, transfer business cycle fluctuations to their patrons/wine growers.

In Table 10.4[5] we investigated the effect of companies' financial policy on the sensitivity of their financial performance to the business cycle. As explained in the theoretical section, four aspects are examined: working capital management, human resources, financing and investment policy.

Table 10.4 The impact of companies' strategies on sensitivity to the business cycle

	ROA	**ATO**	**OPM**
Global model for working capital management			
Stock*RSG	−0.14***	/	/
(T stat)	(3.39)	/	/
Stock*NSG	/	−3.42***	0.087**
(T stat)	/	(2.99)	(2.08)
(Accounts receivable/Sales)*RSG	−0.47**	−5.23*	/
(T stat)	(2.36)	(1.71)	/
(Accounts receivable/Sales)*NSG	/	/	0.20*
(T stat)	/	/	(1.69)
(Operating Liabilities/Sales)*RSG	/	/	−0.0005
(T stat)	/	/	(−0.01)
(Operating Liabilities/Sales)*NSG	0.16	9.73**	/
(T stat)	(0.87)	(2.43)	/
Observations	2767	2758	2835
Adj. R2	0.043	0.016	0.025
Global model for employees management			
(Sales/Labour costs)*NSG	/		−0.004***
(T stat)	/		(−4.12)
(AV/Labour costs)*NSG	0.09***		0.07***
(T stat)	(4.09)		(3.73)
Observations	2910		2914
Adj. R2	0.06		0.073
Global model of financing policy			
(Financial debt/Cash flow)*NSG	−0.008***	/	−0.004***
(T stat)	(−5.76)	/	(−5.76)
(Financial debt/Equity)*NSG	/	−2.52***	
(T stat)	/	(−3.41)	
Observations	2561	3249	2529
Adj. R2	0.058	0.032	0.062
Global model of investment policy			
L.(Original value variation)*NSG	0.59**		/
(T stat)	(2.11)		/
L.(Depreciation/Original value)*NSG	−0.43**		−0.28***
(T stat)	(2.05)		(−3.58)
Observations	2946		2936
Adj. R2	0.053		0.06

Notes: Method: panel data with fixed effect and robust standard error. For each regression, RSG, NSG, trend, constant and the lagged variables used in Table 10.3 are present. * p<0.1, ** p<0.05, *** p<0.01.

Working capital management

Globally, working capital management decreases the sensitivity of company performance to the business cycle for ROA and ATO, but increases it for the more commercial aspect of the performance (OPM). The negative impact on sensitivity is highly significant for inventory management and to a lesser extent for accounts receivable.

Employee management

Human resources management seems to be more linked with the national business cycle; as expected, ATO is not affected by the management of human resources.

We observe that employee productivity amplifies the effect of the business cycle on financial performance. But is this a consequence of the rigidities of human resources management in France due to regulatory constraints? Or is it a consequence of the management's aim to smooth the impact on employees of changes in activities?

Financing policy

Financing policy is more linked to the national business cycle. This policy significantly reduces the sensitivity of companies' performance measures to the BC companies, even if SMEs seem to be able to adjust their debt level (and the nature of their debt, short- or long-term) to activity fluctuations.

Investment

Analysis of investment policy is more complex. The most relevant performance measure in this case is the ROA. For this measure, we observe that investment and disinvestment amplify the impact of the business cycle; that is probably due to the rigidity of investment and the long-lasting effects of this policy. In fact, we observe that companies seem to adjust on the lifetime of assets (a more flexible strategy) to smooth the impact of the business cycle. The coefficient is also negative (significant) for OPM, because this policy has an impact on the income statement.

The results of the three global models presented in Table 10.5 confirm the conclusions reached by partial models. Note that for ROA, the interactions between producers or cooperatives and the business cycle are still significant even when financial policy is taken into account. It is also the case for producer with ATO justifying a specific analysis.

Comparison of best and worst performing companies

We divided the sample into three terciles relative to the mean ROA of companies over the whole period. We compared the strategies of companies with the worst financial performance (W, first tercile) with the strategies of companies with the best financial performance (B, third tercile).

Table 10.5 The impact of companies' financial strategies on sensitivity to the business cycle

	ROA	ATO	OPM
Producer*RSG	−0.14***	−4.28***	/
(T stat)	(−2.75)	(−3.53)	/
Coop*NSG	−0.11*	/	/
(T stat)	(−1.83)	/	/
Stock*NSG	/	−2.68**	0.14***
(T stat)	/	(−2.15)	(3.17)
(Accounts receivable/Sales)*NSG	/	−6.62*	/
(T stat)	/	(−1.65)	/
(AV/Labour costs)*NSG	0.07***	/	0.024
(T stat)	(3.10)	/	(1.57)
(Financial debt/Cash flow)*NSG	−0.007***	/	−0.005***
(T stat)	(−4.84)	/	(−5.71)
(Financial debt/Equity)*NSG	/	−2.59***	/
(T stat)	/	(−3.20)	/
L.(Original value variation)*NSG	0.48*	/	/
(T stat)	(1.79)	/	/
L.(Depreciation/Original value)*NSG	−0.32	/	−0.23***
(T stat)	(−1.55)	/	(−2.70)
Observations	2477	2997	2351
R2 (within)	0.081	0.045	0.087

Notes: Method: panel data with fixed effect and robust standard error. For each regression, RSG, NSG, trend, constant and the lagged variables used in Table 10.3 are present. *$p<0.1$, **$p<0.05$, ***$p<0.01$. L.() is for lagged value.

From Table 10.6 we observe that worst-performing companies are less affected by the business cycle than are the best-performing ones. Producers are less sensitive to the business cycle than wine merchants whatever the performance level, but coefficients are not significant. The worst-performing cooperatives are significantly less sensitive to the business cycle than the worst-performing corporations.

The entire process presented in the paragraph "global study" of the section "Results" is reproduced for the best- and worst-performing companies. Results for the global model are given in Table 10.7.

The comparison of best- and worst-performing companies shows interesting differences (Table 10.7). The best companies use inventory management to reduce their sensitivity to the business cycle, and the worst do not. The best companies have a more risky investment strategy although that investment strategy increases their sensitivity to the business cycle. The sense of the causality remains to be investigated. Is it because they have good performance

Table 10.6 The impact of B/W companies' characteristics on sensitivity to the business cycle

	Wine merchants/producers				Corporations/cooperatives			
	ROA W	**ROA B**	**OPM W**	**OPM B**	**ROA W**	**ROA B**	**OPM W**	**OPM B**
Regional Sales Growth (RSG)	−0.073 (−0.57)	0.279*** (2.86)	0.010 (0.17)	0.090*** (3.32)	−0.041 (−0.54)	0.219*** (2.86)	0.004 (0.06)	0.088*** (3.08)
National Sales Growth (NSG)	0.246 (1.58)	0.193 (1.57)	0.083 (1.02)	0.019 (0.62)	0.258** (2.08)	0.194* (1.85)	0.140* (1.69)	0.043 (1.38)
Producer*RSG	0.077 (0.58)	−0.159 (−0.98)	−0.006 (−0.08)	−0.031 (−0.40)		0.178 (0.41)		
Cooperatives*RSG					0.052 (0.60)		0.003 (0.05)	0.005 (0.03)
Producer*NSG	−0.181 (−1.11)	−0.077 (−0.36)	−0.044 (−0.45)	0.107 (1.02)				
Cooperatives*NSG					−0.245* (−1.87)	−0.542 (−0.89)	−0.155* (1.69)	−0.076 (0.38)
L.(Original value variation)	0.011 (1.35)	−0.008 (−0.52)	−0.002 (−0.24)	−0.004 (−0.89)	0.008 (1.10)	−0.008 (0.48)	−0.003 (−0.37)	−0.004 (−0.92)
L.(Added Value/ Sales)	(0.059 1.30	0.335*** (3.77)			0.060 (1.33	0.336*** (3.85)		
L.(Eco. Asset/Sales)	−0.017*** (−2.74)	−0.557*** (4.56)	−0.003 (−0.51)	0.0008 (0.05)	0.017*** (2.64)	0.054*** (4.45)	−0.003 (−0.47)	0.001 (0.07)

L.(VA/Labour costs)			0.002	0.0008			0.002	0.008***
			(0.43)	(4.43)			(0.50)	(4.54)
Trend	−0.0008	0.0046**	−0.0008	−0.001	−0.001	−0.004**	−0.0008	−0.001
	(−0.57)	(2.46)	(−0.91)	(−1.57)	(−0.71)	(2.30)	(−0.95)	(−1.47)
Constant	0.016	0.168***	0.0058	0.064***	0.017	0.164***	0.006	0.063***
	(1.27)	(8.34)	(0.56)	(4.98)	(1.39)	(8.50)	(0.55)	(5.12)
Observations	608	1087	604	1068	608	1088	604	1069
Adj. R2 (within)	0.033	0.07	0.017	0.081	0.04	0.069	(0.03	0.079

Notes: Method: panel data with fixed effect and robust standard error. t statistics in parentheses. *p<0.1, **p<0.05, ***p<0.01. L.() is for lagged value.

Table 10.7 Comparison of worst- and best-performing companies' strategies

	ROA W	ROA B	OPM W	OPM B
Producer*NSG	/	−0.40***	/	/
(T stat)	/	(−2.96)	/	/
Coop*RSG	−0.17	−0.21*	−0.06	/
(T stat)	(−1.31)	(−1.71)	(−1.36)	/
Stock*NSG	/	0.14***	/	0.05***
(T stat)	/	(3.56)	/	(2.86)
(AV/Labour costs)*NSG	0.081**	0.09*	0.03	/
(T stat)	(2.00)	(1.69)	(1.46)	/
(Financial debt/Cash flow)*NSG	−0.005**		−0.005***	/
(T stat)	(−2.54)		(−3.56	/
(Financial debt/Equity)*NSG	/		0.05**	0.10***
(T stat)	/		(2.43)	(2.78)
L.(Balance sheet value variation)*NSG	/		/	−0.19*
(T stat)	/		/	(−1.64)
L.(Depreciation/Original value)*NSG	/		/	
(T stat)	/		/	
Observations	405	957	403	1014
R2 (within)	0.072	0.092	0.17	0.12

Notes: Method: panel data with fixed effect and robust standard error. For each regression, RSG, NSG, trend, constant and the lagged variables used in Table 10.3 are present. *p<0.1, **p<0.05, ***p<0.01. L.() is for lagged value.

than these companies can afford to have an investment policy that increases their sensitivity to the business cycle? Or is it that because they have a more aggressive investment strategy they obtain better performance? This double causality creates a virtuous circle between investment and performance. The sensitivity of the worst-performing companies to the business cycle is affected by their financing policy. Do debt holders of these companies impose binding constraints on the management? Finally, the positive impact of human resources management on sensitivity to the business cycle is more important for best-performing companies. In a way similar to the virtuous circle described above, they can afford to keep their employees, even during recessions. This policy allows them to retain key skills, resulting in better performance in the long run.

Analysis by regions

In order to account for a very wide diversity of French regional wine reputations and subsequent wine firms' economic environment, we conducted a separate analysis according to traditional producing regions. In order to obtain a larger number of companies in each sub-sample, the Sud-Ouest, Languedoc-Roussillon, Rhône and Provence regions (which share some common characteristics) are grouped in a single sub-sample named South. The other sub-samples correspond to traditional French wine regions: Bourgogne, Alsace, Bordeaux, Loire and Champagne. The results on the impact of business cycle on the companies' performance by region are given in Table 10.8. To avoid complexity, we concentrate on the impact of business cycle on the ROA, which is a synthetic measure of financial performance. As expected, the impact of business cycle fluctuations on financial performance differs from one region to another; companies in South and Bordeaux are sensitive to their local economic situation, whereas in Bourgogne and Champagne they are sensitive to national economic fluctuations, and in Alsace and Loire they seem to be insensitive to the business cycle (see Table 10.8). As for the global sample, producers (except for Bourgogne) and cooperatives are less sensitive to the business cycle, but coefficients are only significant for Bordeaux.

To determine companies' strategies when facing economic fluctuations, the entire process presented in the paragraph "global study" of the section "Results" is once again reproduced for every region. Results are given in Table 10.9. This decomposition by regions confirms the global analysis on the pro-cyclical effect of human resource management and constraints, and the negative role of financial debt (except for Bourgogne where we have a positive, although not significant, coefficient). Bourgogne shows specificities with producers that are more sensitive than wine merchants to the business cycle, and also shows the important role of accounts receivable in smoothing the impact of economic fluctuations. Companies in Alsace seem to be characterised by dependence on the financial conditions of their suppliers. Finally, investment has a positive impact on the sensitivity to the business cycle for Alsace but a negative one for South.

10.5 Conclusion

Altogether, these results would tend to confirm our hypotheses, and also show that individual sensitivity can override the effects of systemic business cycle sensitivity.

The financial performance of French companies is indeed affected by economic fluctuations. This sensitivity depends upon their main characteristics: producers/wine merchants or corporations/cooperatives. Some, such as the cooperatives and (to a lesser degree) the wine merchants, can try to 'transfer' their financial difficulties to their suppliers, when the producers cannot. But some producers operating with higher margins and added value seem to have the capacity to smooth economic turbulence and resist the recent 'wine crises' more effectively.

Table 10.8 Companies' performance (ROA) sensitivity to the business cycle by region

	Wine merchants/producers						Corporations/cooperatives					
	South	**Bourg.**	**Alsace**	**Bord.**	**Loire**	**Champ**	**South**	**Bourg.**	**Alsace**	**Bord.**	**Loire**	**Champ**
Regional Sales Growth (RSG)	.44** .96	/	.07 .39	.68*** 3.63	.07 1.05	−.06 −.32	.40* 1.82	/	.02 0.13	.69*** 3.68	.03 .55	−.14* −1.80
National Sales Growth (NSG)	.14 .62	.57** 2.00	.02 .13	−.33 −1.55	.31 1.05	.32 1.07	.13 .63	.58** 2.19	.09 .93	−.35* −1.65	.28 1.60	.43*** 3.50
Producer *RSG	−.35 −1.12	.73* 1.64	−.09 −.34	−.45** −2.42	−.14* −1.73	−.14 −.77						
Cooperatives *RSG							−.30 −.97	.25 0.45	.14 .56	−.51*** −2.88	−.07 −.65	−.07 −.94
Producer *NSG	−.30 −1.23	−.38 −.83	.15 .91	.009 .04	−.12 −0.55	.12 .39						
Cooperatives *NSG							−.31 −1.38	−.38 −.84	−.13 −.87	.17 .81	−.15 −.79	−.03 −.25

L.(Original value variation)	−.047*	−.007	−.007	−.003	−.004	.02	−.05*	−.009	−.006	−.006	−.003	0.02
	−1.84	−.37	−.58	−0.13	−0.18	1.05	−1.76	−.45	−.48	−.26	−.12	1.06
L.(Added Value/ Sales)	.14	.13	.25**	.19*	.14	.12***	.14	.14	.26**	.20*	0.13	.12***
	.75	.88	2.59	1.74	1.45	2.89	0.72	.92	2.63	1.81	1.36	3.02
L.(Eco. Asset/Sales)	−.02	−.29**	−.028	−.02	−.08***	−.03***	−.02	−.03**	−.03	−.02	−.07***	−0.03***
	.75	−1.99	−1.25	−1.51	−3.18	4.94	−1.18	−1.98	−1.16	−1.53	−2.92	−4.89
Trend	−.008**	−.006*	−.002*	−.004*	−.005	−.007***	−0.008**	−.006*	−.002*	−.004*	−.005	−.007***
	−1.97	−1.93	−1.72	−1.74	−1.37	−5.78	−1.98	−1.78	−1.65	−1.78	−1.37	−5.79
Constant	.12***	.12***	.03	.11***	.14***	0.13***	0.12***	.11***	.03	.11***	.14***	.13***
	3.39	3.19	1.35	4.45	5.91	11.99	3.44	3.10	1.22	4.43	5.65	11.64
Observations	528	189	166	724	261	1004	528	189	166	724	261	1004
Adj. R2 (within)	.07	.11	.09	.08	.05	.11	0.07	.10	.09	0.08	.05	.11

Notes: Method: panel data with fixed effect and robust standard error. t statistics in parentheses. *p<0.1, **p<0.05, ***p<0.01. L.() is for lagged value.

Table 10.9 Comparison of companies' strategies by region. Effect on ROA

	South	**Bourgogne**	**Alsace**	**Bordeaux**	**Champagne**
Producer*NSG		0.87*		−0.37***	
(T stat)		(1.73)		(−3.04)	
(Accounts receivable/Sales)*NSG		−4.38*			
(T stat)		(−1.74)			
(Operating Liabilities/Sales)*RSG			0.93**		
(T stat)			(2.31)		
(AV/Labour costs)*NSG	1.49***	0.63**		0.26***	0.04***
(T stat)	(3.44)	(2.51)		(2.85)	(2.63)
(Financial debt/Cash flow)*NSG		0.004	−0.005**	−0.009**	−0.006***
(T stat)		(1.06)	(−2.05)	(−1.96)	(−4.14)
L.(Balance sheet value variation)*NSG	−1.48		1.89		
(T stat)	(−1.47)		(1.60)		
Observations	491	145	129	536	885
R2 (within)	0.21	0.24	0.23	0.10	0.14

Notes: Method: panel data with fixed effect and robust standard error. For each regression, RSG, NSG, trend, constant and the lagged variables used in Table 10.3 are present. *p<0.1, **p<0.05, ***p<0.01. L.() is for lagged value. We have removed Loire because, probably due to the small number of companies in this sub-sample, none of the coefficients are significant.

Globally, French wine companies actually try to reduce their sensitivity to the business cycle in periods of difficulty by adjusting their working capital management and their financing policy. They also try to reduce the impact of crises playing on the replacement strategy of their assets. Finally, we find that human resources management remains pro-cyclical even in periods of persisting difficulty.

As there is a strong heterogeneity among these (mostly small and medium size) enterprises composing the French wine trade, possible extensions to this research are the following:

– a study of still versus sparkling (Champagne) wine firms.
– a study of recent international, as opposed to national, business cycles / crises, subject to the availability of comparable financial data bases in other producing countries.

Appendix

Appendix 10.1

Table A10.1 Sample structure

	No. of firms	Turnover	Export	Export (%)	French exports* (customs)	Representativeness population/ customs
Alsace	33	734 764	421 144	57%	90 570	465%
Bordeaux	167	3 308 041	995 865	30%	1 299 817	77%
Bourgogne	100	1 192 686	521 894	44%	592 967	88%
Languedoc-**Roussillon**	176	1860562	354 941	19%	891 423	40%
Loire	58	703 215	137 844	20%	196 268	70%
Provence	62	342 378	36 150	11%	109 411	33%
Rhône	95	801 565	156 343	20%	293 111	53%
Sud-Ouest	32	336878	54 566	16%	71 608	76%
Others	70	1 384 793	233909	17%	223861	104%
Totalstillwines	793	10 664882	2 912656	27%	3 769036	77%
Champagne	211	5 065 762	1 493 799	29%	1 600 774	93%
Other sparkling	28	446028	85722	19%	155373	55%
Total sparkling wines	239	5 511754	1 579521	29%	1 756147	90%
TOTAL	1032	16 176636	4 320178	27%	5 525183	81%

Note: *Exports of selected companies in our population represent 81 percent of the total exports of French wines.

Appendix 10.2

Table A10.2 Variables description and computation

Companies' characteristics:	Computation
Number of employees	Given in Diane
Turnover (€m)	Given in Diane
Export intensity	Export sales/total sales
Economic asset (€m)	Equity + financial debts

Continued

Table A10.2 Continued

Companies' characteristics:	Computation
Financial performance indicators	
Return on Assets (ROA)	EBIT/Assets
	EBIT = Earnings Before Interest and Taxes
Asset Turnover (ATO)	Sales/Assets
Operating profit margin (OPM)	EBIT/Sales
Management Indicators:	
General:	
Change in size	Asset variation
Integration/output quality	Added Value/ Sales
Capital intensity	(Cash flow + Interest expenses) / Added Value
Long-term assets Management:	
Asset structure	Long-term assets /asset
Investment	Original value variation
Investment	Balance sheet value variation
Replacement policy	Depreciation / Original value
Disinvestment	Sale of fixed assets / fixed assets
Working capital management:	
Inventory management	Inventories/Sales
Financial relation with customers	Receivables/Sales
Financial relation with suppliers	Operating Liabilities/Sales
Financial Policy	
Capital structure	Leverage (Financial debt / Equity)
Repayment capacity	Financial debt / Cash flow
Employee Management	
Productivity	Sales / Labour costs
Productivity	Added Value/ Labour costs

Notes

1. Telos, E. Cohen, Feb. 2011. http://www.telos-eu.com/fr/globalisation/commerce-mondial/competitivite-pourquoi-la-france-a-un-probleme.html.
2. In recession, the present value of expected future cash flows for equity decreases. As a consequence, following TOT the market value of debt and equity drops. The global impact of the business cycle on leverage expressed in market value is therefore difficult to theoretically assess.
3. Detailed calculations of all the variables used in this study are given in Appendix, Table A10.2.
4. EBIT = Earnings Before Interest and Taxes.
5. Only global models are presented; more details available from the authors.

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Part IV

Intermediary Markets and Strategic Decisions

11
The Technical Efficiency of Wine Grape Growers in the Murray–Darling Basin in Australia

Tim Coelli and Orion Sanders

11.1 Introduction

The wine industry in Australia has grown at an impressive rate during recent decades. From 1982 to 2009 the area under vine grew from 60,000 ha to 163,000 ha, the wine grape harvest grew from 500,000 tonnes to 1.73 million tonnes, and Australia's volume of wine exports grew exponentially from 8 million litres to 764 million litres, becoming the fourth largest exporter by volume behind the traditional wine-producing giants of Italy, France and Spain (Anderson and Nelgen 2011).

In the early part of the twenty-first century, a number of factors combined which placed pressure on the wine industry. First, competition from emerging New World wine producers such as Chile, Argentina and South Africa, and the continued strength of France, Spain and Italy, began to erode Australia's international market share (Anderson and Nelgen 2011). Second, vines continued to be planted in Australia. Third, the resources boom in Australia pushed the value of the Australian dollar from US$0.56 in 2003 to US$1 in 2011, effectively almost doubling the landed cost of Australian wine in overseas markets. Fourth, climatic events caused the price of irrigation water to rise substantially during 2006 to 2007 to 2009 to 2010 in many parts of the Murray–Darling Basin (WaterExchange 2012), where more than two-thirds of Australia's wine grapes are grown on irrigated farms (recently this pressure has eased with the cessation of drought). As a result of these pressures, many small wine grape growers find themselves making regular losses, as grape prices fall and input costs rise (ABARES 2011).

This study is motivated by a desire to obtain empirical information on the degree of technical efficiency among wine grape growers, the degree to which they are operating at an optimal scale of production, and the degree to which these farms are efficiently allocating irrigation water.

To our knowledge, there is no published study that estimates production frontiers or technical efficiency for wine grape growers in Australia. This is surprising, given the importance of the industry in Australia and the extent to which these methods have been applied to other agricultural sectors in Australia and around the world. For example, see reviews by Coelli (1995) and Bravo-Ureta et al. (2007). We found three studies that applied these methods to wine grape growers in countries other than Australia: Conradie et al. (2006), Carvalho et al. (2008), and Moreira et al. (2011).

Conradie et al. (2006) applied stochastic frontier analysis (SFA) methods to sample data on wine grape farms in South Africa. This involved analysis of annual data on 34 farms from the Robertson region and 36 farms from the Worcester region, in 2003 and 2004. The output quantity variable used was tonnes of wine grapes, with price-weighted equivalents of 'other fruit' grown on the farms added onto this measure. The average farm in the sample produced 1140 tonnes of wine grapes and 340 tonnes of other fruit. Three input quantity variables were included in the production frontier: land area in hectares; labour in hours worked; and machinery costs. The study utilised the Battese and Coelli (1995) inefficiency effects SFA model to also investigate the effect of various exogenous factors on efficiency levels. The five variables used were: age of farmer; education of farmer; percentage of non-bearing (young) vines on the farm; electricity used (as a proxy for irrigation usage); and wage rate (as a proxy for labour quality).

Conradie et al. (2006) estimated both Cobb-Douglas and translog functional forms, and concluded that the Cobb-Douglas functions were a better fit to the data. They obtained a mean returns to scale estimate of 1.215, which suggests substantial unexploited scale economies; however, these measures varied significantly from sample to sample. Estimated mean technical efficiency was approximately 72 per cent, and this value was observed to increase with farm size.

Carvalho et al. (2008) investigated the technical efficiency of wine grape growers using panel data on 22 farms over the 2000 to 2005 period in the Alentejo region of Portugal. The output variable used was the gross value of output (including non-wine grape outputs and subsidies). The average farm size was 62 hectares, with 16 hectares planted to vineyards and 60 per cent of farm revenue derived from the sale of wine grapes to a cooperative. Four input quantity variables were used: land in hectares; labour in hours; machinery and equipment costs; and other costs. A Cobb-Douglas functional form was used, and the Battese and Coelli (1992) time-varying efficiency SFA panel data model was estimated. The estimate of returns to scale at the mean was 0.95, indicating mildly decreasing returns to scale, while mean technical efficiency was found to decrease from 79.3 per cent in 2000 to 52 per cent in 2005.

Moreira et al. (2011) studied the technical efficiency of wine grape producers in Chile. Their study is unique in that they use 263 block-level observations from a sample of 38 farms in their empirical analysis. The output measure is kilograms of wine grapes, while the four input quantity measures utilised are: land in hectares; labour costs; machinery costs; and fertiliser and chemical costs. Twelve dummy variables are also included: block age (five years or older); red wine grapes; premium wine grapes; three training system dummy variables for 'simple', 'double cordon' and 'pergola' systems; and another six location dummy variables for different valleys. They estimate a Cobb-Douglas production frontier using SFA methods, obtaining a mean returns to scale estimate of 1.02, indicating near constant returns to scale, and mean technical efficiency of 77.8 per cent.

The remainder of this chapter is divided into sections that describe: the sample data used and the variables that we have selected (Section 11.2); the stochastic frontier analysis (SFA) method (Section 11.3); the empirical results and discussion (Section 11.4); and the conclusions (Section 11.5).

11.2 Sample data and variable selection

Dataset

This study utilises the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) irrigation survey dataset, which contains detailed physical and financial information on irrigation farms in the Murray–Darling Basin (MDB) region of eastern Australia. The ABARES irrigation survey began in 2006 to 2007 and, at present, four years of data are available. The survey is designed to provide coverage of around 10 per cent of the irrigation farm population across three broad industry categories (broadacre, horticulture, and dairy) and across ten regions in the MDB (Figure 11.1). The irrigation survey follows the same methodology employed in the long-running Australian agricultural and grazing industries survey (AAGIS) and the Australian dairy industry survey (ADIS) (see Ashton et al. 2009).

For this exploratory study, we restrict the dataset to wine grape specialists[1] in two adjacent regions in the southern MDB: the Murray and the Murrumbidgee. This is done to maintain relative homogeneity between observations (in terms of specialisation) and because these regions comprise the majority of wine grape growers in the MDB. The resulting dataset comprises an unbalanced panel dataset of 135 wine grape irrigators over four years, for 214 observations in total (Table 11.1).

A significant feature of the dataset is the presence of extended irrigation drought (MDBA 2010). Table 11.2 shows the water allocations to irrigation entitlements as a percentage of the total allowable entitlement. In normal years (such as 2000–2001 and 2005–2006), these allocation percentages are close to, or even above, 100 per cent. However, it is clear that in 2006 to

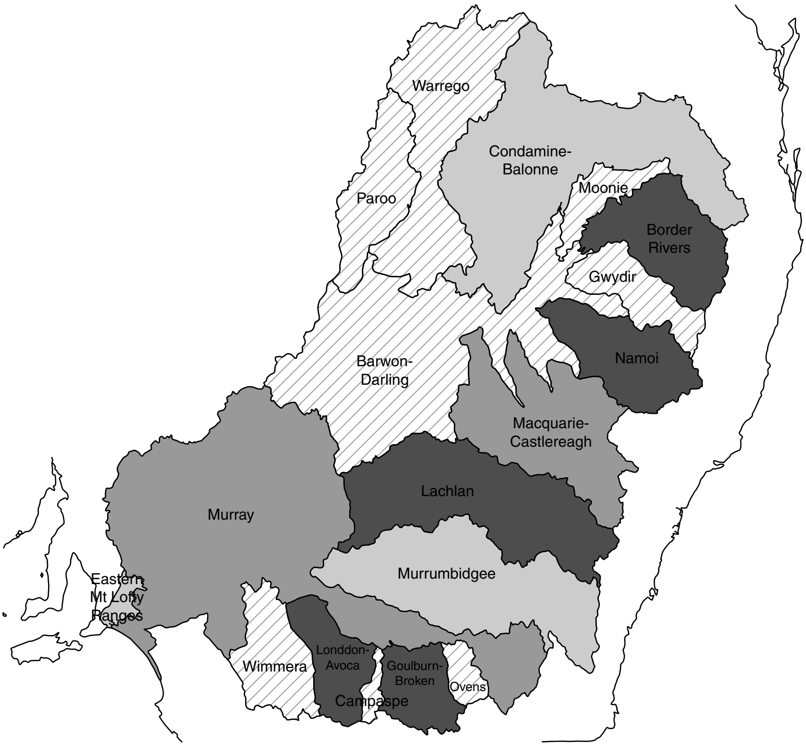

Figure 11.1 Regional coverage of the ABARES survey of irrigation farms in the MDB*
Notes: * - surveyed regions are shaded and their names are indicated in bold font

Table 11.1 ABARES irrigation survey subset: wine grape specialists

	2006–07	2007–08	2008–09	2009–10	Total
Murray	56	74	30	18	178
Murrumbidgee	14	8	7	7	36
Total	70	82	37	25	214

2007 to 2008 to 2009, and to some extent in 2009 to 2010, allocations were significantly below normal levels.

Variable selection

The ABARES irrigation survey contains extensive and detailed information on both the physical and the financial characteristics of the farms surveyed. For key agricultural inputs, such as land and water, data is available at the

Table 11.2 Irrigation water allocations in major areas of the southern Murray–Darling Basin, 2000–2001 to 2009–2010

Region – entitlement type	**2000–01**	**2005–06**	**2006–07**	**2007–08**	**2008–09**	**2009–10**
Murray (SA)	100	100	60	32	18	55
Murray (VIC) – high security	200	144	95	43	35	100
Goulburn (VIC) – high security	100	100	29	57	33	71
Murray (NSW) – high security	100	97	69	25	95	97
Murray (NSW) – general security	95	63	0	0	9	10
Murrumbidgee (NSW) – high security	100	95	90	90	95	95
Murrumbidgee (NSW) – general security	90	54	10	13	21	14

enterprise level, while for other more general inputs data is only available at the whole-of-farm level. The dataset does not contain information on wine varieties.

With a focus on estimating wine grape production frontiers, the output variable is chosen as the total tonnes of wine grapes harvested. This variable does not account for potential differences in output quality between observations, and hence future work is expected to consider quality-adjusted measures of output. The variable also does not account for production of other outputs. However, for the chosen sample, wine grapes were the predominant output, comprising on average over 98 per cent of receipts. Future work will focus on estimating multiple-output distance functions for a wider range of producers.

Similar to the papers reviewed, input variables are combined into five aggregate categories: land; water; capital; labour; and 'other inputs'. Irrigation water is a unique variable not used by the other studies, which mainly focus on dryland farms. Physical measures of land and water inputs used for wine grape production are readily available in the dataset as vine area (in hectares) and volume of irrigation water applied to vines (in mega litres). While generally the input variables should reflect total farm use, given the choice of just one output these were chosen to reflect use at the enterprise level (just for wine grapes).

Other inputs are only available at the whole-of-farm level, and are generally monetary measures. While a physical measure of labour input – hours worked – is available, it is an aggregation of a number of different employment categories. For a more accurate estimate of the value of labour input, this study uses a total wages estimate, which includes expenditure on hired labour and contract labour, as well as the imputed market value of farm family labour (which is available as a standard variable in the survey dataset). In future, we plan to construct a multilateral Fisher index of hourly labour weighted by wage.

Measures of capital and other variable inputs are only available as monetary value estimates provided by the farm operator. Ideally, undepreciated replacement values would be available, as there is evidence that these better reflect capital services (Coelli et al. 2003). For this study, only valuations of 'moveable' capital items were readily available. These moveable capital items include vehicles, plant and equipment, and non-fixed irrigation equipment. Valuations of fixed capital, such as fixed irrigation equipment and buildings, will be available for future work. We are also investigating measures of vine capital.

Finally, as a measure of other variable inputs, a 'materials' variable is defined as total farm cash costs less interest expenses, less labour expenses (hired labour and contract labour) and less water costs (water utility charges and water entitlement and allocation trades expenses). This variable includes costs on items such as fertiliser, fuel and chemicals.

As production function estimation requires quantity estimates, the monetary variables are deflated as follows: capital and materials are indexed to 2009 to 2010 prices using the ABARES (2011) *Australian Commodity Statistics 2011* prices paid by farmers, capital items index and total prices paid index, respectively; labour is indexed by a labour wage index constructed from the survey data using hired labour and family labour weeks worked. Summary statistics for these variables for each survey year are presented in Table 11.2 and include mean, minimum, maximum, and standard deviation as a proportion of the mean. The dataset is highly skewed, with a large number of small family farms lying below the mean, and a few very large farms lying significantly above the mean.[2] This is representative of the current structure of agriculture in Australia (Productivity Commission 2005).

The dataset also contains a number of additional variables of interest that were not used for this study, including number of vines, age of the farm operator, highest level of education completed by the farm operator, off-farm income, and summer rainfall and soil moisture. These variables could be used in future work to explain technical inefficiencies using models such as that of Battese and Coelli (1995).

11.3 Methods

Stochastic Frontier Analysis

In this study we estimate production frontiers for wine grape growers using stochastic frontier analysis (SFA) methods. Aigner et al. (1977) and Meeusen

Table 11.3 Summary statistics, ABARES irrigation survey: wine grape specialists in Murrumbidgee and Murray survey regions

	Variable	**Wine grapes**	**Land**	**Water**	**Moveable capital**	**Labour**	**Other inputs**
	Unit	**tonnes**	**hectares**	**mega litres**	**$'000**	**$'000**	**$'000**
2006/07	Mean	1064.2	63.4	345.2	189.8	311.2	288.1
	SD/Mean	1.9	1.6	1.7	1.7	1.7	2.9
	Minimum	35.0	1.7	10.4	9.2	7.9	11.3
	Maximum	13470.0	515.0	3749.0	1679.4	4022.0	5205.2
2007/08	Mean	622.9	33.4	183.6	115.2	216.9	102.2
	SD/Mean	1.6	1.3	1.4	1.7	1.2	1.3
	Minimum	50.0	3.0	15.0	14.1	21.7	9.2
	Maximum	6008.0	260.0	1420.0	1494.1	1563.0	838.8
2008/09	Mean	840.8	47.0	246.9	125.9	249.8	138.9
	SD/Mean	1.2	1.1	1.2	1.3	1.0	1.1
	Minimum	42.8	3.0	17.0	14.2	24.0	16.8
	Maximum	3964.0	200.0	1300.0	901.8	1136.0	574.4
2009/10	Mean	1516.2	91.6	483.1	182.0	423.0	214.8
	SD/Mean	1.1	1.1	1.2	1.3	0.9	1.1
	Minimum	61.0	5.5	12.0	19.9	57.5	15.5
	Maximum	6652.0	361.7	2210.0	951.7	1563.0	1077.4

and van den Broeck (1977), building on the seminal work of Farrell (1957), independently proposed the stochastic frontier production function:

$$Y_i = f\left(\mathbf{X}_i\right)\exp(v_i - u_i), \quad i = 1, 2, ..., N,$$

where Y_i is the output of the i-th firm, $\mathbf{X}_i$ is the $K \times 1$ vector of input quantities of the i-th firm, $f(.)$ is a suitable functional form and N is the number of firms in the sample. The stochastic frontier production function is characterised by an error term which has two components, a non-negative error term to account for technical inefficiency (u_i) and a symmetric error term to account for other random effects (v_i). Aigner et al. (1977) assumed that the v_i were independent and identically distributed (*i.i.d.*) normal random variables with mean zero and constant variance, independent of the u_i, which were assumed to be *i.i.d.* exponential or half-normal random variables. The parameters of the model are generally estimated using maximum likelihood methods. For an introductory treatment of SFA methods, see Coelli et al. (2005).

Stochastic Frontier Analysis

The choice of a functional form is an important step in any empirical analysis involving the use of SFA. The most widely used functional form in production frontier analysis is the Cobb-Douglas, which is a relatively simple functional form:

$$Y_i = a_0 \prod_{k=1}^{K} X_{ki}^{\alpha_k} \exp(v_i - u_i), \quad i = 1, 2, ..., N, \tag{1}$$

where X_{ki} is the k-th input quantity of the i-th firm, and a_0 and the α_k are unknown parameters to be estimated. Much of the popularity of the Cobb-Douglas is due to the fact that the logarithm of the above equation produces a function that is linear in parameters and, hence, is easy to estimate using standard econometric methods. The logarithm of equation (1) is:

$$y_i = \alpha_0 + \sum_{k=1}^{K} \alpha_k x_{ki} + v_i - u_i, \quad i = 1, 2, ..., N \tag{2}$$

where $\alpha_0 = \ln(a_0)$, $y_i = \ln(Y_i)$ and $x_{ki} = \ln(X_{ki})$ and the α_k are interpreted as the elasticities of output with respect to the k-th input. Another advantage of this functional form is that it only requires the estimation of $K+1$ parameters, which can be done with relatively small data samples.

However, the Cobb-Douglas is a rather restrictive functional form, because it assumes all firms have the same production elasticities, same scale elasticities and unitary elasticities of substitution, which could be rather restrictive for the range of wine grape farms considered in this study.

The translog is a more flexible functional form that requires the estimation of more parameters than the Cobb-Douglas, but does not impose the restrictions implied by the Cobb-Douglas. Hence this form should generally be preferred, unless a hypothesis test justifies the Cobb-Douglas restrictions, or data limitations preclude the use of the translog. A translog production function is quadratic in logs, and may be defined as:

$$y_i = \alpha_0 + \sum_{k=1}^{K} \alpha_k x_{ki} + 0.5 \sum_{k=1}^{K}\sum_{j=1}^{K} \alpha_{kj} x_{ki} x_{ji} + v_i - u_i, \quad i = 1, 2, ..., N, \tag{3}$$

where the α_{kj} are an additional $K(K+1)/2$ second-order parameters to be estimated.[3]

In our empirical analysis, we estimate both the Cobb-Douglas and translog functional forms, and then formally test the null hypothesis that the second-order parameters are equal to zero, using a likelihood ratio test. Acceptance of the null hypothesis would imply that the Cobb-Douglas functional form is adequate while non-acceptance would provide support for the translog functional form.

Panel data

Given that we have access to panel data in this study, we generalise our model using the approach suggested by Battese and Coelli (1992) to provide:[4]

$$y_{it} = \alpha_0 + \sum_{k=1}^{K} \alpha_i x_{kit} + 0.5 \sum_{k=1}^{K}\sum_{j=1}^{K} \alpha_{kj} x_{kit} x_{jit} + \sum_{i=1}^{K} \delta_i x_{kit} t$$

$$+ \lambda_1 t + 0.5\lambda_{11} t^2 + \beta d_{it} + v_{it} - u_{it}, \quad i = 1, 2, ..., N,\ t = 1, 2, ..., T, \tag{4}$$

where t indexes time period and all Greek letters represent unknown parameters to be estimated. The variable d is an additional regional dummy variable to elicit differences between the two study regions, and which takes a value of one for the Murrumbidgee region and zero otherwise. This model allows for time-varying technical inefficiency effects of the form:

$$u_{it} = \left\{\exp[-\eta(t-T)]\right\} u_i, \quad i = 1, 2, ..., N,\ t = 1, 2, ..., T, \tag{5}$$

where the u_i are assumed to be *i.i.d.* generalised truncated-normal random variables:

$$u_i \sim \left| N(\mu, \sigma_u^2) \right|,$$

the v_{it} are assumed to be *i.i.d.* normal random variables:

$$v_{it} \sim N(0, \sigma_v^2)$$

and η, μ, σ_u^2 and σ_v^2 unknown scalar parameters to be estimated. Note that prior to estimation the variance parameters, σ_v^2 and σ_u^2 are re-parameterised as $\gamma = \sigma_u^2/(\sigma_u^2 + \sigma_v^2)$ and $\sigma^2 = \sigma_u^2 + \sigma_v^2$ for computational convenience.

This model is a generalisation of the Aigner et al. (1977) model, in the sense that it:

- accommodates panel data;
- allows for technical efficiency to vary over time ($\eta = 0$ implies time-invariant efficiencies); and
- assumes a generalised truncated normal distribution for the u_i ($\mu = 0$ implies the simpler half-normal distribution).

Each of these restrictions can be tested using a likelihood ratio test.

The model in equation (4) also permits non-neutral technical change (frontier shift), via the inclusion of the time trend variable (t) and its interactions with various inputs. The null hypothesis of zero technical change can also be tested. This can be done by testing the joint hypothesis that λ_1, λ_{11} and the δ_i all equal zero, using a likelihood ratio test.

Given the unbalanced nature of the dataset, with a number of farms observed for only one period, interpreting the time trend estimates does require an assumption that the sample in each time period is relatively homogeneous, and is not influenced by factors such as poor performers leaving the industry; otherwise, the estimates of technical change may be biased.

Shadow prices

In addition to measuring technical efficiency scores, we also make use of the methods described in Kim (1992) to derive measures of the input shadow prices from the curvature of the estimated production functions. We are particularly interested in the shadow price of irrigation water so that we can assess the degree to which this resource is being used in an allocatively efficient manner by these farmers. The shadow price of water reflects the marginal change in output from increasing water use, and hence under perfect market conditions should equal the price of water.

We obtain an estimate of input shadow prices (W) as a proportion of output price (P) from the derivatives of the production function as:

$$\frac{W_{kit}}{P_{it}} = \frac{\partial Y_{it}}{\partial X_{kit}} = \frac{Y_{it}}{X_{kit}} \frac{\partial y_{it}}{\partial x_{kit}} \tag{6}$$

In order to compute these ratios of shadow prices for each observation in the sample, we first compute the partial elasticities with respect to inputs:

$$s_{kit} = \partial y_{it}/\partial x_{kit} = \alpha_k + \sum_{j=1}^{K} \alpha_{kj} x_{jit} + \delta_k t \tag{7}$$

These measures can also be aggregated to obtain scale elasticities for each observation in the sample:

$$e_{it} = \sum_{k=1}^{K} s_{kit}, \tag{8}$$

where $e_{it} < 1$, $e_{it} = 1$ and $e_{it} > 1$ indicate decreasing, constant or increasing returns to scale, respectively.

11.4 Empirical Results

Production frontier estimation

The model defined in equation (4) is estimated using maximum likelihood methods. A number of hypothesis tests were then conducted using likelihood ratio tests at the 10 per cent significance level to determine the most valid functional form and ascertain the significance of the inefficiency, translog, and technical change parameters (Table 11.4). Firstly, the hypothesis that the stochastic inefficiencies are time independent ($H_0 : \eta = 0$) is accepted. Subsequent tests of the additional restrictions against the model with $\eta = 0$ imposed conclude that: the translog functional form represents the data better than a Cobb-Douglas functional form; there are significant technical inefficiencies, and these follow a truncated normal distribution; there is evidence of technical change; and the production frontier intercepts differ for farms across the Murray and Murrumbidgee regions.

Maximum likelihood (ML) estimates of the final estimated production frontier are presented in Table 11.5. Prior to estimation, the data was transformed to allow the direct interpretation of the first-order translog parameters (α_i) as the elasticities evaluated at the sample means. This was done by ensuring that both the arithmetic sample averages of the logged input variables and the time trend were zero. The former is equivalent to setting the geometric means of the original (unlogged) data equal to one.

The ML estimates of the first-order coefficients have the expected signs, with only the elasticity of 'moveable capital' not found to be statistically significant. The lack of significance of moveable capital could be explained by the subjective nature of the capital valuation methods used by farmers, which causes estimates to vary significantly depending on factors such as recall and method of depreciation. Furthermore, it might be explained by the difficulty in econometrically estimating smaller relationships: the contribution of moveable capital items to total production costs is generally quite small across these farms, given that larger expenses such as machine harvesting could also be captured in the materials variable, as contractor payments are not broken down by payment category.

The estimated coefficient of the time trend is 0.027, providing an estimate of technical change of 2.7 per cent per year. This is slightly high when compared to the rates of 1 to 2 per cent that are normally seen in empirical studies in agriculture. However, we suspect that drought in the first three years of the four-year sample period may explain the estimate that we have obtained here. A longer time period is needed to obtain a robust estimate of technical change when using agricultural data. Additionally, it may be possible that changes in the farms sampled over time bias the results.

Estimates of technical efficiency are obtained for each observation. The mean efficiency is found to be 0.79, or 79 per cent, which is very similar to the estimates reported in the three studies reviewed earlier in this chapter.

Table 11.4 Hypothesis tests to determine the significance of the inefficiency, translog, and technical change parameters of the estimated production frontier

Base model	**Null Hypothesis H_0**	**Log-likelihood**		**χ^2 test statistic**	**p-value**	**Decision**
		H_0	**H_1**			
(4) + regional dummy d	No time effects ($\eta = 0$)	−9.06	−9.02	0.07	0.787	Accept
$\eta = 0$	Inefficiencies follow a half-normal distribution($\mu = 0$)	−10.97	−9.06	3.82	0.051	Reject
$\eta = 0$	No technical inefficiency ($\gamma = \mu = 0$)	−28.78	−9.06	39.45	$< 10^{-9}$	Reject
$\eta = 0$	No regional difference ($d = 0$)	−11.57	−9.06	5.02	0.025	Reject
$\eta = 0$	No technical change ($\lambda_1 = \lambda_{11} = \delta_i = 0$)	−16.01	−9.06	13.92	0.053	Reject
$\eta = 0$	Cobb-Douglas functional form ($a_{ij} = 0$)	−25.71	−9.06	33.30	0.004	Reject

Table 11.5 Estimated translog stochastic production frontier parameters

Variable	Parameter	ML Estimate[a]	Significance[b]
Constant	a_0	0.225 (0.058)	***
ln(land)	a_1	0.539 (0.075)	***
ln(water)	a_2	0.297 (0.067)	***
ln(moveable capital)	a_3	0.001 (0.031)	ns
ln(total wages)	a_4	0.071 (0.042)	.
ln(materials)	a_5	0.159 (0.046)	***
$0.5 \times [\ln(\text{land})]^2$		−1.186 (0.326)	***
ln(land) × ln(water)	a_{12}	0.682 (0.242)	**
ln(land) × ln(moveable capital)	a_{13}	0.512 (0.128)	***
ln(land) × ln(total wages)	a_{14}	0.364 (0.139)	**
ln(land) × ln(materials)	a_{15}	−0.108 (0.181)	ns
$0.5 \times [\ln(\text{water})]^2$	a_{22}	−0.621 (0.220)	**
ln(water) × ln(moveable capital)	a_{23}	−0.260 (0.102)	*
ln(water) ×ln(total wages)	a_{24}	−0.207 (0.110)	.
ln(water) × ln(materials)	a_{25}	0.281 (0.118)	*
$0.5 \times [\ln(\text{moveable capital})]^2$	a_{33}	−0.120 (0.065)	.
ln(moveable capital) × ln(total wages)	a_{34}	0.044 (0.069)	ns
ln(moveable capital) × ln(materials)	a_{35}	−0.176 (0.083)	*
$0.5 \times [\ln(\text{total wages})]^2$	a_{44}	−0.299 (0.121)	*
ln(total wages) × ln(materials)	a_{45}	0.049 (0.092)	ns
$0.5 \times [\ln(\text{materials})]^2$	a_{55}	−0.116 (0.110)	ns
dummy variable for Murray region	d	0.137 (0.058)	*
t	λ_1	0.027 (0.020)	ns
$0.5 \times t^2$	λ_{11}	−0.026 (0.031)	ns
t × ln(land)	δ_1	0.065 (0.066)	ns
t × ln(water)	δ_2	−0.082 (0.053)	ns
t × ln(moveable capital)	δ_3	−0.020 (0.030)	ns
t × ln(total wages)	δ_4	−0.026 (0.038)	ns
t × ln(materials)	δ_5	0.093 (0.038)	*
	σ^2	0.516 (0.249)	*
	γ	0.941 (0.037)	***
	μ	−1.394 (0.961)	
Log likelihood: −9.06			
Mean efficiency: 0.79			

Notes: (a) Standard errors are presented in brackets; (b) Significance levels based on z-statistics: '***' p<0.001, '**' p<0.01, '*' p<0.05, '.' p<0.1, 'ns' otherwise.

However, there is considerable variation in the technical efficiency scores obtained, with a number of farms lying well below this point (Figure 11.2). While some degree of inefficiency might be a result of variables omitted from the production function such as soil quality, vine age, or grape variety, the results suggest that a number of growers are inefficient. This also suggests

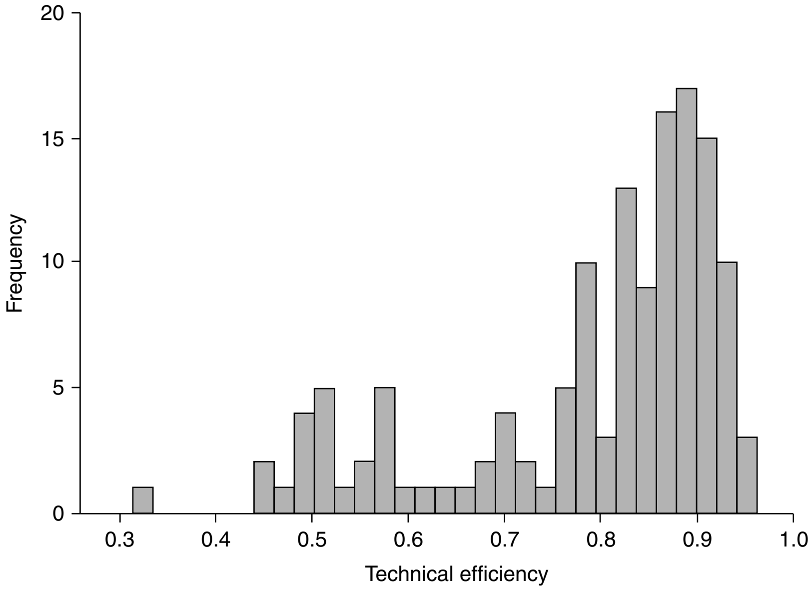

Figure 11.2 Histogram of technical efficiencies for wine grape specialists in the Murrumbidgee and Murray survey regions

that a number of these poor-performing farms may face significant pressure if wine grape prices remain at current levels. However, there may be significant potential for farmers to adjust to these pressures.

Shadow prices

Shadow price information for irrigation water was obtained using the methods outlined in the previous section. Estimated water shadow prices (as a proportion of the output price) are shown in Figure 11.3, which indicates a significant level of variation between observations. The mean water shadow price ratio estimate is 1.07. For an output price of $444/tonne (the average wine grape price received by farmers in the sample), we obtain an estimated mean shadow price of water of $489/megalitre. Given that the average spot price of water in the surveyed years has been around $300/megalitre, this could imply that the average farmer has been underutilising irrigation water.

However, it is important to note that these estimates are obtained from the production frontier itself, but most farms lie below this. Hence, these estimates might not accurately reflect the price of irrigation water use for specific farms. Additionally, this result might be influenced by drought in the first three survey years (and to some extent in the last year): given the large price fluctuations observed during the surveyed years, the price of water may

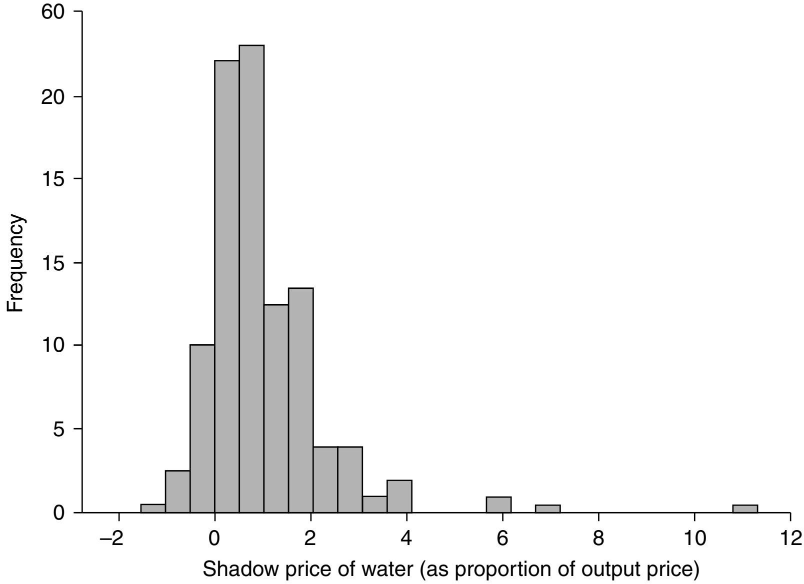

Figure 11.3 Histogram of irrigation water shadow prices for wine grape specialists in the Murrumbidgee and Murray survey regions

have been higher during peak growing periods. As data from non-drought years becomes available, these shadow price estimates may become more meaningful.

It is of particular interest to observe that some negative shadow price ratios are obtained. Negative shadow prices generally indicate that too much of an input is being consumed, to the extent that the marginal product becomes negative. This could be influenced by the type of irrigation method used, or because other factors have not been included. In future work we will attempt to obtain information on the irrigation methods used on each farm (for example, flood, trickle, sprinkler) to investigate this issue further.

Returns to scale

Estimates of scale elasticities presented in Figure 11.4 provide evidence that the majority of farms in the sample are operating under increasing returns to scale, with a sample mean scale elasticity of 1.07. This lies within the range of scale elasticity estimates obtained in the previously reviewed wine grape studies, and is consistent with evidence that smaller wine grape farms are less profitable than larger ones (see Henry et al. 2007 and Seyoum and Chan 2012, for example). Hence we may see ongoing structural adjustment in the industry following the overall trend of increasing farm sizes in the

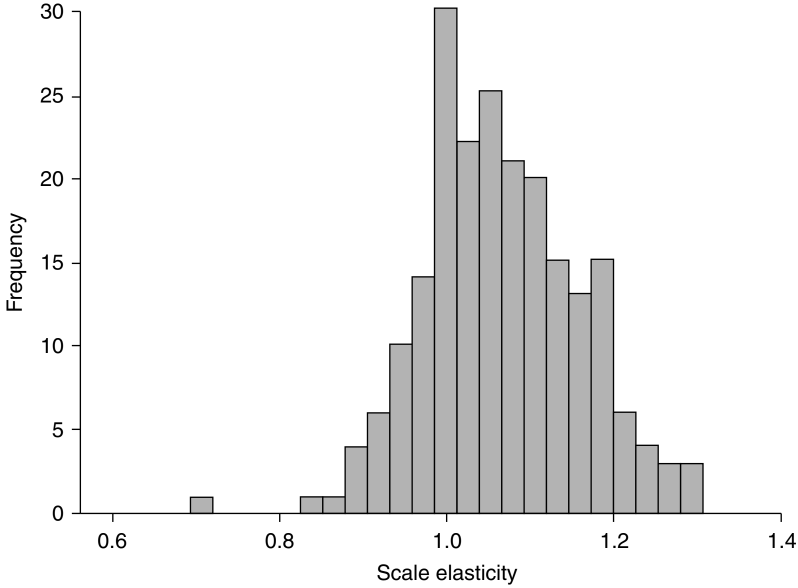

Figure 11.4 Histogram of scale elasticities for wine grape specialists in the Murrumbidgee and Murray survey regions

wider agricultural sector (Productivity Commission 2005). Also note that these estimates appear normally distributed, unlike those in Figures 11.2 and 11.3.

11.5 Conclusion

In this study we provide (to our knowledge) the first frontier analysis study of Australian wine grape growers. We make use of a subset of the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) irrigation survey, consisting of four years of unbalanced panel data on 135 wine grape specialists (214 observations in total) from the Murray and Murrumbidgee river basins in Australia (from 2006–2007 to 2009–2010).

Maximum likelihood methods are used to estimate translog stochastic production frontiers. In our model we allow for (generalised) truncated normal inefficiency effects, time-varying inefficiency and non-neutral technical change. We use likelihood ratio tests to assess the model specification, and conclude that: inefficiency is time-invariant; the translog functional form is preferred relative to the simpler Cobb-Douglas functional form; the generalised truncated normal distribution is preferred relative to the simpler half-normal distribution; and technical change is significant.

Mean technical efficiency is estimated to be 79 per cent, with the likelihood that many farms achieving well below this level face significant pressure in future if grape prices do not improve. However, it also suggests that there may be significant potential for farmers to adjust to these pressures; this is the subject of further study.

A mean scale economies estimate of 1.07 for wine grape producers in these regions provides some evidence of increasing returns to scale, consistent with evidence that smaller wine grape farms are less profitable. This could suggest that farm amalgamations may occur in future.

Technical change is estimated at 2.7 per cent per year. However, these estimates are based on a relatively short time frame and may be biased by stronger drought during the early survey period. Furthermore, we find that our shadow price estimates for irrigation water are above average market prices during the surveyed years. However, the price of water varied widely during the sample years and the average market price might not accurately reflect the price faced by irrigators during critical growing periods.

Finally, we should emphasise that this chapter reports on a study that is very much exploratory at this stage, and hence that one should not place too much weight on this particular set of empirical results. A number of extensions and improvements are planned for the next stage of this work, many of which relate to improving upon the variables used in the study. This will involve the investigation of alternative output measures that attempt to take account of differences in grape quality, and obtaining a measure of fixed farm capital. We also hope to determine explanatory variables for technical efficiency, to better inform policy makers in designing productivity-improving policies. Some possible explanatory variables to be investigated include number of vines per hectare, age of the farm operator, highest level of education completed by the farm operator, off-farm income, and summer rain and soil moisture.

Notes

1. Farms for which wine grape receipts comprise more than 80 per cent of total receipts.
2. Given the unbalanced nature of the dataset, comparisons of the summary statistics between years are likely to be affected by compositional changes.
3. In translog production functions symmetry is implicit. That is, $\alpha_{ij} = \alpha_{ji}$, etc.
4. Note that Battese and Coelli (1992) used a Cobb-Douglas functional form, as opposed to a translog functional form.

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12
Product Assortment and the Efficiency of Farms

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12.1 Introduction

During the past decade, interventions for the restructuring and modernising of viticulture have been of great interest to the winemaking Western Balkan Countries (WBCs) and Early Transition Countries (ETCs) (Food and Agricultural Organization 2009). Within the platform for rural development and support from the national Rural Development Programs (RDP), grape producers have been encouraged to uproot old vineyards consisting of regional/local grape varieties and replace them with recognised European grape varieties. Growing demand for rootstocks of European grape varieties in all WBCs and ETCs has been reported by the FAO (Food and Agricultural Organization 2009). Macedonia,[1] which is used as a case study in this chapter, is an EU aspirant country, and adjustments to match EU regulations and practices, including wine regulations, are considered to be the key to improving the competitiveness and environmental sustainability of the Macedonian wine sector. However, adjustments in the grape assortment in Macedonia may not necessarily be economically sustainable (Bozinovski, personal communication 2011).[2] Moreover, it has not been proven to be appropriate for achieving higher farm efficiency, which is a key objective of the ongoing RDPs.

Since 2000, the acreage of Macedonian vineyards has declined from 28,000 to 21,000 hectares (SSO 2011). Inadequate replacement of old plantations has been proposed as a possible explanation for this situation (Z. Bozinovski, personal communication 2011). During revitalisation and replacement of old plantations, two characteristics need to be taken into consideration: first, vines are perennial plants and thus revitalisation and replacement of old plantations should be based on a long-term strategy. Second, Macedonian grape production is industry-orientated (80% of total production is processed into wine), and thus changes in the grape assortment should meet the demands of the wine sector and enable continuous development of both the grape and wine sectors. The government authorities in Macedonia have introduced subsidies for uprooting old plantations and their replacement with recommended varieties (Book of Rules on classification of wine grape varieties OG 6/2007 Annex 21) consisting of European, and regional/local grape varieties (MAFWE 2007). However, variety recommendation is only based on the (climatic or agri-environmental) appropriateness of a certain grape variety to be grown in a specific district, and has been criticised as not being updated in terms of the market requirements for wine grapes and thus for wine production. On the other hand, professionals (Z. Bozinovski, personal communication 2011) support the uprooting of old vineyards, but emphasise the importance of strategically planned replacements, based both on the variety adaptability to a specific district and the long-term marketing strategy for the wine production. This suggests that the regional/local wine grape varieties need to be favoured. Experts believe that wines need to be seen as differentiated products, and adjustments of Macedonia to the grape assortments and practices of the major winemaking European countries would mean entering the globalisation world, where value added is difficult to achieve. Therefore, Macedonian viticulture and wine strategy should be aimed at brand development from a grape assortment that corresponds with the local resources and conditions and gives high-quality wines. Publicly presented interest in brand development has also been emphasised by Macedonian wine producers; they suggest a single brand called 'Macedonian wines' to be used for all wine exports. Nacka (2011) explains that brand development is essential for strengthening the competitiveness of the Macedonian wine sector, and adjustments with the EU regulation are necessary for quality standards harmonisation and their application. For Macedonian viticulture, there is a suggestion that old plantations be predominantly replaced with recognised regional/local wine grape varieties and table grape varieties, with the Vranec and Stanusina varieties planted on at least 50 per cent and 10 per cent respectively of the wine-grape growing area in Macedonia (Z. Bozinovski, personal communication 2011), the remaining 40 per cent of the wine-grape growing area to be represented both by other recommended regional/local varieties such as: Kratoshija, Smederevka, Prokupec, Zilavka etc. and recognised European wine grape varieties such as: Syrah, Cabernet Sauvignon, Chardonnay, Merlot, Riesling, Rheinriesling, Savagnin, Montepulciano etc. Among the recommended table grape varieties are: Afus Ali, Cardinal, Ribier, Italia (Muscat), Michele Palieri etc. Similarly, the winemaking companies have proposed Vranec as the national choice for wine grape production. Based on current data, Vranec comprises only 25 per cent of the total planted area and 28 per cent of the total revenue obtained (Table 12.1).

Table 12.1 Descriptive statistics: input, output and assortment characteristics. Three-year mean values for 2006–2008

Variable	Farms	Mean	Std Dev.	Min.	Max.
Total area (TArea) ha	300	2.0	1.2	0.3	7.0
Mean revenue (MReven) €/ha	300	2704.6	1032.9	706.4	8337.9
Mean revenue of regional/local wine grape varieties (RRegLoc) €/ha	279	2681.7	1333.4	711.7	18879.5
Mean revenue of European wine grape varieties (REurop)€/ha	158	2904.2	1460.7	1087.4	16810.9
Mean revenue of table grape varieties (RTable) €/ha	102	4465.6	2306.5	699.1	12381.7
Proportion of regional/local wine grape varieties (SRegLoc) %	300	67.6%			
Proportion of European wine grape varieties (SEurop) %	300	22.7%			
Proportion of table grape varieties (STable) %	300	7.6%			
Proportion of Vranec in the total planted area (SAVranec) %	300	25.0			
Proportion of Vranec in the total revenue (SRVranec) %	300	25.0			
Proportion of Stanusina in the total area (SAStanus) %	300	1.4			
Proportion of Stanusina in the total revenue (SRStanus) %	300	1.2			
Mean number of varieties per farm (N^oVarieties) N^o	300	3.2	1.5	1.0	9.0
Mean cost of materials used (MMaterials) €/ha	300	414.0	167.7	79.5	1170.1
Mean cost of hired labour used (MLabour) €/ha	300	136.1	107.3	0.0*	704.0
Mean cost of energy and services (MEnSe) €/ha	300	237.7	118.4	84.2	1178.9

Notes: A case when farms use only family labour.

The issue of product modernisation in assortment terms, even though included in RDPs to date, has not been analysed as a factor that determines farm efficiency, whereas viticulture remains one of the least explained agricultural enterprises within the farm efficiency concept. A few studies examine the influence of crop diversification on farm efficiency (Bojnec and Latruffe 2009; Brümmer 2001; Haji 2007; Paul and Nehring 2005). On the other hand, studies analysing the impact of rural development policy measures on farm efficiency have devoted more attention to the use of the Farm Credit Programs (Brümmer and Loy 2000; Rezitis et al. 2003) and CAP (Common Agricultural Policy) direct payments (Kleinhanß et al. 2007; Latruffe et al.

2009; Zhu et al. 2008). These studies show that measures covered by funding provided by RDPs may not necessarily be appropriate for efficient agricultural production.

This study sought to obtain empirical evidence on the importance of grape assortment in attaining higher farm efficiency through analysing grape-growing family farms in the Tikvevs vineyard district of Macedonia. Although decisions on choice of variety are driven by a combination of inertia, historical precedent, ad hoc criteria and rational decision making (Ramdas 2003, p. 80), the political influence on such decisions should not be overlooked. This study examined the importance of research discussions when policy interventions are about to take place. Variety management is of great interest to both economists and policymakers (Haji 2007). More knowledge about how farm efficiency is affected by the grape assortment could help policymakers formulate better agricultural policies and thereby enhance farm efficiency, which by definition is the main objective of the ongoing RDPs in Macedonia (2007–2013).

12.2 Dimensions of product assortment

Assortment management is crucial for successful business practice, and a balance between assortment decisions, revenues and costs is necessary for long-term profit maximisation (Ramdas 2003). Product variety originates from differences in physical form and product function (Ramdas 2003). Hart and Rafiq (2006) imposed assortment consistency as an alternative assortment dimension where the consistency is interpreted as a specialisation characteristic, and increased specialisation suggests closer relatedness across categories. In the literature, crop product varieties have been expressed as number of varieties per farm (Haji 2007; Paul and Nehring 2005) or as a concentration index (Bojnec and Latruffe 2009; Coelli and Fleming 2004; Llewelyn and Williams 1996).

Variety creation as strategic product planning incorporates decisions on: the type of products to be offered, the number of products to be offered, potential markets, technology selection and the time frame for product introduction (Krishnan and Ulrich 2001; Ramdas 2003). In this chapter, product selection was analysed and grape assortment planning considered. The influences of two assortment dimensions were distinguished: (1) product diversification in terms of the number of grape varieties on the farm; (2) product diversification in terms of the product function/product consistency dimension, represented by three production options: regional/local wine grape varieties, European wine grape varieties and table grape varieties. Variety creation by firms allows a certain degree of synergy among the products, which originates from the technological process, common production process, knowledge etc. (Ramdas 2003).

One might argue that growing a different grape variety differs from growing a different crop. Although the production conditions are similar for all grape varieties, as they are for different crops, different grape varieties have specific biological characteristics (resistance to weeds, diseases, frost etc.), technological potential (yield, content of sugar and dry materials etc.) and quality, and thus the demand for a certain variety on the market (incorporating the winemaking companies for wine grape varieties, and the table grape market) and the purchase price differ.

Specialisation in production is expected to lead to efficiency gains resulting from the specialist skills and knowledge, economies of scale, time savings through not switching between different tasks, avoidance of bottlenecks in the allocation of resources etc. (Coelli and Fleming 2004). Diversification, as opposed to specialisation, ensures a better outcome in an uncertain production environment. The empirical evidence suggests that increasing assortment size is, however, not a guarantee of higher profits in the long run, and can even decrease competitiveness (Ramdas 2003); a negative effect of crop diversification on farm efficiency has been reported by Haji (2007) and Brumer (2001). Paul and Nehring (2005) found crop diversification to be useful for the economic performance of the US agricultural sector, and Coelli and Fleming (2004) found diversification of crop activities to be beneficial for the smallholder farming system in Papua New Guinea.

Product assortment dimension is of great interest to both buyers and producers. From a buyer perspective, two opposing viewpoints are applicable. The first, related to buyers without strict product preferences, is that greater assortment size is more beneficial, allowing consumers to find satisfactory products and enhance their enjoyment of shopping (Oppewal and Koelemeijer 2005). In contrast, for buyers with strict preferences less is preferable to more, and assortment size is perceived as confusing (Hoch et al. 1999). In this study, the product assortment issue was approached from the producer's perspective. However, the product assortment is not impervious to environmental changes; it is affected by changes in buyers' preferences, political decisions, production capacity and technology. Chakravarthy (1986) classifies the transformation processes of a firm into adaptive specialisation and adaptive generalisation; the former involves generating a net surplus by exploiting the current resources, and the latter is the subsequent step, when a firm's net surplus is used for investments that guarantee long-term survival. Chakravarthy (1986) points out that a well-managed firm should be able to pursue adaptive generalisation along with adaptive specialisation, and that replacements should take place on a regular basis. Inadequate transformation in terms of vine replacement has caused a dramatic decline in the acreage of Macedonian vineyards. Since 2007, uprooting of old vines and their re-plantation has been fully supported by the RDP (MAFWE 2007), but the objectives of the RDP need to be fulfilled.

12.3 Method

The influence of the selected grape assortment characteristics on farm efficiency was analysed by the two-stage method for efficiency analysis (Coelli et al. 2005). This is a common method for analysing the influence of various production and environmental factors, including the assortment characteristics (Haji 2007), on farm performance.

In the first stage, Data Envelopment Analysis (DEA) (Charnes et al. 1978), extended by homogeneous bootstrapping application for non-parametric models (Simar and Wilson 1998, 2000), was applied. Ordinary DEA and bias-corrected output-orientated technical efficiency (TE) scores accompanied by their confidence intervals (for the bias-corrected TE scores) were obtained. DEA is a linear programming model used for measuring the relative efficiency of different operating Decision Making Units (DMU). By generating efficiency scores for each participating unit, it constructs a frontier containing the best-performing units. All deviations from the frontier are assumed as inefficiency. The output-oriented TE score generated explains the degree to which each grape producer can maximise output (in this case in monetary units, see Table 12.1) for a given scale of input use. Macedonian grape growers have more adjusted practices for the use of inputs, but vary in production assortment and quality, improvements which require plant revitalisation and assortment strategy (Manevska-Tasevska and Hansson 2011) fully coordinated with the long-term marketing strategy for the wine production. Since the latter study defined the assortment characteristics as being more influential for the output generated, output-orientated TE was deemed more appropriate for the present study. The bootstrapping application was initiated to resolve the problem that the data-gathering process itself influences the validity of the estimated efficiency score and that the efficiency scores obtained with ordinary DEA have no statistical inference. With the bootstrapping application, both considerations were assumed to be solved. The procedure for non-parametric efficiency analysis with homogeneous bootstrapping application (Simar and Wilson 1998, 2000) was carried out in the following steps: In **Step 1**, the output-orientated TE scores, under the assumption of variable returns to scale (Banker et al. 1984) for each farm i were computed as (equation 1):

$$\max_{\hat{\phi}_i,\lambda} \hat{\phi}_i \quad \text{Subject to:} \tag{1}$$

$$-\hat{\phi}_i y_i + Y\lambda \geq 0,$$

$$x_i - X\lambda \geq 0,$$

$$N1'\lambda = 1$$

$$\lambda \geq 0$$

$$1 \leq \hat{\phi}_i < \infty$$

Where $\hat{\phi}_i$ is a scalar that measures the technical efficiency for each farm i; X and Y are matrices of the inputs and outputs of all farms in the observation N; $Y\lambda$ and $X\lambda$ are the efficient projections on the frontier; and $N1'\lambda = 1$ is a constraint for allowing variable returns to scale.

In **Step 2**, the estimated output-orientated technical efficiency scores $\hat{\phi}_i$, $i = 1, ...n$, or $\hat{\phi}_1 .....\hat{\phi}_n$, were bootstrapped, and thus random samples of size n, $\hat{\phi}^*_{1b}, ..., \hat{\phi}^*_{nb}$ were generated.

Step 3 involved re-sampling the ordinary efficiency scores and the original dataset, and thus a pseudo-dataset y^* and x^* was constructed for each i^{th} farm in the sample. For the output-orientated technical efficiency, the pseudo-dataset was: $x^*_{ib} = (\hat{\phi}_i/\hat{\phi}^*_{ib})x_i, i = 1, ...n$, and $y^*_i = y_i$.

In **Step 4**, the bootstrap estimates for the output-orientated technical efficiency $\hat{\phi}^*_{ib}$ of $\hat{\phi}_i$, for $i = 1, ...n$, were then solved by the technical efficiency equations (1).

In **Step 5** the procedures from Step 2 to Step 4 were repeated 2000 times, and provided a set of estimates $\hat{\phi}^*_{ib}$, b = 1...B; where B is the number of replications.

In **Step 6** the confidence intervals for the real efficiency scores ϕ_i were derived from the empirical distribution of the estimated pseudo-efficiency scores $\hat{\phi}^*_{1b}, ..., \hat{\phi}^*_{nb}$; $b = 1, ...B$, where $\hat{\phi}^*_{1b}, ..., \hat{\phi}^*_{nb}$; $b = 1, ...B$ was used for finding values of $\hat{a}_\alpha$ and $\hat{b}_\alpha$, such that:

$$\Pr(-a_\alpha \leq \hat{\phi}_i - \phi_i \leq -b_\alpha) = 1 - \alpha$$

is approximated. The procedure involved sorting the values of $(\hat{\phi}^*_{ib} - \hat{\phi}_i)$ for all $b = 1, ...B$, in decreasing order. The $(\alpha/2 * 100)$ per cent of elements was deleted at both ends of the sorted list, whereas $-\hat{a}_\alpha$ and $-\hat{b}_\alpha$ were found at the truncated endpoints of the list with $\hat{a}_\alpha \leq \hat{b}_\alpha$. The percentage confidence interval for the efficiency $(1 - \alpha)$ of the i^{th} farmer is:

$$\hat{\phi}_i + \hat{a}_\alpha \leq \hat{\phi}_i + \hat{b}_\alpha$$

In the second stage, the influence of product assortment on the output-orientated technical efficiency values obtained was analysed. Four models were tested. Tobit (Table 12.3) and truncation regression (Table 12.4) were applied. In the existing efficiency studies where Tobit regression is applied in the second stage, efficiency scores are characterised as by definition being censored at 1, which Simar and Wilson (2008) criticise as a 'nonsense' and claim that the second stage involves a truncated rather than a censored error term. In the models presented in this study, the Tobit and the truncation regression assessed the relationship between both the ordinary DEA output-orientated efficiency scores (in Model 1 and Model 3 respectively) and the bias-corrected output-orientated technical efficiency scores (Model 2 and Model 4) as a dependent variable and a vector of assortment characteristics (as independent variables), expected to influence farm efficiency. In

Model 2 and Model 4, bias-corrected bootstrapped standard errors derived with regular bootstrapping in STATA were used (Manevska-Tasevska and Hansson 2011). In particular, the second bootstrapping is proposed for corrections of regression results that are assumed to be biased, in cases where a high correlation between the first-stage and second-stage variables exists. This implies heteroscedasticity in the regression analysis, with error terms correlated with the independent variables. Double-bootstrapping purposely designed for non-parametric analysis (Simar and Wilson 2007) is an alternative option for such analysis; it involves application of a bootstrapping procedure for non-parametric analysis in both the first and the second stage of the analysis. Model 2 and Model 4 do not follow the Simar and Wilson (2007) double-bootstrapping procedure, but as it uses heteroscedasticity-corrected standard deviations it is assumed to solve the heteroscedasticity problem (Manevska-Tasevska and Hansson 2011). The bootstrapping promotion (Simar and Wilson 1998, 2000, 2007) has provoked many empirical comparisons of the results obtained with the common two-stage (Coelli et al. 2005) and bootstrap two-stage approach. Yet, apart from the bias-corrected technical efficiency scores (which are obtained in the first bootstrapping procedure) being lower than the ordinary DEA estimates, substantial differences in the sign and the statistical significance of the estimated regression coefficient have not been found (for example Afonso and St. Aubyn 2006; Larsén 2010; Latruffe et al. 2008; Manevska-Tasevska and Hansson 2011).

12.4 Data and variables

A survey conducted via face-to face interviews at 300 grape-growing family farms in the Tikvevs vineyard district of Macedonia provided a panel dataset for three production years (2006–2008). Each production year corresponded to a calendar year, from 01 January to 31 December. Data gathering was performed in two periods (June 2007, and January/February 2008) by six local survey-trained interviewers. As an official register of grape growers was not available, a random sampling method was not possible; sampling was therefore undertaken by a combination of purpose-based and quota-sampling methods, where each interviewer was responsible for establishing contact and collecting data directly from 50 farms. Participation in the survey was limited to commercial grape-growing family farms with a production area above 0.3 ha, and a willingness to participate and provide data for the whole survey period (2006–2008). In Macedonia, grape-growing family farms produce 70 per cent of the total grape production (SSO 2007), and the Tikvevs Vineyard District is one of the most important grape production regions for quality wines. All the farms surveyed specialised in grape production, with on average 3.2 grape varieties on the farm. According to the dataset, regional/local wine varieties were planted on 67.6 per cent of the total grape-growing area. Recognised European wine varieties were grown on 22.7 per cent of the total grape-growing area, and table grape varieties on 7.6 per cent. The traditional regional variety, Vranec, was planted on 25 per cent of the total area, but Stanusina only on 1.4 per cent. Both these varieties are highly recommended by local experts (Z. Bozinovski, personal communication 2011) and according to expert recommendations should cover 60 per cent of the wine grape area in total. In particular, it is recommended that Vranec be cultivated on 50 per cent of the wine grape area, thus to become the leading wine grape variety for the production of high-quality wines. At national level, wine grapes are planted on 87 per cent of the total vineyard area, and table grape varieties on the remaining 13 per cent (SSO 2007).

One output and four input variables were used for the calculation of the output-orientated technical efficiency scores, while four assortment variables were expected to explain the farm efficiency. Many other variables associated with the farm and farmer characteristics can influence efficiency, but such variables were outside the scope of this study. Descriptive statistics for the dataset analysed are presented in Table 12.1.

Although the survey provided a panel dataset for three production years, all variables were represented as a mean value for 2006 to 2008. For the efficiency analysis, mean revenue (MReven) expressed in Euro and normalised per hectare was used as an output variable. Mean cost for materials (MMaterials), mean cost for hired labour (MLabour) and mean cost for energy and services (MEnSe), all in Euro per hectare, and the mean total area in hectares were used as input variables. The assortment characteristics expected to influence the technical efficiency scores were represented by two sets of variables. The first set explained the assortment consistency/product function framework assortment dimension and contained three variables, all given as mean revenue in Euro per hectare: regional/local wine grape varieties (RRegLoc), European wine grape varieties (REurop) and table grape varieties (RTable). The second set explained the assortment size and was represented by the average number of varieties per farm (N^{o}Varieties). As can be seen in Table 12.1, the highest maximum achieved output recorded was from the regional/local wine grape varieties, while the highest mean revenue value was obtained from the table grape varieties. While encouraging in terms of farm success, such figures do not provide information on input use efficiency, and thus further analysis is necessary. The maximum number of grape varieties per farm was nine, which is far above the mean (3.2, standard deviation 1.5). As higher assortment size requires a higher degree of knowledge, a negative influence was an expected outcome. The correlation matrix for the grape assortment characteristics is presented in Table 12.2.

A rather high negative correlation was found between the share of regional/local (SRegLoc) and European wine grape varieties (SEurop), and a moderate negative correlation between the share of regional/local (SRegLog) and table grape varieties (STable), which is understandable, since if one increases the other decreases. In the model (second-stage analysis),

Table 12.2 Correlation matrix: grape assortment characteristics

	SRegLoc	RRegLoc	SEurop	REurop	STable	RTable	N^{O}Varieties
SRegLoc	1.0000						
RRegLoc	0.0947	1.0000					
SEurop	−0.6375	−0.1187	1.0000				
REurop	−0.1908	0.1445	0.0847	1.0000			
Stable	−0.4761	−0.0402	−0.3347	0.0966	1.0000		
RTable	0.1319	0.4146	−0.2892	0.0252	0.0795	1.0000	
N^{o}Varieties	−0.1279	−0.1727	0.0805	−0.0884	−0.0360	0.2924	1.0000

this was the reason why different grape varieties were not represented with such index numbers, as proposed by Coelli and Fleming (2004) and were not part of the regression analysis. A moderate positive correlation also existed between the revenue obtained from the regional/local wine grape varieties (RRegLoc) and the table grape varieties (RTable). Weak evidence for the correlation existed between the number of grape varieties on the farm, the farm revenue obtained from different grape groups and the proportion of different groups. In particular, Table 12.2 shows that higher revenue is obtained from regional/local wine grape varieties and European wine grape varieties if fewer grape varieties are grown on the farm, whereas the opposite applies for table grape varieties. As the proportion of table grape varieties and regional/local wine grape varieties increases, the mean number of varieties per farm decreases. Less specialised farms have a higher proportion of European grape wine varieties. Table 12.2 suggests that better results in terms of higher mean revenue per hectare can be obtained if table grape production consists of more grape varieties. From a technological perspective, this means that such production can ensure grape supply for the longer consumption period, whereas wine grape production, for both European and regional/local wine grape varieties, should tend towards specialisation. Mixed production of table and regional/local wine grape varieties is also profitable.

12.5 Results

For the period 2006 to 2008, the average ordinary DEA output-orientated technical efficiency score for the grape-growing family farms analysed here was 53 per cent, while the bias-corrected technical efficiency score was 39 per cent. The 95 per cent confidence intervals of the bias-corrected technical efficiency score ranged between 0.365 and 0.458. An influence of grape assortment on the output-orientated technical efficiency scores obtained was detected. The results of the regression analysis are presented in Table 12.3 and Table 12.4.

Table 12.3 Tobit regression analysis: Ordinary DEA and bias-corrected technical efficiency (TE) scores regressed on selected assortment characteristics

Assortment characteristics	Model 1: Ordinary DEA TE		Model 2: Bias-corrected TE*	
	Coef (Std err)	P>t	Coef (Boot Std Err)	P>z
Regional/local wine grape varieties	.000015 (5.75e-06)	0.013[b]	.000011 (4.93e-06)	0.028[b]
European wine grape varieties	5.84e-07 (1.60e-06)	0.718	1.11e-06 (2.88e-06)	0.699
Table grape varieties	5.77e-06 (2.04e-06)	0.007[a]	5.64-06 (1.80e-06)	0.002[a]
No. of varieties on the farm	−.028702 (.016231)	0.085[c]	−0.31 (0.145593)	0.033[b]
Constant	.2615623 (.130099)	0.052[c]	.185625(.1353232)	0.170
Sigma	.144556 (.016610)		.1367248 (.0198271)	
McKelvey & Zavoinas R2		0.451	0.418	

Notes: **(a)** statistically significant at 1%, (**b)** statistically significant at 5%, **(c)** statistically significant at 10%.

* In the regression Model 2, 2000 bootstrapping replications were used.

Table 12.4 Truncated regression analysis: ordinary DEA and bias-corrected technical efficiency (TE) scores regressed on selected assortment characteristics

Assortment characteristics	Model 1: ordinary DEA TE		Model 2: bias-corrected TE*	
	Coef (Std. err)	P>t	Coef (Boot Std. Err)	P>z
Regional/local wine grape varieties	.000014 (5.46e-06)	0.009[a]	.000011 (5.09e-06)	0.033[b]
European wine grape varieties	4.18e-07 (1.53e-06)	0.784	1.11e-06 (2.75e-06)	0.686
Table grape varieties	5.58e-06 (1.94e-06)	0.004[a]	5.64-06 (1.73e-06)	0.001[a]
No. of varieties on the farm	−.029083 (.0155292)	0.061[c]	−0.31 (0.146643)	0.035[b]
Constant	.2824952 (.1226453)	0.021[b]	.185625 (.1345584)	0.168
Sigma	.1384419 (.0152883)	0.000[a]	.1367248 (.0210436)	0.000[a]

Notes: **[a]** statistically significant at 1%, **[b]** statistically significant at 5%, **[c]** statistically significant at 10%,

* In the regression Model 2, 2000 bootstrapping replications were used

The results allow empirical comparisons of the outcomes obtained with the common two-stage (Coelli et al. 2005) vs. the bootstrap two-stage approach and Tobit vs. truncated regression. In all models (Model 1 to Model 4), similar results with respect to the sign and the statistical significance of the explanatory variables were obtained, as also reported in recent studies

(Afonso and St. Aubyn 2006; Larsén 2010; Latruffe et al. 2008; Manevska-Tasevska and Hansson 2011). A statistically significant positive influence was obtained from the regional/local wine grape varieties and table grape varieties. European wine grape varieties had a positive but statistically non-significant influence. The number of varieties per farm had a statistically significant negative influence. Statistical significance of the constant was obtained with Model 1 and Model 3. The goodness of fit analysis is presented by McKelvey and Zavoina's R2, which gave a value of 0.451 for Model 1 and 0.418 for Model 2.

12.6 Discussion and conclusions

The results revealed that there is potential for a 47 per cent (61% when bootstrapped standard errors in the regression analysis were used) increase in average revenue on the farms analysed here if farmers could manage to organise their production more efficiently. Assortment characteristics have been pointed out as a possible solution for better output (Manevska-Tasevska and Hansson 2011), and have also been shown to be influential for farm efficiency (Haji 2007). As expected, a statistically significant positive influence on technical farm efficiency was obtained from the regional/local wine grape varieties, and for the table grape varieties. Macedonian grape growers apply the same production practices for the regional/local and the European wine grape varieties, even though the biological and technological characteristics of these groups differ. European wine grape varieties could probably be more beneficial for the efficiency results if know-how and competence-based knowledge could be delivered; the assortment size proved to have a negative influence on technical efficiency. However, a conflicting finding was made in the correlation matrix (Table 12.2), where a rather moderate positive correlation was found for the assortment size and the revenue obtained from table grapes. The economic size of farms has also been found to be positively related to farm efficiency (Carvahlo et al. 2008; Henriques et al. 2009; Latruffe et al. 2005; Manevska-Tasevska and Hansson 2011). This study analysed grape production in three groups (regional/local wine grape varieties, European wine grape varieties and table grape varieties). More accurate and policy-relevant data support on the influence of grape assortment on farm efficiency could be obtained if three different analyses were conducted for farms specialising in these three groups of grape varieties.

From a farmer's perspective, growing an additional crop and thus higher diversification is often seen as a way to reduce risk when unexpected conditions arise. However, this requires more knowledge, for both production and managerial practices. There is currently no consensus regarding the influence of product differentiation on farm efficiency. It has been variously reported to be a restraining factor (Bojnec and Latruffe 2009; Haji 2007; Llewelyn and Williams 1996) or beneficial for farm efficiency (Brümmer 2001; Coelli and

Fleming 2004). Coelli and Fleming (2004) argue that smallholders may benefit from the flexibility in production operations, while Brümmer (2001) found a positive impact of diversification on farm efficiency in Slovenia. Another study on Slovenian farms (Bojnec and Latruffe 2009) found that the benefits of specialisation outweigh the issue of harvest risk. Llewelyn and Williams (1996) argue that proposed government policies that encourage diversification of cropping practices in Java may decrease technical efficiency, but emphasise that the situation may change if farmers improve their ability to grow new crops. For the vegetable-dominated producers in Ethiopia, a negative influence of crop diversification has been reported for allocative and economic efficiency (Haji 2007). The result obtained in this study is in line with the proposal offered by the Macedonian winemaking companies that prioritise specialisation and suggest the regional wine grape Vranec become the national choice for wine grape production.

Changes to grape assortment need to be introduced in a gradual manner that will allow time for the acquisition of the knowledge necessary for the newly planted varieties, as well as for a regular transformation process of the grape and wine production where the adaptive generalisation will be organised along with the adaptive specialisation (Chakravarthy 1986). Adaptive generalisation does not necessarily imply taking steps for changes in technical aspects, since the net surplus gained by adaptive specialisation can also be invested in managerial capacity, reduction of resource dependence etc. (Chakravarthy 1986). Rural development involves a recontextualisation (Ventura and Milone 2000), and it should be performed after extensive consultation and discussion between government authorities, as the main financier of the intervention, and grape and wine specialists. The organisation of product assortment must also match production capacity and organisational technologies (Ventura and Milone 2000). Mantrala et al. (2009) view product assortment planning as a trade-off between consumer preferences, producer constraints, environmental factors and organisation. In this study, the influence of assortment on farm technical efficiency was analysed from the producer perspective. However, as Macedonian viticulture is industry-orientated, the buyer perspective must also be considered; further research in that direction is necessary.

To conclude, restructuring of the Macedonian viticulture assortment is one of the high-priority interventions for increasing the competitiveness of the grape and wine sector. This analysis of current farm technical efficiency showed huge potential for improvements in competitiveness. According to these findings, the ongoing revitalisation and investments in grape assortment should primarily be directed towards regionally recognised wine grape and table grape varieties; grape variety diversification is generally not recommended. The result supports the suggestions presented by the Macedonian scientific professionals and the winemaking practitioners, which recommend old plantations be predominantly replaced with recognised regional/local wine grape varieties and table grape varieties, thus the wine industry be oriented towards brand development from a grape assortment that corresponds with the local resources and conditions and gives high-quality wines.

Notes

This research was funded by the Swedish International Development Agency (SIDA) which is gratefully acknowledged. The author thanks the Professor Bo Öhlmer, Professor Yves Surry, Associate Professor Helena Hansson, Associate Professor Aleksandra Martinovska-Stojceska and Staffan Waldo PhD, for their comments and suggestions on the earlier drafts of the manuscript and to the National Agency for Rural Development in Negotino, Macedonia, and to farmers and interviewers for their participation in the research.

1. Republic of Macedonia is a constitutional name of the country provisionally referred to within the United Nations system as 'the former Yugoslav Republic of Macedonia' (UNSC Resolution 817/1993).
2. Personal communication: Professor Zvonimir Bozinovski at the Department for Viticulture and Wine Production, Faculty for Agricultural Sciences and Food – Skopje, University St Cyril and Methodius. What is the most appropriate assortment for the viticulture in the Republic of Macedonia. 15 March 2011, Skopje R. Macedonia.

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13

Determinants of Wine-Bottling Strategic Decisions: Empirical Evidence from the Italian Wine Industry

Giulio Malorgio, Cristina Grazia, Francesco Caracciolo and Carla De Rosa

13.1 Introduction

Multiple factors contribute to creating and maintaining a competitive advantage in the current world wine market: firm size and, more generally, the financial capacity to undertake long-term quality investments (equipment, technologies, innovation, R&D etc.), the possibility to exploit scale and scope economies in production and sales activities, the strategic flexibility to adapt volumes and product range to changing market conditions, and product quality and quality differentiation (and signalisation) strategies either through individual or collective brands. In this setting, the recent European CMO (Common Market Organisation) wine reform aims at improving the competitiveness of the EU wine sector, encouraging structural adjustments, modernisation of vineyards, greater cost-effectiveness and market orientation of wine production (EC 2007). Moreover, a strong information and promotion policy aims at improving the image of EU wines and 'exploiting the new opportunities provided by the emerging markets'.

Quality differentiation plays a crucial role in shaping firms' strategies, based either on individual brands or on collective initiatives such as Designations of Origin.[1] Two contrasting quality-differentiation strategies – the brand strategy and the Designation of Origin strategy[2] – shape the world wine market, reflecting different structural and organisational firm characteristics, and 'stylise' the traditional 'New–Old World' dichotomy. The brand strategy consists in an individual quality differentiation strategy that relies on the firm's individual reputation. Brand development implies long-term investments in production/processing/bottling and marketing/promotion activities, as well as additional costs related to procurement strategies (supplier selection, contract negotiation, upstream quality control etc.). High volumes and the breadth of product range improve the strategic flexibility and enable firms to adapt quickly to changing market conditions. Scale and scope economies and a quality differentiation strategy based on individual brands are the main sources of competitive advantage. The Designation of Origin strategy, however, represents a collective quality-differentiation strategy that may imply a long-term quantity/quality commitment for the firm (for example delimited production area, maximum yields per hectare, maximum yield of wine from grapes, minimum density of rootstocks per hectare etc.), while giving access to a collective reputation and to related market opportunities (Chambolle and Giraud-Héraud 2005).

The wine system has often been represented as a 'quality pyramid' (Fregoni 1994) where wines are ranked according to an increasing degree of stringency of production norms.[3] Wines are classified as: table wines; table wines designated with a geographical indication (IGT in Italy); and quality wines produced in specified regions (DOC and DOCG in Italy). In the reminder of the chapter, as regards the Italian system and for a better readability, we refer to "GI wines" as the entire set of DOC/DOCG and IGT wines. On the one hand, committing to a DOC/DOCG system requires compliance with relatively more stringent production requirements with respect to IGT. More specifically, firms adhering to the system are likely to pre-commit output levels (delimited production area, maximum yields per hectare, maximum yield of wine from grapes, minimum density of rootstocks per hectare etc). In an uncertain environment volume pre-commitment may result in a loss of volume-strategic flexibility (Giraud-Héraud and Grazia 2008; Spencer and Brander 1992). On the other hand, the specific product and process standards confer specific quality characteristics on wines belonging to a given DOC/DOCG, substantially differentiate each DOC/DOCG from the others, and build the DOC/DOCG collective reputation (Giraud-Héraud et al. 1998) that gives access to a potential premium price on the final market based on consumers' willingness to pay for GI wines (Hertzberg and Malorgio, 2008).[4] DOC/DOCG wines are thus likely to be associated with low-volume / medium–high-price strategies or, in some cases, to 'niche' strategies (consider for example the high-premium wines Bolgheri Sassicaia DOC in Tuscany or Barolo DOCG in Piedmont). In contrast, IGT is relatively less stringent and allows for a greater volume flexibility. Indeed, as noted by Pomarici and Sardone (2009), Italian firms have profited from the 'flexibility' of IGT norms by selling high volumes of low–medium-priced wines without having to commit to the more stringent DOC/DOCG norms. It is worthy to notice that *premium wines* have also been developed relying on well-known individual brands and often based on the (more flexible) IGT system.[5] Given these premises, the Italian wine industry that operates within the GI system can be seen as characterised by several 'wine worlds': vertically integrated DOC/DOCG-specialised 'low-volume' firms coexist with a relatively low number of industrial wineries that 'dominate' much of the marketed volume, relying both on the DOC/DOCG and on the IGT system (the latter contributing mostly to the total volume), wide (IGT) product ranges, sourcing from multiple production areas and also developing well-known brands (Malorgio et al. 2011).

The aim of this chapter is to investigate the determinants of wineries' strategic decisions concerning the bottling of GI wines (investments in the bottling activity, choice of product range, and marketed volumes). Starting from a dataset covering the whole population of Italian wineries that processed wine in 2008, we have firstly estimated a sequential probit model to characterise wineries' long- and short-term strategies. More specifically, the aim is to investigate the determinants of wineries' long-term strategic decisions to develop a commercialisation strategy to the final market (that is, investments in the bottling activity). We then further investigated short-term strategic choices of the quantity of wine to bottle and commercialise on the final market, applying the Heckman two-step estimator. Looking more closely at the short-term strategic decision, we investigated the role of multiple factors likely to shape quantity choice: the winery's structural and organisational characteristics (size, juridical status, types of vertical relationship between the vine-growing and the wine-processing stages), characteristics of procurement (number of suppliers and geographical areas covered), and of the territory where the winery is located. In addition, we considered the incidence of the DOC/DOCG on both the total wine processed and on the product range chosen in the long term, and investigated how adhesion to the DOC/DOCG system shapes wineries' short-term strategic choice of quantity.

13.2 Conceptual framework

Winery strategies comprise several strategic decisions: breadth of product portfolio, export orientation, alignment with competitors, and price/quantity (Santini and Cavicchi 2010). We distinguished between long- and short-term strategic choices, and hypothesised that wineries choose quality strategy (product range) in the long term and (bottled) quantity in the short term. Hence, focusing on GI wine-bottling decisions, we investigated the role of winery size, procurement characteristics, winery location, and product range chosen in the long-term on a winery's short-term strategic choice of quantity. This section provides a brief overview of the role of these factors in winery bottling decisions.

Size of the processing activity

A first factor that may influence the bottled quantity is winery size. Large wineries are expected to have more financial and human resources than smaller ones and to benefit from scale and learning economies that may facilitate investments in innovation, quality and advertising campaigns as well as highly responsive strategies to changes in customer demand (Taplin and Breckenridge 2008; Gilinsky et al. 2001; Fombrun and Shanley 1990). Large wineries are thus expected to have a higher investment capacity than smaller ones. This may facilitate the development of commercialisation strategies on the final market.

A number of variables have been used in the literature to measure firm size, including average assets, number of employees, average sales (Leiblein and Miller 2003; Pisano 1990), capacity (Fernández-Olmos et al. 2009; Ohanian 1994; Dillon et al. 1992), and capacity converted to cases (Folwell and Volanti 2003; Folwell et al. 2001; Dillon et al. 1994 a, b). As for Italian wineries, most of them (88.9 percent) have only one processing plant, with an average production of 2936 hectolitres; only 0.08 per cent of wineries have more than four plants, with an average production per winery of 209,387 hectolitres.[6] The number of processing plants, together with the total wine production, may represent a good proxy of the size of the processing activity.

Characteristics of procurement (grape sourcing)

We consider the role of the procurement characteristics, notably the number of upstream suppliers and the number of geographical production areas from which wineries source their inputs. Notably, we assume that the higher the number of suppliers and/or the number of geographical areas from which wineries source inputs (for example grapes), the higher wineries' mix flexibility. At a broad level, flexibility contributes to the firm's ability to absorb (or even benefit from) variations in its environment. In the spirit of Carlsson's (1989) definition of strategic flexibility, relating to 'how the firm is positioning itself with respect to future challenges and opportunities', we consider that sourcing from multiple suppliers *and* multiple geographical production zones is likely to increase a winery's *strategic flexibility*, notably the so-called 'mix flexibility', the ability to change output qualitatively.[7] Mix flexibility can lead to economies of scope (Gimeno and Woo 1999; Panzar and Willig 1981; Willig 1979) and thus to an increase of the bottled quantity.

In addition, given the fragmentation of the Italian vine-growing stage,[8] it is plausible to assume that a winery that wants to increase volumes has to increase the number of its suppliers. A positive relationship is thus expected between the number of suppliers and bottled volumes. In addition, sourcing from multiple suppliers also increases the 'substitutability' among them and may increase horizontal competition upstream, thus resulting in a higher bargaining power for the winery (see for example Redondo and Fierro 2007).

Characteristics of the territory where the winery is located

A winery's strategic choice of quantity may also be affected by the characteristics of the territory where the winery is located, notably by the incidence of GI on total wine production in a given geographical area. This indicator may be used to measure the 'GI orientation' of a given geographical area. We assume that the higher the proportion of GI production in a given area, the more this zone is perceived by consumers as a GI area. Assuming that 'countries, regions, places and other geographical entities' behave rather like brands (Orth et al. 2005) and in the vein of the literature on brand (here, region) equity (Keller 1993), GI perception constitutes one of the elements that build brand (region) knowledge and thus the potential 'differential effect' on consumers. Does GI orientation of the territory influence individual quantity strategies on the final market?[9] Here, we investigate whether higher levels of GI orientation of the territory where the winery is located affect a winery's quantity decisions.

Strategic flexibility

Lastly, long-term quality strategies may influence the short-term strategic choice of quantity. We focus here on the role of the long-term strategic choice of product range, and namely on the relative importance of DOC/DOCG (with respect to IGT) on total product range.

Hence, we raise the question of whether compliance with the DOC/DOCG system constitutes a volume constraint for the firm; or, equivalently, whether compliance with the IGT system allows for greater volume flexibility. As noted in the Introduction, compliance with the DOC/DOCG system implies several types of quantity restrictions on the firms (for example delimited production area, maximum yields per hectare, maximum yield of wine from grapes, minimum density of rootstocks per hectare etc.) and thus is likely to negatively affect volumes.

In the vein of the pre-commitment and flexibility literature (see for example Boyer and Moreaux 1995; Spencer and Brander 1992; Boyer and Moreaux 1989), adhesion to a DOC/DOCG system may be interpreted as an output *pre-commitment* in an uncertain environment (Giraud-Héraud and Grazia 2008), whilst IGT constitutes a more flexible system, since the associated production requirements are less stringent. As uncertainty and/or the expected market size becomes more important, the relative value of pre-commitment falls, and may turn negative (Boyer and Moreaux 1995). That is the reason why firms may have an incentive to choose IGT rather than DOC/DOCG in order to exploit IGT's higher flexibility (Giraud-Héraud and Grazia 2008). As for the Italian market, as argued by Pomarici and Sardone (2009) Italian firms may turn to IGT in order to benefit from the flexibility of IGT norms, either to sell high volumes of low–medium-priced wines[10] or to develop premium wines based on well-known individual brands (such as Super Tuscan IGT wines), without having to commit to the more stringent DOC or DOCG norms.

These premises may explain the reasons why the Italian DOC/DOCG potential does not necessarily correspond to what is effectively produced and commercialised. At an aggregated level, this is shown by the gap that exists in Italy between the DOC/DOCG potential production, the effective (or declared) production and the bottled (and certified) production (see for example, Unioncamere 2009). This shows that the DOC/DOCG potential may be partially turned to other wine's typologies (either IGT or table wines), according to market opportunities.

13.3 Data, variables and model specification

The above hypotheses were tested on data concerning the *entire population* of Italian wineries that processed GI wine in the year 2008. The analysis was conducted at firm level, and the analysis unit was the 'winery', defined as a (wine-processing) firm that produced (and declared) GI wines in the year covered by the study (2008). This section outlines the definition of wineries' strategic decisions, model specifications, data sources and variables.

Wineries' strategic decisions

Wineries' strategic decisions may be represented through the following two-stage decisional process.

We consider that in the long term a GI wine-processing winery decides whether or not to invest in GI wine-bottling activity. This strategic choice implies undertaking investments in bottling plants and equipment. In addition, in the specific case of DOC/DOCG, this strategy requires compliance with specific requirements pertaining, in addition to the vine-growing and wine-processing stages, to the bottling stage.[11] Moreover, the decision to invest in the bottling activity generates collateral decisions pertaining more in general to the commercialisation strategy on the final market.[12] Simultaneously, the winery chooses the potential GI product range, that is the GIs that it plans to bottle. Notably, the long-term decision corresponds to the 'registration' of at least one bottling plant in the Italian registry of GI wine bottlers, with the specification of the GIs that could be (potentially) bottled. The potential product range does not, however, necessarily correspond with the GIs that the winery effectively chooses to bottle in the short term.

In the short term, the winery that has chosen to invest in the GI wine bottling activity chooses the quantity to bottle and sell on the final market and, simultaneously, its effective product range, that is the GIs that it will effectively bottle (among the registered GIs). The short-term strategic decision corresponds to the winery's declaration of the bottled quantity (for each effectively bottled GI).

Model specification

a) Sequential probit

We assumed that wineries face strategic choices sequentially over time. Furthermore, we assumed that the observable characteristics of the wineries influence their strategic choices in terms of the probability that they will adopt short- or long-term strategies. Because we are investigating choices, a qualitative dependent variable approach is suggested.

Considering a sample of n observations indexed by i, the outcome $\{y_i\}$of the decision process is a qualitative random variable taking, in the case presented, three levels: 1, 2 and 3.

As previously anticipated, the wineries' behavioural process determining the choices is made sequentially: the *i-th* winery chooses firstly a long-term quality strategy, that is whether to invest in the bottling activity (and choose the potential product range) ($y_i \neq 1$) or not ($y_i = 1$). Then, given $y_i \neq 1$ the winery successively determines in the short term whether to bottle ($y_i = 3$) or not ($y_i = 2$). If we denote n_j the number of wineries observed at each level j, the total number of observations n is equal to $n_1 + n_2 + n_3$.

From an empirical point of view, following Amemiya (1985) and Maddala (1983), we assume that the two choices described – long-term (L) and short-term (S) – are made according to two different binary models. Two latent stochastic variables, L^* and S^*, are defined: they capture the propensity of the wineries to follow the long term and the short term strategies. We do not observe latent variables L^* and S^*, but instead two dichotomous variables showing the wineries' long-term and the short-term choices:

$$\mathrm{L}_i = \begin{cases} 1 & \mathit{if}\, L_i^* \quad > 0 \\ 0 & \mathit{if}\, L_i^* \quad \leq 0 \end{cases} \quad \text{and} \quad \mathrm{S}_i = \begin{cases} 1 & \mathit{if} \quad S_i^* > 0 \\ 0 & \mathit{if} \quad S_i^* \leq 0 \end{cases} \tag{1}$$

We can reformulate the outcome as follows: for $y_i = \mathbf{1}$, we observe only the first choice $L_i = 0$; for $y_i = \mathbf{2}$, we observe the first choice, $L_i = 1$ and the second choice, $S_i = 0$. For $y_i = \mathbf{3}$, lastly we observe $L_i = 1$, $S_i = 1$.

The propensity that a winery follows a strategy depends on a set of explanatory variables and unobserved variables:

$$L_i^* = \mathrm{x'}_{1i}\beta_1 + u_{1i} \quad i = 1, 2, \ldots, n_1 + n_2 + n_3. \tag{2}$$

$$\mathrm{S}_i^* = \mathrm{x'}_{2i}\beta_2 + \mathrm{u}_{2i} \quad \mathrm{i} = 1, 2, \ldots, n_2 + n_3. \tag{3}$$

where x_{1i} and x_{2i} are respectively k_1 and k_2 vectors of known constants, and β_1 and β_2 are respectively k_1 and k_2 vectors of unknown parameters, and the error terms follow a bivariate normal distribution: $\begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$~N($\mathbf{0}$, Σ) where $\Sigma = \begin{bmatrix} 1 & \cdot \\ \rho & 1 \end{bmatrix}$.

Van de Ven and Van Pragg (1981) describe this model in greater detail: in our case the null hypothesis of independence of errors (H_0: $\rho = 0$) cannot be rejected by performing a likelihood ratio test on the errors covariance.[13] Therefore, assuming that random factors influencing the choices at the two stages are independent ($\rho = 0$), we can specify the probabilities sequentially as:

$$\begin{aligned}
&P(y_i = \mathbf{1}) = 1 - F(x'_{1i}\beta_1) \\
&P(y_i = \mathbf{2}) = F(x'_{1i}\beta_1)[1 - F(x'_{2i}\beta_2)] \qquad (4) \\
&P(y_i = \mathbf{3}) = F(x'_{1i}\beta_1)F(x'_{2i}\beta_2) \quad i = 1, 2, \ldots, n_1 + n_2 + n_3 \\
&\text{and } F(\theta) = \Phi(\theta) \equiv \int_{-\infty}^{\theta} \frac{1}{\sqrt{2\pi}} e^{[-(t^2/2)]} dt
\end{aligned}$$

The probit sequential model described above is particularly attractive because of its computational simplicity: the log-likelihood function for the sample uses the following structure:

$$\begin{aligned}
Loglike = \sum_i \{ & L_i S_i \ln\left[F(x'_{2i}\beta_2)F(x'_{1i}\beta_1)\right] \\
& + L_i(1 - S_i)\ln\left[F\left(x'_{1i}\beta_1\right)[1 - F(x'_{2i}\beta_2)]\right] \qquad (5) \\
& + (1 - L_i)ln[1 - F(x'_{1i}\beta_1)]\} \quad i = 1, 2, \ldots, n_1 + n_2 + n_3
\end{aligned}$$

This model fully explains the structure of the wineries' strategic decisions; a second, distinct, analysis will focus on the continuous short-term outcome conditional on the choices being observed.

b) Heckman two-step estimation

The second empirical analysis will investigate in greater depth the short-term strategy, using a two-step Heckman procedure (1979). Due the independence of long- and short-term strategies ($\rho = 0$), we focus only on the wineries that followed a long-term strategy to invest in wine-bottling activities ($L_i = 1$). (More specifically, the outcome of the wineries' short-term choice (Q_i^*), the quantity of wine to bottle, is observed only when a winery has followed a strategic choice to bottle $Si^* > 0$: formally, we can write the selection equation and the resultant outcome equation for Q^* as follows:

$$\begin{aligned}
&x'_{2i}\beta_2 + u_{2i} > 0 \quad i = 1, 2, \ldots, n_{2+}n_3 \\
&Q_i* = x'_{3i}\beta_3 + u_{3i} \quad i = 1, 2, \ldots, n_3 \qquad (6)
\end{aligned}$$

where $\begin{bmatrix} u_2 \\ u_3 \end{bmatrix} \sim N(\mathbf{0}, \Sigma)$ and $\Sigma = \begin{bmatrix} 1 & \cdot \\ \sigma_{32} & \sigma_3 \end{bmatrix}$

Assuming that the winery decision on the quantity to bottle is influenced by a set of k_3 explanatory variables x_3, we wish to estimate β_3 parameters, under sample selection, with a potential source of inconsistency, as:

$$E(Q_i|\mathbf{x_3}, Si^* > 0) = x'_{3i}\beta_3 + E(u_{3i}|Si^* > 0) \quad i = 1, 2, \ldots, n_3 \qquad (7)$$

Because error terms have a bivariate normal distribution, the expectation $E(u_{3i}|Si^* > 0)$ is equal to $\sigma_{32}\lambda_i(x'_{2i}\beta_2)$ where λ_i is known as the inverse of the Mills' ratio:

$$\lambda_i(x'_{2i}\beta_2) = \frac{\phi\left(x'_{2i}\beta_2\right)}{\Phi\left(x'_{2i}\beta_2\right)} \quad i = 1, 2, \ldots, n_3. \tag{8}$$

where $\phi(\cdot)$ is the PDF of the standard normal distribution.

Following Heckman (1979) a consistent estimation of β_3 and σ_{32} can be obtained by augmenting the outcome equation with the inverse of the Mills' ratio obtained from probit estimates of the selection equation as computed in the previous sequential model. In order to obtain a better identification of the Heckman model, we impose the exclusion restrictions as well.[14] The augmented equation was estimated by OLS using a log-linear functional form, while test statistics are based on a Huber-White Sandwich estimation of variance.

Data, variables, and hypothesis

Datasets and data sources

Two datasets were used. The first contains data on the vine-growing and wine-processing declarations by the entire population of Italian wineries. Data were provided by the Italian Agency for Disbursements in Agriculture (AGEA). Each winery was given a specific code enabling the winery's activity to be traced from the vine-growing to the wine-processing stage. This first database contains all the available data concerning the vine-growing and the wine-processing stage for each winery, including the quantity produced/processed, the number of processing plants, the number of grape suppliers, the winery's and suppliers' localities, and the typology of the wine processed (table wine, IGT, DOC or DOCG wines). By merging the data pertaining to the vine-growing and the wine-processing stage, we have classified wineries into three organisational typologies according to the degree of vertical relationship between the vine-growing and the wine-processing stages (see Malorgio et al. 2011):

(i) Vertically-integrated (or 'agricultural') wineries that operate at both the vine-growing and the wine-processing stage (wine production stems from both own-produced grapes and grapes acquired through market transactions);
(ii) Industrial wineries that solely undertake the wine-processing activity (the wine production stems entirely from grapes acquired through more or less contractualised market transactions);
(iii) Cooperatives that were identified according to their juridical status regardless of whether they produced grapes or not (wine production here stems from grapes conferred by associated growers, or partially acquired through market transactions).

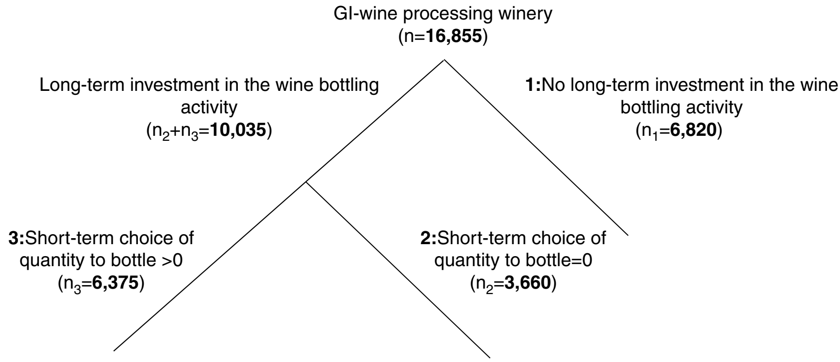

Figure 13.1 Winery's long-term and short-term strategic decisions

Source: Own elaborations on vine-growing/wine processing declarations dataset and bottling dataset.

A second database contains data from the GI wine bottling declarations by Italian firms that registered at least one bottling plant, whether or not they bottled in 2008. The data was provided by the Italian Union of Chambers of Commerce (Unioncamere/Infocamere). Each firm was given a specific code in the database. This database contains the wine typologies (IGT, DOC/DOCG) for each firm, the specific GIs chosen by the firm, and wine-bottling declarations (effectively bottled GIs with the respective bottled volumes).

The creation of a single database enabled us to track the '(long-term) investing winery' from the wine-processing to the wine-bottling stage.

Given the winery's sequential strategic decision and the model specification previously outlined, the two datasets were merged (at firm level), and GI wine-processing wineries were classified according to their strategic long-term and short-term strategic choices concerning the bottling strategies. Figure 13.1 below summarises the sequential decision process of the GI wine-processing winery. Out of the total number of GI wine-processing wineries (n=16,855), a first subset of wineries (n_1 =6820) did not registered any bottling plant, that is they did not undertake any investment in the bottling activity in the long term (they are thus included in the first, but not in the second, database). These wineries thus only sold wine in bulk on the spot market. A second subset, of 10,035 wineries, registered at least one bottling plant, that is they undertook investments in the bottling activity (thus were included in both databases), of which 3660 wineries (n_2) did not bottle and 6375 wineries (n_3) bottled a positive quantity of wine.

Finally, given the wineries' classification according to the degree of vertical relationships between the vine-growing, wine-processing, and bottling stages, and given the wineries' distribution according to their long-term and

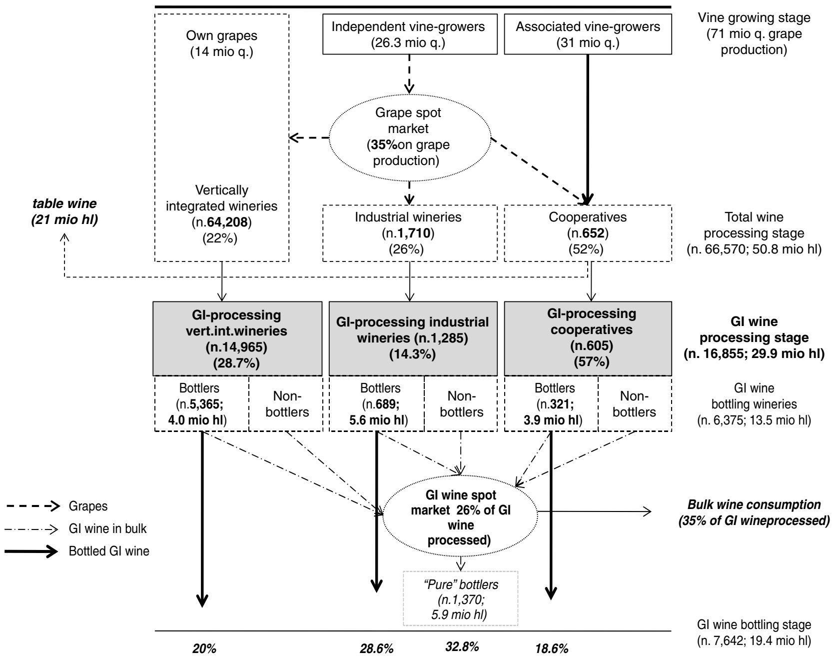

Figure 13.2 Italian wine supply chain structure and organization: actors and flows

Source: own elaborations on vine-growing/wine processing declarations dataset and bottling dataset.

short-term strategic decisions, it is possible to provide a synthetic representation of the Italian wine supply chain actors and flows (Figure 13.2). In 2008, the total number of wineries was 66,570, processing 50.8 million hectolitres, of which 52 per cent was processed by cooperatives, followed by industrial wineries (26%) and vertically-integrated wineries (22%). As previously mentioned, out of the total number of wineries, 16,855 processed 29.9 million hectolitres of GI wine in 2008 (whether or not exclusively). Looking more closely at the distribution of processed GI wine according to the winery's typology, the highest was obtained by cooperatives, followed by vertically-integrated wineries, and then industrial wineries. Given the sequential decisional process described above, the total amount of GI wine bottled by GI wine-processing wineries that chose strategy 3 (as reported in Figure 13.1) was 13.5 million hectolitres. Looking more closely at the distribution of bottled GI wine according to winery typology, the highest volume was bottled by industrial wineries, followed by vertically-integrated wineries and cooperatives.[15]

This representation also makes it possible to quantify the role of the intermediary spot markets of both grapes and GI wine, the latter accounting for

26 per cent of the total amount of GI wine processed in 2008 (Malorgio et al. 2011).

Variables and hypothesis

We considered that the long-term strategic decision to undertake investments in the bottling activity is affected by several categories of factor. First, we consider the size of the processing activity (number of processing plants and total wine produced) and other related structural and organisational characteristics of the winery, such as the winery's juridical status and the type of vertical relationship between the vine-growing and the wine-processing stage. Second, we take into account the role of the characteristics of procurement (number of grape suppliers and the geographical areas where the grapes are sourced), and the characteristics of the territory where the winery is located (incidence of GI on total wine production at province level, and location of the winery, whether in northern or in southern Italy). Finally, we consider the typologies of the wine processed.

In addition to these factors, the short-term strategic choice of the quantity to bottle is influenced by the potential product range chosen in the long term.

Given the theoretical background illustrated in Section 13.2, the following hypotheses were formulated pertaining to the influence of explanatory variables on the short-term strategic choice of quantity:

(i) *Size of the processing activity and other structural and organisational characteristics of the winery.* We hypothesise that the size of the processing activity positively influences the bottled quantity. We consider two indicators of a winery's size: the total quantity of wine processed (Tot wine prod) and the number of processing plants per winery (N_plants). Moreover, in order to further investigate the role of the size of the processing activity, we also consider the type of vertical relationship between the vine-growing and wine-processing stages and the winery's juridical status. First, relating to cooperatives and industrial wineries with relatively higher average processed volumes than vertically-integrated wineries, we hypothesised that being a cooperative (Cooperative) or an industrial winery (Industrial) positively affects bottled volumes. Second, we test the role of the juridical status of the winery by hypothesising that being a private company (Private company) positively affects investment capacities.[16]

(ii) *Characteristics of procurement (grape sourcing).* We hypothesise that both the number of upstream suppliers (N_suppliers) and the number of geographical production areas (N_geoareas) positively affect bottled volumes.

(iii) *Characteristics of the territory where the winery is located.* We hypothesised that the incidence of IGT and DOC/DOCG production on the total wine production at Province level (Igt_terroir and Docdocg_terroir, respectively) positively affect the GI bottled volumes. Moreover, in order to further investigate the role of the territory, we consider whether the winery is located in northern or southern Italy (North and South, respectively).

(iv) *Strategic flexibility.* As noted in Section 13.2, the aim here is to test whether adhesion to the DOC/DOCG system represents a quantity commitment for wineries (with respect to the IGT system). For this purpose, we defined a series of variables, and formulated a specific, related hypothesis. First, we consider the typologies of wine processed, notably the incidence of DOC/DOCG on the total volume of wine processed (Docdocg_vo), as well as the incidence of table wine (Vdt_vo). The DOC/DOCG rate on total wine production is interpreted here as an indicator of the degree of commitment undertaken by the winery at the processing stage. We thus expect that the DOC/DOCG rate on the total wine processed has a negative effect on bottled volumes. Second, we define a series of variables pertaining to the potential product range chosen in the long term, and formulate a specific hypothesis.

I. The DOC/DOCG or IGT (potential) product range is defined by the absolute number of DOC/DOCG or IGT registered by the winery in the long term (Docdocg_PR, Igt_PR, respectively).
II. The DOC/DOCG (or IGT) specialisation of the (potential) product range (Docdocg_spec, Igt_spec) is a dichotomic variable indicating whether the winery is specialised in DOC/DOCG (or IGT) or not. We expect the DOC/DOCG specialisation to negatively affect the bottled volumes.
III. The DOC/DOCG rate on the (potential) product range (Docdocg_rate_PR) represents the incidence of the (potential) number of DOC/DOCG on the total (potential) product range. This ratio represents a proxy of the level of commitment undertaken by a winery in the long term pertaining to the bottling activity. Therefore, higher values of this ratio may indicate higher compliance constraints. We thus hypothesised a negative effect on bottled quantity.

Table 13.1 below defines explanatory variables (and the related descriptive statistics) affecting long-term and short-term strategic decisions.

13.4 Results

Long-term strategic decisions

Before analysing the determinants of the strategic choice of quantity for wineries that have invested in bottling activities in the long term, we provide a brief overview on the factors affecting long-term strategic decisions to invest in the bottling activity. The results are illustrated in Table 13.2 below.

Table 13.1 Explanatory variables: long term and short-term strategic choice of quantity

Variable	Definition	Category	Mean	Std. Dev.
N_plants	Processing plants per winery (n)	Size of the processing activity and other structural and organisational characteristics of the winery	1.12	0.41
Tot. wine prod (ln)	Total wine processed by the winery		5.14	2.09
Private company	1 if the winery is a private company		0.28	0.45
Cooperative	1 if the winery is a cooperative		0.04	0.19
Industrial	1 if the winery is an industrial winery		0.08	0.27
N_suppliers	Suppliers per winery (n)	Characteristics of the procurement (grape sourcing)	4.68	20.05
N_geoareas	Geographical areas from which the winery sources grapes (n)		0.24	1.05
Igt_terroir	IGT production on total wine production at Province level	Characteristics of the territory where the winery is located	0.51	0.26
Docdocg_terroir	DOC/DOCG production on total wine production at Province level		0.31	0.23
South	1 if the winery is located in Southern Italy		0.11	0.32
North	1 if the winery is located in Northern Italy		0.46	0.50

Continued

Table 13.1 Continued

Variable	Definition	Category	Mean	Std. Dev.
Vdt_vo	Incidence of table wine on total wine processed (%)		0.10	0.20
Docdocg_vo	Incidence of DOC/DOCG wine on total wine processed (%)		0.56	0.41
Docdocg_PR	DOC/DOCG (potential) product range or absolute number of DOC/DOCG (n)	Strategic flexibility: typologies of wine processed and product range	2.42	8.99
Igt_PR	IGT (potential) product range or absolute number of IGT (n)		0.95	2.99
Docdocg_spec	DOC/DOCG specialisation of (potential) product range (0/1)		0.11	0.31
Igt_spec	IGT specialisation of (potential) product range (0/1)		0.06	0.24
Docdocg_rate_PR	DOC/DOCG incidence on GI (potential) product range (%)		0.37	0.38

The size of the wine-processing stage positively and significantly affects the long-term strategic decision, in terms of both total wine processed and number of processing plants. In addition, a winery being an industrial one, that is a winery sourcing grapes from upstream suppliers or through spot market transactions, also has a positive influence on the decision to invest in the bottling activity. Hence, industrial wineries are more likely to invest in bottling activities than are other types of wineries (for example cooperatives). This result may be partially explained by industrial wineries' brand-oriented strategies (Malorgio et al. 2011).

The negative influence of the number of suppliers is likely to suggest that long-term investing wineries tend to establish (more or less contractualised) vertical relationships with a relatively low number of suppliers rather than having multiple sourcing relationships.

The GI orientation of the territory where the winery is located has an ambiguous influence on the long-term strategic choice. The incidence of the IGT (respectively, DOC/DOCG) on total wine production at province level has a positive (respectively, negative) influence on the long-term strategic decision. While the IGT result is quite intuitive (that is, the winery being located in highly IGT-oriented territories tends to favour its long-term investment in the GI bottling activity), the DOC/DOCG result is more surprising, that is, being located in DOC/DOCG-oriented territories negatively affects the long-term strategic decision to invest in the GI bottling activity. Looking more closely at the mechanisms behind this result, we might argue that on the one hand wineries located in such territories are likely to benefit from a relatively high *collective territory-based reputation*, which potentially results in relatively high spot market prices.[17] On the other hand, since these wineries are mostly small, vertically-integrated wineries,[18] investment in the commercialisation strategy on the final market (for example bottling equipment, brand development, advertising and communication etc.) could constitute a great burden for such a typology of firms. Finally, when the spot market commercialisation option seems to be relatively favourable with respect to the direct sale of bottled wine to the final market, this could encourage firms to sell bulk wine rather than investing in the bottling activity.[19] The northern/southern location of the winery also affects long-term strategic decisions; notably, wineries located in the north of Italy are more likely to undertake long-term investment in bottling activities than are wineries located in the south.

Finally, as could have been expected, the incidence of DOC/DOCG on total wine processed positively affects the long-term strategic choice of whether or not to invest in GI bottling activities, whilst the incidence of table wine on total wine processed has a negative influence.

Table 13.2 Long-term and short-term winery strategic choices – sequential probit results

	Long-Term strategic choice (*n* = *16852*)				**Short-Term strategic choice (*n* = *10034*)**			
	Coeff.	**Std. Err**	**t**	**$\delta\Phi/\delta x_k$**	**Coeff.**	**Std. Err**	**t**	**$\delta\Phi/\delta x_k$**
N_suppliers	−0.006***	0.001	−9.7	−0.002***	−0.002***	0.001	−3.25	−0.001
Private company	0.216***	0.027	8.09	0.065***	0.020	0.030	0.66	0.007
Cooperative	−0.02	0.074	−0.27	−0.006	−0.116	0.075	−1.55	−0.041
Industrial	0.138***	0.047	2.94	0.042***	0.067	0.051	1.31	0.023
Igt_terroir	0.177***	0.057	3.11	0.053***	0.452***	0.082	5.49	0.159***
Docdocg_terroir	−0.605***	0.059	−10.17	−0.181***	−0.308***	0.094	−3.27	−0.108***
N_plants	0.052*	0.027	1.94	0.016*	0.045	0.037	1.22	0.016
Vdt_vo	−0.451***	0.057	−7.89	−0.135***	−0.020	0.078	−0.25	−0.007
Docdocg_vo	0.117***	0.032	3.65	0.035***	0.031	0.048	0.64	0.011
Tot wine prod (ln)	0.34***	0.007	48.74	0.102***	0.125***	0.010	12.77	0.044***
South	−0.446***	0.041	−10.94	−0.134***	−0.680***	0.058	−11.79	−0.238***
North	0.307***	0.023	13.21	0.092***	−0.016	0.030	−0.53	−0.006
Docdocg_PR					0.015***	0.004	3.54	0.005***
IGT_PR					0.018	0.015	1.19	0.006
Docdocg_rate_PR					0.180**	0.073	2.48	0.063**
N_geoareas					0.046*	0.024	1.88	0.016*
Constant	−2.771***	0.065	−24.4		−0.737***	0.105	−7.05	

Notes: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level; Log likelihood = −15,065.6.

The determinants of the short-term strategic choice of quantity: model results and discussion

This section analyses the determinants of the short-term strategic choice of quantity, focusing on long-term investing wineries. Results are illustrated in Table 13.3 below.

a) Size of the processing activity and other structural and organisational characteristics of the winery

Both the total wine processed and the number of processing plants have a positive influence on GI bottled volumes.[20] The size of the processing activity thus affects both the long-term strategic decision to invest in the wine-bottling activity (Table 13.2) and the short-term strategic choice relating to quantity (Table 13.3). As expected, the juridical status of private company positively affects both long-term and short-term strategic choices. Equivalently, whether a winery is an industrial one or a cooperative positively affects bottled volumes. This result may be partially explained by the 'size effect: a processing stage that is of relatively large average size is likely to favour high bottled volumes. Finally, comparing long-term and short-term strategies; while both types of wineries (cooperative and industrial) favour high volumes in the short term (due to the relatively high average size), it is only the industrial typology that positively affects the long-term strategic decision, whilst the status of cooperative does not seem to affect the choice of investing in bottling activities. Combining the box plot and density trace (or smoothed histogram) into a single diagram (Hintze and Nelson 1998) the role of the winery's size (number of wine-processing plants) and vertical relationship (the typology of the vertical relationships between the vine-growing and the wine-processing stages) in affecting bottled volumes can be further explored graphically (Figure 13.3).

b) Characteristics of procurement (grape sourcing): number of suppliers and geographical production areas

Both the number of upstream suppliers and the number of geographical areas from which wineries source grapes have a positive influence on GI bottled volumes.

Hence, wineries bottling high volumes have a larger number of suppliers at the upstream stage (grape, must, new wines etc.).[21] This finding might suggest that the heterogeneity of upstream supply (for example, input quality levels, product range, geographical area etc.) is likely to increase winery's mix flexibility and thus (potentially) volumes. In addition, this result might be partially explained by the fragmentation of upstream supply.[22] Therefore, the more the upstream supply is fragmented the more an increase in the number of suppliers is needed in order to increase marketed volumes. Finally, it is worth noting that while the number of suppliers positively affects bottled

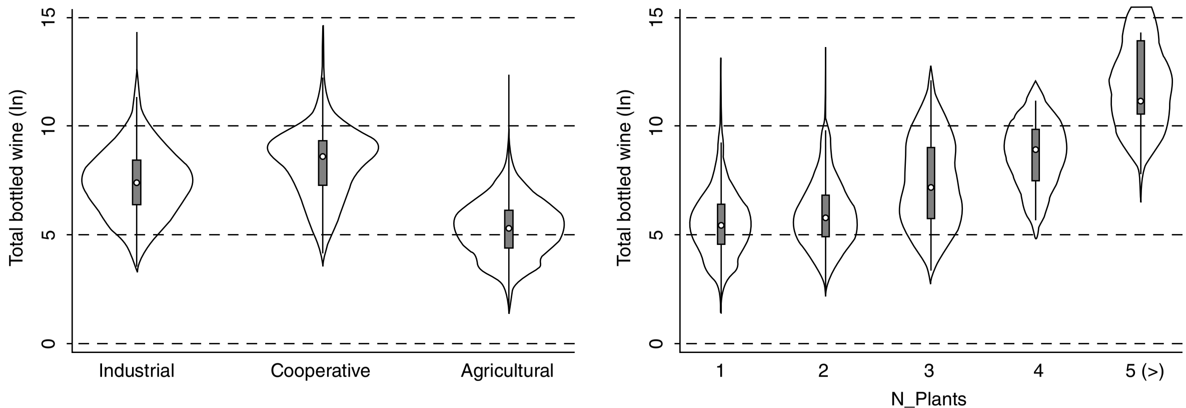

Figure 13.3 The effect of winery's size and vertical relationship on bottled volumes

Source: own elaborations on vine-growing/wine processing declarations dataset and bottling dataset.

volumes, it negatively affects the long-term strategic choice. As detailed in Section 13.4, long-term investing wineries are more likely to establish relations with a relatively low number of suppliers (compared to non-investing wineries); despite this, for the reasons detailed above increasing the number of suppliers seems to be necessary to increase commercialised volumes.

Alongside the number of upstream suppliers, the number of geographical areas covered also positively influences bottled volumes.[23] Hence, high-volume wineries have a wide range of geographical production areas in their procurement area (other than the area where the winery itself is located), and thus source grapes and/or wine from a relatively high number of regions. As previously detailed for the number of suppliers, the 'geographical heterogeneity' of procurement may result in a higher product variety, enabling the winery to be more flexible in its quality strategy and capture multiple market segments, thus increasing volumes.

It is worth noting that these findings seem to suggest how high volumes may coexist with a relatively high *complexity* of procurement strategies (due to fragmented or geographically dispersed procurement). In this context, the outcome of the commercialisation strategy (for example quality, volume/price etc.) is likely to depend heavily on the mechanisms implemented by the downstream firms to regulate procurement (supplier selection, contract setting, quality control and inspection systems, transaction costs etc.).

Characteristics of the territory where the winery is located

Neither the DOC/DOCG nor the IGT incidence on total wine production at the province level affects the short-term strategic choice of quantity. Hence, the GI orientation of the territory solely affects the long-term strategic decision, as previously detailed, in Section 13.4. Moreover, and interestingly, being located in southern Italy negatively affects the long-term decision to invest in the bottling activity, while it positively affects bottled volumes.[24] On the contrary, being located in northern Italy positively affects the long-term decision, whilst it has a negative (but not significant) influence on the bottled quantity.[25]

d) Strategic flexibility

Results pertaining to the product range seem to validate the hypothesis of the volume-constraining nature of the DOC/DOCG system.

As for the wine-processing stage, the incidence of DOC/DOCG on total wine production positively affects long-term strategic decisions to invest in the GI wine-bottling activity, while it negatively affects GI bottled volumes in the short term. Looking more closely at the mechanisms behind this result, we represent in Figure 13.4 the scatter diagrams of the probability of observing a long-term quality strategy (to invest in the bottling activity, choosing the potential product range – on the left) and the short-term strategy of

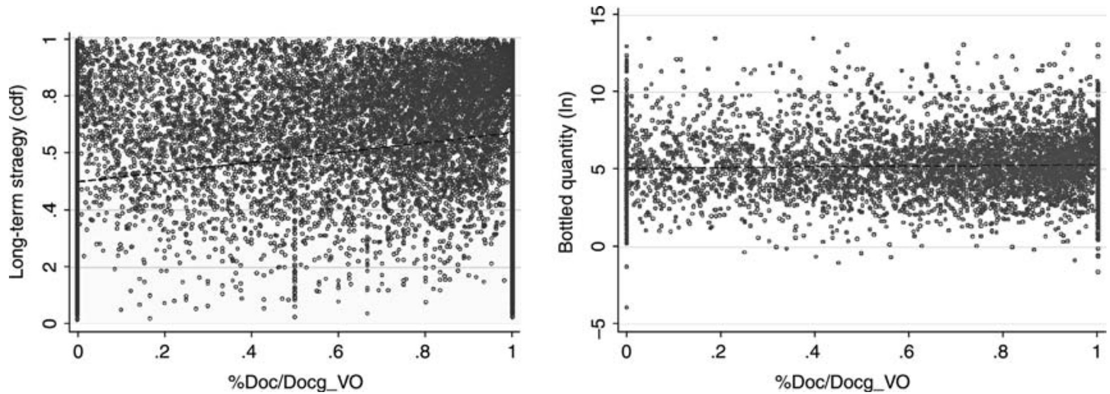

Figure 13.4 The degree of commitment to the DOC/DOCG system and its role in long-term and short-term strategic decisions regarding investment in bottling

Source: own elaborations on vine-growing/wine processing declarations dataset and bottling dataset.

quantity (the logarithm of bottled quantity – on the right) plotted against the ratio Docdocg_vo.

The ratio Docdocg_vo being interpreted as a proxy of the degree of adhesion to the DOC/DOCG system in the long term, and thus of the degree of commitment to the DOC/DOCG system, pertaining to the processing stage, this result (and namely the comparison between long- and short-term effects) interestingly points out the following mechanisms. On the one hand, adhesion to the DOC/DOCG system tends to favour long-term investment in commercialisation strategies on the final market (depending on the extent of the collective's reputation-based market opportunities). On the other hand, the negative influence on volumes bottled in the short term may be interpreted as a consequence of the DOC/DOCG's volume-constraining nature, or as a result of wineries switching from DOC/DOCG commercialisation strategies to alternative options (for example the selling of wine in bulk on the spot market, according to market opportunities).

As could have been expected, the incidence of table wine on total wine production has a negative influence on the decision to invest in both the GI bottling activity and the GI bottled volumes, as it reflects the strategic behaviour of table wine-oriented wineries.

As for the wine-bottling stage, the incidence of DOC/DOCG on the potential product range has a positive influence on the strategic choice to bottle S_i*>0 (Table 13.2), but then negatively affects bottled volumes (Table 13.3).

Table 13.3 Short-term winery strategic choices on quantity – Heckman's two-step estimation

	Coeff.	**Std. Err**	**t**
N_suppliers	0.002*	0.001	1.62
Private company	0.292***	0.035	8.26
Cooperative	0.675***	0.086	7.84
Industrial	0.601***	0.057	10.50
Igt_terroir	0.146	0.138	1.06
Docdocg_terroir	0.107	0.132	0.81
N_plants	0.153***	0.038	4.02
Vdt_vo	−1.342***	0.097	−13.80
Docdocg_vo	−0.214***	0.066	−3.22
Tot wine prod (ln)	0.489***	0.030	16.38
South	0.888***	0.180	4.93
North	−0.024	0.034	−0.70
Docdocg_rate_PR	−0.372***	0.098	−3.80
N_geoareas	0.164***	0.013	12.72
Igt_spec	−0.936***	0.054	−17.27
Docdocg_spec	−0.612***	0.040	−15.21
λ	0.186***	0.039	4.73
Constant	3.528***	0.482	7.32

Notes: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

On the one hand, the positive effect on the decision to undertake a commercialisation strategy on the final market might be explained by the incentive for the winery to capture market opportunities based on the DOC/DOCG collective's reputation. On the other hand, the negative effect on the bottled quantity seems to reinforce the previous finding and thus confirm that adhesion to the DOC/DOCG system represents a quantity constraint for wineries. Hence, these findings seem to suggest that whilst compliance with the DOC/DOCG constitutes a quantity restriction for wineries, it potentially provides access to collective reputation-based market opportunities.[26] The greater the market-driven opportunities (for example consumers' willingness to pay for DOC/DOCG wines), the greater will be the incentive for the firm to undertake commercialisation strategies on the final market.

The absolute number of registered DOC/DOCG wines positively affects the strategic choice to bottle $S_i^*>0$ but does not have any influence on bottled volumes. The reason behind this result may be explained as follows. Looking more closely at the distribution of wineries per class of quantity *and* the (potential) number of DOC/DOCG wines, we verify that out of the total number of wineries with a relatively wide (potential) DOC/DOCG product range (at least 10 DOC/DOCG), 63 per cent bottle less than 1000 hectolitres. Hence, despite having chosen a wide DOC/DOCG product range in the long term, these wineries bottle relatively low (or zero) GI volumes in the short term. This phenomenon seems to suggest that wineries may register a relatively wide DOC/DOCG product range in the long term, but may have an interest in switching to alternative commercialisation strategies in the short term (for example selling bulk wine rather than bottles and commercialising on the final market). The potential GI product range has then been excluded from the analysis of the short-term strategic choice of quantity (Table 13.3) in order to impose the exclusion restrictions required by the Heckman model for the identification. We assume that these regressors, being significant in the selection part, do not directly influence the choice of bottled quantity.

The volume-constraining nature of the DOC/DOCG system is also confirmed by the negative influence of the DOC/DOCG specialisation on bottled volumes.[27] Despite the negative effect of both, DOC/DOCG- and the IGT-specialisation seems to suggest that this result may be also explained by a size effect, since specialised wineries also tend to be small (Malorgio et al. 2011); this implies relatively lower bottled volumes.

13.5 Discussion and final remarks

This chapter provides a set of empirical tools for investigating the determinants of winery strategic decisions concerning GI wine-bottling activities. In detail, the sequential probit analysis and the Heckman two-step estimator have highlighted the following results.

A first set of factors with an influence on wineries' strategic decisions is that of the structural and organisational characteristics of wineries. The size of the processing activity is shown to promote high-volume bottling strategies; it might be argued that scale economies foster long-term investments in bottling and commercialisation strategy. In addition, the nature of industrial wineries and private companies tends to favour investment in the bottling activity as well as high-volume strategies. Despite its positively affecting bottled volumes (arguably for the size effect) the status of cooperative does not seem to affect the choice of investing in bottling activities.

The characteristics of procurement also affect wineries' strategic decisions. We have shown that high volumes tend to be favoured by a high number of suppliers and geographical production areas. As highlighted, this finding may suggest that input heterogeneity tends to favour wineries' mix flexibility and thus their high-volume strategies.

Interestingly, results pertaining to the role of the territory where the winery is located are quite unintuitive and highlight the crucial role of the territory. Notably, we have shown that being located in an almost DOC/DOCG-oriented area solely (and negatively) affects the decision to invest in bottling activity. Given the prevalent nature of wineries located in such territories (almost vertically-integrated and small) and the plausible relatively high collective reputation (resulting in favourable market opportunities), from which they might benefit, alternative commercialisation options (for example, the sale of bulk wine to the spot market) might be preferred to direct commercialisation on the final market. In addition, the wineries' location in northern/southern Italy also affects their strategic decisions.

Finally, the extent of adhesion to the DOC/DOCG system negatively affects bottled volumes. This finding seems to validate the hypothesis of the volume-constraining nature of a DOC/DOCG with respect to the (more flexible) IGT system. Nevertheless, its positive influence on both the decision to invest and/or on the strategic choice to bottle might be explained by the incentive for wineries to capture a DOC/DOCG collective's reputation-based market opportunities. The results thus seem to highlight the existing and well-recognised trade-off of wineries between volume constraints and the market opportunities associated with the DOC/DOCG system, which influences the long-term decision to invest in bottling activity and the volumes commercialised on the final market in the short term with respect to the possible alternative options (for example bulk wine spot market or the commercialisation of IGT or table wines).

Based on the main results of our model, we can indicate the factors that are likely to favour high-volume strategies and thus (potentially) make it possible for wineries to adjust volumes and quality to changing market conditions, take advantage of market opportunities, and *in fine* increase their competitiveness on the final (national and international) market.

First, both scale and scope economies may favour high-volume strategies on the final market. On the one hand, sourcing from multiple geographical areas and suppliers allows for a greater mix flexibility, and may result in scope economies and make it possible to adjust better to market conditions. Moreover, sourcing from multiple suppliers increases substitutability among them and thus the winery's bargaining power. On the other hand, multiple sourcing may result in higher transaction costs and a higher complexity of procurement; hence it may be geographically dispersed and/or fragmented among a high number of upstream suppliers. This may be problematic when assuring the quality of the final product and may require the implementation of upstream–downstream coordination mechanisms between the vine-growing and wine-processing stages.

High-volume strategies are more likely to be developed through IGT-branded rather than DOC/DOCG-branded wines, given the constraining nature of the latter (both in terms of quantity restrictions and minimum quality standards). Hence, our results seem to highlight the co-existence of two systems in the Italian GI system (and of course of a continuum of mixed systems between them), high-volume wineries mainly relying on the IGT system and low-volume wineries tending to be DOC/DOCG-specialised. On the one hand, small DOC/DOCG wineries mainly rely on the GI's collective reputation and on wine-terroir synergies. Highly constrained in terms of quantity, they benefit from an improvement in consumer willingness to pay for designations of origin. On the other hand, medium–large wineries sell high volumes of well-known brands, often relying on the IGT system (or on a multiproduct range) to benefit from a greater strategic flexibility and thus better exploit market opportunities. This may explain the reason why a significant gap is shown to exist between the DOC/DOCG potential and what is effectively bottled; according to market opportunities (market size and consumer willingness to pay) wineries may have an incentive to deviate from the DOC/DOCG system and sell bulk wines or bottle IGT wines. In this respect, the CMO wine reform is likely to strongly influence firms' strategic choices; for example, the new wine classification increases the stringency level of PGIs (IGT in Italy) with respect to PDO (DOC/DOCG in Italy). Despite reinforcing the reputation and image of European GIs on the international market, it is likely to reduce the strategic flexibility that is currently associated with IGT wines and thus favour high-volume and flexible strategies based on table wines.

The co-existence of these two systems makes it possible to highlight possible different product development and marketing strategies for GI wineries.

Both IGT and DOC/DOCG-based strategies allow for a *place-based marketing strategy*, thus focusing on the role of origin and emphasising the specificities of *terroir*. Relying on more stringent production requirements and according to the Italian 'quality pyramid', a DOC/DOCG-based strategy develops (and communicates) a higher quality level, while implying a volume constraint for the firm. In addition to the place-based marketing strategies, *individual brand-based marketing strategies* may be developed. Premium wines based on well-known private brands may rely on the DOC/DOCG system, focusing on niche markets; consider as an example Sassicaia (Bolgheri Sassicaia DOC), Castello Banfi Poggio all'Oro (Brunello di Montalcino DOCG) or 'Nos' Mezzacorona (Teroldego Rotaliano DOC). Premium wines based on well-known brands may also rely on the IGT system (consider the Super Tuscan Tignanello or Solaia, IGT Tuscany).

Our research could be extended in several ways. First, the analysis could be interestingly improved by considering, as a dependent variable, the ratio of bottled/processed wine volumes, in order to study the degree of the wineries' market orientation (see Malorgio et al. 2011). Analysing the determinants of this ratio could enable the study of the wineries' trade-off between direct sales of bottled wine on the final market and alternative commercialisation options (for example the sales of bulk wine to the spot market or a switch to table wines) and to assess the mechanisms behind the role and the functioning of the intermediate wine market, in Italy accounting for about 30 per cent of the GI wine production. Second, a dynamic model could be developed in order to analyse both investment choices in bottling activities and volume decisions over time. Also, a dynamic analysis could make it possible to evaluate the effect of policy variables, such as, for example, storage subsidies and quality improvement measures.

Notes

1. Especially for an experience good like wine and, more in general, when product quality is not directly observable before purchase (Nelson 1970; Darby and Karni 1973) and experience (or credence) attributes are concerned, consumers tend to rely on extrinsic quality cues such as well-known brands, labels, or geographical indications to increase the 'likelihood of product success' (Mitchell and McGoldrick 1996; Henson and Traill 1993).
2. These contrasting strategies are representative of the rationale behind the New World and Old World 'logics': while New World producers tend to base their strategy on strong brands (for example Gallo, Concha y Toro, Robert Mondavi, Yellowtail, and Jacob's Creek) and relatively homogeneous product ranges, and mainly base wine differentiation on grape variety, thus taking advantage of increasing consumers' interest in varietal wines (Labys and Cohen 2006), the Old World system is traditionally based on an emphasis on the specificity of *terroir*.
3. Hence, quality can be interpreted as a 'normative concept' and can be referred to as vertical product differentiation (De Fraja 1996).
4. Indeed, several studies show consumers' willingness to pay for GI wines (Martínez-Carrasco et al. 2006; Skuras and Vakrou 2002). GI wines are thus shown to determine consumers' positive responses and generate their willingness to pay.
5. Consider for example the so-called Super Tuscan wines, which are characterised by product innovation according to a strict market-oriented approach

(the 'international taste model'), such as Antinori's Tignanello and Solaia IGT (Mattiacci and Zampi 2004).
6. Authors' elaborations on vine-growing and wine processing declarations (AGEA 2008).
7. Mix flexibility is defined as 'being able to handle a range of products or variants with fast setups' (Gerwin 1993). According to Gerwin (1993), mix flexibility relates to the uncertainty as to which products customers will accept; a firm desires a number of broad product lines and/or numerous variations with a line.
8. The Italian vine-growing stage is highly fragmented: the average size of the vineyard is 2.58 hectares; 53.4 per cent of vine-growers have less than one hectare (Malorgio and Grazia 2010).
9. For example, Malorgio et al. (2011) showed that higher levels of incidence of GI production on total wine production at regional level do not necessarily imply higher levels of market orientation (at regional level), 'market orientation' being interpreted as the ratio between bottled and processed GI wine.
10. According to recent ISMEA surveys (2011, 2010, 2009), IGT has registered a slightly better performance than DOC/DOCG. Hence, over the period 2007 to 2008, total wine consumption decreases by 1.8 per cent in volume (and increases by 4.1% in value); DOC/DOCG wine consumption increases by up to 1.5 per cent in volume (and 5.3% in value), whilst IGT wine consumption shows a better trend by increasing by up to 2.9 per cent in volume and 7.7 per cent in value. The better performance of IGT also characterises the period 2008 to 2009; hence whilst DOC/DOCG consumption decreases by 2.4 per cent in volume and by 11 per cent in value, IGT wine consumption increases by up to 4.9 per cent in volume (and decreases by 2.3% in value). This shows that consumers are likely to move towards relatively low–medium-priced wines (IGT) within the set of GI wines.
11. For example, the specific requirements may establish that the bottling must exclusively occur in the production zone, or the period of bottle fining or the month of the year starting from which the wine can be released for consumption.
12. For example, brand development, advertising campaigns, promotional activities etc.
13. Likelihood-ratio test for $\rho = 0$: $\chi 2(1) = 0.11$; Prob $> \chi 2 = 0.7383$.
14. At least one regressor being significant in the selection part, but not in explaining the outcome, should be excluded.
15. In addition, 5.9 million hectolitres were bottled by 'pure bottlers', i.e. firms included in the second database but not in the first (firms that solely operate at the wine-bottling stage) (see Malorgio et al. 2011). This category does not fall into the scope of this chapter. Hence, the aim here is to characterise wineries' bottling strategies by considering the winery as the unit of analysis.
16. It appears that industrial wineries have an average wine production of about 8000 hectolitres, as against 169 hectolitres for vertically-integrated wineries. Cooperatives have the highest average processed volumes (more than 40,000 on average). In addition, it appears that the juridical status positively affects processed volumes (notably, private companies tend to process relatively higher average volumes than individual companies).
17. In Italy, Piedmont, Tuscany and Veneto are the first three regions for the number of GIs and the highest proportion of DOC/DOCG on the total number of GIs (ISMEA 2011, 2010). The consequent territory-based reputation is likely to result in relatively higher spot market prices (ISMEA 2011).

18. As noted by Malorgio and Grazia (2010), Piedmont, Tuscany, and Veneto are characterised, at the same time, by a relatively high proportion of DOC/DOCG production on total wine production at regional level and by a relatively high incidence of small, vertically-integrated wineries.
19. It is worth noting that the relatively high DOC/DOCG orientation of the territory is not systematically accompanied by a high incidence of bottling wineries relative to the total number of GI wine-processing wineries (for example, in Tuscany and Veneto, this ratio is relatively lower than the national average – 54.05% and 59.48% respectively – whilst it is relatively higher in Piedmont, at 74.64%).
20. Looking more closely at the distribution of wineries according to GI bottled volumes and number of processing plants, we notice that wineries bottling more than 50,000 hectolitres have 1.72 plants on average, whilst wineries bottling less than 500 hectolitres have 1.10 plants on average.
21. Hence, if we analyse the average number of grape suppliers per class of bottled quantity, we show that the average number of suppliers increases in the bottled quantity (from two suppliers for wineries that bottle less than 1000 hectolitres to 51.7 for wineries that bottle more than 50,000 hectolitres).
22. Looking more closely at the structure of the upstream sector, we verify that 70 per cent of suppliers sell to a single winery less than 10 per cent of the total quantity bought by the latter from all of its suppliers.
23. Looking more closely at the distribution of GI wineries classified by number of regions and number of bottled GIs, we notice that the average number of GIs increases from 1.53 for wineries sourcing from a single region to 26.59 for wineries sourcing from more than five regions.
24. This finding may be explained as follows. On the one hand, 'South' is negatively correlated (−0.12) with the incidence of DOC/DOCG on total wine processed, which in turn has a positive influence on the long-term decision to invest in the GI bottling activity (as shown in Table 13.2). On the other hand, 'South' is positively correlated with wineries' total wine processed (+0.14) and number of plants (+0.09), which in turn positively affect bottled volumes (Table 13.3).
25. 'North' is positively correlated (+0.04) with the incidence of DOC/DOCG on total wine processed and negatively correlated with the wineries' number of plants (−0.05).
26. Indeed, several studies show consumers' willingness to pay for GI wines (Martínez-Carrasco et al. 2006; Skuras and Vakrou 2002).
27. This result is confirmed by the analysis of the incidence of DOC/DOCG-specialised wineries per class of bottled quantity: DOC/DOCG-specialised wineries account for 16 per cent of wineries that bottle less than 1000 hectolitres and 3 per cent of wineries that bottle 1000 to 10,000 hectolitres, whereas no DOC/DOCG-specialised winery is found among wineries that bottle more than 10,000 hectolitres.

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14
Export Intentions of Wineries

Isabel Bardají, Belén Iráizoz and Julio Estavillo

14.1 Introduction

The theory of reasoned action, initially proposed by Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980), is one of the most widely used models that explains the relationship between attitudes, intentions and behaviour. The theory rests on the assumption that behaviour results from intentions, which in turn are the result of attitudes and subjective norms, the latter being a reflection of social norms (Beedell and Rehman 2000). Extending from this, the theory of planned behaviour (TPB), posited by Ajzen (1985, 1991), introduces perceived behavioural control or perceived ability to perform an action as additional factors to explain intentions. This theory, which focuses on the motives underlying decisions, may prove useful in exploring the internal determinants of export behaviour (Marshall et al. 2005; Sommer 2010; Sommer and Haug 2011).

Focusing on the Spanish wine industry, this chapter considers the trends in demand and trade, and the profound transformation of the wine industry that has been observed in recent years. As overall domestic wine consumption levels decline, traditional wine producers are gradually shifting their focus towards foreign markets, which are increasingly considered their key strategic options. Following steady growth in recent years, Spanish wine exports accounted for 44 per cent of total production in 2008. Since then, the economic crisis has battered the wineries, which now face a new environment. Exports increased in 2010, but this increase was due mainly to a higher proportion of wines without denomination of origin (DO) and with lower mean prices (Rabobank 2011). These changes have necessitated the widespread adoption of new strategies, mainly in the export markets.

These changes have reinforced other recent changes in the wine industry; due to trade liberalisation and economic globalisation, the traditional wine-producing sector in the European Union has encountered entry into the world market of new countries. The aggressive marketing techniques of these new competitors have pushed traditional producers aside, raising the competitive stakes in the main markets worldwide (Hussain et al. 2008; Green et al. 2003).

The reform of the Common Market Organisation of the wine sector in 2008 attempted to counteract this trend and, with the aim of increasing the world market share of European wines, provided strong support for their promotion in external markets, which dramatically reduced the management measures in the internal market.

Thus, the move towards foreign markets appears inevitable, although it will be far from easy. Deep-rooted territorialism, relatively fragmented supply, lack of brands with significant or high production volume, and the constraints imposed by a somewhat inflexible normative framework are some of the major hurdles the Spanish wine industry must overcome to position itself efficiently in the new consumer markets (Bardají 2003).

For many Spanish wineries, which are characterised by a strong territorial identity and a tendency to focus preferentially on the local and domestic markets, foreign market entry represents a major break from their usual business approach. The growth of the international wine trade (Anderson et al. 2003; Rabobank 2011) might accelerate this change and help to create and strengthen an exporting culture in Spanish wineries.

Changes in the decision-making process demand behavioural changes from producers, who may react to the increasing difficulty of selling to the domestic market by seeking new markets and significantly increasing exports (Leonidou et al. 2007). With the increase in the level of internationalisation among wineries, there is growing interest in the theoretical approaches to this business process (Kuivalainene et al. 2010). An understanding of the driving forces behind these decision-making processes and the variables influencing winemakers' choices might shed some new light on the situation. The description above provides the framework for this chapter, the primary purpose of which is to identify the explanatory factors of the export intentions of Spanish wineries. An additional contribution of this chapter is to test the TPB in the formation of export intentions, where at the moment there are few applications (as far as we know, only the works of Sommer (2010) and Sommer and Haug (2011) are based on this approach).

Section 14.2 presents the theoretical foundation used in the chapter and discusses the development of the hypothesis, Section 14.3 includes the main details of the research design, Section 14.4 reports the findings and discusses the behavioural determinants of export intention, and Section 14.5 summarises the main conclusions.

14.2 Theoretical foundation and hypothesis development

The aim of this chapter is to identify export intentions in wineries and attempt to explain them by analysing the potential determining factors.

Sousa et al. (2008), in a review of the literature on the determinants of export behaviour, report the use of two main theoretical approaches: the first focusing on determinants within the unit of analysis and the second focusing on external or environmental factors. Leonidou and Katsikeas (2010) refer to environmental, organisational and managerial sources of export antecedents.

In parallel with this body of literature, a set of studies has attempted to explain export behaviour as the result of a managerial decision-making process. This perspective assigns a significant role to attitudes and intentions as determinants of managerial behaviour. Attitude is defined as the subjective inclination to respond favourably or unfavourably to a possible occurrence, and the nature of the response then influences the intention to perform a certain action. Behaviour can, therefore, be explained in terms of intentions. These intentions are determined by attitudes and other significant factors (Willock et al. 1999). Many authors working in the context of internationalisation processes signal the importance of attitude for firms wishing to develop and successfully exploit international market opportunities (Wickramasekera and Oczkowski 2004, Larimo 2007).

It is in this context that the theory of reasoned action (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980) and its extension, the TPB (Ajzen 1985, 1991), are applied. According to these theories, behaviour depends on three types of considerations: (i) beliefs in and evaluations of expected outcomes, which shape attitudes; (ii) perceived social norms and the motivation to comply with them, which gives rise to subjective norms; and (iii) belief in the ability to perform the behaviour, which gives rise to perceived behavioural control. Overall, the more favourable the attitude and subjective norms that lead towards a given behavioural response and the stronger the perceived control over the decision, the stronger the intention to act. Hence, intention is the antecedent of behaviour (Ajzen 2002). Other studies also add past behaviour as an explanatory variable for intention (Axinn et al. 1995; Bergevoet et al. 2004). The incorporation of subjective norms and perceived behavioural control into the analysis provides the means to capture the effect of some of the external conditioning factors.

Additionally, this theory is beginning to be used to explain the behaviour of diverse actors regarding their attitudes, intentions and behaviour in different situations (Armitage and Conner 2001), including the business decision-making process.

The planned behaviour model has also been used in numerous empirical applications in the field of agriculture, particularly in recent years when reform of the CAP has motivated research into the responses of farmers to different policy initiatives (Rob and Burton 2004). Many researchers have focused their analysis on the factors leading to the adoption of new environmental protection schemes (Willock et al. 1999 or Beedell and Rehman 2000) or on different responses to the introduction of new policies (Gorton et al. 2008).

In the industrial and services sectors, the applications range from the analysis of the adoption of innovations (Riemenschneider et al. 2003), environmental practices (Cordano and Frieze 2000; Martín-Peña et al. 2010) or specific management strategies (Grandón et al. 2011; Nasco et al. 2008; Riemenschneider et al. 2003) to the development of internationalisation processes (Haug and Sommer 2008; Sommer 2010; Sommer and Haug 2011). In the wine industry, Marshall et al. (2005, 2010) apply the model in relation to the adoption of environmental practices.

Linking the TPB with the so-called Uppsala model, Pauwels et al. (2009) attempt to explain the internationalisation process of a series of service companies. The Uppsala model (Johanson and Vahlne 1977, 1990) suggests that greater knowledge of a given market reduces perceived risk and increases the likelihood of additional resource allocation. It also argues that because the learning process is cumulative, it is reasonable to suppose that internationalisation is also an incremental process. Observing that the literature neither develops nor examines the attitudinal dimension of this commitment, the authors of the aforementioned model constructed a market commitment variable from the amount of resources allocated and the level of commitment. In developing a commitment construct to study the internationalisation process, they drew largely on attitudinal and behavioural models, specifically Ajzen's TPB.

The implicit assumption behind the analysis is that the attitudes of winery managers towards foreign markets are influenced by a range of variables, including both economic and social/institutional factors; many of them are interrelated, some are specific and internal to the context of the entrepreneur or the winery and others vary with the immediate environment and wider context. The purpose of this approach is to show the large set of diverse variables that complicate the task of increasing exports.

The TPB model is also used in the present study which assumes that intentions formed through a process mediated by economic, social and psychological variables approximate the export behaviour of wineries.

Hypothesis

The model described above explains export intentions in terms of attitudes, subjective norms, perceived behavioural control and past behaviour.

Attitudes indicate the tendency to react favourably or unfavourably towards a possible occurrence (Gorton et al. 2008). In this study, the occurrence was opening up to foreign markets. A positive attitude towards exports is one of the aspects stressed by Leonidou et al. (2007) as a determinant of the initiation and development of export process, and it has been tested in numerous applications (Ibeh 2003; Okpara 2009; Javalgi and Todd 2011; Shih and Wickramasekera 2011). In the wine industry, Maurel (2009), Suárez-Ortega (2003) and Suárez-Ortega and Álamo-Vera (2005) highlight that entrepreneurial attitudes and perceptions influence the degree of internationalisation of a firm. In our survey, entrepreneurial attitude was assessed by including a set of statements to probe the opinions of respondents regarding the importance of various export management and marketing issues; for example, high agreement with the statement 'the strength of competition in foreign markets means that the risks outweigh the possible benefits' reflects a negative attitude towards increasing export sales. This discussion drives us to formulate the first hypothesis to test:

> *Hypothesis 1: The more positive the attitudes towards management and marketing issues of exports, the stronger the intention to export.*

Subjective norms reflect perceived social and institutional pressure to behave in a particular manner (Ajzen and Fishbein 1980). Numerous studies find that subjective norms evolve from perceptions of the approval or disapproval of family and friends, the most influential social group (Leon et al. 1999; Rob and Burton 2004; Gorton et al. 2008). Some evidence also suggests that being part of a particular cluster or district can influence the export intention of a firm (Aylward 2004; Belso-Martinez 2006). In the present case, given that wine is a quality product with a strong territorial character, we included in the survey a set of statements related to the image the firm acquires by exporting its products and joining a DO, both of which can influence the approval or disapproval of neighbouring firms. The survey also explores the role of the institutional setting in stimulating exports (Leonidou et al. 2007) because environmental factors can either increase the opportunities or add to the constraints faced by firms considering export activity (Maurel 2009).

> *Hypothesis 2: Subjective norms are an important factor explaining export intention.*

To investigate the issue of perceived behavioural control, some of the statements in the survey aimed to elicit the self-assessed capabilities, strengths and weaknesses of entrepreneurs for conducting export activity (Ajzen 2002). The idea is that the firm's perspective of its capacity to compete in international markets could be considered as a variable that could potentially influence export intentions (Wickramasekera and Oczkowski 2004; Karelakis et al. 2008a). The export marketing literature suggests that the managers' perceptions of the problems involved in exporting are heavily influenced by firm-specific characteristics (Karelakis et al. 2008b); some authors have even suggested that a manager's perception of his or her own capacity is more influential than his or her actual skills (Krueger and Dickson 1994). In a study of firms in several countries, Sommer (2010) concludes that managerial perception is the more influential factor in export intention. To consider these factors, we included some statements in the survey describing subjective perceptions of the position of the firm vis-à-vis its foreign competitors with respect to variables such as price, product quality and design, and the specificity of its wines. These assumptions support the following hypothesis:

> *Hypothesis 3: The greater the perceived situation regarding foreign competitors, the stronger the intention to export.*

The literature contains some evidence of the influence of firm age on the export process (Becchetti and Santoro 2001; Javalgi et al. 2000, Martín et al. 2010). In our case, firm age, measured as the number of years since the founding of the firm, captures past behaviour, and the model uses the assumption that experience influences export behaviour by enabling firms to mature in the areas of management, international transaction and business partnerships (Majocchi et al. 2005). Thus, our last hypothesis is the following:

> *Hypothesis 4: The older the winery, the stronger the intention to export.*

14.3 Research design

The data used in the study came from a postal survey distributed at the beginning of 2008 to a set of wineries in various locations across Spain. The sample universe was the 469 wineries listed in the Alimarket (2008) database (*Alimarket* is a journal specialising in the publication of data on the Spanish agro-food industry; see www.alimarket.es). The survey had a pretesting process that comprised personal interviews in certain key wine-producing areas, such as Navarra, Ribera de Duero and Rioja. The survey was sent to all wineries included in the Alimarket database with a letter attached explaining the aims of the study, the confidentiality of the information gathered and the procedure to follow. Postage-paid envelopes were also included. The individual responsible for export decisions, where this position existed, completed the survey, and the manager completed the survey in all other cases.

The survey was completed by 115 wineries, of which 113 were validated. This represents a response rate of 24 per cent, which surpasses values highlighted by Larimo (2007), who states that responses rates in this type of mailed survey typically range between 14 per cent and 20 per cent. Consequently, the sample error is 8.2 per cent, which is acceptable according to the relevant literature (technical details of the survey are given in Table 14.1).

Mail surveys have been criticised due to no response bias. Proposals have been made to avoid them (Armstrong and Overton 1977), being the most common method to maximise the sample in relation to the population. Another method is based on comparing the values of specific variables in the sample with similar values in the population to contrast significant differences. Accordingly, we considered the winery size (measured by number of employees) and concluded that the sample was representative of the entire population of wineries. The possible existence of significant differences

Table 14.1 Technical details of survey

Universe	**Wineries listed in the drinks section of the annual Alimarket report 2007**
Scope	National
Census population	469 wineries
Sample	113 wineries
Sampling error	8.2%
Confidence level	95.5% k=2 p=q=0.5
Date of fieldwork	February–August 2008
Data collection method	Postal survey (followed up by phone and personal interview)
Sampling procedure	The questionnaire was sent to the entire population

between the companies that responded first and those that responded later was also analysed. Univariate tests of significance were conducted, and no significant difference was found between the two waves of respondents along a series of variables. Therefore, we concluded that there were no significant differences between the two groups; this indicates that the potential issue of no response bias can be rejected.

The firm size and export performance data, shown in Table 14.2, reveal that the firms in the survey sample are small wineries, in line with the expectations suggested by the structure of the Spanish wine industry. In terms of export performance, almost half have been exporting for less than 10 years. Only 20 per cent fit the description of relatively long-term exporters (over 20 years). Most export to a small number of countries (fewer than 10). The average percentage of exports over total sales is approximately 32 per cent, and this value surpasses the 60 per cent mark in only a few cases (14% of the total).

To characterise the intentions of the firms towards foreign markets, the survey included a set of statements designed to capture a broad spectrum of subjective opinions. The literature, particularly the contributions of Wickramasekera and Bamberry (2003) and Wickramasekera and Oczkowski (2004), guides the construction of these statements, which have been adapted to this specific environment. The opinions range from the very negative 'we prefer to consolidate our domestic sales channels before resorting to exports' to the highly dynamic 'exporting is a long-established business strategy in our firm and accounts for the bulk of our sales'. Respondents indicate their level of agreement with the various statements on a five-point Likert-type scale (1 = totally disagree; 5 = totally agree). The full list of statements considered, and the mean and standard deviation values appear in Appendix, Table A14.2.

The proposed model in the section above tries to explain the export intentions (once identified) in terms of attitudes, subjective norms, perceived behavioural control and past behaviour. To define the first three groups of

Table 14.2 Sample characteristics

Variables	Nº of wineries	%
Size (number of workers)		
Less than 10	44	38.9
10–20	32	28.3
20–30	13	11.5
More than 30	24	21.2
Size (storage capacity in millions of litres)		
Less than 0.5	31	27.4
0.5–1	26	23.0
1–4	29	25.7
More than 4	27	23.9
Exporting history		
Less than 10 years	48	42.5
10–15 years	26	23.0
15–20 years	16	14.2
More than 20 years	23	20.4
Number of export destination countries		
Less than 5	32	28.3
5–10	26	23.0
10–15	32	28.3
More than 15	23	20.4
Percentage of exports over total sales		
Less than 15%	37	32.7
15–30%	27	23.9
30–60%	33	29.2
More than 60%	16	14.2

variables, the survey includes another set of statements for participants to indicate their level of agreement on a five-point Likert-type scale (1 = totally disagree; 5 = totally agree). The statements considered appear together with the means and standard deviations in Table A14.2 of the Appendix. Past behaviour is approximated by the winery age.

In light of the previous considerations, the analysis begins with a descriptive analysis of the survey responses and the distribution of the Likert-scale responses. Predictions of specific export intentions are obtained by a two-stage procedure. In the first stage, the different types of export intentions are derived from a factor analysis of the survey responses, which reduces the number of variables considered in Table A14.2 of the Appendix while maintaining the multidimensional nature of export commitment suggested in the literature (Stump et al. 1998; Sullivan 1994). The objective of the second stage is to explain how intentions form from attitudes, subjective norms, perceived behavioural control and past behaviour. The exploratory nature of the study allows us to use the ordinary least squares (OLS) method to estimate an equation using a stepwise technique (Sommer 2010). In the equation, each of the factors in turn serves as the dependent variable, and the explanatory variables are those defined above.

14.4 Results

Descriptive analysis

Table A14.1 and Table A14.2 in the Appendix present the distribution of the responses over the five-point Likert scale and the mean scores for the statements proposed to capture export intentions, attitudes, subjective norms and perceived behavioural control. As the results show, most of the wineries surveyed have a very positive intention towards export development. The statement that elicited the highest level of agreement was 'we are continually exploring the possibility of entering new markets'. Firms claiming to agree with this statement will tend to put more effort into increasing their exports by budgeting for promotion in foreign markets, creating a specific department to deal with export projects and committing strongly to the training of an export management team. Most of the wineries consulted indicate complete disagreement with statements in favour of prioritising the domestic market. Thus, very few believe in the capacity of the domestic market to absorb their total output or prefer to consolidate domestic sales channels before turning to exports. Nevertheless, despite the importance they attach to exports, most respondents (95.7%) do not indicate that their future viability depends entirely on their ability to find new foreign markets. These findings contrast with the wider dispersion of opinion regarding the statements that compare the relative effectiveness of the domestic and foreign markets as sales channels.

The findings related to attitudes reveal high levels of agreement with the need for extra effort to compete at the level imposed by foreign markets, accompanied by the belief that sales diversification can reduce the overall risk. The importance given to innovation in labelling, bottle design and product development as a means of boosting competitive advantage also clearly represents a positive attitude. The results also show that the aspects where the wineries believe to have advantages to compete in foreign markets are the quality and specificity of their wines rather than prices.

Finally, an exploration of the impact of subjective norms shows that the highest level of agreement is with the statement about the importance of country image. Of the wineries consulted, 81 per cent somewhat agree or completely agree that a good country image abroad facilitates foreign market entry. The image that wineries acquire through exporting is also important, with 72 per cent of the sample firms expressing the belief that exporting has a significant image-enhancing effect. This section of the questionnaire reveals significant agreement regarding the role of DO. While most of the wineries value the effect of DO recognition both at home and abroad and consider participation in activities promoted by the DO regulatory body to be worthwhile, the majority indicate that individual brand promotion is more effective than DO promotion for increasing market share.

Behavioural determinants of export intentions

A varimax rotated factor analysis of the 22 statements listed in Table A14.1 of the Appendix explores the export intentions of the wineries. The standard tests used to verify the statistical significance of the factor analysis confirm its suitability for the variables considered. The KMO measure of sampling adequacy was 0.863, which is an acceptable level according to Hair et al. (2006). The Bartlett's test of sphericity of 2310.9 allows rejection of the null hypothesis that the correlation matrix is an identity matrix. Four factors with an eigenvalue greater than one jointly explain 69.72 per cent of the variance. The internal consistency of the scales was tested using a reliability analysis (Cronbach's alpha coefficient), and the obtained values all exceed 0.7, suggesting both adequate reliability and that the scales employed are acceptable (Hair et al. 2006).

The export intention factors along with their associated variables are listed below in descending order of intensity (see Table 14.3).

Factor IN1: Active exporting

This intention factor correlates with the statements that represent a more positive intention towards exporting. One statement is that exports account for more than 50 per cent of total sales, and another refers to the continuous search for new markets and extra resource allocation, even in firms with years of exporting experience. In this respect, the creation of a specific budget to promote products abroad through participating in trade fairs, advertising and conducting foreign market research exhibits a close relationship with this factor. The results reveal a particularly strong belief in the effectiveness of training the management team in areas such as market knowledge and languages.

Factor IN2: Non-priority exporting

This factor relates to statements in favour of prioritising the domestic market as the main sales focus and the principal means of accomplishing business growth plans. Under this approach, exports account for only part rather than the bulk of the sales of the firm.

Table 14.3 Rotated intention factor loadings

Variables/factors (1)	**F IN1**	**F IN2**	**F IN3**	**F IN4**
I1: Home market growth prospects are sufficient to meet my business growth plans.	0.07	0.80	–0.19	–0.12
I2: Our marketing plans are oriented towards expansion in the home market.	–0.17	0.77	0.07	0.14
I3: The home market takes up all our effort and attention, and we keep a constant watch on its evolution.	–0.03	0.71	0.16	0.02
I4: Our goal is to place a significant, but not majority, share of our sales abroad.	0.01	0.63	0.26	0.09
I5: We are continually exploring the possibility of entering new markets.	0.85	0.08	0.01	0.09
I6: We consider it very important to set aside a specific budget to promote our company abroad.	0.79	–0.03	0.19	–0.36
I7: We consider it very important to devote a specific part of our budget towards conducting our own market research abroad.	0.63	0.15	0.24	–0.17
I8: The importance we attach to exports has led us to set up a specific export department.	0.76	–0.08	0.12	–0.29
I9: Exporting has been a well-established strategy in our company for years, and it accounts for the bulk of our sales.	0.72	0.01	–0.07	–0.16
I10: Foreign market training for our management team (knowledge of markets, languages…) is something to which our company is deeply committed.	0.82	–0.11	0.14	–0.30
I11: In recent years, we have been conducting our main sales promotion activities abroad.	0.78	–0.17	–0.08	–0.27
I12: We are concentrating our export activities in one or two countries for the time being.	0.25	0.18	0.70	–0.09
I13: We are gradually increasing our number of export destination countries.	0.79	0.10	–0.03	–0.34
I14: We are unlikely to increase our proportion of foreign market sales.	–0.12	0.10	0.74	–0.18
I15: Exports are likely to account for over 50% of our sales in the near future.	0.72	–0.24	–0.14	–0.16
I16: The home markets easily absorb our total output.	–0.35	0.08	–0.21	0.73
I17: The future viability of our company will depend on finding foreign markets for our wines.	–0.17	0.07	–0.08	0.89
I18: Our sales department is considering the possibility of exporting.	–0.19	0.03	–0.04	0.97
I19: Although we want to export, we are finding it difficult.	–0.15	–0.04	0.02	0.89
I20: We would like to export but lack the means to enter such competitive markets.	–0.27	–0.13	–0.00	0.82
I21: We prefer to consolidate our domestic sales channels before turning to the export market.	–0.28	0.13	–0.15	0.75
I22: We think we need to export and are therefore making plans to learn about foreign markets and entry methods.	–0.18	0.11	–0.10	0.90
Eigenvalue	8.74	2.51	1.14	2.95
% variance (69.7)	39.7	11.4	5.2	13.4

Factor IN3: Incipient exporting

Two statements referring to the initiation of exporting activity in one or two markets and the perceived difficulty of increasing exports in the future explain this factor.

Factor IN4: Considering exports

The 'considering exports' intention is at the centre of a series of statements reflecting a single focus on the domestic market, full reliance on the domestic market to absorb the total output, and a preference for consolidating domestic sales channels before turning to exports. It represents the perception of exporting as an option to ensure future viability, although the perceived difficulties and scarce means of addressing them make some firms cautious.

Formation of intentions

The second stage of the analysis is to explain formation of intention based on the factors extracted from the variables used to represent attitudes, subjective norms, perceived behavioural control and past behaviour. OLS is used to estimate an equation using a stepwise procedure where each of the factors in turn serves as the dependent variable and where the above-mentioned variables serve as explanatory variables. Only 17 of the 28 initial explanatory variables are significant in any of the regressions. Table 14.4 shows the results along with the fit statistics. In all cases, the results are statistically significant, and the fit goodness is acceptable for this type of analysis.

To test collinearity, we calculated the variance inflation factors (VIFs) associated with each coefficient of the variables that were finally included in every regression. None were considerably larger than 1 (they ranged from 1.011 to 1.330), suggesting that collinearity is not a serious concern (the rule of thumb is to accept that a variable is highly collinear if a VIF value exceeds 10, see Gujarati 2004).

The results obtained allow for the following observations.

> *Hypothesis 1: The more positive the attitudes towards the management and marketing issues of exports, the stronger the intention to export.*

Only one marketing variable contributes to the formation of export intentions: the emphasis on product innovation as a means of adapting to foreign market demands, which is statistically significant in three regressions. In all cases, the positive sign reveals its importance to the formation of all intentions, suggesting the need to consider a broad product portfolio in planning foreign market entry.

The attitudes towards management exports have a significant effect on the export intentions, highlighting the risk attitudes implied in foreign markets. The perception of exporting as a means to diversify risks and the conviction that the benefits are worth the effort to drive the most dynamic export intention (FIN1), despite the strength of competition in foreign markets and the

Table 14.4 Explanatory variables for intention formation[a]

Variable	Intention factor 1 FIN1		Intention factor 2 FIN2		Intention factor 3 FIN3		Intention factor 4 FIN4	
	Beta	**t**	**Beta**	**t**	**Beta**	**t**	**Beta**	**t**
Constant	−3.84	−6.2***	−1.90	−4.0***	−0.61	−0.9	−1.99	−3.1***
Hypothesis 1: Attitudes toward exporting								
M2_Adaptation of product to foreign markets	0.24	2.82***			0.32	3.02***	0.43	4.02***
G2_In exports, risks outweigh benefits	−0.27	−3.9***	0.19	2.42**				
G3_Difficult to secure export agreements							−0.13	−1.6*
G4_Exports allow us to use full capacity					−0.21	−2.8***		
G5_Sales diversification enables us to reduce risks	0.18	2.62**						
G6_To export, diversification of product portfolio is required					0.13	1.72*		
G7_Export margins are lower than domestic margins	0.11	1.82*						
Hypothesis 2: Subjective norms								
N1_Institutional support	0.18	3.32***						
N4_Administrative costs and legal barriers							0.15	1.82*
N5_Country image	0.14	1.62*			−0.29	−2.6***		
N7_Spanish and EU regulations					0.30	3.82***		
N8_Exchange rates	0.13	2.12**			−0.16	−2.0**		
N9_Uncertainty of payment							0.21	2.42**
N11_Denomination of origin label in home market			0.18	2.72***				
N13_Participation in regulating body					0.15	2.12**		
N14_Exports improve firm image							−0.13	−1.5*

Continued

Table 14.4 Continued

Variable	**Intention factor 1 FIN1**		**Intention factor 2 FIN2**		**Intention factor 3 FIN3**		**Intention factor 4 FIN4**	
	Beta	**t**	**Beta**	**t**	**Beta**	**t**	**Beta**	**t**
Constant	−3.84	−6.2***	−1.90	−4.0***	−0.61	−0.9	−1.99	−3.1***
Hypothesis 3: Situation compared with foreign competitors								
VC1_Competitive on prices			0.12	1.62*				
VC3_Competitive on design	0.13	1.72*						
VC4_Competitive on specificity	0.16	2.12**						
Hypothesis 4: Firm age								
Firm age			0.19	2.12**				
R^2	0.53		0.15		0.27		0.21	
Corrected R^2	0.49		0.11		0.22		0.18	
F	12.8***		4.6***		5.6***		5.8***	

Notes: (a) Includes only those variables that were statistically significant in at least one regression. ***, ** and * indicate statistical significance at 1, 10 and 15%, respectively.

belief that they show lower sales margins than domestic markets. Moreover, in the non-priority exporting intention, characterised by having a primarily domestic market focus (FIN2), the belief that in foreign markets the risks outweigh the potential benefits has a positive coefficient.

The results reveal the existence and influence of adverse risk attitudes on the formation of intentions. In the most dynamic intentions, exports are considered a means of reducing the overall business risk, and in the less active intentions, the prevailing perception is that the risk involved in the export activity outweighs the potential benefits.

Hypothesis 2: Subjective norms are an important factor explaining export intention.

Under subjective norms, we include the influence of proximity or environmental factors as the importance of country or regional image or the institutional setting in promoting or restricting exports.

The first finding is the positive influence of the valuation of institutional support as organised promotion schemes, and the belief in the influence of country image as an aid to foreign market entry to explain the most active export intention (FIN1). Otherwise, the variable 'influence of country image' has a negative coefficient in explaining the incipient export intention (FIN3). Although somewhat surprising, this finding may be explained by the incipient and selective nature of this type of export intention and the fact that at this stage it could be more important to rely on other variables (for example, the image of the firm or regional images) to gain market share.

The results obtained regarding belonging to a DO showed a favourable association with domestic market, explaining the non-priority export intention (FIN2). Participation in actions promoted by the regulatory body relates positively to incipient exporting (FIN3), where the support of regulatory bodies could prove essential to introductions in new markets. This result highlights the difficulties confronted by medium and small firms associated with developing promotion strategies that induce them to develop collective brands (Martínez and Medina 2010).

Regarding the institutional setting in promoting exports, the perception of Spanish and EU regulatory norms as obstacles has a positive and significant effect only on the incipient export intention (FIN3). This finding is not surprising, as the perceived difficulty in increasing exports explains this intention.

More significant is the perception of the importance of exchange rates. The evolution of exchange rates can imply both serious barriers to exporting and a stimulus to start or expand exporting (Leonidou et al. 2007), and it can introduce a source of risk in the decision-making process. Our findings reveal the positive influence of this factor on the formation of the more dynamic export intention (FIN1) but a negative influence on incipient exporting (FIN3). This difference can be explained by the more active wineries exporting to a larger number of external markets with high exchange market risk, while the other wineries initiating the activity engage with closer markets (that is, other EU countries), where this risk does not exist or is smaller.

Finally, there are two subjective norms with a significant influence on the intention to consider exports (FIN4): the perception of administrative costs and legal barriers in some destinations being the main obstacles to export plans and the uncertainty over receiving payment. These findings are similar to those of Pinho and Martins (2010) for medium and small Portuguese firms.

Hypothesis 3: The greater the perceived situation regarding foreign competitors, the stronger the intention to export.

Our results lead us to accept the hypothesis mainly for the most active export intention (FIN1), supporting the findings of Sommer (2010), which suggests that wineries that feel well-positioned to compete with foreign firms in design and wine specificity tend to pursue an active export strategy. For the non-priority export intention (FIN2), the variable associated with competitive advantage over foreign rivals is price.

Hypothesis 4: The older the winery, the stronger the intention to export

Finally, the hypothesis about the effect of firm age on export intention is partially confirmed. The results show that firm age has a positive impact on the non-priority export intention (FIN2), indicating that a long history may imply more traditional business practices. However, it does not have a significant effect on the more active export intention (FIN1), which may be because the most active wineries in international markets are emerging groups with a clear export orientation (Martínez and Medina 2010).

14.5 Conclusion

First, the findings suggest that the TPB is valid in this context and can potentially explain the formation of export intentions from attitudes, subjective norms, perceived behavioural control and past behaviour. This finding represents enrichment of the knowledge of the factors that lead to the formation of the theory and contributes to its further development.

All the hypotheses, with the exception of the influence of past behaviour, have been accepted. The results suggest that the experience may not have a direct effect on the formation of intentions and that younger wineries can show a more active intention than older wineries.

However, the results also show that exporting is a key issue for most wineries, as manifested by a continuous search for new markets, export development efforts, specific export promotion budgets and a commitment to export training for management teams. Despite the general view that exports enhance the image of a firm and diversify risks, the domestic market continues to be the main production outlet for most of the wineries that do not see foreign markets as the key to their future viability.

The more dynamic intention places the emphasis on innovation in terms of label and bottle design, the use of specific marketing techniques to enable the firm to compete in hotly disputed markets, and the development of new products as a means to adapt to the increasing sophistication of consumer demand.

Firms taking this approach also believe in the effectiveness of promoting quality and specificity as a means of gaining a competitive advantage over other wine-producing countries. Price is significant only in explaining the more traditional approach. This marks a major change in the export attitude of Spanish wineries, which are increasingly shifting their emphasis to a search for better quality and pride in the specific characteristics of their wines, which represents a departure from the traditional approach whereby Spanish wines aimed at the low-price segment are now the target for bulk table wines.

The results cast some doubt on the role of the DO to promote more dynamic export activity. Although wineries generally value DO membership, respondents prefer to rely on the promotion of their own brand as a way to increase sales abroad.

Several points are worth noting with respect to the effects of subjective norms on the formation of export intentions. First, the removal of legal barriers and the reduction of administrative costs would stimulate both active and incipient export intentions. Public action might have some potential in this regard. The results suggest that specific policies to pursue these goals would encourage more dynamic export behaviour in the wine industry. Another potential key driving factor is institutionally funded export promotion schemes. Finally, with respect to the role of country image in explaining the more active export intention, the projection of the cultural values and way of life of a country can be a useful tool in generic promotion campaigns.

This study has some limitations that must be specified. First, although our sample of wineries is statistically representative of the studied universe, it is relatively small. An improvement and enhancement of the sources of information would allow us to better quantify some of the explanatory factors of the export intentions, specifically attitudes and perceived behavioural control, which are more dependent on the subjective characteristics of the respondents. This would increase the explanatory capacity of the models and would also allow us to continue with future research, because we could analyse the degree to which those intentions, conditioned by barriers and skills, transfer to an active behaviour in foreign markets. Finally, more sophisticated methods could be applied to an augmented available dataset.

Acknowledgements

We would like to thanks the participants at the 4th American Association of Wine Economists, Davis (USA) and at Enometrics XVII, Palermo (Italy). In any case, this chapter is a revised and expanded version of the papers presented in both conferences. This study is part of a research project financed by the Spanish Ministerio de Ciencia e Innovación under the National Research and Development Plan (Project AGL2006/6252).

Appendix

Appendix 14.1

Table A14.1 Statements about export intentions

Statements (*)	Mean	Standard deviation	Response distribution (%) 1	2	3	4	5
I1: Home market growth prospects are sufficient to meet our business growth plans.	2.7	1.22	20.4	22.1	25.7	25.7	6.2
I2: Our marketing plans are oriented towards expansion in the home market.	2.5	1.09	18.6	33.6	28.3	15.0	4.4
I3: The home market takes up all our effort and attention, and we keep a constant watch on its evolution.	3.1	1.30	15.0	19.5	21.2	29.2	15.0
I4: Our goal is to place a significant, but not majority, share of our sales abroad.	2.6	1.27	26.5	20.4	22.1	25.7	5.3
I5: We are continually exploring the possibility of entering new markets.	4.0	1.19	7.1	5.3	11.5	31.9	44.2
I6: We consider it very important to set aside a specific budget to promote our company abroad.	3.9	1.28	10.6	3.5	11.5	32.7	41.6
I7: We consider it very important to devote a specific part of our budget to conducting our own market research abroad.	3.0	1.41	18.6	23.9	17.7	20.4	19.5
I8: The importance we attach to exports has led us to set up a specific export department.	3.9	1.44	15.0	3.5	9.7	23.0	48.7

Continued

Table A14.1 Continued

Statements (*)	**Mean**	**Standard deviation**	**Response distribution (%)**				
			1	**2**	**3**	**4**	**5**
I9: Exporting has been a well-established strategy in our company for years, and it accounts for the bulk of our sales.	2.9	1.39	22.1	21.2	18.6	23.0	15.0
I10: Foreign market training for our management team (knowledge of markets, languages …) is something to which our company is deeply committed.	3.74	1.32	11.5	7.1	12.4	33.6	35.4
I11: In recent years, we have been conducting our main sales promotion activities abroad.	3.5	1.34	12.4	12.4	18.6	29.2	27.4
I12: We are concentrating our export activities in one or two countries for the time being.	2.0	1.21	48.7	19.5	15.9	12.4	3.5
I13: We are gradually increasing our number of export destination countries.	3.7	1.27	10.6	8.0	14.2	38.1	29.2
I14: We are unlikely to increase our proportion of foreign market sales.	1.9	1.10	52.2	21.2	15.0	9.7	1.8
I15: Exports are likely to account for over 50% of our sales in the near future.	3.1	1.51	21.2	17.7	16.8	17.7	26.5
I16: The home markets easily absorb our total output.	1.2	0.76	93.8	0.9	–	3.5	1.8
I17: The future viability of our company will depend on finding foreign markets for our wines.	1.2	0.75	95.6	0.9	–	–	3.5
I18: Our sales department is considering the possibility of exporting.	1.1	0.65	94.7	0.9	1.8	0.9	1.8
I19: Although we want to export, we are finding it difficult.	1.1	0.7	96.5	–	–	0.9	2.7
I20: We would like to export but lack the means to enter such competitive markets.	1.2	0.79	94.7	0.9		0.9	3.5

Continued

Table A14.1 Continued

Statements (*)	Mean	Standard deviation	Response distribution (%) 1	2	3	4	5
I21: We prefer to consolidate our domestic sales channels before turning to the export market.	1.1	0.53	94.7	1.8	0.9	2.7	–
I22: We think we need to export and are therefore making plans to learn about foreign markets and entry methods.	1.1	0.68	95.6	–	0.9	1.8	1.8

Note: * 1= completely disagree to 5 = completely agree.

Appendix 14.2

Table A14.2 Attitudes, perceived behavioural control and subjective norms

Factor	Statements	Mean	Standard deviation	Response distribution (%) 1	2	3	4	5
Marketing (*):	M1: Innovation in wine bottle and label design is essential if you want to be competitive.	4.0	0.88	–	5.3	21.2	39.8	33.6
	M2: To be competitive in foreign markets, you need to innovate to adapt your product to foreign market tastes.	4.0	0.83	–	4.4	19.5	45.1	31.0
	M3: Innovation in label and bottle design is more important in foreign markets.	3.5	1.10	3.5	15.9	28.3	31.0	21.2

Continued

Table A14.2 Continued

Factor	Statements	Mean	Standard deviation	Response distribution (%) 1	2	3	4	5
Management (*):	G1: Competition is strong in foreign markets, and a great investment effort is required to gain entry and consolidate sales.	4,0	0.95	2.7	2.7	21.2	39.8	33.6
	G2: The strength of competition in foreign markets means that the risks outweigh the possible benefits.	2.3	1.13	28.3	29.2	27.4	10.6	4.4
	G3: One of the biggest problems we face in exporting is the fact that it is so difficult to secure export agreements.	2.9	1.15	11.5	22.1	38.1	16.8	11.5
	G4: Exports allow us to use our full output capacity.	3.1	1.21	12.4	19.5	29.2	26.5	12.4
	G5: Sales diversification in foreign markets enables us to reduce risks.	3.8	1.13	6.2	4.4	22.1	34.5	32.7
	G6: To compete abroad, we need to diversify our product portfolio, which is difficult for our company.	3.1	1.14	10.6	19.5	32.7	27.4	9.7
	G7: The strength of competition abroad means that our export margins are lower than our domestic sales margins.	2.7	1.29	23.9	20.4	25.7	21.2	8.8

Continued

Table A14.2 Continued

Factor	Statements	Mean	Standard deviation	Response distribution (%)				
				1	2	3	4	5
Perceived control over behaviour (**):	VC1: Subjective evaluation of the firm's situation vis-à-vis its competitors with respect to prices.	2.8	1.19	15.9	24.8	30.1	20.4	8.8
	VC2: Subjective evaluation of the firm's situation vis-à-vis its competitors with respect to quality.	3.7	1.00	3.5	11.5	15.9	52.2	16.8
	VC3: Subjective evaluation of the firm's situation vis-à-vis its competitors with respect to design.	3.2	1.03	5.3	17.7	40.7	24.8	11.5
	VC4: Subjective evaluation of the firm's situation vis-à-vis its competitors with respect to the specificity of its wines.	3.4	1.07	6.2	8.0	39.8	28.3	17.7
Subjective norms (*):	N1: The institutional support we have received to organise events and attend trade fairs has played a significant role in helping us to run our business.	3.1	1.25	15.0	16.8	27.4	28.3	12.4
	N2: Institutional support is more important when selling abroad than when selling to the home market.	3.7	1.10	6.2	8.0	20.4	43.4	22.1

Continued

Table A14.2 Continued

Factor	Statements	Mean	Standard deviation	Response distribution (%) 1	2	3	4	5
	N3: The supply of reliable information from official bodies (ICEX and others) and private institutions about foreign markets has been useful in organising our export plans.	3.3	1.08	9.7	7.1	38.1	33.6	11.5
	N4: The administrative costs and legal barriers that exist in some markets seriously hamper our possibilities of selling abroad.	3.6	1.14	3.5	14.2	27.4	26.5	28.3
	N5: A good country image facilitates foreign market entry.	4.2	0.81	0.9	0.9	16.8	41.6	39.8
	N6: Official promotion is important for opening up markets.	3.6	1.14	8.0	5.3	26.5	36.3	23.9
	N7: Our foreign sales are hampered by Spanish and EU regulations.	2.7	1.15	13.3	33.6	32.7	9.7	10.6
	N8: Changing exchange rates have a major impact on our sales abroad.	3.6	1.15	3.5	14.2	29.2	24.8	28.3
	N9: One of the main difficulties in export market management is the uncertainty of obtaining payment.	2.9	1.12	12.4	23.9	34.5	21.2	8.0
	N10: The denomination of origin label on our wines is well received in foreign markets.	3.5	1.29	9.7	15.9	15.9	33.6	24.8
	N11: The denomination of origin label on our wines is well received in the home market.	3.4	1.32	13.3	12.4	14.2	38.1	22.1

Continued

Table A14.2 Continued

Factor	Statements	Mean	Standard deviation	Response distribution (%)				
				1	2	3	4	5
	N12: With a view to increasing our market share, it is better to promote our own brand than to rely on denomination of origin.	3.8	1.08	2.7	8.8	26.5	29.2	32.7
	N13: We take an active part in events organised by the regulating body because they help to boost our business strategy.	3.4	1.17	8.8	10.6	28.3	33.6	18.6
	N14: Exports help to improve our firm's image.	3.9	1.07	5.3	3.5	18.6	38.9	33.6

Note: * 1= completely disagree to 5 = completely agree; **: 1 = no advantage 5= great advantage.

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Part V

New Topics

15
Wine Tourism and On-Site Wine Sales

Françoise Bensa and Marie-Claude Pichery[1]

15.1 Introduction

The concept of oenotourism first appeared in the 1980s and was really developed in the 1990s although action relating to this type of tourism and vineyard visits had already begun to take place in several viticultural regions. One dimension of wine tourism is linked with the organisation of trips and the reception of visitors. In this aspect, France became a pioneer when the first *Route des Vins* was created in 1934 in Burgundy, followed by the *Routes des Vins* (wine roads) of Alsace and Champagne in 1953. This model was adopted and enhanced in Europe, followed by other great viticultural regions of the world, in particular the United States (Robert Mondavi's objective was to educate the public about wine when he created the first winery with an open cellar in California in 1965) and later in Australia.

The definition of oenotourism or wine tourism – *œnotourisme* for Francophiles – was established by different national organisations (such as the Conseil Supérieur de l'Œnotourisme, created in 2009), European organisations (the Charte Européenne de l'Œnotourisme, and the Assemblée des Régions Européennes Viticoles, AREV, created in 1994), and global organisations (the Organisation Mondiale du Tourisme, OMT). This form of pleasure-oriented tourism is associated with the discovery and exploration of a viticultural region, its people and its products as well as its heritage, directly and historically linked to wine. Behind the overall demand for and offer of services are professionals in the field of viticulture, and heads of tourism offices and tourist agencies; they develop initiatives and offer services in order to assure a pleasant reception and the success of the visitors' trips. The domain and winemaker remain the centre of this activity, of which S. Lignon-Darmaillac (2009) presents different example in France.

What does this type of tourism bring to a domain or a winemaker directly involved in this new activity? Increased sales? Contact with clientele and potential consumers? One possible way to become known? And what do visitors expect when they come to visit the vineyards? How does one prepare for them? These are the types of questions that will be addressed in this chapter. After a presentation of the actors and their expectations in Section 15.2, we will explore the aspects of experiential marketing (Section 15.3), followed by the empirical aspects from a study conducted in Alsace and Burgundy presented in the next two sections (15.3 and 15.4). Section 15.6 briefly concludes.

15.2 The actors of wine tourism and their expectations

The choice here was to analyse the actors' behaviour by laying the emphasis principally, but not exclusively, on the relationship between the tourists and the winemakers who welcome the tourists to their estate. With the development of this type of tourism at the heart of viticultural zones, it is apparent that each actor's expectations have evolved over recent years. The objective of older studies (AFIT – Agent Franccaise de l'Ingénierie Touristique 2001, for France; Gatti and Maroni 2004, for Italy) was to identify what it is that visitors and tourists come in search of. This clientele is local or regional as well as national or international. These investigations (conducted between 1999 and 2000) revealed the existence of several types of vineyard enthusiast: of the region, of the wine and of touristic offers. There are the professionals of the wine world, cultured people and wine enthusiasts, but also tourists that arrive by chance. Most visitors are principally interested in the landscape, gastronomy and art; when they travel, they want to meet the producer, visit the winery, vineyards, cellars and wine warehouses, and then learn production techniques as well as tasting and purchasing wine. Winemakers and their professional partners must supply a suitable response to each of these different demands.

More recent investigations in each of France's viticultural regions (Atout France 2010) reveal that a percentage of the visitors are no longer simply looking to purchase one or several wines but wish to live an unforgettable experience by meeting producers at their domains. Although these tourists tend to have different levels of knowledge about and commitment to wine and wine production, they are quite frequently 'enlightened connoisseurs' asking for information, requiring meetings and discussions with a winemaker; some may wish to have access to vineyards as well as domain installations; and outside the commentated tasting, others wish to learn how the winemaker works and which methods he or she uses. The winemaker needs to know how to satisfy this new type of demand, to be ready to respond to the occasional very specific question and to reallocate time from other activities. These are privileged moments, not just communicating the entirety of the activities that take place within the domain, presenting the diversity of their wines and their association with other products (cheese, *charcuterie*,...), but also inciting the discovery of new products, that may be unknown to the visitor, or not of priority in tasting. The winemaker's reputation outside the region is often at stake as well, as visitors will share their experience with their social circle after returning home (the powerful phenomenon known as word of mouth). The winemaker can also expect a return in the form of network building and client contact.

If an individual visit is a privileged moment in order to create a personal relationship with a visitor, it can also take on a collective form for festive occasions such as picnics in Alsace, open days, winemaker festivals, and village festivals organised by joint trade organisations or other organisations.

Winemakers are at the heart of the different activities proposed, and their profession has evolved profoundly over time. If at the outset they were cultivators of vines, producers of grapes and then winemakers, they have gradually been obliged to become company and estate directors, managers and strategists; as a result, they have found themselves deeply involved in the sales of their production (grapes, must, and then, little by little, bulk or bottled wine). Unable to carry out all of these functions alone, they must count on the help of their family (life partner, children, parents) and hire paid employees. Moreover, winemakers today have become more and more involved in the protection of their land and patrimony, engaged in the protection of the landscape and in the process of sustainable development.

Concerning the marketing of wines, Castaing (2007) and A. Moullec (Loire wines) explain that oenotourism encourages the development of new clientele for certain winemakers who do not have total control over their distribution network. In a privileged manner, it puts them into direct contact with their clientele, which could eventually help them increase their profits and give them the opportunity to offer supplementary services (tastings, accommodation, catering etc). Oenotourism also creates a loyalty conveyor to sell wine on the property.

For the family domains, providing a welcome to visitors to their farm, and competition with other winemakers in their viticultural area, become an incentive to redesign their buildings in order to ensure a professional, yet convivial, welcome (the requirements will include reception rooms and tasting rooms, views of the vineyards, photos for decoration, cards, objects relating to work on the vineyards, even a slide show). Speeches to visitors have to be carefully prepared and adapted to the audience (whether novices, enthusiasts, connoisseurs or children) particularly when references to the *terroir* are a part of the specificity of the vineyard. The presentation of the domain's plots, the differences of other villages, and snippets of news about viticultural zones and foreign vineyards are all types of information which visitors and buyers are very fond of, and are also elements that add value to the wine offered by the winemaker. These cultural and patrimonial dimensions are today part of the winemaker's environment and the visitor's expectations. The latter want to add value to their vacations and leisure time in terms of culture, discovery, *art de vivre*, gastronomy and authenticity; they want to discover the wines that constitute the *patrimony of appellations* of a region, to taste and experiment sensory analysis. They wish to find out about the jobs and techniques of vine and wine that form the *patrimony of know-how* that winemakers, coopers and so on have constructed through the years.

15.3 Wine tourism in terms of experiential marketing

Experiential marketing, emphasising the involvement of the clients and their reactions to the setting, sheds new light on the behaviour of tourists when they decide to visit a domain. Pioneering initiatives include the *Hameau du Vin* at Romanèche-Thorins, near the museum and industrial site, and the Winery in Bordeaux, with its discovery centre featuring educational, multi-sensory and highly original workshops that involve visitors in a tasting to help them find their *Signe Œnologique* ®. Such services are, however, out of reach of small estates and they must be inventive in order to provide different forms of entertainment to their visitors and customers.

The viticultural universe

Viticultural tourists aim to immerse themselves in the universe of the product and engage in a unique experience. In consequence, it seems pertinent to attach wine tourism to experiential marketing. For Caru and Cova (2006) 'experiential marketing offers to consumers an immersion in extraordinary experiences rather than the purchases of simple products and services'. Indeed, the consumer who travels to visit a winemaker is looking for immersion in an original adventure that will touch all his senses and present the opportunity of feeling a personal emotion. The winegrower who offers a tasting in his cellar puts the consumer at the centre of the event. Cova (2002) specifies that 'the value to the consumer does not only lie in the purchased product, in the chosen brand or in the possessed object, but also in the experience of the purchase and the consumption he experienced on this occasion'. This trend seems essential to the comprehension of the enthusiasm of consumers for oenotourism. As Meyronin (2006) shows, what clients consume is in fact a form of excitement (related to the place, its ambiance and decor), and they will keep the memory of the place and the magical moment they shared with others and will continue to share through the souvenirs – the products – they will have brought back home.

Winemakers have well understood that the experience of wine tasting is a way of avoiding trivialisation of the product. What follows is a combination of relationship between the client and the product, the story of the product and the role of the physical environment (Mencarelli 2008). A visit to the domain can result in an adventure that combines hedonistic (pleasure in the product), with cognitive (rich intellectual experience) and social (based on the relationship with the winemaker) components (Mencarelli 2008; Filser 2002). For the visitor, immersion in the viticultural universe can begin with a site visit (the landscape and its 'reading', contact with the plants and their various stages of annual development, and viticultural work through the seasons). The visit will be followed by a presentation of the winery and the cellar (explaining the winemaking process, oenological practices and agricultural methods) before moving on to the tasting itself.

Decor and ambiance

The place of tasting will also support the winemaker's image: the vaulted cellar, barrels and gravel floor will accentuate authenticity and contribute to a warm ambiance; this place is set to create emotional and imaginary evocations by a form of enchantment. Tastings may, however, be held in places other than the cellar. The countryside, too, will have an influence on the tasting. Winemakers who have buildings available will equip these with a welcoming decor (cards, objects related to work in the vineyards, posters, paintings related to sensory aspects of wine) and if possible will offer views of the vineyards. If the countryside can occasionally be an argument for direct sales of wine, the experiments conducted by Tomasi and his colleagues (2005, 2006) then Tempesta et al. (2010) confirm that in beautiful surroundings the perception of wine and its sensorial evaluation (olfactory and taste appreciation) are modified as a result of 'a psychological perception that is of capital importance'; even professional tasters are influenced by photographs of more or less aesthetic viticultural landscapes. In this way the landscape, having a significant effect on the sensory appreciation, can add value to wine and play a role in the ultimate pleasure of its consumption.

This confirms the importance of decor and ambiance. It is necessary to create a proper place to dramatise the tasting area, which must have total coherence in its smallest details (Pine and Gilmore 1999) in order to stimulate the five senses of the individual. Caru and Cova (2006) condense the production of experience into three main facets corresponding exactly to what the consumer can find at the winemaker's estate:

(i) the decor, design and setting, with a special attention paid to multisensorial stimulation (taste, sight and smell for the tasting; touch, sight and hearing for the ambiance). The objective is to develop different spaces to arouse positive emotions in the consumer that surpass the singular functionality of the act of purchasing and give a meaning to the process of consumption (Ochs and Remy 2006);

(ii) the active participation of the consumer while visiting the cellar or vineyard, or even at a tasting, involves and appropriates the environment;

(iii) the narrative, the story, the plot that develops; what fascinates the consumer is to discover the life of the winemaker, the history of the vineyard and the domain.

The study by the CRT Bourgogne (Comité Regional du Tourisme) in 2007 shows that what tourists look for is the ambiance of the vineyards, their meeting with the winemaker and the discovery of their know-how and traditions, and of course the tasting and purchase. These elements correspond with those made evident by Bergadaà (2008) in the experience of the authenticity of arts and crafts products and artisans. As a result, the author demonstrates that the experience of authenticity depends on three dimensions: the object itself (here it is wine that is the fruit of the expertise of the winemaker), the profession (the winemaker's passion for the product, evolution of tradition and transmission of expertise) and the link between the artisan (winemaker) and his client. On the other hand, it seems logical to add the region and more specifically the *terroir* that are in the case of wine the most important determinants of the authenticity of the product (Camus 2004; Cova and Cova 2002). As a result, wine is the fruit of *terroir* (Rigaux 2006).

Cova (2002) describes the four phases that constitute an experience: anticipation of consumption, purchasing, consumption itself, and finally memories. The staging of the offer will therefore be the differentiating element and the value creator for the company. As Caru and Cova (2006) and Meyronin (2006) specify, it is important to hold on to memories – and this is where the direct sale comes in, so that the consumer can take back some of the products in order to relive this unforgettable experience. It is therefore necessary to create a favourable atmosphere during the visit to the cellar and the tasting in order to trigger purchasing decisions.

But the inclination towards 'recreational' behaviour in the visitor creates a risk for the producer that the visit will not turn into a purchase (Mora and Castaing 2005). To overcome this problem the winemaker must first precisely tailor both his speech and his product to meet the customers' expectations, and then offer them a range of wines of the same quality in appellations as well as in price.

On-site sales and customer loyalty

The direct sale is not a notion clearly defined by all members of the viticultural profession. Vicard (2006) proposes a summary of diverse definitions. The statistics published by FranceAgriMer cover sales of bulk wine as well as bottled, distinguishing direct sales in export and traditional stores, restaurants and the community, from other direct sales (individuals, mail, internet, fairs, wine shows and so on). In the current study, we stipulate that direct sales concern the 'sales to individuals that take place on or originating from the domain'. As a result, sales in the cellars, by mail-order and online are included, but not sales at fairs and wine shows.

Customer loyalty arises from the consumer's perception after the visit and/or the purchase. The excitement and unexpected aspects are strongly emotional components. The objective of the winemaker is to make each consumer feel that the experience they lived was created especially for them and can be renewed. This impression can be maintained by letter, by regularly sending information by email (with links to websites giving updates about the life of the winemaker, the domain, the evolution of the wine, a recognition or award from a contest), with blogs, mailing lists to send individual invitations to events: open days, picnics with the winemaker (in Alsace), gastronomic markets and walks (in Burgundy and Alsace), and participation in fairs and wine shows.

But above all even if the wine is a famous one, it is essential to make the existence and the content of these offers known through articles and advertisements in guides and magazines, whether specialised or general-interest, as well as tourist guides, and also with the collaboration of prescribers such as restaurant owners and sommeliers. For this reason, the quality of wine tourism activities in a region depends on a large number of actors, and winemakers must think about appearing on tourist networks in connection with tourist offices.

On-site sales and proximity

The analysis of direct sales at the domain refers to the concept of buying local (Traversac 2010); this form of sale is a partial response to the recent concern in development of short circuits in the food industry, with a reference to food miles. With a *spatial proximity* the emphasis is on the distance imposed on visitors in order to get to the winemaker. The frequency of visits may depend on whether the customer is local, regional or even more distant; if they visit two or three times a year, this will be a form of loyalty that winemakers may well wish to protect. Relying on the local market with the objective of retaining customers located close at hand can constitute a form of security, especially if exposed to cyclical phenomena.

A second type of proximity is the *relational proximity* that at its origin corresponds to the limitation of the number of intermediaries between the producer and the final buyer, whether the purchase is made for personal consumption or as a gift. An encounter at a domain corresponds to a situation with a total absence of intermediaries. It may also be the case where, following an initial contact with both parties satisfied, a form of 'dematerialisation' relationship leads to regular purchases despite the existence of a spatial distance, or only occasional meetings. We could equally evoke *cultural proximity*, considering that one of the oenotourists could originate from wine-producing nations.

The development of wine tourism leads to the question of its influence on the situation of the businesses. The objective here is to perform an assessment of the wine tourism activities put in place by the winemakers in two regions

(Alsace and Burgundy) and then identify and measure their effects on direct sales.

15.4 Methodology

The questionnaire

The first objective of the questionnaire is to understand the wine tourism activities practised by wine-producing domains in Burgundy and Alsace, two regions with economic and cultural models that are apparently different in both wines and types of visits: Burgundy, which puts its emphasis on their *terroirs*, and Alsace, known for its grape varieties and a tendency to promote its grand crus. During the Entreprissimo show in Dijon in November 2007, J. Richard, member and founder of Clos Mosaïc, and M. Dumont, Leader of ODIT (Agence Franccaise d'Ingénierie Touristique), made an inventory of the wine tourism offers in Burgundy: 100 per cent offered tastings (17% paid); 81 per cent cellar visits (14% paid); 20 per cent vineyard; 15 per cent accommodation; 10 per cent oenological introduction; 6 per cent meals. We applied these different activities, to which it seemed judicious to add participation in or creation of an event, and the sale of local products.

For the principal activities (tasting, cellar and vineyard visits, events, accommodation and catering) we attempted to evaluate the importance of activities in terms of attendance (average annual number of people participating) and the effects on the clientele (percentage of people that bought wine on this occasion and percentage of people who, having bought wine at the time, became loyal clients – that is, who subsequently made purchases at least once a year).

The second objective is to evaluate the influence of the listed activities on on-site sales. Sales were measured in two ways: first, by interrogating the winegrowers on how many hectolitres were sold in 2011 for each channel of distribution, and second by calculating the percentage of increase in their sale at the domain that created and implemented these wine tourism activities.

More general questions finished the survey: an estimation of the investments required to set up wine tourism activities, the types of communication practised by the domains, the type of clientele at the winery and the winemakers' motivations to put these activities in place.

Sample and method of questionnaire administration

The questionnaire (available from the authors) was self-administrated via email. The sample group size was 376 responses, 212 coming from domains in Burgundy (out of 2756 farms there) and 164 from Alsace (out of 1035). These two regions have production based almost exclusively on the Appellations of Origin (AOC/AOP) formerly known as VQPRD (*Vin de Qualité Produit dans des Régions Déterminées*).

Table 15.1 Distribution of winegrowers (in VQPRD) depending on the size of the VQPRD production

	Less than 5ha	**5–10ha**	**10–15 ha**	**15–20 ha**	**more than 20ha**	**Together**
Alsace	3 777 76.12%	888 17.90%	218 4.39%	49 0.99%	30 0.60%	4 962
Sample	**8.5%**	**42.1%**	**26.2%**	**6.7%**	**16.5%**	**(164)**
Bourgogne	2 505 52.79%	1 278 26.93%	564 11.89%	210 4.43%	188 3.96%	4 745
Sample	**14.2%**	**31.1%**	**25%**	**10.4%**	**19.3%**	**(212)**

Note: VQPRD means *Vin de Qualité Produit dans des Régions Déterminées.*

Source: FranceAgriMer – statistics 2010 – http://www.onivins.fr/pdfs/641.pdf

Table 15.2 Number of hectolitres sold in accordance with distribution channels

	Alsace		**Burgundy**	
	FranceAgriMer	**Sample**	**FranceAgriMer**	**Sample**
Wine merchant + wholesaler + GD	39.85%	37.96%	57.75%	50.77%
Direct sale (cellar man and CHR)	16.53%	14.41%	20.91%	13.8%
Other direct sale (on-site sale)	43.62%	47.63%	21.44%	35.36%

Note: CHR means Café – Hôtel – Restaurant; GD means *Grande Distribution.*

Source: sample and statistics from FranceAgriMer – 2010.

Regarding size of domain, the sample group is mostly composed of companies with more than 10 hectares, which does not reflect reality (Table 15.1). This can be explained by the fact that farms of less than five hectares did not feel our questionnaire concerned them; indeed, the term ‘wine tourism’ could well have disconcerted them because in general they sell their production to wine merchants and do not have open cellars; and businesses with more than 20 hectares generally have a marketing department that took the time to fill the form.

On the other hand, the sample group perfectly reflects the reality of distribution circuits.

In Burgundy, 60 per cent of sales are made to wine merchants while in Alsace sales are mostly conducted directly on the property (chi^2 significant at 96.9%); perhaps this is something that can explain the enthusiasm of winemakers for wine tourism, as they may consider it a way of escaping the wine merchants and thus the possibility of making higher profits. But what is it really? This is the question we are trying to answer. It will therefore be interesting to make a comparison between the two regions; which will be the subject of the third part of the results.

15.5 Analysis of results

One hypothesis is taken from the sample: the more the estate offers in the way of activities, the higher the on-site sales.

The influence of wine tourism activities on on-site sales

The link between sales and wine tourism activities offered by domains is captured by the use of a model of structural equations used particularly for marketing studies and adapted to information in qualitative form. After a presentation of fixed variables, a diagram of relationships will be followed by the estimated model.

Variables

Wine tourism activities from the 376 responses are summarised in Table 15.3.

It can be noted that we find nearly the same percentages as do J. Richard and M. Dumont for tastings (the 3.5% who do not offer free tastings charge for them) and for cellar visits. On the other hand, the results from the data are greater for visits to the vineyards, accommodation and catering; they are less for introductions to oenology. One might think that since 2007 some techniques have been developed; regarding the introduction to oenology in particular, it seems that this is practised more by specialised wine tourism agencies or wine retailers, who were not part of the sample data.

Sales : on-site sales are significant and represent on average 40.98 per cent of sales of the domains considered (Table 15.4); then wine merchants are the intermediary that put the most wine onto the market (25.32%) or into

Table 15.3 Wine tourism activities

Activities	Number of responses	Frequency
Free tasting	363	96.5%
Paid tasting	113	30.1%
Cellar visit	319	84.8%
Vineyard visit	177	47.1%
Catering	35	9.3%
Accommodation	88	23.4%
Introduction to oenology	14	3.7%
Sale of local products	70	18.6%
Events	129	34.3%
Other	35	9.3%

Table 15.4 Distribution channels

Distribution channels	**Average percentage**
Trading company	25.32%
GMS	3.37%
Wine merchants	6.31%
Catering	7.76%
Export	16.02%
Hard discount and cooperative wineries	0.34%
On-site sales	40.89%

Note: GMS = *Grande et Moyenne Surface.*

Table 15.5 Percentage of increase in on-site sales after setting up wine tourism activities

Sales after wine tourism activities	**Number of responses**	**Frequency**
Less than 10%	155	41.2%
10–30%	153	40.7%
30–50%	45	12.0%
50–70%	13	3.5%
70–90%	2	0.5%
More than 90%	8	2.1%
Total responses	**376**	**100%**

direct export (16.02%). The increase in direct sales after the implementation of wine tourism activities (Table 15.5) is for the most part (41.2%) below 10 per cent, or (40.7%) is between 10 per cent and 30 per cent.

Thus nearly 82 per cent of winemakers declare that their sales have increased by at least 10 per cent or from 10 to 30 per cent following the implementation of wine tourism activities.

The model of structural equations

This model (Chin 1998) permits (i) relationships to be established between numerous predicted and predictive variables, (ii) underlying and directly non-observable variables ('wine tourism activities' and 'sales') to be introduced (iii) the measurement error of observable variables to be taken into account, (iv) specific relationships to be statistically tested from a theoretical point of view. This analysis of covariance structures is used in nearly all research applying structural equations to marketing (Korchia 2001). The following model was tested with Statistica's SEPATH.

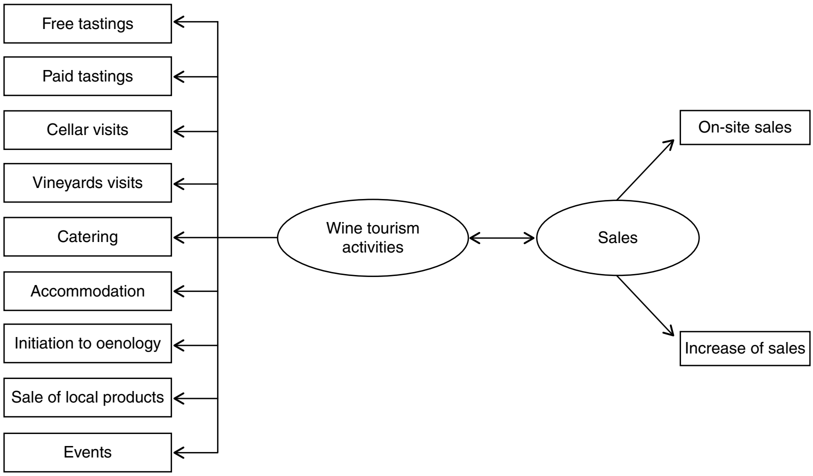

Figure 15.1 Model structure

Table 15.6 Adjustment indices

Criterion	Value	Criterion	Value
chi^2	79.916	GFI	0.935
dof	43	AGFI	0.900
p-value	0.001	RMSEA	0.064
RMC	0.069	chi^2/dof	2.98

Table 15.6 provides the adjustment indicators of the theoretical model for the empirical data. Their values allow us to ensure that the adjustment is correct.

Table 15.7 shows factor contributions of indicators on underlying variables.

This table provides the factorial weight of each variable on the factor specified by the model. We also find the variance for terms of error (DELTA1 to DELTA11) and finally the estimation of the correlation between ‘sales’ and ‘wine tourism activities’ factors.

As regards the variables associated with 9 *wine tourism activities*, the adjustment of the theoretical construct with these indicators is correct (ratio $t > 1.96$) except for the tasting ($t = 0.753$). This can be explained by the fact that tasting *per se* is considered as a basic, integral part of the winemaking profession, whereas the paid tasting event that is generally laid on for a group of tourists corresponds to a wine tourism activity.

The variable ‘sales’ is measured here only by the percentage of on-site sales, not by the percentage of increase in sales after the implementation of wine

Table 15.7 Model estimation

	Estimated parameters	Std errors	t-statistics	p-value
Tasting	*0.014*	*0.018*	*0.753*	*0.452*
Paying tasting	**0.181**	**0.040**	**4.546**	**0.000**
Cellar visits	**0.110**	**0.032**	**3.313**	**0.000**
Vineyard visits	**0.154**	**0.044**	**3.492**	**0.000**
Catering	**0.148**	**0.029**	**5.187**	**0.000**
Accommodation	**0.151**	**0.040**	**3.282**	**0.000**
Introduction to oenology	**0.071**	**0.018**	**3.955**	**0.000**
Sale of local products	0.196	0.037	5.352	0.000
Events	**0.266**	**0.043**	**6.254**	**0.000**
On-site sale	**0.202**	**0.049**	**6.699**	**0.000**
Sales after setting up wine-Tourism activities	*0.256*	*5.892*	*0.688*	*0.491*
(DELTA1)	**0.041**	**0.004**	**10.216**	**0.000**
(DELTA2)	**0.172**	**0.019**	**8.910**	**0.000**
(DELTA3)	**0.129**	**0.013**	**10.242**	**0.000**
(DELTA4)	**0.225**	**0.024**	**9.518**	**0.000**
(DELTA5)	**0.083**	**0.010**	**8.376**	**0.000**
(DELTA6)	**0.198**	**0.019**	**10.156**	**0.000**
(DELTA7)	**0.036**	**0.004**	**9.283**	**0.000**
(DELTA8)	**0.133**	**0.016**	**8.208**	**0.000**
(DELTA9)	**0.153**	**0.022**	**6.987**	**0.000**
(DELTA10)	**1.271**	**0.168**	**7.587**	**0.000**
(DELTA11)	**739.018**	**85.160**	**8.678**	**0.000**
Sales – wine-tourism activities	*0.686*	*0.946*	*0.725*	*0.468*

tourism activities ($t = 0.688$, inferior to 1.96). This reveals the weakness in reliability of this social construction; the indicators do not therefore measure the underlying variable 'sales' correctly. Nevertheless, the model shows that there is no relationship between wine tourism activities and sales; in consequence, our hypothesis is disproved.

However, if wine tourism activities do not influence on-site sales in the short term, it seems appropriate to ask about their effect on long-term sales. An analysis of variance between the percentage of on-site sales and the amount of time that accommodation and catering have been provided show that there is indeed a relationship. As a result, the longer these activities have been in place, the more the percentage of direct sales is significant.

The following paragraph is concerned with the suggestion of a typology of domains stemming from their wine tourism activities, followed by a detailed analysis of these different activities practised by the winemakers in our sample.

Table 15.8 Influence of the length of accommodation and catering on on-site sales

Length of accommodation	**On-site sales (%)**	**Length of catering**	**On-site sales (%)**
less than 2 years	26.90	Less than 2 years	27.45
2–4 years	22.87	2–4 years	**53.08**
4–6 years	**34.31**	4–6 years	–
More than 6 years	**49.49**	More than 6 years	**45.10**
TOTAL	**44.20**	TOTAL	**42.78**

Typology of domains with respect to their wine tourism activities

A precise analysis of the tourism activities introduced in the questionnaire allows for a qualification of viticultural domains according to the functions of the activities they develop. A classification is created by the use of k-means clustering, and the groups were determined using the following criteria: the parsimony or small number of classes, their homogeneity of groups (0.79), the distribution of the sample at the interior of classes (36.96) and the dispersion (1.5). As a result, four types of domain become apparent.

The four groups of domains

The activities proposed by domains that allow us to qualify and distinguish them are: paid tastings; tours (of cellar, of vineyard); offers of catering and/or accommodation; sale of local products; organisation of oenological courses; and participation in a range of events. The k-means tests (Table A15.1 and Table A15.2 in Appendix) lead to a division of domains into four classes, characterised by their implication in touristic activities (remembering that nearly all domains offer free tastings). The first group (96 responses, 25.5%) is concerned essentially with cellar and vineyard tours: the '*visitors*'. The second group, with a significant number (141 responses, 37.5%), offers a cellar tour; they are considered as '*classics*'. The third group, classified as '*Oenotourism Pro*' (88 responses, 23.4%) is particularly engaged in various activities: other than tastings and tours, they offer sale of local products, catering and courses in oenology, and participate in different local or regional events, as listed below. The last category (51 responses, 13.6%) offers only accommodation: these are the '*accommodation providers*'.

The content of these diverse activities offered to tourists are specified below.

Tastings: as we noted previously, the free tasting is not a discriminatory variable. Indeed, practically all the domains (96.3%) offer them, and those who don't offer a paid tasting. It is always the owner that hosts the tastings, but half the time he or she is assisted by a member of their family, and in the minority of cases (35.5%) by a paid employee.

Table 15.9 Characterisation of classes

Classes	Paying tasting	Cellars visits	Vineyards visits	Catering	Accomm-odation	Introduction to oenology	Sale of local products	Events
1	–	++	++	–	–	–	–	–
2	–	+	–	–	–	–	–	–
3	+	++	+	+	–	+	+	++
4	–	–	–	–	+	–	–	–

Table 15.10 Events

Events	Number of responses	Freq.
Reception of groups	17	7.6%
Open days	62	27.6%
Theme tasting	12	5.3%
Picnics	19	8.4%
Cultural activities	17	7.6%
Organised walks	12	5.3%
Fairs	14	6.2%
Introductions to tasting	9	4.0%
Marriages – parties	17	7.6%
Other	5	2.2%
Fairs – markets – festivals	38	16.9%
Sporting events	3	1.3%
Total responses	**225**	**100%**

Events: the participation or creation of an event is the prerogative of the *Oenotourism Pro* (class 3), a dynamic category involved with the reception of clients and prospects.

The event that is undertaken most by estates is the open day (27.6%), followed by participation in fairs, markets and festivals (16.9%). It is interesting to note that the former is an event arising from the domains' own initiative, while in the latter they are merely participants. Next, we find picnics, group hosting, cultural events, marriages and parties, professional wine shows, theme tastings and organised walks. Here we find the introduction to tasting that winemakers consider an event more than an activity. If we add these nine responses to the fourteen previous ones, the oenology courses come in at 6 per cent, similar to Richard and Dumont's results. We can also note that participation in sporting events by their organisation is rare. All the events are implemented 84.4 per cent of the time by the owner, who acts either alone (46.9%) or with the help of a family member (40.6%). In general, the large domains (chi^2 significant) will mostly use employees for assistance.

Accommodation: this activity is practised essentially by '*accommodation providers*' (class 4) and has been for over four years. In 62 per cent of cases, accommodation offered by the domain is in cottages, and in 36 per cent of cases in bed & breakfasts. It is usually the owner accompanied by a member of their family, who takes care of accommodation,.

Catering : less than 10 per cent of domains practise this activity. The services offered are in the same proportion as tables d'hôte, the restaurant and the picnic basket. The owner and a member of their family are the principal participants at tables d'hôtes or picnics. On the other hand, when there is a restaurant it is more often a member of the family, or an employee, or even an exterior contractor, that takes responsibility.

Characterisation of Classes

The four categories of domains identified above according to the wine tourism activities they offer will now be characterised by three criteria: first the types of clientele they serve, then information about sales and client loyalty, finally by the implemented investments in terms of development and means of communication. In the three tables below, only the explanatory variables of the differences between the classes (over-represented forms) are shown.

The clientele : the information collected from the 376 domains allows us to form an image of the origins of their clientele. 28.5 per cent are from the local region; foreign visitors represent 29 per cent, and the remaining French,42.5 per cent. Visitors come principally as couples (54%) then as families (30%) and finally in groups (16%) (the low percentage of groups can be explained by the fact that the sample is comprised mostly of small domains not adapted to the reception of large groups.) These differences allow us to distinguish the domains.

Table 15.11 Customers

	Visitors	**Classics**	***Oenotourism Pro***	**Accommodation providers**
Customer origin			Less French	Less local
Type of customer		Less groups	more groups Less couples	

Beyond the characteristics of the clientele that do not allow for the distinction of the four classes of domains, the *Oenotourism Pro* are distinguishable because they have turned towards clientele from abroad; they welcome fewer French than their colleagues, and they are better equipped to host large groups. The *accommodation providers* have a lower interest in a regional clientele, and the *classics* are more oriented towards an individual clientele.

The origin of the clients associating primarily with the *Oenotourism Pro* and the *accommodation providers* with a foreign clientele is coherent with the observation that Alsace and Burgundy are largely visited by people from neighbouring countries (Belgium, Germany, Switzerland) as well as wine enthusiasts and buyers of Anglo-Saxon origins. Beyond a geographical proximity (region), there is also an interpersonal proximity behind this clientele, even a cultural proximity for visitors with origins from places further away, such as viticultural zones like Australia and New Zealand.

Sales: these are measured here by their increase following the implementation of wine tourism activities, by the amount of the average basket when there is a purchase, and by the number of people welcomed.

Table 15.12 Sales and attendance

	Visitors	**Classics**	***Oenotourism Pros***	**Accommodation providers**
Sales percentage increase after Implementation of activities	Less than 30%	Less than 30%	More than 50%	Less than 30%
Amount of average basket	€50 to €150	€150 to €200	€50 to €150	Less than €100
Number of persons received (per annum) for tastings	Less than 200	200–400	More than 600	Less than 200

Here again, the *Oenotourism Pro* prove to be very active: they receive a large number of visitors (in general, they are equipped for it), and their sales have clearly increased (by more than 50%), but the basket remains moderate. It is the number of visitors and buyers that permit them to increase their sales. The *classics* come in second, but maintain an average that is greater than that of their colleagues. The characteristics of *accommodation providers* lead to the belief that they have other interests besides the increase of their sales (that remain interesting) and the reception at the domain (cellar, vineyard). As for *visitors*, they have seen their sales increase with a modest number of visitors and a basket with an average amount that is not negligible for the domain revenue.

Investment and communication: the information obtained is relative to investment in buildings, in employment and in commercial actions and advertisements. The strategies developed by the domains make the clearly different practices apparent.

Here again the *Oenotourism Pro* distinguish themselves: they do more communicating, participate in more organisations, re-contact their clients, receive mostly groups. They claim that all activities allow them to increase their on-site sales, but the average basket is weak and their direct sales are

Table 15.13 Investments and communication

	Visitors	**Classics**	***Oenotourism Pro***	**Accommodation providers**
Investments	Renovation	None	Salaried employment Point of sale creation Commercial activities establishment	Renovation Property purchase
Communication relationship			Tour operator Group of professionals Associations Promoting private enterprise	
Means of communication			Press advertising Radio advertising Poster Booklet distribution	

Table 15.14 Average person who buys wine during a wine-tourism activity (in %)

	Average percentage		**Average percentage**
Tasting	81.07	Lodging	64.27
Event	50.40	Catering	48.31

not more significant than other domains. We can assume that these activities have effects on the notoriety of the image and therefore have long-term consequences that would be interesting to measure.

In terms of communication relationships, all the domains are in contact with at least the tourist office and their trade organisation. When looking at the means of communication used, we find guides and personal internet sites in each class. The re-contact with clientele is done principally by traditional mail except for the *Oenotourism Pro* who re-contact clients by email. The telephone is no longer used, which is understandable because this takes too much time.

The activities that lead to the most purchases and create the most loyal consumers

It is during tastings that visitors tend to buy wine (81.07%). On the occasion of events or meals, only one in two people buy wine on average, and a little more if they have taken accommodation. Consumers are therefore more inclined to purchase wine while they taste with a winemaker.

Table 15.15 Among people who buy wine, the average people who become loyal customers (who bought at least once per year, in %)

	Average percentage		**Average percentage**
Tasting	45.19%	Accommodation	33.70%
Event	38.70%	Catering	38.74%

The activity that creates the most customer loyalty is the tasting (45.19%). In this setting, the consumer is surrounded by the universe of the winegrower and a link is created between them. The percentages of purchasing and re-purchasing are not correlated with the percentages of direct sales.

Comparison Alsace-Burgundy

According to the last study by Atout France (Tourisme et Vin 2010), if Alsace and Burgundy remain close in the number of open cellars, with a slight edge for Alsace (respectively 674 and 650), the two regions are distinguishable by the number of visits (respectively 1.4 million and 2.5 million). Alsace is presented as ‘a region of tradition that offers a potential appeal’ and Burgundy as ‘a reputed region, centred on wine’. They are also distinguishable in that Alsace is a region that is slightly distant, with assets in typicality, and Burgundy is an enclosed region with assets in expertise. In addition, if in our sample the structure of domains (number of hectares and employees) is the same in Alsace and in Burgundy, the elements of differentiation are apparent and are presented below.

Practice of wine tourism activities: Alsace does more cellar and vineyard visits and paid tastings, although the prices are the same between the two regions. This explains the over-representation of the class of *visitors* in this region. On the other hand, Burgundian winemakers participate in or create more events. There is also a difference in the level of type of event: open days are more common in Burgundy, while picnics – especially picnics on Whit Monday (Pentecost) – is an Alsatian tradition.

The number of domains that offer accommodation is identical in the two regions, but the difference lurks in the type of accommodation offered to guests and in the capacity of the reception. As a result, more Alsatian domains offer cottages, while more domains in Burgundy receive over 600 people per year. However, regarding tastings, the results are opposite: it is the Alsatians that receive more people per year.

Clientele: of the domains that responded to the questionnaire, the Alsatians receive more couples and fewer groups than their Burgundian colleagues, which allows for a greater relational proximity.

Sales: the percentage of sales to wine merchants is more significant in Burgundy, while it is dominated by on-site sales in Alsace (Table 15.2). We can perhaps explain this by the fact that Alsace has operated wine tourism for longer than Burgundy.

Communication: the Alsatians have less contact with their trade organisation. When they communicate, they do this more by email than the Burgundians, while the latter more often use guides and their trade organisation (Table A15.3 in Appendix). Re-contacting clients is done more by traditional mail in Alsace.

15.6 Conclusion

The analysis of the sample shows, in Burgundy as in Alsace, that even if the wine tourism activities offered by the winemakers do not have an influence on on-site sales to individuals in the short term , they do at least permit the creation of a relationship of confidence with the consumer that encourages the growth of customer loyalty and an increase in sales in the long term.

The maintenance of the winegrower–client relationship takes place through more or less regular contact. Globally, 86 per cent of winemakers re-contact clients who have come to their domain, and they do this by traditional mail (in 60% of cases) or by email (35%), and minimally by telephone (5%). Next, these clients come back (32%), send family or friends (32.5%) or place new orders (30.5%); this shows that in fact the wine tourism activities are important for attracting consumers and building a relationship between them and the domain; winemakers declare that these are the principal motivations to their offering wine tourism activities. As a result, the three principal elements that drive the development of these activities are, in order of importance: increasing direct sales, creating customer loyalty, and attracting new customers.

Appendix

Table A15.1 Domain classification and wine tourism activities (responses)

Paid tastings	**Yes**	**No**	**Total**	**Cellars visit**	**Yes**	**No**	**Total**
Classification				Classification			
Class n°1	32	64	96	Class n°1	93	3	96
Class n°2	27	114	141	Class n°2	113	28	141
Class n°3	45	43	88	Class n°3	82	6	88
Class n°4	8	43	51	Class n°4	29	22	51
Total	112	264	376	Total	317	59	376

Continued

Table A15.1 *Continued*

Vineyard visits	**Yes**	**No**	**Total**	**Catering**	**Yes**	**No**	**Total**
Classification				Classification			
Class n°1	96	0	96	Class n°1	4	92	96
Class n°2	0	141	141	Class n°2	4	137	141
Class n°3	72	16	88	Class n°3	21	67	88
Class n°4	4	47	51	Class n°4	6	45	51
Total	172	204	376	Total	35	341	376
Accommodation	**Yes**	**No**	**Total**	**Introduction to oenology**	**Yes**	**No**	**Total**
Classification				Classification			
Class n°1	18	78	96	Class n°1	2	94	96
Class n°2	0	141	141	Class n°2	1	140	141
Class n°3	19	69	88	Class n°3	9	79	88
Class n°4	51	0	51	Class n°4	2	49	51
Total	88	288	376	Total	14	362	376
Sale of local products	**Yes**	**No**	**Total**	**Events**	**Yes**	**No**	**Total**
Classification				Classification			
Class n°1	10	86	96	Class n°1	0	96	96
Class n°2	13	128	141	Class n°2	25	116	141
Class n°3	40	48	88	Class n°3	38	0	88
Class n°4	6	45	51	Class n°4	15	36	51
Total	69	307	376	Total	128	248	376

Table A15.2 Domain classification and wine tourism activities (chi^2 test)

	Chi ^{2}	**dof**	**1−p**	**Dependence**
Clas * paid tasting	32.23	3	=> 99.99%	Significant
Clas * cellar visit	47.59	3	=> 99.99%	Significant
Clas * vineyard visit	308.40	3	=> 99.99%	Significant
Clas * catering	32.45	3	=> 99.99%	Significant
Clas * accommodation	211.31	3	=> 99.99%	Significant
Clas * introduction to oenology	14.68	3	=> 99.99%	Significant
Clas * sale of local products	56.50	3	=> 99.99%	Significant
Clas * events	237.24	3	=> 99.99%	Significant

Table A15.3 Communication – relation between winemakers and trade organisation or region (chi^2 test)

Trade organisation	**Burgundy**	**Alsace**	**Total**
Yes	125	71	196
No	87	93	180
Total	212	164	376

Note: chi^2 = 9.10 ; ddl = 1 ; 1−p = 99.74%.

Note

1. Translated from French by Lisa N. Brown.

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16
The High and Rising Alcohol Content of Wine

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16.1 Introduction

Initial motivation for the work in this chapter came from an observation that the sugar content of California wine grapes at harvest had increased by more than 9 per cent, from 21.4 degrees Brix in 1980 (average across all wines and all districts) to 23.3 degrees Brix in 2008.[1] Sugar essentially converts directly into alcohol, so an 11 per cent increase in the average sugar content of wine grapes implies a corresponding 11 per cent increase in the average alcohol content in wine. Questions arose as to whether the rising sugar content of grapes was indeed reflected in rising alcohol content of wine and whether we could distinguish between causes related to climate change versus other causes related to evolving market preferences, as indicated by expert ratings for wines, and government policies that discourage the production of wine with higher alcohol content.[2]

Accurate detailed data on the alcohol content of California wines are not generally available.[3] However, the Liquor Control Board of Ontario (LCBO), which has a monopoly on the importation of wine for sale in the province of Ontario, Canada, tests every wine it imports and records a number of characteristics including the alcohol content. Alston et al. (2011) reported results from the analysis of the sugar content of California wine grapes and the alcohol content of California wine imported by the LCBO, which indicated that climate change does not appear to account for much of the recent increase in sugar content of grapes or in the alcohol content of wine in California.

In this chapter we present two related sets of empirical work. First, we summarise the main results from Alston et al. (2011) on the analysis of the sugar content of California wine grapes. Second, we present new, complementary international evidence on trends in the alcohol content of wine and the contribution of climate change to those trends. This new work is based on 16 years of annual time-series data from the LCBO on the alcohol content of wine from a large number of countries that experienced different patterns of climate change and influences of policy and demand shifts.

16.2 Increasing sugar content in California grapes

In California, between 1980 and 2008 the sugar content of wine grapes at harvest increased by nearly 9 per cent. The change in sugar content varied by variety and growing region, as well as over time, but it is clear that a shift towards higher sugar at harvest became evident in the mid-1990s and through the first decade of the twenty-first century (Table 16.1). The sugar content of white varieties increased by just under 12 per cent, from an average of 20.7 degrees Brix during 1980 to 1984, to 23.2 degrees Brix during 2005 to 2007. The sugar content of red grapes increased from 22.2 to 24.3 degrees Brix over the same time period.

Annual data on average degrees Brix for the years 1990 to 2008 for over 200 varieties in 17 crush districts were used to analyse the sugar content of wine grapes over time. Variants of the following model were used to examine the extent of changes in degrees Brix (*BRIX*) over time across crush districts

Table 16.1 Trends in sugar content (degrees Brix) of California wine grapes, 1990–2008

	Region					
Variety	**North Coast**	**Central Coast**	**Delta**	**San Joaquin Valley**	**Southern California**	**California**
	average annual percentage change					
Sauvignon Blanc	0.18	0.39	0.08	0.37	0.42	0.21
French Colombard	–0.05	–	0.19	0.04	–	0.04
Chardonnay	0.35	0.49	0.39	0.22	0.00	0.32
Chenin Blanc	0.12	0.72	0.23	0.16	0.07	0.20
All White Varieties	**0.36**	**0.63**	**0.69**	**0.26**	**0.25**	**0.43**
Cabernet Sauvignon	0.50	0.49	0.46	0.29	0.53	0.42
Merlot	0.44	0.55	0.44	0.18	0.35	0.40
Zinfandel	1.11	1.01	1.02	0.33	0.60	0.55
Pinot Noir	0.88	0.63	0.75	1.49	0.26	0.87
All Red Varieties	**0.72**	**0.75**	**0.96**	**0.31**	**0.49**	**0.53**
All Varieties	**0.57**	**0.69**	**0.85**	**0.36**	**0.43**	**0.53**

Notes: Entries in this table are average annual percentage changes, computed as ln(final value) – ln(initial value) divided by the number of years and multiplied by 100. For some years and some varieties, records are unavailable, which is indicated by – in this table.

Source: Created by the authors using data from NASS/CDFA Grape Crush Reports, 1981–2010.

and varieties:

$$BRIX_{dvt} = \beta_0 + \beta_h H_{dt} + \sum_{j=1}^{V} v_j \, VAR_{vj} + \sum_{i=1}^{D} \delta_d \, DIST_{di} + \tau_0 T_t$$
$$+ \sum_{j=1}^{V} \tau_j^v \left(VAR_{vj} \times T_t \right) + \sum_{i=1}^{D} \tau_i^d \left(DIST_{di} \times T_t \right) + \varepsilon_{dvt} \quad (1)$$

In this model, H_{dt} is defined as the 'heat index' for crush district d during the growing season in year t.[4] The other variables are dichotomous dummy (or indicator) variables such that $VAR_{vj} = 1$ if $j = v$, 0 otherwise, and $DIST_{di} = 1$ if $i = d$, 0 otherwise and a time trend T_t. In this model, a statistically significant value for τ_0 implies annual growth at that rate in degrees Brix per year for the default variety in the default region. The coefficients on the dummy variables modify this rate such that the corresponding growth rate for variety j in district i is $\tau_0 + \tau_j^v + \tau_j^d$.

Crush districts were aggregated into four regions, based on the average 2008 wine grape crush prices. Additionally, wine grape varieties were aggregated into 'red' versus 'white', and 'premium' versus 'non-premium' varieties, where 'premium' included Cabernet Sauvignon, Merlot and Chardonnay. Alston et al. (2011) provide details of the growing regions and varietal specifications.

Four different model specifications were estimated using weighted regression, where the data from each crush district were weighted according to shares of California's total production, and Newey-West robust standard errors were reported where possible.[5] The results are reported in Table 16.2.

Table 16.2 California Brix Regression Results, annual observations, 1990–2008

Regressor	**(1)**	**(2)**	**(3)**	**(4)**
Constant	20.91**	18.79**	19.25**	0.58**
	(0.107)	(0.447)	(0.418)	(0.424)
	[0.187]	[0.649]	[0.616]	
Trend	0.14**	0.10**	0.02	0.01**
	(0.011)	(0.009)	(0.011)	(0.007)
	[0.020]	[0.015]	[0.018]	
Variety				
Red		0.96**	0.22	0.19**
		(0.087)	(0.158)	(0.091)
		[0.156]	[0.274]	
Premium		1.89**	2.25**	0.36**
		(0.072)	(0.119)	(0.100)
		[0.123]	[0.200]	

Continued

Table 16.2 Continued

Regressor	**(1)**	**(2)**	**(3)**	**(4)**
Region				
Ultra-premium		1.34**	0.48	0.40**
		(0.121)	(0.176)	(0.116)
		[0.189]	[0.290]	
Premium		1.71**	0.80*	0.50**
		(0.206)	(0.215)	(0.140)
		[0.302]	[0.336]	
Fine		0.28	−0.91*	0.18**
		(0.137)	(0.265)	(0.154)
		[0.241]	[0.463]	
Heat Index (growing season		0.04*	0.08*	0.03**
average degree days)		(0.018)	(0.017)	(0.010)
		[0.027]	[0.025]	
Trend x Region				
Ultra-Premium			−0.03**	−0.01
			(0.014)	(0.009)
			[0.023]	
Premium			0.09**	−0.00
			(0.013)	(0.009)
			[0.021]	
Fine			0.10**	0.00
			(0.023)	(0.013)
			[0.040]	
Trend x Variety				
Red			0.12**	0.00
			(0.015)	(0.008)
			[0.025]	
Premium			0.05**	0.02**
			(0.011)	(0.008)
			[0.019]	
Brix(Year−1)				0.35**
				(0.030)
Brix (Year−2)				0.41**
				(0.029)
Brix(Year−3)				0.17**
				(0.033)
Adjusted R^2	0.14	0.49	0.52	0.91
RMSE	1.94	1.49	1.45	0.63

Notes: 'Ordinary', 'White Wine' and 'Non-premium White Wine x Trend' are the default categories. 13,379. ** Significant at the 1% level, * significant at the 5% level. OLS robust standard errors in parentheses. Newey-West robust standard errors in square brackets.

The statistical performance is strongest in the model in column 4, which augments the base model with the following explanatory variables: (a) a colour dummy, which is set equal to one for ‘red’ varieties (including Zinfandel, although significant quantities of Zinfandel are used to make White Zinfandel); (b) a variety dummy, which is set equal to one for ‘premium’ varieties (Cabernet Sauvignon, Merlot, or Chardonnay); (c) regional dummies that represent the ‘fine’, ‘premium’, and ‘ultra premium’ regions such that the default region is ‘ordinary’; (d) a heat index for the growing season; (e) variables that interact the time trend with the dummy variables for varieties and regions; and, (f) lagged values of the dependent variable.

In column 4 of Table 16.2, the coefficients on all of the dummy variables for varieties and regions are positive and statistically significant, indicating that red and premium varieties, and grapes from districts commanding price premia are expected to have higher sugar content at crush compared with the default category. Compared with the default variety, non-premium white, for red varieties sugar content is higher by 0.19 degrees Brix and for premium varieties it is higher by 0.36 degrees Brix. Compared with the default region (‘ordinary’) the other regions have higher degrees Brix associated with higher prices for wine grapes: by 0.18 degrees Brix for the ‘fine’ region, 0.50 degrees Brix for the ‘premium’ region and 0.40 degrees Brix for the ‘ultra premium’ region. Importantly, none of the coefficients on interactions of trend with region, or trend with red varieties, is statistically significant. For these categories the coefficient on the trend is the same as for the default category, 0.01 degrees Brix per year. Only for premium varieties is the trend growth rate significantly different: it is higher by 0.02 degrees Brix per year.

The coefficient on the heat index indicates that a one-degree increase in the average growing season temperature would result in a 0.03 degrees Brix increase in the sugar content of wine grapes in the current year. Taking the lagged dependent variables into account, a permanent increase in the heat index by one degree Fahrenheit would imply a 0.43 degrees Brix increase in the sugar content of wine grapes in the ultimate long run.[6] Of particular interest is the relative importance of the heat index as an explanation of the past rise in Brix. Across all the models, the results suggest that even a substantial rise in average temperature (or the average of the daily maximum and minimum temperatures) during the growing season would have had only modest effects on the sugar content of wine grapes. In fact, our data do not show a substantial rise in temperature in California between 1990 and 2008 (see Alston et al. 2011).

Combining the insignificant trend in the heat index with its low coefficient in the model, our results imply that warming average temperatures in the growing season did not contribute substantially or significantly to the increase in sugar content of California’s wine grapes over the 19-year period from 1990 to 2008. Other factors in the model account for much of the rise in sugar content, including changes in the varietal mix and location of production.

16.3 International evidence on the rising alcohol content of wine

The LCBO provided us with data for 18 years (1992–2009) comprising 129,123 samples of wines, including 80,421 red wines and 46,985 white wines from around the world. The amount of detail reported varies widely among the observations; some contain information on the brand and variety name, others only the variety; some report only country of origin, while others refer to smaller regions within countries, or other details of the appellation reported on the label. In the early stages of the analysis we decided to set aside the data for German wines because they entail substantial differences in winemaking styles and techniques – emphasising white wines with significant residual sugar, mainly Riesling, for which many of the structural relationships could be expected to be different from their counterparts for dry table wines that predominate elsewhere. We also excluded wines that were clearly dessert wines, either because of other indications or because they reported very high alcohol content (more than 17 per cent by volume), and wines with total residual sugar above 1 per cent, volatile acidity above 10 per cent, or very low alcohol content (less than 8 per cent). The observations for 2008 and 2009 were set aside because they were incomplete and we did not have sufficient observations for analysis in some regions. Of the remaining observations 91,432 were usable in that they were non-duplicates that included data on the actual alcohol percentage, the alcohol percentage stated on the label, the vintage year, and the country (and, in some cases, the region) of origin.

We acquired corresponding region-specific climate data from several sources. We obtained data recorded by various weather stations, and worked to identify those weather stations that would provide the best representation of the respective growing regions. Where they were available, we used weather station data from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center. Climate data in the form we desired were not available for New Zealand or South Africa from NOAA. Instead we were able to obtain information for New Zealand from the Marlborough Wine Research Centre and for South Africa from Irene van Gent AgroMet-ICSW. To create a useful heat index, we averaged the daily high and low temperatures over the relevant growing season (April–October in the northern hemisphere, October–April in the southern hemisphere). We refer to this variable as the average daily temperature over the growing season, or the heat index.[7]

Base values and growth in alcohol percentages and growing season temperatures

Table 16.3 provides summary statistics on the numbers of observations for each type of wine (red, white, or both red and white pooled) for each country, the average actual alcohol percentage recorded for that country in 1992, and the average value of the heat index for the sample period, 1992 to 2007. The spatial patterns in the alcohol content of wine in 1992 are consistent with expectations generally. Specifically, 'Old World' wines tend to have lower alcohol content percentages than 'New World' wines; wines from cooler regions (for example, Canada and New Zealand) tend to have lower alcohol percentages than wines from hotter regions (for example, the United States and Australia); and red wines tend to have higher alcohol content percentages than white.

Table 16.3 also provides two measures of the growth rate of the alcohol percentage and the heat index: the average of annual percentage changes and the trend growth rate from a semi-logarithmic regression (details of these regressions are available from the authors). All of the trend coefficients for alcohol are highly statistically significant, indicating growth in the alcohol percentage in every country, but at different rates (with the trend rate sometimes quite different from the average annual rate).[8] The growth rates range between about 0.1 and 1.0 per cent per year implying total growth of 1.5 to 16.0 per cent over 16 years (that is, an increase in the average alcohol content of between 0.2 and 2.0 per cent alcohol on a base of 12–13 per cent).[9]

Table 16.4 includes the same information as in Table 16.3, but now for sub-national regions, which were defined based on an inspection of the data, and in consideration of the availability of data for some regions relative to others (details on the regressions are available from the authors). The disaggregated regions have much more disparate patterns in their growth rates, partly reflecting the relatively small sample sizes in some cases. While the model fit was poor for these specifications, the estimated growth rate was positive and highly significant for each regional specification, with the exception of 'Canada Other', representing wine-growing regions of Canada outside British Columbia and Ontario, or observations without a designated growing region. In the heat index regressions, the specific regions within France (Bordeaux, Burgundy, Languedoc, Rhone, and France Other) and Italy (Piedmont, Tuscany, Veneto, and Italy Other) all had statistically significant growth rates.

16.4 Regressions of alcohol percentage against the heat index

We pooled the data across countries, years and types of wine, and ran a series of regressions to explore the effects of climate change, as represented by the heat index, as a potential contributor to the rising alcohol content of

Table 16.3 Alcohol content and heat index: base values, and percentage changes, by colour of wine and country

Country	No. of Obs.	Alcohol percentage by volume, average annual % change, and trend growth rate									1992–2007	Heat Index	
		Red Wine			White Wine			Red and White Wines			Average		
		1992 Average	Annual % change	Trend growth rate	1992 Average	Annual % change	Trend growth rate	1992 Average	Annual % change	Trend growth rate	growing season temp.	Average annual % change	Trend growth rate
		% by vol.	*% per Year*		*% by vol.*	*% per Year*		*% by vol.*	*% per Year*		*°F*	*% per Year*	
Old World													
France	25,404	12.4	0.33	0.55	12.5	0.12	0.30	12.5	0.22	0.46	63.5	0.03	0.20
Italy	19,806	12.4	0.21	0.46	11.8	0.42	0.50	12.2	0.25	0.45	66.7	0.19	0.21
Spain	2,993	12.6*	0.60	0.89	12.1*	0.27	0.44	12.4*	0.37	0.69	65.3	0.22	0.27
Portugal	2,321	12.3	0.29	0.95	11.9	0.39	0.68	12.2	0.27	0.84	69.2	–0.01	0.17
Total	*50,524*	*12.4*	*0.31*	*0.56*	*12.3*	*0.20*	*0.37*	*12.4*	*0.23*	*0.49*	*66.2*	*0.09*	*0.20*
New World													
Argentina	1,778	12.6	0.59	0.67	13.2	0.17	0.30	12.7	0.48	0.60	72.1	0.14	0.09
Australia	9,617	13.1	0.46	0.76	12.5	0.27	0.22	12.9	0.29	0.58	66.7	0.07	0.07
Canada	4,113	11.7	0.50	0.51	11.8	0.60	0.62	11.8	0.56	0.57	60.0	0.10	0.15
Chile	3,744	12.3	0.82	0.88	12.8	0.42	0.47	12.5	0.63	0.74	65.6	0.09	0.06
New Zealand	2,125	12.4	0.51	0.51	12.2	0.50	0.43	12.3	0.51	0.43	60.1	0.35	0.16
South Africa	3,347	12.7	0.59	1.03	12.7	0.25	0.57	12.7	0.38	0.85	67.8	0.04	–0.08
United States	16,184	13.4	0.13	0.56	13.4	0.08	0.32	13.4	0.09	0.48	65.4	–0.21	–0.10
Total	*40,908*	*13.1*	*0.31*	*0.63*	*12.9*	*0.22*	*0.33*	*13.1*	*0.25*	*0.53*	*65.1*	*0.09*	*0.03*
World	*91,432*	*12.7*	*0.31*	*0.62*	*12.5*	*0.21*	*0.35*	*12.6*	*0.23*	*0.53*	*65.5*	*0.09*	*0.11*

Notes: * Values represent 1993 average alcohol content. Annual alcohol percentage change accounts for 1993 starting year.

Source: Created by the authors using data from LCBO and NOAA NCDC Climate Radar Data Inventories, 1992–2007.

Table 16.4 Alcohol content and heat index: base values, and percentage changes, by colour of wine and region of production

Country	No. of Obs.	Alcohol percentage by volume, average annual % change, and trend growth rate: Red Wine: 1992 Average	Red Wine: Annual % Change	Red Wine: Trend Growth Rate	White Wine: 1992 Average	White Wine: Annual % Change	White Wine: Trend Growth Rate	Red and White Wines: 1992 Average	Red and White Wines: Annual % Change	Red and White Wines: Trend Growth Rate	1992–2007 Average Growing Season Temp.	Heat Index: Average Annual % Change	Heat Index: Trend Growth Rate
		% by vol.	*% per Year*		*% by vol.*	*% per Year*		*% by vol.*	*% per Year*		*°F*	*% per Year*	
France													
Bordeaux	4,284	12.1	0.22	0.57	11.7	0.35	0.66	11.9	0.26	0.62	64.6	0.00	0.18
Burgundy	4,781	12.7	–0.13	0.18	13.0	–0.17	0.13	12.9	–0.16	0.15	60.9	0.00	0.21
Languedoc	1,534	12.1	0.68	0.80	12.0	0.58	0.47	12.0	0.64	0.70	67.7	0.02	0.12
Rhone	2,073	12.7	0.52	0.70	12.5	0.65	0.69	12.7	0.55	0.71	65.5	0.10	0.26
France Other	12,731	12.2	0.43	0.64	12.3	0.20	0.37	12.2	0.30	0.50	63.5	0.03	0.20
Canada													
B.C.	789	11.6	0.96	1.17	12.0	0.86	1.07	11.9	0.89	1.14	58.9	–0.19	0.05
Ontario	3,245	11.8	0.48	0.40	11.7	0.54	0.52	11.8	0.52	0.46	60.8	0.52	0.26
Canada Other	79	–	–	–0.74	12.0	0.66	0.45	12.0	0.35	–0.09	60.0	0.10	0.15
US													
California	14,218	13.5	0.17	0.57	13.4	0.10	0.30	13.5	0.12	0.48	70.2	–0.16	–0.18
Oregon	880	13.5	–0.39	0.38	13.8	0.12	0.24	13.6	–0.44	0.33	62.4	–0.32	–0.12
Washington	583	13.2	–0.02	0.64	12.8	0.14	0.75	13.1	0.03	0.78	63.7	–0.15	0.00
US Other	503	11.8	0.83	0.52	11.9	0.48	0.55	11.9	0.57	0.59	65.4	–0.21	–0.10
Italy													
Piedmont	1,227	13.5	–0.04	0.43	11.4	0.53	0.58	12.6	0.22	0.47	64.1	0.20	0.23
Tuscany	2,547	12.7	0.12	0.35	12.3	0.22	0.53	12.6	0.13	0.38	68.9	0.19	0.24
Veneto	1,401	11.8	0.40	0.59	11.5	0.35	0.44	11.6	0.34	0.49	67.1	0.11	0.16
Italy Other	14,631	12.4	0.22	0.48	11.8	0.43	0.51	12.2	0.26	0.47	66.7	0.19	0.21

Source: Created by the authors using data from LCBO and NOAA NCDC Climate Radar Data Inventories, 1992–2007.

Table 16.5 Regressions of alcohol percentage against trend and temperature, 1992–2007

Regressor	Model (1)	(2)	(3)	(4)	(5)	(6)
Constant	12.72**	9.589**	10.41**	10.92**	10.87**	10.14**
Trend	0.0701**	0.0645**	0.0643**	0.0613**	0.0654**	0.0667**
Avg. Growing Temp		0.0486**	0.0384**	0.0364**	0.0280**	0.0393**
White Wine Dummy			–0.486**	–0.518**	–0.495**	–0.207**
Old World Dummy				–0.630**		
Argentina					0.295**	0.0291
Australia					0.547**	0.324**
Canada					–0.0887**	–0.171**
Chile					0.547**	0.150**
Italy					–0.165**	–0.194**
New Zealand					0.354**	0.325**
Portugal					–0.296**	–0.787**
South Africa					0.349**	–0.235**
Spain					0.230***	–0.0807**
United States					0.845**	0.730**
White x Trend						–0.0348**
Argentina x Trend						0.0171**
Australia x Trend						0.0220**
Canada x Trend						0.0144**
Chile x Trend						0.0411**
Italy x Trend						–0.000154
New Zealand x Trend						0.00904*
Portugal x Trend						0.0494**
South Africa x Trend						0.0624**
Spain x Trend						0.0337**
United States x Trend						0.0118**
R-squared	0.10	0.12	0.17	0.29	0.34	0.35
MSE	0.888	0.880	0.851	0.791	0.763	0.756

Notes: Dependent variable is actual % alcohol. 'France', 'Red Wine' and 'France X Trend' are default categories. ** Significant at the 1% level, * significant at the 5% level, and - significant at the 10% level. 91,432 Observations.

Source: Created by the authors using data from LCBO and NOAA NCDC Climate Radar Data Inventories, 1992–2007.

wine. The alcohol percentage by volume is the dependent variable in all of the regression models reported in Table 16.5.[10] In column (1) we show the results from regressing the alcohol percentage against a linear time trend. The coefficient is positive, and statistically significantly different from zero at the one per cent level of significance. It indicates that, on average across the data, the predicted alcohol content of wine increased by 0.07 percentage points per year, or 1.12 percentage points over the 16 years relative to an initial mean of 12.7 per cent alcohol by volume; an increase of one-tenth in the average alcohol content of wine.

The model in column (2) also includes our climate variable, the average growing season temperature in degrees Fahrenheit. Both coefficients in this model are positive and statistically significant at the one per cent level. The coefficient on the trend variable in column (2) is somewhat smaller than in column (1), indicating an underlying growth rate in alcohol content of 0.06 percentage points per year, after accounting for the effects of temperature changes. The coefficient on the heat index is approximately 0.05, suggesting that an increase by one degree Fahrenheit in the average growing season temperature everywhere in the world would cause the average alcohol content of wine to increase by 0.05 percentage points; it would take a whopping 20°F increase in the average temperature in the growing season to account for a one percentage point increase in the average alcohol content of wine.

In the other models in Table 16.5, with additional explanatory variables included, the measured effect of the heat index is, if anything, even smaller, while the general results for the effects attributable to the trend are roughly constant. These other models progressively introduce dummy variables to allow different intercepts (fixed effects) for white wine versus a default of red wine in column (3); for Old World wines versus a default of New World wines in column (4); and by country of origin versus a default of France (such that the combined default category is red wine from France) in column (5). The model in column (6) is the model column (5) augmented with interactions between country and trend such that we have individual slope and intercept dummies allowing for different growth rates of alcohol content among countries, with common coefficients to adjust for the difference between red and white wine, and the effects of region-specific temperatures.

In all of these models every coefficient is statistically significantly different from zero at the one per cent level of significance, with one exception (the coefficient on the time-trend dummy for Argentina), and the coefficients are plausible. The white wine effect in column (3) is approximately −0.5, indicating that we can expect white wines generally to have about 0.5 percentage points less alcohol than red wines. In column (4) the estimates indicate that we can expect Old World (European) wines to have about 0.63 percentage points less alcohol than wine produced in the New World (the Americas, Australia, New Zealand and South Africa). The latter effect is not measured in the other models; columns (5) and (6) report country-specific fixed effects instead. In column (5) the effects of the country dummies indicate that compared with France, three countries produce somewhat lower-alcohol wine (Canada, New Zealand, and Portugal) while the rest produce higher-alcohol wine, with the effects being most pronounced for Australia (0.55 percentage points higher on average) and the United States (0.85 percentage points higher on average).

The results of the model in column (6) are slightly harder to interpret because we now have, in effect, colour-of-wine and country-specific time trends as well as intercepts. The coefficients on the trend interaction terms measure the additional trends relative to the default, which is red wine from France. The coefficient of −0.0348 on 'white × trend' measures the difference in the trend growth rate. It indicates that compared with French red wine, for which the alcohol content grew by 0.0667 percentage points per year, the alcohol content of French white wine was growing more slowly, at a rate of $0.0667 - 0.0348 = 0.0312$ percentage points per year; less than half the rate for red. The 'country × trend' interaction terms indicate that, compared with French red wine for which it grew by 0.0667 percentage points per year, the alcohol content grew more quickly in every other country except Italy. For instance, the coefficient of 0.0220 on 'Australia × trend' indicates that the alcohol content of Australian red wine grew by $0.0667 + 0.0220 = 0.0887$ percentage points per year, implying an accumulated increase over 16 years of 1.4 percentage points. Combining this with the coefficient of −0.0348 on 'white × trend' indicates that the alcohol content of Australian white wine grew by $0.0667 + 0.0220 - 0.0348 = 0.0539$ percentage points per year, implying an accumulated increase over 16 years of 0.9 percentage points for Australian white wine. These estimates are comparable to those implied by the proportional growth rates reported in Table 16.3 for Australian wine.

The main lesson from the results in Table 16.5, combined with the information in Tables 16.3 and 16.4, is that the heat index does not account for much of the growth in the average alcohol content of wine, for two reasons. First, the heat index did not increase by very much in most places, perhaps especially in those places that exhibited the fastest growth in alcohol content of wine (Australia and the United States). Second, the estimated regression coefficient on 'Avg. Growing Temp.' indicates that a very large change in the heat index would be required to bring about an appreciable increase in the alcohol content of wine. These findings parallel those from the regressions for California wine grapes, in which the (slightly different) heat index did not contribute much to accounting for increases in the sugar content of California wine grapes. We are conscious of the possibility that our results might be fragile, and conditional on our data and model specification choices, and on our use of a measure of growing season temperature that might not optimally capture the true impacts of changes in climate on wine production – but for now we must conclude that climate change has not been the main factor driving the steady, systematic, and pervasive rise in the alcohol content of wine.

16.5 Conclusion

In this chapter we have used extensive data on the alcohol content of wine from around the world to examine a number of questions that have been the subject of much conjecture but usually with limited empirical support. Our results indicate that the average alcohol content of wine varies systematically among countries, reflecting differences in climate, which we proxy using a measure of the heat index during the growing season for wine grapes, but also differences among varieties (lower for white than red wine varieties) and culture (lower for countries in the Old World of Europe than for the New World producers, mainly in the southern hemisphere and the United States).

The average alcohol content of wine has been trending up significantly around the world, though at different rates in different places. Some, but not much, of this trend can be accounted for by trends in the heat index. The trend in alcohol that is not explained by the heat index is attributable to unobserved factors, such as other features of the climate or cultural responses to the market. While other measures of climate might have additional effects that we have not measured, our findings lead us to think that the rise in alcohol content of wine has been determined primarily by decisions made by wine grape growers and winemakers. Even so, the rise in alcohol content of wine may be in many cases a nuisance by-product of actions taken in the vineyard or the winery aiming to achieve other changes in the quality of wine or other purposes.

Notes

1. Degrees Brix (°Bx) is a measurement of the relative density of dissolved sucrose in unfermented grape juice, in grams per 100 millilitres. A 25°Bx solution has 25 grams of sucrose sugar per 100 millilitres of liquid. The percentage of alcohol by volume of the finished wine is estimated to be 0.55 times the °Bx of the grape juice.
2. A literature on the economic effects of weather and climate on wine has developed over the past 20 years, with contributions such as Ashenfelter et al. (1995), Ashenfelter and Byron (1995), Nemani et al. (2001), Tate (2001), Jones (2005, 2006, 2007), Jones et al. (2005), Webb et al. (2005), White et al. (2006), Jones and Goodrich (2008), Ashenfelter (2008), Jones and Goodrich (2008), Bar-Am (2009), and Ashenfelter and Storchmann (2010). Issues addressed include various aspects of wine quality, yield, and the optimal location of production.
3. While every wine bottle reports a figure for alcohol content on the label, the tolerances are wide and the information content is therefore limited. Specifically, U.S. law allows a reporting range of plus or minus 1.5 per cent alcohol content for wine with 14 per cent alcohol by volume or less, and a reporting range of plus or minus 1.0 per cent for wine with more than 14 per cent alcohol by volume.
4. The daily measure of growing degrees (GDs) is equal to the average of the daily minimum and daily maximum temperature minus a base temperature of 50°F. The growing season for wine grapes is defined as extending over the six months April through September in the northern hemisphere, and October through April in the southern hemisphere. The accumulated total of growing degree units (GDUs) is the sum of GDs accumulated during the season. We use a growing season heat index, H defined as the average daily GDs during the growing season, equal to the accumulated GDUs divided by the total number of days. We also experimented with the same variable applied to different periods (e.g., the entire year or particular months). We thank Professor Andrew Walker from the Department of Viticulture

and Enlogy at UC Davis for advising us about the appropriate choice of a heat index for our purpose.

5. The rationale for using a weighted regression is that the data we are using are themselves annual averages for particular varieties within individual crush districts, with very different numbers of observations contributing to the average, depending on the volume of the crush. The weights were calculated using STATA's 'aweight' option, with the weights for particular observations equal to the corresponding observation-specific tons crushed as a share of total California tonnage in the same year.
6. The long-run multiplier for a permanent increase is equal to the short-run multiplier, divided by one minus the sum of the coefficients on the lagged dependent variable: $1 - 0.93 = 0.07$.
7. This index is slightly different from the one used in the analysis of data on sugar content of California wine grapes in that here we did not subtract 50 from the average of the daily high and low temperatures in degrees Fahrenheit. In our linear models this difference is immaterial; subtracting 50 simply changes the intercept.
8. Each approach has advantages and disadvantages. The average of annual percentage changes is dominated by end points of the series, which might be a disadvantage if the end points contain large idiosyncratic elements or measurement errors, but can be an advantage if measurement errors are negligible. A trend line will most likely not pass through the end points and will not be dominated by measurement error in the end points but may be influenced by other outliers, functional form and other specification errors, and other general problems with the linear regression model. We can hope that the two measures might bracket the truth.
9. We report robust standard errors in all regressions.
10. Essentially the same results were obtained when we ran the same models with the dependent variable in natural logarithms, instead. These alternative results are available from the authors.

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