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# THE GEOGRAPHY OF UNDERDEVELOPMENT

Institutions and the  
Impact of Culture

**Mariam Khawar**



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Institutions and the Impact of Culture

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*For Abbajan, without whom this book would not have started and  
Paul, without whom it would not have been completed*

## PREFACE

Growing up in Pakistan, I took it as a given that ten months of the year the whole country was united in enduring the suffering brought about by the heat, humidity, scorching sun and abundant opportunity for infectious diseases. We would return home from school with our uniforms plastered to our bodies and drenched in sweat (our uniforms were grey and enhanced the appearance of every drop of moisture). Gym classes meant possible fainting spells from dehydration. After-school sports meant that the 3:00–4:30 pm practice times were the slots that we dreaded the most, as the sun was fiercest in the mid-afternoon. Shops didn't open until 11 am, closed from 2 to 4 pm while the owners had an extended lunch and napped, and stayed open until 9 pm to take advantage of the cooler evenings. Phoning our parents or ringing the doorbell between 2 and 4 pm was guaranteed to elicit a highly annoyed response followed by a severe reprimanding as many adults would be taking their afternoon naps to escape the hottest part of the day. The unpredictable and intermittent monsoon rain was a joyous occasion for celebration, causing us to rush outside wearing our swimsuits in some crazy version of a rain dance, a pretty ineffective one since it was after the fact. Finally, the two months of blessed relief in 'the winter' meant that we got to use our sweaters at least a couple of times a year and convince our parents that we needed those fashionable blazers with the embroidered school emblem to ward off the half hour of morning chill.

Despite the discomfort, I was still one of the luckier ones. I was one of the few privileged upper-class members of society who got to ride in an air-conditioned car and come home to a cool, concrete house, designed by

a leading architect to take advantage of cool sea breezes and airflow. When I was growing up, window air-conditioning units were the norm. My parents had one in their bedroom where we kids were invited to crash anytime we wanted. Preferring the privacy of my own bedroom, I spent many an afternoon sprawled on my bed absorbed in a book, vaguely aware of my perspiration soaked-clothes sticking to my back which even the ceiling fan could not evaporate speedily enough. Still, it was preferable to sitting in a room with no electricity, no fan (and thus no airflow) and the still air suspended like a moisture-laden cloud above your head. We did get to experience that a couple of times a day during the hottest months of the year when the demands on the city's power grid caused the state-run utility company to institute mandatory 'load-shedding', basically cutting off electricity to various parts of the city on a rotating basis. Predictably, the wealthier neighborhoods experienced the least load-shedding while residents in the poorest segments of the city suffered for up to ten hours a day.

The majority of my fellow citizens meanwhile, toiled in the unrelenting heat – the day labourers working on construction, the vendors pushing their produce laden carts (imagine an outdoor farmer's market in 110 degrees F and 90% humidity), the lady who cleaned our house and walked miles to and fro, the farmers trudging through fields while the heat drained their last ounce of reserves – returning at the end of the day to shantytowns or basic dwellings with tin roofs and no electricity, a scenario guaranteed to maximise the misery wrought by the heat and humidity. Life in the tropics, as they knew it, was definitely *not* a breeze.

Although I had travelled abroad as a child, I had never lived for an extended period of time in a different climate until I went to college in rural Illinois. It was there that I first experienced breathtaking fall foliage and cool, brisk days; vibrant spring colours on pleasant, sunny days which made you want to lie back under a tree with a good book and eventually drift off to sleep with the sun warming your back in a gentle, loving embrace. A far cry from the blistering sunburn and heat stroke I would have gotten had I been foolish enough to try that in Karachi in the month of May. Yes, Galesburg had its share of hot, humid days and bone-chilling blizzards but the change in the seasons meant that just when you dreamt of being in some other place – Alaska or Hawaii as the case may be – the weather changed for the better and you felt energised and invigorated once again.

Several years later, when I was a newly minted assistant professor visiting my parents in Karachi during one of those torrid heat waves, my father and I were discussing economics over our afternoon tea. He was curious about what I was working on at the time as I was searching for a research agenda to move on to after finishing my dissertation. He made a simple comment that stayed with me and wouldn't go away. Since this was well over a decade ago, I'm not sure I can quote him exactly but it went something like this, "I wonder why most of the countries close to the Equator are the poorest countries in the world and those in colder climates are the richest?" In retrospect, this may seem like a trivial observation, but at the time it simply wasn't something that I had thought about. Realising that I had no satisfactory answer to his question I began, upon returning from my vacation, to read and research everything that I could find on the topic.

At the time very little had been written about this phenomenon and some of the most recent writings that I came across included Andrew Kamarck (1976) and Richard Landes (1998). A couple of years later I was participating in a seminar at the National Humanities Center in North Carolina and was introduced to the work of Jared Diamond (1997). That is when my journey really took off and I spent the next decade or so working on different aspects of the question, like a dog worrying at a bone and turning it around to get at it from various angles. In the course of this quest, I came across more questions than answers. Each time I thought I had a satisfactory response it would lead to more questions. In the end, this turned out to be a much more ambitious project than I had ever envisioned when I first thought about that simple question. In the intervening time period, other researchers have also been whittling away at this issue (apparently we all had conversations with our fathers at the same time) and there is now quite an extensive and expansive literature on the topic that includes climate, disease, endowments, culture, biogeography and institutions.

The story that this book weaves is of the interplay between geography, culture and institutions and how *together* they might explain the origins and persistence of underdevelopment. The scope of this story is broad and one that incorporates more than just economics. Of particular interest is the anthropological notion of culture and how the origins of culture might be traced back to geographical and environmental factors. For that I owe a debt of gratitude to my long-time friend, colleague and next-door office mate, an anthropologist who first introduced me to an enormous data base of cultural variables coded by anthropologists that turned out to be



important in my research. I have to take the opportunity here to put a plug in for the value of working at a liberal arts institution. Having my office next to an anthropologist's has introduced me to new ideas and ways of viewing the world that complement the economics that I hold so dear. This would have been unlikely had I been at a larger research-oriented university in a department full of economists working mainly on purely mathematical models of explaining the world.

Like any question that encompasses such a broad, sweeping array of issues, approaching this is a bit like peeling back the layers of an artichoke. The goal is to get at the 'heart' of the question and provide a satisfying answer, but the journey involves a meticulous examination of the outer layers first. The obvious starting point is geography given that this is the visual pattern that first emerges when one studies underdevelopment. Can a rationale be established that explains why geography is important? But what is geography and what elements of it are important?

The next layer leads to the direct and proximate effects stemming from geography. Are there specific features of geography that have favourable and adverse effects on economic activity and if so, what are they? Additionally, can geography be indirectly responsible for other causes of underdevelopment that have already been identified, such as cultural and institutional differences?

This leads to the third layer which uncovers the heart of the issue. Geographical factors, through influences on the environment and ecology of a region, might give rise to particular cultural traits in a society. These traits could have lasting effects and find themselves embedded as more formal institutions evolve over time. Both positive and negative traits might develop this way thus impacting future paths leading to development or underdevelopment. The idea that these three variables – geography, culture and institutions – are important in the narrative of development is not a new one. Numerous studies have documented both qualitative and quantitative analyses that suggest that these factors are significant. However, the literature persists on pitting them against each other in an either/or scenario with one side claiming superiority over the other in being the more valid hypothesis. What this book aims to do is to tie these threads together into a convincing strand and provide an explanation that incorporates these disparate versions into a cohesive whole.

I hope that the book increases our understanding of how the world came to be the way it is today and also why that pattern is persistent. While

this book does not contain any policy prescriptions or suggestions for ways to address the disparities in income, it is my hope that an understanding of how we got here will prove to be illuminating in figuring out where we go from here. After all, the southeastern United States might still be full of sleepy backwater towns were it not for a little something known as the New Deal (Wright 2010).

Some may find the direction and the tone to be unappealing, especially when it comes to attributing differences based on climate, geography or culture. Climate-based explanations have suffered a bad rap mainly because they are construed as, or in the case of some intended as, race-based claims of superiority. This idea could not be further from my mind. Nothing in my experience suggests that the culture, heritage or societies of those living north and south of 23 degrees latitude are superior to those who live in between. If anything, one marvels at the adaptation, resourcefulness and innovation of those who have to struggle for an existence in some of the most inhospitable regions on the planet. As a thought experiment, imagine what the economies of Europe and North America would be like if the earth had a geological hiccup and those areas were squeezed between the tropics while tropical countries switched places with them. It might take some time but eventually the disadvantages of geography would manifest themselves as heat, humidity, infectious diseases and crop infestations began to leave their mark on the formerly fortuitous societies of the West. And perhaps Malawi would change from being one of the poorest nations on earth to a relatively prosperous country. It's worth pondering, isn't it?

## ACKNOWLEDGEMENTS

As I mentioned in the Preface, this book would not have been conceived without a conversation that I had with my father many years ago which started me along a path of research that consumed the better part of two decades. My father would have been tickled pink that the culmination of our conversation was this manuscript and were he still around to read it, I know he would have been privately pleased, and proud.

I am grateful to several editors at Palgrave MacMillan. Leila Campolini initially contacted me to solicit a book proposal based on this topic. Sarah Lawrence and Allison Neuberger patiently answered my questions and guided me through the process of preparing a monograph for publication.

My long-time friend, colleague and next-door office mate, Robin O' Brian endured many lunches during which I quizzed her about culture and cultural evolution. I owe her a huge debt of gratitude for introducing me to the Standard Cross Cultural Sample, an anthropological dataset which I used in empirical analyses involving culture. My conversations with her helped me understand and appreciate the importance of cultural context and widened my scope of thinking on the subject.

My student Michael Girard '17 provided excellent research assistance in helping me obtain data on the regional comparisons for Italy, proof-read the manuscript and constructed the maps that are illustrated in the book.

I am thankful for the support I received from the Elmira College Class of '58 and the Malcolm and Virginia Marsden Endowed Fund.

To my three children Jamal, Rohail and Aisha who received less of my attention than they deserved during the last few months of writing, I am

grateful for their patience. Their reward, you ask? We can start having real meals again.

Finally, there's a reason why writers thank their significant others. I truly would not have been able to complete the book without the support of my husband. Over these last few months, in addition to his full-time job, Paul took on the role of chauffeur, caregiver (for both humans and pets), entertainer, homework helper, grocery shopper and general errand-runner. I hope all writers who are also parents have such supportive partners; otherwise I'm not sure how one can manage it. I should note that I already repaid the debt by convincing the Chicago Cubs to win the World Series in 2016. ☺

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# Whither Geography? Reviewing its Impact on Economic Development

**Abstract** The impact of geography on economic outcomes has traditionally been ignored by economists. Research by scientists and other social scientists, however, has uncovered connections between factors such as climate and ecology, and economic progress. Recently, economists have also begun to examine the existence of this relationship by studying the effects of geography on aggregate levels of economic activity and more specifically on productivity. This chapter summarises the recent literature on this topic and traces the pathways through which these effects take place. The direct influences of geography include factors such as climate, disease ecology, location and natural resources all of which can impart distinct advantages or obstacles to development, as the case may be.

**Keywords** Geography · Economic development · Climate · Tropics

**JEL field codes** O1

A quick glance at a map of the world reveals a startling fact. If countries are ranked by average income or gross domestic product (GDP) per capita, the belt around the tropics is home to the world's poorest countries, with the exception of a few oil-rich nations.<sup>1</sup> The further away from the tropics one travels to more temperate climates, the better off the average citizen is. Perhaps no other geographical feature of the earth is subject to such a

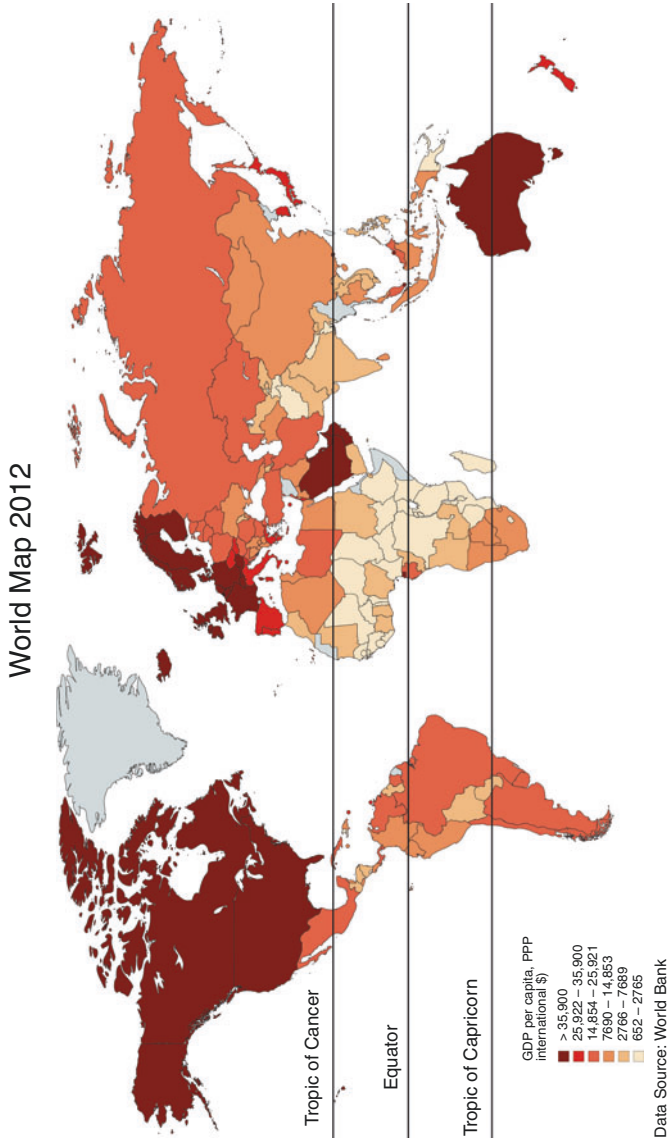


singularity. Why? Is it a simple coincidence? Or does tropical geography have specific characteristics that affect economic development? Do societies in the tropics share cultural characteristics that somehow impede development? Or is this the result of the unfortunate legacy of colonialism and simply an unavoidable consequence? Or are the three somehow linked together in a chain of cause and effect?

A reasonable question to ask before continuing down this road might be whether the divergence in income across the world is a recent phenomenon or whether it is a persistent pattern. Studies of income convergence focusing on the period from 1950 to 1980 find little evidence of it amongst the poorer, less developed countries of the world.<sup>2</sup> More recent studies show that while income inequality and poverty has fallen globally, much of the decline is due to improvements in East Asian countries while African and Latin American countries have not fared as well.<sup>3</sup> Thus, it does not appear that the gap between the rich and poor countries of the world is closing any time soon.

Let's start by taking a closer look at geography. Examine the map of the world (Fig. 1.1). What is evident right away, if you study the pattern of development? The ten poorest countries in the world lie between the Tropic of Cancer and the Tropic of Capricorn, while the ten richest countries, with the exception of city-states and oil-exporting nations, are in northern and Western Europe and North America, all outside of the tropics.<sup>4</sup>

The relationship between geographical factors and economic development has historically been ignored by economists. However, views about the correlation between climate and economic activity have been expressed in works dating at least as far back as Montesquieu (1748) and Huntington (1922). Montesquieu suggested that climate and soil quality affects cultural practices and forms of government and as such the laws of the land ought to be adjusted in accordance. Although his writings are based primarily on observations and there is an unscientific quality to some of his musings especially on the effects of climate on temperament, anthropological evidence suggests that the physical environment influences the types of social structures that emerge in pre-industrial societies around the world, a claim that is examined later. Extracting from Huntington's book is a little more difficult. Buried amidst much of the scattered racial biases are a few observations worth mentioning. Huntington discusses the effects of climate on health and economic activity by examining conditions in Europe where he finds that the



**Fig. 1.1** World map according to GDP per capita, 2012  
*Data Source:* World Bank

distribution of health and economic progress is correlated with favourable climatic conditions. He also studies the efficiency of work in factories in Connecticut and Florida in the early 1900s and finds that efficiency varies inversely with temperature.<sup>5</sup>

Some of the most influential contemporary writings on this topic include economist Andrew Kamarck (1976) and later, historian David Landes (1998). In his original and later works, Kamarck details specifics that can hamper both human and agricultural productivity such as disease vectors (malaria, yellow fever), worms, parasites and insects. These are unique to the tropical climate as is intermittent and unpredictable rainfall, high temperatures and humidity, and most importantly, the absence of frost which allows harmful pests to continue unabated throughout the year.<sup>6</sup>

Landes takes a slightly different approach while still focusing on differences in geography. In comparing Europe and China he notes that due to an accident of geology, the northern equatorial current known as the Gulf Stream is primarily responsible for bestowing upon Western Europe its favourable climate consisting of mild winters, warm but not hot summers and abundant rainfall. All of this enabled the growth of crops year round, cultivation of large livestock and growth of dense, thick forests providing an abundance of wood.<sup>7</sup> Interestingly, Landes observes that even within Europe differences in the level of economic development emerge as one moves further east and inland and the climate becomes more variable with greater extremes in both rainfall and temperature. The same is true when comparing northern and southern Europe. Mediterranean countries are the recipients of less predictable and sparser rainfall and southern Europe lags behind northern Europe in most measures of development.

Additionally, Landes believes that Europe's topography, especially the presence of dense forests, is one of the reasons for Europe being a relative latecomer compared with other regions of the world. He contends that the advent of metallurgy eventually allowed the clearing of forests and from that point on, the advantages of geography enabled Europe to develop large food surpluses and thus sustain increases in population and urban centres of development.

The subject has proved to be of interest to researchers in other fields as well. Crosby (1986) and Diamond (1997), a historian and a biologist, respectively, have provided detailed and plausible explanations of the connection between geographical, climatic and economic factors. Their

studies have a historical focus extending over several centuries and several millennia.

To explain the spread of European imperialism Crosby uses the term 'Neo-Europes' to refer to those parts of the world where the climate and peoples populating those regions are similar to Europeans.<sup>8</sup> This would include North America, southern South America, and parts of Australia and New Zealand, all of which lie within temperate zones and in similar latitudes and which are similar in terms of population and culture. He further narrows down his definition of the 'seed bed' of Neo-Europe where the climate is most similar to Europe such as the eastern third of the United States and Canada, south-eastern Australia and parts of Argentina, Brazil and Uruguay.<sup>9</sup> In his view European imperialism has a biological or ecological component. These were areas where European crops and livestock, as well as humans, could easily adapt and in many cases, overwhelm the native flora and fauna. While this is a satisfying explanation of the geographical spread of European settlement, it doesn't really address the origin of how the Europeans came to be the conquerors and were able to achieve the technological and military superiority that allowed them to annihilate the native inhabitants of the Old World, Australia and New Zealand. That part of the story is simply not part of Crosby's thesis.

A more sweeping and comprehensive analysis is undertaken by Diamond. I was first introduced to his work at a seminar at the National Humanities Center in Durham, North Carolina, and was immediately captivated by the first convincing explanation I had read that addressed the origins of European superiority.<sup>10</sup> Unlike Huntington's thesis, Diamond does not focus on race or genetic differences but instead points to the accidents of geography. Diamond notes that those parts of the world that were ideal for food production such as the Fertile Crescent and China gave rise to the earliest sedentary civilizations. Other parts of the world where the environment (climate, topography, soil, etcetera) was more inhospitable required continuous hunting and gathering and continued much later with nomadic societies, such as Australia and sub-Saharan Africa. The accumulation of food surpluses was critical for two reasons. First, it increased population size, and second, it allowed those societies to specialise in non-food production activities. Hence innovation and technological advancement was possible. As an example, he presents the case of Australia where Aboriginal societies did not develop either metal tools or writing and the continent remained sparsely populated until the arrival of

the Europeans. Most of Australia is arid, hot, generally inhospitable and as such not conducive to sedentary society. Diamond reiterates the point that only the importation of technology that had evolved in their home country allowed European settlers to inhabit the Australian continent.

Next is the second cog in Diamond's wheel which is the geographical bearing of the continental land masses. He suggests that the east-west axis of Eurasia's landmass allowed for the easy diffusion and accumulation of technology, something that was much harder to accomplish in Africa and South America which are both centred around a north-south axis.

Diamond's thesis is appealing on several fronts. It is one of the few works that traces back the origins of European conquest and inquires specifically as to why the Europeans conquered the rest of the world and not the other way around. Many writings, including subsequent works by other authors, examine the historical impacts of European colonisation including attempts to explain the geographical pattern. However, they all use as the starting point of their investigation, the notion that colonisation is an exogenous variable, external to any process that they are attempting to explain. Diamond treats it as an endogenous event, one that merits an explanation on its own account. Moreover he dismisses the notion that genetic or biological superiority allowed white Europeans to conquer and take over the lands of a host of indigenous peoples from the Americas to Africa and Australia. His premise that the proximate causes stem from geographical factors is convincing and devoid of the unsavoury explanations many others associate with these differences.

Economics however, being a quantitative discipline, has been reluctant to embrace these mainly qualitative explanations of divergent development paths. After the earlier work by Kamarck (1976), a few decades passed before economists at Harvard's Center for International Development (CIDS) began to use Geographical Information Systems (GIS) software to map GDP per capita and climate related variables to develop more precise measures that could be tested to see if a relationship exists. The measures of geography that they find significant in explaining variations in average income across countries include the extent to which a country's land mass lies in the geographic tropics, whether or not a country is land-locked and the proximity of the population to the coast or a navigable river.<sup>11</sup> Hence they demonstrate that being a tropical country is negatively related to output per capita both in levels and growth rates. However as they acknowledge, this doesn't fully *explain* the nature of the relationship, just confirms its existence.

A closer look at agriculture, however, provides some more insight into their findings. Since agriculture is a larger component of the economies of developing countries, the productivity of agriculture is important to their economic success. It turns out that agricultural productivity in tropical climate zones is about half of that in temperate zones.<sup>12</sup> This is also true of both land and labour productivity. An explanation for this is provided through citing evidence by agriculturalists and ecologists who have studied the issue and point to soil quality in the humid tropics as the culprit. Other factors such as rainfall variability and irrigation potential are also found to inhibit agriculture in the arid tropics.

Another study focuses on the disease burden of malaria which affects the productivity of labour in agriculture and other economic activities.<sup>13</sup> After controlling for several factors, the authors find that the countries in which malaria incidence is the most intense had average incomes that were only one-third of countries without malaria. And as they show, it gets worse. The malaria free countries also grew at rates which were five times higher than the other set.<sup>14</sup> Malaria is a mosquito borne disease and as such directly a consequence of the climate. However, the possibility exists that the severity of its impact can be adversely affected by the level of development itself. For example, the authors demonstrate the causal effect of malaria on economic growth by citing the success stories of countries in southern Europe and even the southern states of the United States, all of which grew faster after the eradication of malaria. On the other hand, they also point to countries that still face severe malaria outbreaks like Oman and the United Arab Emirates but are wealthy in spite of it. Thus, malaria by itself is a climate related obstacle that could potentially be overcome at a certain threshold of development. This does not detract from the fact that only countries with a particular type of climate and ecology have to face it as a significant impediment to the process of development.

One of the most direct links between geography and agricultural development can be found in a recent study of the effects of the tsetse fly on African development.<sup>15</sup> Africa's low pre-colonial population density has long been suspected as one of the underlying causes of its persistent underdevelopment. The tsetse fly transmits a disease known as 'sleeping sickness' to both humans and animals, the latter of which succumb fatally after being bitten. Supported by pre-colonial anthropological data on farming, the study's authors argue that the prevalence of the fly in Africa made the development of agriculture more difficult and also contributed to the population being more dispersed across that land.

A separate line of inquiry also focuses on climate and weather related issues but has researchers studying the prevalence or lack of frost and how that may impact agricultural productivity as well. In temperate climates the last frost of the season generally signals to all avid amateur gardeners that they are safe to go ahead and plant their gardens now. It is something that we never think about other than as a precursor allowing us to indulge in our hobby. Farmers in temperate regions watch the return of frost anxiously since for them the length of their growing season and the success of their crops depend on its absence. The beneficial properties of frost go unnoticed by most of us since we take its presence for granted. Strange then, that in the tropics the reverse is true. This is because the lack of freezing temperatures in the tropics causes a much greater number of agricultural pests. Studies show that ground frost kills organisms which spread both human diseases as well as plant and animal diseases, thus helping control their spread.<sup>16</sup> The same research shows that frost increases soil fertility since it positively impacts mechanisms which result in a deeper and richer layer of topsoil. These are convincing findings which point to the presence of frost as a significant factor influencing average incomes positively, while its absence has the reverse effect. Although the effects on labour and agricultural productivity are not explicitly dis-aggregated, the assumption is that those are the main channels through which the link exists.

One might well suppose that the hallmarks of tropical climate, sunshine and warm temperatures would be positively associated with crop yields. After all, in temperate climates the growing season is at its peak in the warmest months of the year. However, in places like sub-Saharan Africa the rainfall pattern is influenced by large-scale intra-seasonal and inter-annual climate variability.<sup>17</sup> Additionally, the relationship between temperatures and agricultural productivity can be nonlinear for certain crops. Researchers have found that higher maximum temperatures and rainfall variability reduce agricultural yields in sub-Saharan Africa.<sup>18</sup> Such effects have been found by others in different parts of the world as well.<sup>19</sup> Thus, the evidence on climate and weather directly affecting agricultural productivity is strong.

Let us turn now to a discussion of the effects of climate on human activity. This includes the effects of both temperature and precipitation on disease and productivity. An examination of the thermal physiology of organisms explains how warm temperatures speed up biochemical reactions and consequently the growth rates of organisms.<sup>20</sup> Various factors,

including temperature, precipitation and sunlight, combine to increase biodiversity in the tropics including the diversity of infectious diseases. This helps explain the existence of higher diversity of infectious diseases in the tropics. Another climate related factor potentially affecting productivity that doesn't get much attention is humidity. Research shows that as temperature and humidity increase, malaria transmission can increase from zero to epidemic rates.<sup>21</sup>

Other ecologists have also found that the diversity of infectious human diseases is higher in countries near the equator than in countries at higher latitudes.<sup>22</sup> The diversity of all disease categories increases with the maximum range of precipitation, and most disease categories increase with monthly temperature range. One of the most interesting findings is that infectious human diseases were equally likely to have originated in tropical or temperate regions. According to this research the early humans that migrated out of Africa and into temperate latitudes initially left several infectious diseases behind: only one of the 10 major tropical diseases, cholera, followed into temperate latitudes.<sup>23</sup> The reverse though is not true. The same study claims that about 11,000 years ago, around the time that agriculture was developed, several infectious diseases originating from domesticated animals jumped to humans and most of these new infectious diseases easily spread to the tropics. In addition, several important differences between disease ecology in the temperate and tropical regions emerge, all of which suggest a higher disease burden for the tropics.<sup>24</sup> Out of these perhaps the most significant is the fact that tropical diseases are less acute but more chronic than those in temperate climates with 40% of them lasting for months or even years. This is an important factor potentially affecting both human capital and labour productivity in a negative way.

In recent years there has been an extensive array of studies using panel data to estimate the effect of temperature and precipitation on industrial output. In a comprehensive summary of this literature, the authors note that the findings consistently report an estimate of a 2% loss of output per 1 degree Celsius.<sup>25</sup> These studies are consistent with micro-level studies of labour productivity as well. As an example, one of the investigations looked at long-term differences in productivity in call centres under different temperatures and found it to be 5–7% lower under elevated temperatures.<sup>26</sup>

Studies measuring aggregate economic activity and climate have also found a link between the two. Since temperature and rainfall are two main



components of climate, recent work using more sophisticated panel estimation techniques has examined them more closely and finds that for each 1 degree Celsius increase in temperature, countries are on average 8.5% poorer as measured by GDP per capita.<sup>27</sup> Additional evidence is provided by data on global economic activity, the G-Econ database, which measures economic activity for all large countries, measured on a 1 degree latitude by 1 degree longitude scale. Amongst other results, the relationship between temperature and output is negative when measured on a per capita basis.<sup>28</sup>

The research on precipitation is less clear and convincing with mixed evidence. A study using data for 12 countries in the Americas finds a statistically significant negative relationship between income and average temperatures but little or no impact of average precipitation levels.<sup>29</sup> Newer studies using panel data report a negative link between temperature and per capita income but again no effects of precipitation.<sup>30</sup> However, others have demonstrated that higher rainfall is associated with faster growth in sub-Saharan Africa but not elsewhere.<sup>31</sup>

Lastly, the effects of climate can be traced even in a seminal paper on the topic of comparative development, where the intent is to take a different route and suggest that the quality of institutions plays a more prominent role than geography in comparative development outcomes.<sup>32</sup> The authors emphasise that the type of colonisation that a country was initially subjected to is responsible for subsequent institutional quality. Furthermore, the authors conclude that the type of colonisation was determined by the mortality rates of the colonisers in the conquered countries, which in turn were determined by the disease ecology of those lands. Since the latter is ultimately determined by climate, this suggests that climate played a pivotal role in the origins of colonial institutions. An important caveat to keep in mind, with studies that control for the effects of institutions, has been suggested by subsequent researchers who have pointed out that if hot and humid climates resulted in low-quality institutions which in turn lead to low income, then controlling for institutions can have the effect of partially eliminating the explanatory power of climate, even if climate is the underlying cause.<sup>33</sup> Research that argues for the supremacy of institutions as the primary determinant of income can be subject to this critique.<sup>34</sup>

Hence, the summary evidence on climate and average income, industrial output and agricultural and labour productivity demonstrates a clear and negative association with temperature but a weaker and questionable link with precipitation. It would be safe to say that based on the volume of

research on this topic over the last decade, geography has made a comeback and that climate-based explanations are not only accepted by economists but have in fact been subject to the exacting scrutiny with which we approach any question that interests us. By conducting rigorous and extensive quantitative analyses, economists themselves have announced that geography has arrived.

## NOTES

1. It is worth mentioning at the outset that gross domestic product (GDP) per capita (per person) is the measure of average income levels in a country and is the most commonly used indicator of standards of living or levels of development across countries. When measured at purchasing power parity (PPP), it accounts for differences in the cost of living between countries as well and is a more accurate indicator of the well-being of a country's citizens, in terms of how many goods they can purchase. It is generally acknowledged that GDP provides a one-dimensional view of development. Despite this shortcoming, the lack of reliable alternatives results in its use in most empirical studies.
2. Baumol 1986.
3. Sala-i-Martin 2006.
4. The ten poorest countries in the world according to gross domestic product (GDP) per capita measured at purchasing power parity (PPP) are Central African Republic, Burundi, Congo, Democratic Republic of Congo., Liberia, Malawi, Mozambique, Guinea, Guinea-Bissau and Madagascar. The ten richest countries in the world according to the same measures are Norway, Switzerland, United States, Ireland, Netherlands, Austria, Germany, Denmark, Iceland and Sweden (Source: World Bank indicators 2015 <http://data.worldbank.org/indicator>).
5. Huntington's book is titled 'Civilization and Climate' and although his intention may have been otherwise, I choose to interpret his use of the word 'civilization' as equal to economic advancement. Certainly there is no desire on my part to subscribe to his other, less palatable, theories on race.
6. Kamarck 2001.
7. Landes 1998.
8. Crosby 1986, 6.
9. *Ibid*, 3.
10. The National Humanities Center sponsors the Jesse Ball Dupont Seminar for faculty at small liberal arts colleges. For 3 weeks, one has the opportunity to immerse oneself in a topic by reading and discussing works with other colleagues in academia. For me the timing was just right and I'm grateful to have had that opportunity.

11. Gallup et al. (1999). The authors construct measures of the density of GDP per capita which can vary across a single country as opposed to GDP per capita which is an aggregate measure for the entire country. Defining an area considered the geographic tropics (lying between the Tropic of Cancer and the Tropic of Capricorn), they conduct empirical tests to verify the relationship between various elements of geography and GDP per capita.
12. *Ibid.*
13. Gallup and Sachs 2001.
14. Gallup and Sachs (2001) base their findings on an index of malaria prevalence derived by World Health Organization (WHO) data. The index as defined by them is the fraction of the population at risk of malaria multiplied by the fraction of cases of malaria that are falciparum malaria (P.85). *Plasmodium falciparum* is the species of mosquito that is most responsible for cases of mortality and morbidity. Moreover, as they explain, sub-Saharan Africa is particularly cursed with the prevalence of a species of mosquito that has the most efficient mosquito vector in the world (that which causes the most secondary infections) which has caused malaria eradication in that region to be especially difficult.
15. Alsan 2014.
16. Masters and McMillan 2001.
17. Haile 2005.
18. Schelenker and Lobell 2010. Although the authors include four different model specifications including average temperature, they use as a baseline model the number of days with temperature above 30°C. Hence, the notion of a threshold range of temperature is used above which the impact of warmer weather becomes negative which gives rise to the nonlinearity in the relationship.
19. Using panel data on rice farms in Asia, Welch et al. (2010) find that higher minimum temperature reduces yields but higher maximum temperature increases yields. While studying land invasions in Brazil, Hidalgo et al. (2010) estimate that rainfall deviations lower agricultural incomes.
20. Lafferty 2009.
21. Lafferty (2009) cites others who have found that the diversity of mosquitos decreases with latitude and as such so does the diversity of mosquito-borne diseases such as malaria. This makes eradicating malaria in the tropics even more difficult. He also cites experiments which demonstrate that higher temperatures increase bacterial pathogens and hence spread bacterial infections at a faster rate.
22. Guernier et al. 2004.
23. Wolfe et al. 2007. The high diversity of infectious diseases in the tropics could result from a high diversity of vectors. The inability of human tropical diseases to spread from the tropics to temperate regions may be due to the

higher fraction of tropical diseases that have a specific vector (80% tropical vs. 13% temperate) and/or a wild animal reservoir (80% tropical vs. 20% temperate).

24. *Ibid.* Five findings are significant in this regard: a higher proportion of diseases are transmitted by insect vectors in the tropics; a higher proportion of diseases convey long-term immunity in temperate zones versus tropical zones; animal reservoirs are more frequent in the tropics; a higher proportion of diseases in temperate zones are acute rather than slow, chronic or latent; a higher proportion of diseases in temperate zones are strictly confined to humans.
25. Dell et al. 2014.
26. Niemela et al. 2002.
27. Dell et al. 2009.
28. Nordhaus 2006.
29. Dell et al. 2009.
30. Dell et al. 2012; Hsiang 2010.
31. Barrios et al. 2010.
32. Acemoglu et al. 2001.
33. Dell et al. 2014.
34. Rodrik et al. 2004.

## Pinpointing the Tropical Effect – The Relevance of Climate

**Abstract** Countries that are located in and near the Tropics have lower levels of average income than those in more temperate climates. Research shows that aspects of geography such as climate and disease ecology can affect economic outcomes and standards of living. This chapter focuses in particular on the effects of climate as it pertains to temperature and rainfall. A study is conducted which finds evidence of a negative relationship between higher temperatures and average incomes across countries. It also finds that countries that have wider ranges of temperature extremes have higher incomes. Lastly, the evidence points to the importance of rainfall but the relationship between levels of precipitation and income is more complex.

**Keywords** Climate · Temperature · Precipitation · Economic development · Economic growth

**JEL field codes** O1

A contemporary study of the effects of climate might examine specific characteristics such as temperature and rainfall as possible factors that could influence productivity, and through it, income per capita across countries. Since climate appears to be on the surface, one of the main factors distinguishing the developing world from the developed world, I

decided to attempt such a test by building on previous studies by economists and ecologists who have studied the impact of climate on agricultural productivity and disease burden.<sup>1</sup> My goal was to pinpoint those characteristics of climate that might somehow have a causal link with development.

Let us pick up the thread from the previous chapter and follow it further with an empirical analysis to see where that leads us. On one hand we have ‘the tropical effect’ which is a catch-all phrase for all characteristics that are unique to the tropics – temperature, rainfall, humidity, soil quality, water availability, topography, etcetera. On the other side we have studies that have looked separately at some of these characteristics but not in conjunction with each other. Given that temperature and precipitation are two defining features of the tropics, it makes sense to focus on them and test to see if their relationship with average incomes is robust in the presence of the catch-all tropical effect. It would also be interesting to test this relationship on growth rates of GDP per capita, not just levels. The launching point for this study goes back to one of the earliest works on this topic which was based on defining, separating and focusing on different climate zones.

The rest of this chapter will detail the specifics of my own research starting with the data used, followed by an analysis and interpretation of the results. Finally, I will conclude with comments on some possible directions of future research on this topic.

## DATA

Since Gallup et al. (1999) were the first to bring geography back to the forefront of the development debate, I wanted to facilitate a direct comparison between my study and theirs so I started with their original dataset for the economic, social, policy and geographical variables. All but the geographical variables are from established, widely available sources.<sup>2</sup> The physical geography and malaria index variables were constructed by them using GIS software.<sup>3</sup>

The main problem I ran into was data mining related to temperature and rainfall. Failing to find conveniently aggregated data that I could use, I faced the prospect of constructing my own variables for temperature and precipitation. A comprehensive set of climate related data is maintained by the National Climatic Data Center (NCDC).<sup>4</sup>

A summary of the various data sets commonly used in the climate and economic analyses shows how this type of information has been used by others.<sup>5</sup> Out of the two methods suggested for aggregating the data, spatially or using population weights, I chose the former. From the raw data set, country averages for total annual rainfall, mean temperature and the difference between the extreme maximum and minimum temperatures were computed.<sup>6</sup>

## ESTIMATION

The linkage between climate and development is investigated both on levels and growth rates of GDP per capita. It begins by estimating an equation of the form

$$Y_{it} = \alpha_0 + \beta Z_i + \lambda W_i + \gamma X_i + \varepsilon_i \quad (2.1)$$

where  $Y_{it}$  is GDP per capita for country  $i$  at time  $t$ ,  $Z_i$  is a vector of geography variables created by Gallup et al. (1999),  $W_i$  is a vector of social and political variables which are routinely used in the literature and have been established as influencing aggregate output and  $X_i$  is a vector of climate variables consisting of temperature and precipitation. Three different specifications of this equation are used to carry out estimations using standard OLS. One uses GDP per capita as the dependent variable, one substitutes the log of GDP per capita and the third focuses on its growth rate. In the latter specification a measure for initial standard of living in 1965 is added to the vector of independent variables as is standard in the growth literature.

## WHAT DID THE FINDINGS REVEAL?

To start with, let's study the correlation between climate, as defined in this study by temperature and precipitation, and the catch-all tropical effect (Tropical).<sup>7</sup> As a reminder Tropical represents the percentage of land area in the geographic tropics as identified by Gallup et al. (1999). A simple correlation shows that countries with larger ranges of extreme temperature are negatively correlated with both average temperature and average rainfall. A glance at the data confirms the notion that countries with greater temperature ranges lie primarily in temperate

zones. This makes sense since closer to the equator at lower latitudes the variation in temperature both during the day and during the seasons is much less.<sup>8</sup> It stands to reason that temperate countries will have lower temperatures on average as well. The negative correlation with rainfall is not an obvious finding. As mentioned previously, tropical rainfall is notoriously unpredictable, ranging from drought to torrential. Unfortunately the average rainfall measure does not capture the *variability* in rainfall which is perhaps a more telling feature of this climate.

After replicating the initial study, the significance of the climate variables is tested. As soon as the climate variables are added, the Tropical effect loses its significance, possibly due to multicollinearity, and in subsequent regressions it is left out. The other variables behave as expected; the proportion of a country's population within 100 km of the coast is positive and significant as is a measure of openness to international trade and the quality of public institutions in the country. These three variables are all positively related to per capita income as expected and demonstrated in earlier studies.

The main result of interest is that average temperature is a significant determinant of the average income level of a country and is negatively related to it, indicating that warmer temperatures have detrimental effects on output and are perhaps one of the more important features of the tropical effect. This is not the same as stating that tropical countries have lower per capita income (the main finding of the Gallup et al. (1999) study) since being tropical includes a variety of features pertaining to climate, vegetation, soil, etcetera. At the very least it singles out temperature as an important determinant of the tropical characteristic. Moreover, this finding holds while correcting for the effect of institutions, something that has not been found in earlier studies.

The reasons for this phenomenon, and the channels through which heat can affect economic activity, have been discussed in the previous chapter. They include the impact of infectious diseases on mortality and morbidity, which may influence labour productivity in manufacturing and services. The same factors could also affect crop yields and labour productivity in agriculture, which have been shown to influence agricultural output and productivity.

To test the robustness of the temperature variable, I added two more variables which could impact income, a human development indicator and a measure of human capital. One of them measures life expectancy and the



other measures years of secondary schooling. Both enter as expected and the temperature variable remains negative and significant.

To further explore this relationship I added the variable which captures the range of temperatures experienced and measures the country average difference in extreme maximum and minimum temperatures. The results indicate that countries with wider ranges in temperature extremes had higher income levels. Recall that there is a fairly strong negative correlation between the mean temperature and the difference in extreme temperatures, indicating that colder countries are also more prone to extremes in climate.<sup>9</sup> A closer examination of the data shows that these countries have much lower extreme minimum temperatures and not as high extreme maximum temperatures as the warmer climates (not surprising). Hence, extreme cold may not have as detrimental an effect on output as extreme heat and as we have learned earlier from previous studies, extreme cold brings with it the beneficial effects of frost which is absent from those regions where temperatures are in a narrower range.

To facilitate a more direct comparison with earlier studies, the analyses were replicated on the log levels of GDP per capita. The most robust variable that emerges in this estimation is one that captures the range of temperatures, reinforcing the notion reiterated previously regarding the importance of cold, winter like conditions in killing pathogens that otherwise survive the absence of frost.

I was curious as to how precipitation fits into the puzzle, so I tested two variables: average annual total rainfall and its squared term. The specifications of these variables were designed to test for nonlinearity in the data which has been suggested by other researchers. The findings confirm that by itself precipitation is not significant but in conjunction with its squared term it has a powerful impact on average income. The direction of this relationship was a surprising finding since the level of precipitation appears to have a negative influence on output but in light of the fact that it is only significant when its squared term is included (which enters as a positive factor) perhaps this could be reinterpreted. It could be that at low levels of precipitation an increase in the amount of precipitation will not increase output and in fact could have a negative impact if it contributed to an increase in infectious diseases, parasites, fungi, etcetera. Also, the infrastructure of developing countries is susceptible to many factors, and rainfall could easily disrupt basic utilities such as energy, water and transportation.<sup>10</sup> Thus the low level of development of a country could intensify the adverse effects of moderate rainfall, but this is accounted for in the analysis which

controls for that factor. Subsequently, above a certain threshold level of precipitation, the benefits accruing to agriculture may outweigh these factors and result in an overall positive impact on GDP per capita.

This interpretation is certainly open to debate. A better measure of precipitation, as mentioned previously, would probably be the *variability* in rainfall. Kamarck (1976) summarises the argument perfectly in pointing out the pattern of rainfall in the tropics as being either excessive or not enough. He notes that the notion of an ‘average’ measure of annual rainfall can be misleading if rainfall fluctuates wildly from one year to the next or even within a single season.<sup>11</sup> Hence a measure of the variation in rainfall might be a better indicator to estimate the significance of precipitation as a factor in affecting output.

I decided to extend the investigation further to test the effects of these same variables on the growth rate of average income. In the economic growth literature the basic specification of the model controls for the initial levels of development of the country by including initial GDP per capita, a measure of the stock of human capital which captures initial levels of human development, a measure of the openness of the economy to international trade and the quality of public institutions. To this model I added the same geography and climate variables that were used previously.

A replication of earlier studies confirmed the finding that the tropical effect is associated with lower rates of economic growth. However, once I added the more specific climate variable which measures average temperature, the effects were surprisingly reversed, that is, warmer countries have experienced higher rates of economic growth.<sup>12</sup> To try to work through this puzzle I tested the same model and substituted the range of temperature differences for average temperature. This time I found that wider temperature ranges are associated with higher rates of growth. Interestingly, the tropical effect drops out and is no longer significant once the range of temperatures is included in the specification. This helps to pinpoint the forces behind the tropical effect as explained later.

Since countries with wider temperature ranges are generally those where either night time temperatures or the change of seasons vary considerably, this leads me to suggest that the latter measure is more reliable in terms of capturing the temperature effect of climate as opposed to simply average temperatures. An explanation for why this may be the case emerges from the work of other researchers who have studied the effects of frost on growth rates of economies. After separating countries into two groups, tropical and temperate, they find that temperate

countries converge to a common higher level of income while tropical countries face internal constraints.<sup>13</sup> Thus, they conclude that the effects of frost may have been more important historically when most economies were still predominantly dependent on agriculture. As a consequence frost could also have had a hand in determining where industrialisation first took place.

Once these results are reconciled, the conclusion that emerges is one that is hard to escape – climate, in particular heat and the absence of cold, matters for development.

### WHAT NEXT?

My own analysis leads me to join other researchers and advocate for the return of geography-based explanations as being relevant to our study of underdevelopment. Climate, as defined specifically by temperature and rainfall, may have an important role in determining both the levels of output per capita and how fast a country grows. Since climatic and geographic variables are (largely) exogenously determined, reverse causation is unlikely to be of concern although the effects of climate can certainly be amplified via existing conditions of development.

One of the constraints with an analysis of this nature is the difficulty of controlling for a host of factors. In a cross-country study, there are many conditions that might differ across countries, and although some of the main ones such as initial levels of income, human capital and institutions are controlled for, there are still other possibilities not accounted for. The measurements of some of the political economy variables are prone to error, and variables such as religion, culture, fractionalisation and language are not considered. To avoid the possible effects of such wide-ranging differences, a parallel approach might be to study income differentials *within* a country to see whether climate has played a role in regional economic growth. Such a method would eliminate the inter-country differentials that are difficult to control for and focus on the intra-country factors which are related to some of the more physical differences in climate, topography, terrain, natural endowments, etcetera.

Before moving on, it is worth a reminder that the purpose of studies such as this are not to suggest that geography *alone* is responsible for determining the economic outcome of a country, a concept that has come to be known as ‘geographical determinism’. Instead, the intent is to draw attention to the fact that geography and climate do matter and *how* they matter is an area worthy

of further investigation. If a particular technology or policy prescription works in a certain environment because of the right conditions, then adapting it to work in a different one where conditions are substantially altered would require a commitment to research and development that may be beyond the scope of poorer countries but could be pursued in the developed world. In addition, policy or development might increasingly be tailored to regional conditions, even in more developed countries. A parallel can be drawn by examining the case of the cotton-growing industry in Lubbock, Texas, which benefited enormously from the superior research, technology and innovation provided by the partnership of the United States Department of Agriculture (USDA) and the University of Texas. This enabled cotton farmers to overcome the obstacles created by weather, pests and other forces of nature and build a successful, thriving industry in the region.<sup>14</sup>

## NOTES

1. This chapter is based on previously published material in Khawar (2016).
2. Appendix A includes details on the data and empirics of the analysis.
3. Detailed explanations regarding the calculations of these variables are contained in the appendix to Gallup et al. (1999). A word about GIS software and how it works in this context. Unlike aggregate measures of GDP per capita, GIS allows researchers to develop measures that are based on smaller geographical units at a greater resolution (for example a 5 minute by 5 minute grid). As a parallel, imagine a landscape photograph taken with a 2 mega pixel camera versus a 12 mega pixel one. The camera with the greater resolution will allow you to see much greater detail. The same is true with GIS mapping. The increased availability of data on global weather has led to an increase in the use of GIS software and data sets in investigating weather-related phenomena as evidenced by recent research in the area. GIS has the advantage of being potentially more accurate since it corresponds to the particular surface area being analysed instead of a countrywide average. This would be particularly helpful if one were to study differences in output and climate within a certain region or country, for instance, Brazil.
4. The data set contains information on worldwide temperatures and precipitation for at least one location in each country throughout the world, whenever possible. For large countries the stations are selected to provide comprehensive geographical coverage. The data are presented as an annual average calculated over a record length ranging from 3 to 105 years, averaging about 30 years for most countries. The temperature data consists of values of average daily temperature in January, April, July and October, as well as extreme maximum and extreme minimum temperatures, all in

Fahrenheit. The precipitation data consists of average precipitation in each month as well as an annual total, all in inches.

5. Dell et al. 2014.
6. Appendix A includes details on how these values were computed and a listing of the values of these variables for each country in the study.
7. Consult Appendix A for details on the empirical results of the study.
8. An exception is countries in North Africa where colder temperatures in the desert at night might account for the wide range found and countries like Pakistan where high altitude in the northern mountainous area could account for the same.
9. This may explain why average temperature now loses significance, again due to multi-collinearity.
10. This is less far-fetched than it might seem. Even an inch of rain in Karachi causes roads to flood as sewers overflow and the entire city almost grinds to a halt. When I attended school in Karachi, we would routinely arrive at the school gates only to be waved back by the *chawkidar* (gate keeper) who turned us around to return home as our school and most others in the city had to close due to the roads being almost impossible to navigate and the grounds being flooded. If an inch of rain could have this effect, imagine the havoc wrought by the more torrential monsoon rains.
11. Kamarck 1976, 15–16.
12. This result is robust even when a control for malaria, a measure of the malaria index in 1966 that was highly significant and important in the Gallup et al. (1999) study, is included.
13. Masters and McMillan 2001.
14. Rivoli 2014.

## North Versus South – An Examination of Regional Comparative Development in Italy and Brazil

**Abstract** The ‘institutions versus geography’ debate argues for the primacy of institutions over geography in determining economic development. One way to parse this issue is to study differences in economic development within the same regions where institutional differences are less severe. This chapter examines data and maps illustrating regional disparities in income within South America, Brazil and Italy to establish a geographical pattern. The patterns reveal that in Italy which lies north of the equator, the northern areas of the country fare better in terms of economic performance, while the reverse is true for South America in general and Brazil in particular which lie south of the Equator. Even within the same countries income differences emerge suggesting that geography is at the root of the disparities.

**Keywords** Geography · Institutions · Regional disparities · Economic development

**JEL field codes** O1

Regional differences in economic development are not uncommon in countries around the world. The United States, Brazil and Italy are all examples of countries where income disparities exist based on geographical boundaries. Interestingly, in all three countries the differentials persist in a pattern which separates the northern and southern parts of these

nations. In the previous chapters we discussed differences in economic development between tropical and temperate countries which might be rooted in climate – in particular, the effects of heat, humidity, precipitation, soil conditions and pathogens on human and agricultural productivity. Countries that are sufficiently large in terms of land area such as the United States and Brazil, or as in the case of Italy are centred around a north-south axis, might experience different climate zones. If climate can play an important role in economic activity across countries, then one way to test its significance would be to see whether the same effects occur within countries as well. In fact this test is stricter than the former since it controls for cross-country variance in factors that are difficult to account for.

### DOES GEOGRAPHY INFLUENCE INSTITUTIONS?

Earlier in the book, I cited studies which demonstrated the various ways in which geography and climate have had a direct effect on economic development as measured primarily by average national income. At the same time another group of researchers have argued that it is not geography *per se* that dictated the fortunes of countries but the institutions that were in place in those countries that eventually determined whether they would succeed or not. The ‘geography versus institutions’ hypothesis has enjoyed a vigorous debate in the literature. On the institutions side of the dispute the main proponents of the argument allow for an indirect effect of geography by arguing that those countries whose climates were more suited to settlement by white Europeans developed more participatory and democratic institutions.<sup>1</sup> They further contend that those countries in which Europeans had higher mortality rates due to diseases to which they had no immunity (the effect of an inhospitable climate) were not intended for settlement by the conquerors and thus exploited in a way that led to the development of extractive institutions that were largely reflective of that legacy (of colonialism).

Two authorities on the subject, Stanley Engerman and Ken Sokoloff, have written numerous papers on the topic of institutions, their role in economic growth and their dependence on the natural and physical environment. In a discussion of the endogenous nature of institutions, they contend that climate and natural resources were the most important determinants of the geographical pattern of slave labour.<sup>2</sup> They further note that different areas of the world settled by the same European power ended up with institutional

differences and provide the example of New England and the British West Indies, both of which were colonised by the British. Additional evidence provided is the differences between French and English temperate zone colonies and their Caribbean counterparts on the one hand, and the similarities between French and English colonies in the Caribbean.

Returning to an examination of the pattern of slavery in the United States, Engerman and Sokoloff (2005) dismiss the notion of differences in the attitudes of immigrants who settled in the different parts of the country. Instead, they believe that natural resources and the physical environment, including land endowments, climate and soil all played a hand in determining the types of crops that were best suited for growing in the northern and southern colonies. Sugar, being the most valuable traded commodity of the time, was most suitable to the climate and soils of the southern colonies. Furthermore, its mode of production required economies of scale and as a consequence led to the development of plantation style agriculture. Hence, in those colonies slavery arose as the dominant model of labour and along with it the associated inequalities in society emerged. On the other hand, in regions that were well-suited to the growing of grains, slavery conferred no particular advantage since slaves were expensive to buy. Thus, farmers relied on their own or the free labour of others and a more egalitarian society developed.

An interesting aspect of this story that is not often studied is how institutions themselves change or evolve in response to external conditions of which the physical environment and endowments would be a subset. Once again Engerman and Sokoloff (2005) point to the eighteenth and nineteenth centuries and the varied responses to the abolition of slavery in the colonies during this time period. In areas where the land was highly productive and well-suited to the growing of sugar, the plantation system was simply replaced by an alternative system of indentured labour from India.<sup>3</sup> Thus, one system of institutions evolved into a different but similar form, in which the power and incentive to extract surplus still rested with the elite because the natural resources of the land enabled that structure to continue.

### THE CURIOUS CASE OF ITALIAN GROWTH

One would typically expect a discussion on institutions and growth to centre around developing countries. After all, the colonial legacy and related institutional problems are normally associated with former colonies in Africa, Asia and Latin America. It is surprising then to consider the case



of Italy, a country in Western Europe and member of the Group of Seven (G-7), an industrialised country by any standards but one that still masks huge regional disparities between the north and south of the country.<sup>4</sup>

The regional differences in Italy have been noted in studies by economists and historians alike. One earlier analysis looks at data on the northern and southern regions of Italy before and after unification from the period 1861–1914.<sup>5</sup> The study finds that the north led in almost every economic category prior to unification except for agricultural output, in which both were roughly equal, and the proportion of labour employed which was higher in the south. However, by the 1950s the south still had the majority of its labour force employed in agriculture and lagged behind the north in terms of industrial and manufacturing employment. Agriculture was equally important to both the north and south pre-unification. However, different agricultural activities were carried out in each region. The research finds that fruit crops, citrus tobacco and cotton were more important in the south whereas wine, hemp and linen dominated in the north. Additionally livestock also differed between the two regions with pigs and sheep being the primary species in the south while cattle was predominant in the north. The paper doesn't give a ready explanation for these differences but speculates that it could be due to different soil characteristics. It also notes that the north appears to have been more suited for intensive agriculture and that it had a significant advantage in the silk industry which was a major source of export income in the nineteenth century.<sup>6</sup> With respect to measures of human capital as well, it finds that the literacy rate in the north was over three times that in the south pre-unification.

The author wades through a mountain of statistical evidence to conclude that after unification agriculture grew faster and more steadily in the north than in the south. The textile industry which was concentrated in the north grew rapidly there while it stagnated in the south. Overall, he finds that the differences in development between the north and south which were present prior to unification were only amplified afterwards. He attributes a large portion of this to the fact that the south never generated agricultural surpluses that enabled savings and investment and that it relied too heavily on its agricultural base and hence did not provide a sufficiently broad market for industrial products. While the study does not focus on resources and endowments as the cause of these differences, it hints at differences which may exist between the two regions in terms of their suitability towards various agricultural activities. There is also a

reference to possible cultural differences, a topic which we will examine more thoroughly in a later section of the book.

An alternative explanation which focuses on differences in social capital in Italy has also been provided by scholars. When examining discrepancies in the functioning of regional governments in the 1970s, researchers note that they could be explained by variations in social capital, in particular trust, cooperation, participation and social interaction.<sup>7</sup> These differences are further attributed to the experience of the region as a free city (self-governing) in the twelfth century and it is hypothesised that the experience of participatory government created long-lasting cultural traits in those societies.<sup>8</sup> Geographical relevance is subsequently traced back to the notion that the location of the free cities was partially determined by geographical features which allowed some cities to be more defensible against imperial control.<sup>9</sup>

To summarise the argument: geography played a role in the governing structure that cities eventually adopted. These political institutions in turn influenced the evolution of specific cultural and societal values which may have had long-lasting effects. Once again, culture creeps into the discussion urging us to pick up the thread further down the road.

What of modern Italy? A recent article suggests that this divide is still present.<sup>10</sup> The last couple of decades have not been kind to Italy but they seem to have disproportionately affected the southern regions compared to the north. [Table 3.1](#) highlights the main disparities.

As the data shows, the divide between north and south is still substantial since the study conducted in the 1960s, with the south experiencing lower rates of output and employment growth as well as higher rates of unemployment and poverty. In a separate study on convergence of incomes across Italy, researchers have found that per capita income in 1950 was 70% above the national mean in the northern regions but 32% below the average in the southern regions.<sup>11</sup> In the subsequent 35 years, the southern regions grew faster than the north, ending up at 25% below the mean compared with the north's 38% above the mean. Although their results support convergence, the rate of convergence is less than predicted at approximately 2% a year, accounting for the still wide gap between the regions. [Figure 3.1](#) illustrates the current regional income disparities.<sup>12</sup>

The persistent lag between the two regions is puzzling given the ease of technology transfer in the modern economy, the unified institutions, laws and governments of the country, and the relatively homogenous population of the area. Moreover, within a country both labour and capital should be more mobile than across countries, a phenomenon that should speed up the

**Table 3.1** A comparison of northern and southern Italy

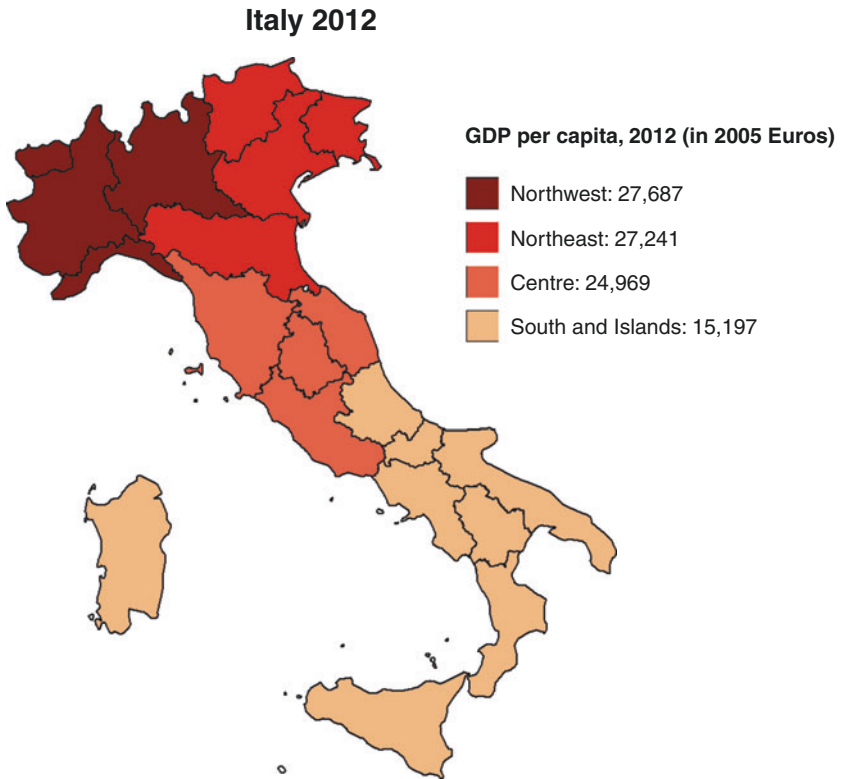
<i>Economic data</i>	<i>North</i>	<i>South</i>
GDP per capita 2000 (euro, chain-linked values, reference year 2005)	28,505	16,009
GDP per capita 2012 (euro, chain-linked values, reference year 2005)	26,739	15,197
GDP growth (%) (2001–2013)	2	–7
GDP growth (%) (2008–2013)	–7	–13
Proportion of newly unemployed (%) (2007–2014)	30	70
Growth in employment (%) (2007–2014)	0	–10.7
Employment rate (%) 2013	67.2	45.6
Female Employment (%) 2013	58.9	33
Unemployment rate (%) 2013	9.1	19.7
Proportion of families living in absolute poverty (%) (2007; 2013)	3.3; 5.8	5.8; 12.6

*Data Source:* Istituto nazionale di statistica (ISTAT); The Economist, May 16th, 2015, 68

rate of convergence. This pattern is visible even within the larger regional picture. Among the Western European nations Italy, Spain, Portugal and Greece are the poorest, having the lowest measures of average income. To be more precise, GDP per capita in Italy and Spain is 10% below the European Union (EU) average while Greece and Portugal are 30% below the EU average.<sup>13</sup> Is it a coincidence that they are also the southern most countries in the region and the closest to the equator?

### SOUTH OF THE EQUATOR

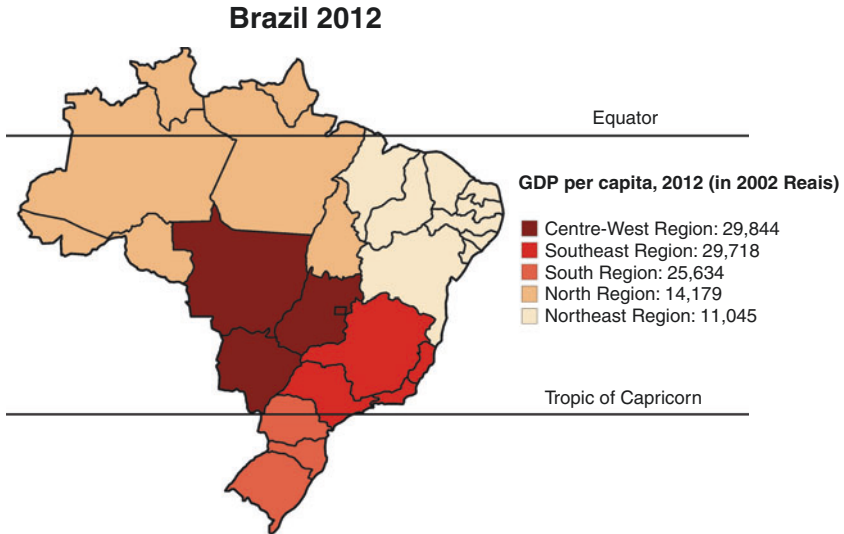
If fortune favours the north above zero degrees latitude, what happens south of the equator?<sup>14</sup> Remember that below the equator, the northern most regions are closer to it and to the tropics while southern areas are farther away. A study of regional inequality during the period 1939–1995 in Brazil finds considerable disparities between the northern and southern areas of the country.<sup>15</sup> In 1939 average incomes in the south were 111% of the national average while those in the north were 75%. By 1996, the



**Fig. 3.1** Map of Italy according to GDP per capita, 2012

*Data Source:* Istituto nazionale di statistica (ISTAT)

south had maintained its lead at 109% of GDP per capita in the country as a whole but the north had fallen behind even more at 65% of average income.<sup>16</sup> Thus, while standards of living in the south increased six and a half times, those in the north increased by a factor of less than six. Not only did the north fail to decrease the gap between itself and the rest of the country, it actually grew slower. This is contrary to the evidence on convergence across states within a country which shows that typically poorer regions experience faster rates of economic growth.<sup>17</sup> Differences are even more acute when comparing the northeast with the southeast regions of Brazil. By 1996 the southeast had achieved levels of average



**Fig. 3.2** Map of Brazil according to GDP per capita, 2012

*Data Source:* Instituto Brasileiro de Geografia e Estatística (IBGE)

income which were 139% of the national average while the northeast was at just 46%. Overall, research finds weak evidence of income convergence across states in Brazil but offers little explanation for the initial and persistent differences in standards of living. [Figure 3.2](#) illustrates these regional differences for Brazil.<sup>18</sup>

Let's take a look at regional differences in average incomes across South America to see if a similar pattern emerges.<sup>19</sup> If we consider countries south of the equator, we can divide them into two groups – one where the majority of the land area lies between the equator and the Tropic of Capricorn and the second group where most of the country is below latitude 23 degrees south. [Table 3.2](#) illustrates the pattern.

As the data clearly shows, the southernmost group has an average income that is more than twice that of the northern group. Since the countries in South America were colonised by the same European powers, the differences cannot be attributed to exogenous or imported institutions but instead must be reflected in the evolution of development that has taken place since then, perhaps as an adaptation to local conditions. It is worth noting that after

**Table 3.2** GDP per capita, 2013 – South American countries

<i>Countries</i>	<i>GDP per capita</i>	<i>Regional average</i>
Bolivia	2231.5	5752.44
Brazil	11,797.4	
Ecuador	5291.4	
Paraguay	3640.6	
Peru	5801.3	
Argentina	12,198.9	13,343.53
Chile	14,364.1	
Uruguay	13,467.6	

*Data Source:* World Bank; data measured in constant 2010 dollars

independence from the Spanish, immigrants to the southern areas of South America were mainly from other European countries that were attracted to the region due to its similarities in climate.<sup>20</sup> The emergence of a wine producing industry in Chile, Argentina, Uruguay and southern Brazil where the climate is suitable for growing grapes is perhaps a direct consequence of that selection process.

In the next chapter we'll tackle the debate on 'institutions versus geography' more directly by examining disparities in labour productivity across the United States over a 100 year time period. The United States is a perfect choice for many reasons: it is large enough to encompass different geographical zones; climatic data is easily available; differences in income do exist amongst the different states; institutional factors can be controlled for *more* than in a cross-country study. Arguments are presented to view the economy of the pre-1940s US South, its climate and geography, as being comparable to that of contemporary developing countries. The discussion is grounded in an empirical investigation which shows that geography (location and climate) as well as institutions have shaped the economic success of regions within the United States, although the effects have dissipated over time as federal policies and mandates have helped the disadvantaged regions catch-up to national norms.

## NOTES

1. Acemoglu et al. 2001; Hall and Jones 1999.
2. Engerman and Sokoloff 2005.
3. Trinidad and British Guiana are listed as examples of this sort of change.

4. The G-7 are Canada, Germany, France, Italy, Japan, the United Kingdom and the United States and represent the seven major industrialised countries of the world based on income and human development.
5. Eckaus 1961. The author cites an even earlier study that suggests that the south's deficit might actually have its origin in ancient times. Unfortunately little explanation is provided for this tantalising hypothesis.
6. Eckaus refers to the silk worm culture in rural areas as a by-product of agricultural activities. Unfortunately he does not expand on this to explain whether this was related to specific inputs or resources. Thus the reason for the north's apparent comparative advantage in this is not clear.
7. Putnam 1994.
8. This hypothesis has been tested empirically and verified by others more recently (see Alesina and Giuliano 2015).
9. Ibid.
10. The Economist 2015, 68.
11. Barro et al. 1991.
12. The map was constructed using data from the Instituto Nazionale di Statistica (ISTAT).
13. Source: Eurostat (statistical office of the European Union).
14. I realise that I'm giving myself considerable latitude (pun intended!) in making this generalisation.
15. Azzoni 2001.
16. Statistics calculated based on data in Azzoni (2001).
17. Barro and Sala-i-Martin 1992.
18. The map was constructed using data from the Instituto Brasileiro de Geografia e Estatística (IBGE)
19. Data is measured as GDP per capita 2013 in constant 2010 US\$. Source: World Bank Development Indicators.
20. Crosby 1986.

## Did Geography Influence the United States?

**Abstract** Regional gaps in income dating back to the pre–Civil War era still persist in the United States. This chapter reviews evidence by economic historians of the United States and traces those disparities to differences in geography, including climate, ecology and natural endowments. Arguments are presented to view the economies of the pre-1940s southern states, along with their climate and geography, as being comparable to that of contemporary developing countries. The empirical investigation which follows shows that geography (location and climate) as well as institutions have shaped the economic success of regions within the United States although the effects have dissipated over time, largely due to the provision of federal policies and aid which aided the transformation of the southern states.

**Keywords** Climate · Geography · Economic history · United States · Institutions · Regional disparities

**JEL field codes** O1 · N0

Let us continue an examination of these issues by studying the case of the United States. Doing so will eventually allow us to draw parallels between regional disparities in the United States and global disparities between developing and industrialised countries. The United States is an excellent



example of a geographically (and climatically) diverse area where there was considerable disparity amongst the states in income per capita 130 years ago. This has lessened considerably over time, although it has not completely dissipated. Let us first establish the existence of differences in the level of regional development in the United States. [Table 4.1](#) illustrates regional comparisons of personal income per capita in the eight geographical areas of the United States.<sup>1</sup>

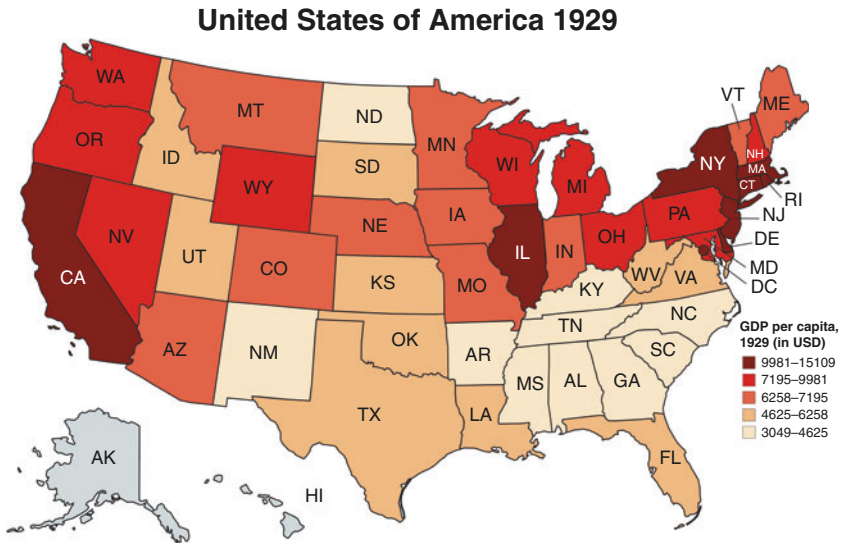
The data shows that the southwest and southeast regions of the country have consistently ranked at the bottom in terms of average personal income. In 1929, 1970 and 2015 the southeast was 52%, 87% and 88% of the national average respectively while the southwest was at 67%, 89% and 94%, respectively. Meanwhile the northern regions stood at 139%, 108% and 123% for New England and 129%, 112% and 117% for the Mideast, respectively. Out of the bottom 15 states ranked by average personal income, in 1929 13 were in the southeast, southwest or south central areas of the United States, while by 1970 and even 2015, 11 states were still from those regions.<sup>2</sup> The tendency of the southern states to lag in the rankings has been noted by others as well.<sup>3</sup>

While no region of the mainland contiguous United States lies in the tropics, parts of the country are considered subtropical (defined as between either of the tropics and 38 degrees latitude). Not surprisingly, that area comprises much of the southeast and southwest. The following three maps of the United States, [Figs 4.1](#), [4.2](#) and [4.3](#) illustrate the regional picture over time.

**Table 4.1** Personal income per capita in the United States, 1929–2015

<i>Regions</i>	<i>Personal income per capita in current dollars</i>		
	<i>1929</i>	<i>1970</i>	<i>2015</i>
New England	972	4547	58,863
Mideast	905	4711	55,667
Far West	876	4849	51,124
Great Lakes	796	4229	44,815
Rocky Mountains	589	3927	45,126
Plains	565	3931	46,515
Southwest	470	3748	44,774
Southeast	363	3468	42,252
United States	699	4196	47,669

*Source:* Bureau of Economic Analysis.

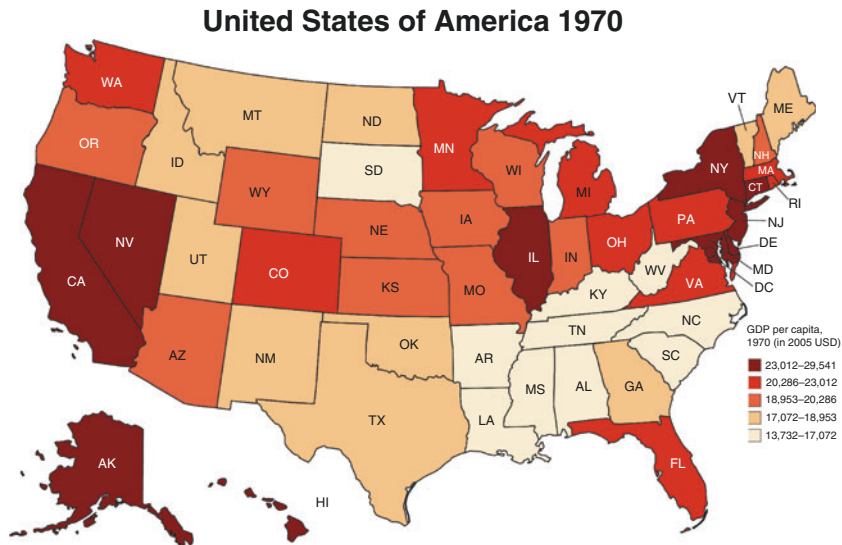


**Fig. 4.1** Map of the United States according to GDP per capita, 1929

*Data Source:* Bureau of Economic Analysis (BEA)

The empirical evidence on convergence in income per capita amongst the US states is mixed. Most cross-sectional studies find in favour of convergence.<sup>4</sup> Studies of convergence across the US states from 1840 to 1988 show positive evidence of it at a rate of around 2% per year.<sup>5</sup> Research also shows that the estimates remain the same whether measures of per capita personal income or per capita gross state product are used.<sup>6</sup> A later study that examines data on US states from 1880 to 1980 notes that the convergence was driven early on by the western states while the performance of the southern states was sluggish.<sup>7</sup> However, after 1940 the faster growth of the southern states was the main drive towards convergence for the sample as a whole. The authors attribute this to a favourable shock (the discovery of natural resources in the west) and an adverse shock (the defeat of the south in the Civil War).

A subsequent paper using time-series data (and hence more sophisticated unit root and co-integration techniques) supports the finding of non-convergence.<sup>8</sup> Despite this more recent finding, the fact remains that

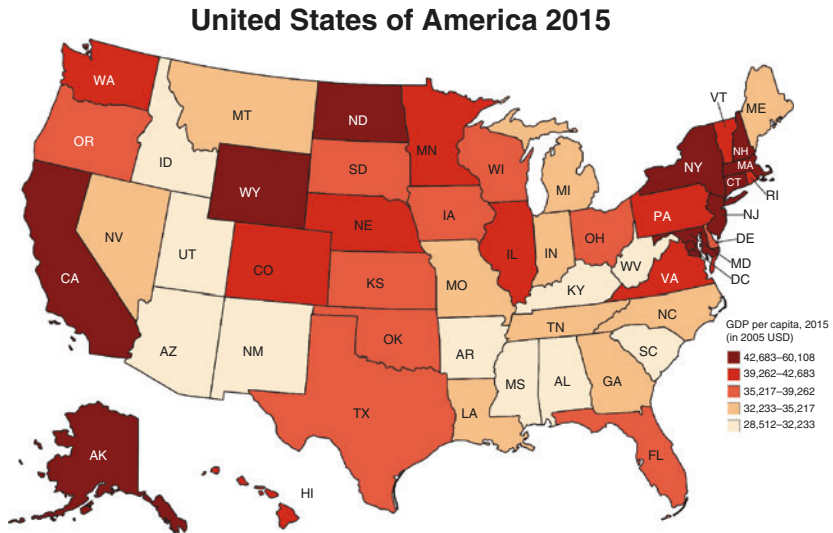


**Fig. 4.2** Map of the United States according to GDP per capita, 1970

*Data Source:* Bureau of Economic Analysis (BEA)

the difference between the richest and poorest states in the United States is several orders of magnitude less that it was 130 years ago. Overall, most of the evidence points towards a slow rate of convergence in average incomes across the US states. However, most of the empirical studies are focused on the quantitative nature of the analyses and results and do not question too deeply the reasons for the initial disparities or the slowness of the convergence process. [Figures 4.1, 4.2, 4.3](#) illustrate the regional disparities in the United States over three time periods, 1929, 1970 and 2012.<sup>9</sup>

To pursue this line of inquiry it is useful to first take a look at other studies that have examined the ‘institutions versus geography’ hypothesis for the United States. After that I will explore what economists and historians have provided as explanations for the divergence in income in the pre-1940s south and build the case for a comparison of the south to contemporary developing countries. Next I will outline my own empirical study which extends this analysis further and spend some time discussing the results. Finally we will return to the literature and examine the reasons



**Fig. 4.3** Map of the United States according to GDP per capita, 2012

*Data Source:* Bureau of Economic Analysis (BEA)

for the south's convergence in income, hoping to draw some lessons for contemporary development.

### EXAMINING 'INSTITUTIONS VERSUS GEOGRAPHY' FOR THE UNITED STATES

An examination of regional development in the United States brings us back to the issue of geography. Previous research has studied comparative development in the United States specifically from the perspective of geography. One study investigates the effects of what is referred to as 'tropicality' on nominal income per capita across US states over intervals of approximately 20 years, from 1929 to 1990.<sup>10</sup> 'Tropicality' is proxied by the average distance of a state from the equator and is found to be a significant determinant of average income. However, the fact that nominal income per capita is used poses two problems. The obvious one is that the measure does not correct for differences in the price level across states and

thus the purchasing power of income across states is not reflected. The second is that measures of personal income include transfer payments. More importantly, because other possible influences on income are not accounted for, the explanatory power of the model is weak.

A subsequent study is more comprehensive and constructs a measure of price-adjusted labour productivity for each state, drawing from previous cross-country studies to test for the impact of location, climate, natural resources and institutions on that measure over 20 year periods from 1880 to 1980.<sup>11</sup> This is the first paper to frame the ‘institutions versus geography’ debate in the context of the United States and the empirical study in this chapter owes a lot to their data and methodology. The advantage of using the United States to examine this issue is considerable. Differences in ethnicity, language, culture, religion, and political and legal systems which are difficult to control across countries are not as prominent when considering regions within a national border. However, the institution of slavery is a prominent factor representing regional differences within the United States and is the main variable representing institutional differences across states while variables capturing both climate and aspects of the physical environment are used to capture geography. The authors find that location (access to navigable water) and institutions were significant in explaining differences in income. They also find that natural resources and endowment were significant in explaining differences in labour productivity across the states especially with regard to mining activity.<sup>12</sup> However, even though endowments were significant, climate was not found to be relevant to the analysis. As I will contend next, a more comprehensive definition of climate can alter that conclusion.

### AN EMPIRICAL STUDY OF THE GEOGRAPHY HYPOTHESIS IN THE UNITED STATES

Let us now turn to an empirical test of the geography hypothesis and examine it through looking at the United States. The main question of interest is whether climate was a contributing factor in the poor performance of the south prior to 1940. An additional issue to be examined later will also be whether its effects were subsequently mitigated after interventionist policies by the federal government. As mentioned earlier, this study owes a great deal to an earlier paper by Mitchener and Maclean (2003)

from which all the data with the exception of the climate variables were obtained.<sup>13</sup>

The core model to be tested is:

$$Y_t = \alpha \text{Mining} + \beta \text{Slavery} + \chi \text{Access} + \sum_{i=1}^6 \theta_i \text{Climate}_i + \varepsilon \quad (4.1)$$

where:

$Y_t$  is the dependent variable and measures labour productivity at time  $t$ ; mining is a control variable to account for the resource-abundance of states in the West which is considered to be a factor in their early successes; Access represents locational advantages and is an indicator variable signifying access to (bordering) oceans, rivers or the Great Lakes;  $\varepsilon$  is the error term. The second to last term is a vector of climate variables which distinguishes this model from that of the study on which it is based.<sup>14</sup> From the additional climate variables only relative morning humidity was significant in the estimation and is reported, with more humid states experiencing lower labour productivity in the period 1920–1960. All the data is at the state level and includes all states with the exception of Alaska and Hawaii.

The equation is estimated six times using ordinary least squares, at 20 year intervals, for the years 1880, 1900, 1920, 1940, 1960, 1980.<sup>15</sup> The results for the core model using ordinary least squares are different from Mitchener and Mclean (2003) revealing evidence of the importance of climate. The Mining variable, representing the percentage of the 1880 workforce in mining, is only significant in 1880 but not thereafter, whereas the authors find it to be significant until 1940. The change is due to the inclusion of the relative humidity variable which enters with significance from 1920 to 1960 and thus their model is sensitive to the addition of climate variables.<sup>16</sup> In my analysis the average number of cooling degree days was not significant in any of the years except for 1940 where it negatively impacts labour productivity. Together with the earlier results for the effects of humidity, a case for climate albeit a weak one can be made thus far.

Slavery enters as expected, negative and strongly significant, confirming the detrimental impact of poor institutions. Also, parallel to the authors' results, geography (location) is important, indicating the advantage conferred by access to navigable water. The explanatory power of the model

diminishes significantly over time and by 1980 the model is obviously a poor fit for the data by as indicated by the low value of R-squared.

When a more robust estimate of the model is computed using a procedure to account for outliers, the results are stronger for almost all the variables (except for Mining). Slavery and Access are significant with the expected signs for all time periods considered. Both climate variables are significant with the expected negative signs for relative humidity (i.e. more humid states had lower productivity) and for the number of cooling days.<sup>17</sup>

Overall, it is difficult to draw strong conclusions from the findings. The results indicate that some features of geography, defined as climate and location, along with institutions have significant and lasting effects in explaining differences in productivity and hence standards of living across US states. As previously discussed, studies on convergence across US states have shown that these factors have eventually dissipated, a finding confirmed by the weakening explanatory power of this model over time, and the differences in per capita income between states have been reduced by several orders of magnitude. The effect of climate appears to be the weakest and the least persistent of the three, becoming insignificant by 1980. However, a closer look at the climatology data provides some insights. Both western and southern states are characterised by warmer temperatures, but the climate in the southwest and western states is drier and humidity levels are lower. States that have higher levels of humidity are in the southeast, northwest and northeast, the latter two regions mainly due to higher levels of precipitation. Average temperatures in those two regions however are lower than in the southern states. This suggests that the unique combination of subtropical warmer temperatures and higher humidity that characterises the southeast may not be captured by the model that is estimated. An interaction term including both variables may improve the specification and provide a better test of the hypothesis.

Unfortunately since the available data does not go as far back as we would ideally like it to (the eighteenth century), it would still be difficult to assess the direct effect of climate on the period for which it is available. The effects of the Civil War, the New Deal and reconstruction efforts in the south all confound the observations for most of the time period. It would be a mistake, however, to rely solely on empirical estimation as the only methodology capable of providing a definitive answer. As in this case, the paucity of data often makes that impossible and the richness of

historical analysis can be used to fill in the gaps. The narrative woven by many historians describes the south in terms of its endowments, climate, physical geography, ensuing institutions and economy, and provides a way in which to examine a period in which data limitations handicap the traditional tools of the economist. So let us see what historians have to say on the subject.

### ORIGINS OF DIVERGENCE

To set the stage for a study of this nature it is important to understand how economic historians view the evolution of the institutional differences which set the North and the South on such different trajectories leading up to the Civil War. However, before beginning that we need to back up even further and start with the concepts of ‘North’ and ‘South’. In the context of the United States, they evoke images of the Civil War, slavery, the Confederacy, cotton plantations and perhaps even Hollywood renditions of a bygone era with classics like *Gone with the Wind*. There are though, more official definitions of the South which is what we’ll focus our attention on.

The United States Census Bureau, a branch of the Federal government, defines the South as those states below the Mason and Dixon line.<sup>18</sup> An alternative climate based definition comes from the National Oceanic and Atmospheric Administration, a branch of the US Department of Commerce. The agency has two regional climate centres in the south of the country defined as Southern and Southeast. Jointly the two centres represent 12 of the above 17 states/districts with the exception of Delaware, District of Columbia, Maryland, Kentucky and West Virginia.

Other definitions of the South have been proposed by historians. In a study of income inequality in the South from 1950 to 1970, the South is defined as including the 12 states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia.<sup>19</sup>

Conkin (1998) believes that the least ambiguous South is the climatological South defined as the humid subtropical zone of North America, distinguished by heavy annual precipitation (over 30 inches) and winter frosts but mean temperatures never below freezing during any month. This ‘climate-based South’ is characterised by precipitation which consists mainly of summer rainfall, which although abundant on average, is highly variable with periods of destructive storms and extended droughts (similar



to tropical conditions in other parts of the world).<sup>20</sup> He makes a further division of the South into the 'upper South' where the average low temperature in January is below freezing but mean temperature is above freezing and the 'lower South' where the average low temperature in January is above freezing. Other definitions suggested are the 'slave South' (area with legal slavery in 1860) and the 'Confederate South' which is mainly a political definition.

Rubin (1975) categorises the South into upper, lower and isolated according to physical characteristics (soil, climate, etcetera). The lower South was the lower half of piedmont Virginia, most of North Carolina, half of Tennessee, all of Arkansas, most of Oklahoma and Texas, lower half of California, all of South Carolina, Georgia, Alabama, Mississippi, Louisiana and Florida. The upper South consisted primarily of the Chesapeake area.

Having established the different definitions of the South that have been suggested in the literature, let's examine the research which discusses its distinguishing economic characteristics. One study points to the ease with which tobacco could be grown in the greater Chesapeake area, together with its high demand, as being the reason it dominated agriculture in that region.<sup>21</sup> The research suggests that since tobacco was exceptionally labour-intensive, large-scale profitable production needed vast quantities of cheap labour, giving rise to the institution of slavery. An argument is also made that a similar production function for sugarcane and rice gave rise to the plantation system.<sup>22</sup> The cotton boom and the Industrial Revolution ensured the persistence of the system even more because the South's climate and soil were perfect for growing cotton. However, it appears that this imposed a heavy cost on the region in that the environmental cost of cotton-growing left most of the soils depleted and devoid of nutrition as well as opened the ground up to erosion.<sup>23</sup> The result was that although in the early 1800s average incomes in the South were close or equal to (some say even exceeding) those in the non-South, extreme income inequality coupled with a lack of emphasis on social services such as health and education, resulted in the South being considerably underdeveloped compared to other areas of the country, even before 1860 and the Civil War.<sup>24</sup> This observation on income inequality is an important one because most of the literature emphasises the relative prosperity of the South prior to the Civil War and attributes the decline to the destruction and decimation caused by the war, ignoring the pre-existing conditions. Another significant point raised is that the predominance of slave labour discouraged migration to the South by other ethnic groups, thus limiting

its exposure to the innovations of other cultural groups. In addition, the income inequality especially affected public education and hence the stock of human capital in the region.<sup>25</sup>

This view of the Southern colonies is echoed by other economic historians as well. In an excellent discussion of the economic divergence of the North and South, Coclanis (2000) cites many studies (including the influential work of Sokoloff and Engerman (1997)) that trace the roots of these differences back to the seventeenth century. He dismisses the argument of revisionist historians that the North and South were more similar than dissimilar and that much of the conflict leading up to the Civil War was the result of political mishandling. Instead, he firmly plants the differences between the two regions as originating in the climate, natural resources and opportunities for profit that characterised each region. In particular he references the production of tobacco as a staple crop in the South, which gave rise to plantation style agriculture and the associated institution of slavery. According to him, climate and endowment related variances coupled with economic motives were responsible for these divergent paths, rather than initial differences in the background, culture or values of the settlers to the regions.

The study also highlights the effect of the ensuing system of agriculture (plantation economy) on landholding, income and wealth, as well as political, social and structural variables, all of which were marked by extreme inequality and affected long-term institutional development as early as 1770. It is viewed as both a consequence of the system and as a deliberate strategy invoked to maximise economic surplus.

While explaining the simultaneous industrialisation embarked upon by the northern colonies, Coclanis (2000) attributes it to a series of fortunate circumstances in which northerners were forced to improvise, innovate and respond to adverse conditions which in the end turned out to foster the development of advantageous characteristics. Since they lacked the favourable climate and soil of the South, they also lacked the ability to grow economically productive staples like rice, tobacco and sugar (resulting in the need for few agricultural slaves). He suggests that this led to the development of a strategy which was focused on commerce, shipping, trade and the knowledge and skills associated with such enterprises. Additionally, an assertion is made that these early institutional differences continued to broaden, such that by 1900 the North and South were even more distinct than before the Civil War. This claim can be verified by evidence provided by other researchers that even after the Civil War, the

educational levels of both blacks and whites were much lower than in the rest of the country.<sup>26</sup> Part of the reason for this could be that racial discrimination against blacks affected the overall support for public education in the region.<sup>27</sup> Other factors adversely affecting public education could have been the lower tax base.<sup>28</sup>

One study in particular focuses on explaining why the use of bonded labour in the plantation style agricultures specifically ended up with the importation of slaves from West Africa.<sup>29</sup> As a starting point, the need for slave labour in the South but not the North is also explained by the fact that southern agriculture has a yearlong agricultural season, while northern regions do not. Hence it was economically feasible to buy slaves for use in the South, similar to the economies of scale argument put forth by others. The authors question the claim made by some that the initial choice of imported labour was due to the selective adaptation of West Africans to a tropical and subtropical climate and Europeans to cooler northern climates.<sup>30</sup> Instead they concentrate on the *aftermath* of that choice which, in their view, changed the disease environment in such a way that the labour productivity of each group was adversely affected in the geographical area to which they were not acclimated. They believe that the disease ecology of the South began to resemble that of tropical West Africa even more after the slave trade commenced, setting in motion a circular process whereby the environment became more and more hostile to Europeans and correspondingly increased the necessity to use slaves. Thus, in many ways they view the disease environment as endogenous to the process, something which is not commonly found in other studies.

The authors also address an issue that is often ignored in the literature – why the need for large-scale labour resulted specifically in the importation of slaves from West Africa instead of the enslavement of the indigenous population of Native Americans that already inhabited the area. Their explanation rests on the fact that the relative isolation of Native Americans, compared to Europeans and West Africans, resulted in extremely high rates of morbidity and mortality when exposed to diseases from the Old World. Thus, the relative labour productivity of the indigenous population was much lower and the authors conclude that alternatives to the use of African labour were tried but were not successful.

In another expose on the relationship between factor endowments and institutions, Sokoloff and Engerman (1997) draw a direct parallel between the southern United States and the colonies of Latin America. The

resemblance is most acute when comparing the production structure which focused on large-scale plantation agriculture and the high degree of overall inequality that prevailed in the society. In particular, they note that although economic growth in the South was high when measured by output per capita both before and after the Civil War, it lagged behind the North in terms of developing participatory political and economic institutions as well as capital and product markets. Their argument rests on the finding that slave plantations were relatively self-sufficient economic units with greater product diversification, both of which inhibited the evolution of markets. This in turn contributed to lower levels of manufacturing productivity and output and resulted in a smaller manufacturing base in the South as compared to the North.

In research focusing on the origins of American industrialisation in the northeast, another historian echoes others in comparing the relatively mild climate of the South with the harsher, northern winters and notes that the South was also relatively well-endowed and suited for large-scale agriculture.<sup>31</sup> In combination with colonial policy regarding English settlement, he believes that the resulting evolution of the northeast as the centre of industrialisation was a combination of accident, geography and natural resources all of which worked in conjunction with each other to produce the growth and spread of urban centres in the region, while the South remained a rural, agricultural based economy.

An interesting distinction is made between agricultural potential in the upper and lower South in the nineteenth century. One agricultural historian goes so far as to state that the main factors distinguishing the upper and lower South were the climatic constraints on the spread of agricultural methods.<sup>32</sup> In particular, he suggests an imaginary line dividing the two regions based on the area infested by cattle ticks. Below this line lay the lower South, where the ground froze but not for a sufficient length of time to kill parasites and food and livestock yields were lowest in quality and quantity. Above this line the opposite was true and planters experienced occasional success in raising high-quality cattle. He finds that even though in the early stages of settlement (characterised by shifting cultivation) both regions were similar in productivity, by 1820 the entire area was suffering the effects of soil exhaustion and erosion. He suggests that in Maryland and Virginia, a dramatic reversal occurred from 1820 to 1860 due to the large scale use of soil-conserving forage crops which permitted simultaneous

improvement in agriculture and livestock. However and this is the important distinction that he claims, the new agriculture was severely limited in its spread, in particular to the southern tier of Virginia counties and the upper South due to climatic factors. It wasn't until the advent of commercial fertiliser that the lower South was able to experience gains from the diversification of livestock and crops.

A somewhat parallel but equally relevant comparison can be found in the work of Pietra Rivoli (2014). As part of the story of the politics, economics and institutions involved in the making of a t-shirt, she begins with the growing of cotton in the United States. Rivoli illustrates very effectively, the differences in cotton-growing between the south-eastern United States and Lubbock, Texas. Throughout the contrast the same themes regarding the South come up – the historical resistance of farmers to innovation, the legacy of slavery and the system which replaced it (share-cropping), the lack of human and physical capital and the constant struggle of farmers who barely scraped by. On the other hand, the same exact crop was grown in Texas with far more efficiency as Texas growers overcame challenge after challenge with innovation and resourcefulness.<sup>33</sup> The idea of the company town was first introduced in Texas as a solution to the seasonal demand for labour in the industry, and farmers in that region adopted new technology and mechanisation at a rate that far exceeded their southern counterparts. Studying the agricultural experience of two regions growing the exact same crop, is in many ways the clearest example of how the geography driven institutions of the South left a lasting legacy.

The evidence presented thus far by historians and economists traces a path by which climate, resources and endowments, all elements of geography, led to the evolution of different institutions in the North and South. Extrapolating from this, one might conclude that it is not necessarily colonialism *per se* (both the North and South were colonies) but instead the combination of geography and prevailing technology which under the right circumstances leads to an institutional system where a small privileged class finds it economically beneficial to extract surplus from and dominate a substantial segment of the population. A perfect storm so to speak. Parallels may be drawn to other areas of the world such as South Asia, South and Central America and Africa. This provides a convenient segue to now present the case for comparing the economy of the pre-1940s South and its climate and agriculture to contemporary developing countries.

## COMPARISONS OF THE SOUTH TO CONTEMPORARY DEVELOPING COUNTRIES

In an examination of agriculture in the nineteenth-century South, some researchers focus specifically on factors, such as soil and climate, to separate them from the institutional effects of slavery. According to one, these geographical factors alone are enough to account for the South being placed in similar categories to other regions of the world that are semi-tropical and tropical.<sup>34</sup> More globally, he compares life in the nineteenth-century lower South to the contemporary underdeveloped world (much of which is still valid 40 years later) where an efficient mixture of crop and livestock activities is extremely difficult to achieve. Some of the other important characteristics that he believes are common to both regions are high levels of acidity in the soil due to heavy rainfall and the length and severity of summer heat that affects transpiration.<sup>35</sup> All these factors mean that grains, grasses and fodder crops cannot be grown extensively.

The author also believes that livestock yields suffered from direct effects of the climate. This claim is based on data from experiments in which persistent exposure to high temperature, humidity and solar radiation depressed milk production, growth rates and reproductive efficiency.<sup>36</sup> Similar effects are not evidenced by the cold. He also cites studies that provide evidence that in the twentieth century yields in the lower South were still significantly below average for the United States. Other problems mentioned are animal parasites affecting hogs and cattle since parasites could survive in the ground from year to year. This occurs because even though there are frost days, it never freezes to an appreciable depth. These issues which prevent a productive combination of crop and livestock farming are similar to those faced by tropical regions in other parts of the world.

Another relevant point raised by the author concerns the impact on the stock of human capital in the region. He postulates that the lack of diversification and focus on producing one crop for the market required a limited amount of decision-making which was primarily carried out by the elite.<sup>37</sup> Hence, both the breadth and depth of human capital formation was constrained as a result of the existing institutions, a hallmark of the dualistic structure of development which is also typical of lesser developed countries.

A much earlier study examines the lack of backward and forward linkages that categorised cotton production in the Antebellum South

and equates southern plantations to their counterparts in contemporary lesser developed countries.<sup>38</sup> The author contrasts the development of the South with that of the central plains and areas to the northwest in terms of the peripheral activity generated by the main economic activities of the regions. As has been pointed out before, the South was not diversified in its production of primary products and a few main staples dominated the market. In addition, cotton had few backward or forward linkages associated with it due to its mode of production.<sup>39</sup> It was simply ginned, pressed into bales and sent for shipping. By contrast the regions to the north and west of the country had diversified into the production of different types of minerals and grains. The types of primary products produced in those regions resulted in many linkages being formed in the collection, storage, processing and shipping of the commodities.<sup>40</sup> This resulted in many positive spillover effects as it led to numerous opportunities for entrepreneurship and commerce. The reader might note the many similarities between this illustration and those drawn by other authors in comparing the rural nature of the South with urban development in the North.

The definitive narrative in many ways belongs to Douglass North (1959). Although North's purpose is simply to contrast the development of the South with that of the West, in doing so he exposes many of the schisms that capture the issues pertaining to present day developing countries. He begins with a discussion of natural endowments which at the time, based on the available technology, determined the initial economic activities and commodities. As North suggests, if the initial comparative advantage is significant then the region will end up specialising in it. That in itself is not a problematic outcome. After all, neoclassical economic theory introduces the notion of comparative advantage and specialisation in terms of the possible gains from trade that are achievable. However, as North explains, the nature of the specialised commodity can then have significant ripple effects further down. For example, as in the case of the South and other developing countries, if the commodity is produced most efficiently on large plantation-style farms, it sets in motion a process of institutional development that becomes entrenched and is not easy to change.

Without repeating many of the same ideas that have already been mentioned, let me just build on a few of North's more significant ones. One of the institutional characteristics that becomes hard to dislodge is the extreme disparity of income between the plantation owners, who are few,

and the rest of the population, which is large. A parallel to this can be found in developing countries as well, in the 'core-periphery' argument in which owners of large land-holdings (the core) disproportionately wield both economic and political power (over the periphery).<sup>41</sup> Another consideration raised by North, which is also echoed by the dependency school of thought, is the subsequent demand for luxury goods that develops as wealthy plantation owners (a parallel would be absentee landlords in developing countries) desire luxury goods for consumption. As the demand for imported luxuries increases, it inhibits the growth of domestic markets supplying a broader range of goods and services. A similar situation arises with the development of human capital. Plantation owners had little incentive to invest in education, skills or training for their slaves, just like today's absentee landlords in South Asia and Latin America. As North cites, the eighteenth- and nineteenth-century South had the highest illiteracy rates, the smallest percentage of pupils and the fewest number of libraries, even compared to the West which was just emerging from its frontier economy.<sup>42</sup>

Another parallel between the South and developing countries can be drawn by examining the flow of migrants in both directions from areas in the South and the North of the United States. Historical data on migration patterns show an influx of black migrants from the South to the North after World War I and a reverse flow of mainly skilled, educated white migrants in the 1960s from North to South.<sup>43</sup> The outward migration from the South is a similar pattern to that experienced by developing countries. The pattern of migration from developing countries to more developed ones includes both unskilled, poorly educated labour seeking low-wage jobs as well as highly skilled, educated labour comprising what is known as the 'brain-drain'.<sup>44</sup> The flow of skilled expatriates back to their home countries, the 'reverse brain-drain' is a more recent phenomenon which is happening in some of the faster growing developing countries such as India and China. Just as in the case of the United States the reverse brain-drain occurs only when significant opportunities arise in the home country which makes it attractive to return to.

Overall, the analysis of numerous historians provides compelling evidence to view the historical South through the same lens as that of a developing country. An examination of the subsequent convergence in incomes across the country might prove to be illuminating in deriving useful policy implications for the disparities in standards of living that currently exist across the world.



## EXPLANATIONS OF CONVERGENCE

Before examining explanations of the convergence, let us review the evidence on it as it pertains to the United States. As mentioned earlier, a previous study by Mitchener and McLean, (1999) which focused on convergence in labour productivity across US states from 1880 to 1980 found that in the earlier period 1880–1940, convergence was driven by slower growth in the western states while from 1940 to 1980 it was primarily motivated by faster growth in the southern states. Economists and historians alike have identified numerous factors to explain the rapid convergence in income of the Southern states to the rest of the nation. One study measures convergence in the United States over the period 1929–1990, specifically based on the distance from the equator, and finds that the effects of tropicality dissipate over time.<sup>45</sup> It attributes this phenomenon to several important factors. Amongst them are the transformation away from agriculture that occurred during that time period; technological change which affected the economy as well as medical advances which together improved human capital and productivity (both directly and indirectly); federal income-support programs and income distribution policies and finally the free flow of human and physical capital across the country.<sup>46</sup> Three out of the four factors mentioned are arguably endogenous to a theory explaining increases in per capita income and are just as likely a consequence as a cause of convergence. The one more easily distinguishable as exogenous is the deliberate implementation of government policies.

Labour migration between the South and the rest of the country has been mentioned as playing an important role in the final convergence of the South to national norms by other economists and historians as well. The slow rate of convergence is attributed to the severely depressed level of human capital formation that existed in the region even after the abolition of slavery.<sup>47</sup> Hence, it wasn't until capital and labour were able to flow freely in both directions that the movement towards equalisation in incomes occurred. Even so, the pattern of migration did not always represent the flows one would expect. Data on the period 1939–1963 shows that both physical and human capital was imported into the South as a result of the migration of whites into the region. However, there was a simultaneous export of educated blacks as well as outward migration of uneducated and unskilled labour from the South.<sup>48</sup>

According to researchers of southern history, by far the most significant factor which enabled an unprecedented catch-up by the South after World War II was the improvement in agricultural productivity over a 25 year period from 1950 to 1975. Although this 'agricultural revolution' was a worldwide phenomenon, the South benefited enormously from the concomitant government policies that accompanied it. Productivity mainly increased as a result of research and development in the agricultural sciences, the mechanisation of agriculture and the expanded and improved use of agricultural chemicals.<sup>49</sup> The improvement in agricultural productivity in the South was also aided by the migration of mid-western grain farmers to Louisiana, Arkansas and Texas where they helped develop a mechanised, efficient form of rice culture.<sup>50</sup> One unintended consequence of this surge in productivity was the displacement from 1935 to 1940 of 25% of Southern tenant farmers, which resulted in a significant labour surplus and large rural to urban migration.<sup>51</sup> Eventually, the advent of World War II enabled these migrants to find jobs and the surplus labour was absorbed, primarily in the North. The South also benefitted from its close proximity to the manufacturing and commercial hubs of the north-east. Parts of the upper South were absorbed into this belt where the demand for manufacturing goods resulted in the establishment of low-wage manufacturing centres in the piedmont region.<sup>52</sup>

Federal subsidies also played a large role in the transformation. Historians believe that a major shift in political alignment after 1932 focused national attention on the South. Work relief programs, minimum wage legislation and farm policies targeted Southern states that benefited from a positive balance in federal payments.<sup>53</sup> These federal policies included agricultural subsidies for education, price supports for major crops and federal mandates to improve human services.<sup>54</sup> Transportation infrastructure was also a beneficiary, especially the new interstate highway system which was largely funded by the federal government.

Some historians have gone so far as to refer to the New Deal as a case of 'state-sponsored economic development'.<sup>55</sup> Specifics on how the New Deal accelerated the pace of transformation in the South include numerous statistics on its impact. Of particular note is the employment opportunities created by the Works Progress Administration (WPA) and the miles of bridges, roads and viaducts it had built or improved all over the South by the early 1940s.<sup>56</sup> Another major milestone was the electrification of the region through dams and hydroelectricity which helped bring

power and refrigeration to rural households and together with affordable radios, reduced their isolation.<sup>57</sup>

In the 1960s low wages, surplus labour, low taxes, federal subsidies and government promotions all served to make the South an attractive destination for investment from the rest of the country. Historical data shows that in the five decades between World War I and the 1960s, there was a large flow of black migrants from South to North which was replaced by an equal inflow of white migrants from North to South, mainly in the 1960s.<sup>58</sup> The migrants to the South in the 1960s were mostly entrepreneurs and investors and were attracted by the opportunities created in the region by the concerted efforts of the Federal government mentioned earlier. An interesting caveat concerns the introduction of air-conditioning as being considered a prerequisite to lure investors to the South.<sup>59</sup> It appears that the active role of the federal government in the story of the South's convergence cannot be understated.

According to one historian, the solution to the soil-exhaustion problem, and a significant increase in the range of commercial crops, was not available to the lower South until well into the twentieth century.<sup>60</sup> In his view this was enabled by the United States Department of Agriculture's (USDA) elimination of parasites and its ability to search worldwide and experiment with new forage crops and its development of new cattle breeds. The USDA represents a formidable government agency with enormous resources at its disposal and the ability to conduct complex and sophisticated research involving science, statistics and biochemistry. Additionally, the government extension and educational programs went a long way towards reaching out to isolated lower South farmers. The author believes that this is what finally allowed farmers in the South to adopt the same characteristics of commercialisation as their neighbours to the North.<sup>61</sup> Prior to this assistance, the South in the nineteenth century resembled contemporary developing countries which currently lack the means to achieve the same transformation.

Lastly, two additional suggestions for the convergence are presented by economic historians of the United States.<sup>62</sup> They claim that since the physical endowment of land in the South was never as favourable for the growing of sugar cane as it was in the Caribbean, the scale of slave plantations and the proportion of the slave population was never as high either; hence, many of the institutional inequalities while more than in the North were not as severe as in many Latin American colonies. Secondly, the South had the good fortune of belonging to and being able to benefit

from being part of a larger federation. Hence it eventually came under the umbrella of a more progressive and egalitarian institutional framework that had evolved separately from its own.

### WHAT HAVE WE LEARNED?

So far we have studied evidence which shows that both geography (location and climate) as well as institutions have played significant roles in shaping the disparate paths of economic successes across regions in the United States, although the effects of these variables have dissipated over time. We have also examined arguments to view the economic conditions in the pre-1940s South, as well as its climate and geography, as being comparable to that of many developing countries in tropical regions. Lastly, we considered the circumstances that lifted the South from its relative backwardness in the eighteenth and nineteenth centuries to its relative prosperity now.

The fact that the economies of developing countries have not been similarly transformed by agricultural and technological revolutions and still resemble to a large extent the pre-1940s South points to the importance of the policies implemented by the Federal government in the United States at the time. The impact of concerted and targeted government policies such as subsidies for agricultural education, price supports for agricultural goods and wages, research and development into agricultural technology, and investment in human capital formation and infrastructure cannot be overlooked. All of these are essential components of development policy and are areas where developing country governments and international organisations have a role to play. Neoclassical economics did not provide a solution for the South, and it has not so far come up with one for eliminating poverty in many regions of the world. The preconditions for unleashing market forces are missing in these areas, just as they were for the South until the mid-twentieth century.

An important constraint for developing countries, the ability to absorb surplus labour and the role of labour migration is equally significant, especially since it would entail a substantial shift in the rural to urban population as occurred in the South during that time. This shift has already been taking place in many developing areas of the world with adverse consequences for both rural and urban development. Land reform and technological backwardness are also some of the biggest limitations faced by developing countries today. If the American South presents a successful example

of transformation from an underdeveloped agrarian economy to a developed industrialised region, then it illustrates that all of these problems must be confronted before a successful resolution can be implemented. In the case of the South, the solutions were implemented mainly from 'the outside' with the help of federal mandates, aid, technological diffusion and the free movement of labour. While the first of these would infringe on a country's sovereignty, the latter three sensibly implemented are certainly within the purview of the international community.

One big caveat in examining causes and solutions for regional disparities in the United States and other regions of the world is that backward areas in the United States were able to benefit from a well-developed institutional structure once they were fully integrated. This is not true of sovereign nations around the world. This brings us to the forefront of examining institutions. In the case of the United States we saw how the institutions and some would say the culture of North and South were quite different and to a large extent rooted in the geographical differences between the regions. So what exactly is the process by which institutions evolve? What are the key factors that are important in their development and can they be changed from within? Answers to these questions are vital for the rest of the developing world since it is not the beneficiary of a benevolent set of institutional structures imposed from without. The remainder of the book is now devoted to exploring these topics.

## NOTES

1. Source: Bureau of Economic Analysis.
2. *Ibid.*
3. Mitchener and McLean 1999.
4. All these studies define convergence in the neoclassical sense, that is it takes place if those states which had initial lower per capita income grew faster over the time period considered.
5. Barro and Sala-i-Martin 1992.
6. Barro et al. 1991.
7. Mitchener et al. 1999.
8. Alvi and Rahman 2005.
9. The maps were constructed using data from the Bureau of Economic Analysis (BEA).
10. Ram 1999.
11. Mitchener and Mclean 2003.

12. *Ibid.* The authors find that in 1880, 27 states had less than 1% of their workforce employed in mining, while 7 states had greater than 10%. They also find that a 10% increase in mining share of employment corresponded with an 11% increase in labour productivity for that state.
13. See Appendix B for a detailed description of the variables, data sources, corresponding correlation matrix and descriptive statistics.
14. See Mitchener and Mclean (2003). One of the variables, Cooling (the average number of cooling degree days in the 100s), is the same one used by them while the rest have been added to allow for a broader definition of climate. The additional variables measure the annual mean temperature, annual mean precipitation, monthly standard deviation of precipitation, relative morning humidity and relative afternoon humidity.
15. Consult Appendix B for details on the results of the analysis. Robust standard errors of the model were computed iteratively using Huber weights and bi-weights. This method of estimation detects and accounts for outliers. Results using this method and standard OLS estimation are reported.
16. This is not surprising since the authors themselves mention that the measure of labour productivity factors in state-level differences in demographic characteristics and already accounts for the high labour input that the mining sector typically attracted.
17. The cooling variable though enters as a positive determinant for 1980.
18. [http://www.census.gov/econ/census/help/geography/regions\\_and\\_divisions.html](http://www.census.gov/econ/census/help/geography/regions_and_divisions.html). The states are Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia.
19. Gunther and Leathers 1975.
20. Conkin 1998, 4.
21. Rubin 1975.
22. Some have suggested that this is a simplistic view of the situation and that economies of scale while requiring cheap labour do not necessarily imply *bonded* labour. They also argue that the use of African slaves as opposed to white indentured servants in the South had more to do with the ecological adaptability of West Africans to the climate and disease environment of the South which ironically was altered by the introduction of Africans to the New World (Coelho and McGuire 1997)
23. Rubin 1975.
24. *Ibid.*
25. *Ibid.*
26. Smith 1984. According to this study, amongst whites born in the late nineteenth century in the South only 20% completed high school and less than 30% continued their education beyond elementary school.

27. Connolly 2004.
28. *Ibid.*
29. Coelho and McGuire 1997.
30. *Ibid.* This claim uses as its justification the fact that West Africa is in a tropical and subtropical climate zone. Curiously, even though the authors question this claim, they then discuss the reasons why West African were so well-suited to the southern disease ecology (and Europeans were not) as the consequence of the process of biological evolution which has taken place over several millennia and resulted from the exposure of peoples to different environments, basically echoing Diamond (1997).
31. D Eysberg 1989.
32. Rubin 1975.
33. An important caveat, and one that has been mentioned in the previous chapter, is that farmers in Texas were the fortunate recipients of government-sponsored research and development which helped them overcome many natural impediments due to the weather and harmful pests. Thus part of their success was attributable to external factors as well.
34. Rubin 1975. This categorisation is complemented by Rubin's refusal to define the South traditionally in terms of slavery and plantations (the area below the Mason-Dixon Line), as was customary and instead to consider the South as a series of subregions defined by their physical characteristics.
35. The ability to grow crops and raise livestock simultaneously results in a virtuous circle as described by Rubin (1975) in which improvements in soil nutrients and structure are dependent on increases in the quantity and quality of livestock.
36. *Ibid.*
37. As an example of the perverse consequences of this process, Rubin (1975) suggests that when commercial fertiliser simplified cotton production, it actually had a regressive effect because it further reduced the necessity of developing techniques for soil maintenance and had an adverse effect on innovation.
38. Rothstein 1966.
39. The importance of linkages in economic development has been emphasised by development theorists such as Hirschman (1977).
40. *Ibid.*
41. The core-periphery argument is a corner stone of the Latin American dependency school of thought. For examples see Cardoso and Faletto (1979). The argument to view the North-South divide in the United States as a core-periphery problem can also be found in Connolly (2004). She cites selective outward migration by more-skilled blacks from the South to the 'core' regions of the North as evidence of this phenomenon.
42. North 1959, 949.

43. Rubin 1975. The reverse flow occurred after concerted efforts by the Federal government, a topic which is addressed in the next section of this chapter.
44. For details on the brain drain phenomenon see Carrington and Detragiache (1999).
45. Ram 1999.
46. Ibid.
47. Conolly 2004.
48. Colberg 1965.
49. Conkin 1998.
50. Ibid.
51. Ibid.
52. Ibid.
53. Ibid.
54. Ibid. By 1970 the level of social services in the South averaged that in the rest of the nation.
55. Wright 2010, 2.
56. Ibid.
57. Ibid.
58. Conkin 1998.
59. Ibid.
60. Rubin 1975.
61. Ibid.
62. Engerman and Sokoloff 1997.



## Untangling Cultural Evolution and Economic Development

**Abstract** The geography-institutions-income hypothesis is re-examined and the importance of cultural beliefs and practices in influencing economic development is presented as an additional link in the chain of causality from geography to economic development. The work of behavioural ecologists, anthropologists and cross-cultural psychologists is examined to support the notion that certain cultural traits are influenced by environmental factors such as climate, ecology and topography. Connections are also made between culture and institutions. An empirical analysis using anthropological data on cross-cultural traits demonstrates a link between geography and culture.

**Keywords** Geography · Culture · Cultural evolution · Institutions

**JEL field codes** O1 · Z1

The central thread of this book so far has been geography and its impact on economic development both directly and via institutions. This chapter will argue that there is an additional link in this chain that has recently begun to be taken seriously in the economics literature – the role of culture and the avenues through which it may also have an effect on both institutions and development. The connecting tissue is the suggestion that geography may

also be responsible for aspects of cultural evolution, which in turn has an effect on institutional development. In addition to the evidence already considered on the geographical causes of underdevelopment, we will uncover a powerful proximate force which has long-lasting consequences. An additional contention will be that the existing studies, which have found an indirect role for geography through its impact on institutions via colonisation, still leave unanswered the question of what enabled the colonisers to be the aggressors and the native inhabitants of those regions to be colonised. In other words, the argument by Diamond (1997) has not been addressed in these studies since colonisation is assumed to be an exogenous event.

Our examination of cultural evolution will allow us to step outside the economist's comfort zone and consider both anthropological and biological definitions of culture. Furthermore, we will be able to utilise data from one of the largest cross-cultural data sets constructed by anthropologists and empirically test some of these theories. To begin with it is necessary to review some of the earlier connections that have been constructed and to point out what remains unexplained.

### FROM GEOGRAPHY TO INCOME

As noted earlier in the book, geography was traditionally an area ignored by economists and was brought into the mainstream mainly through the works of Jeffery Sachs and other economists.<sup>1</sup> Researchers showed that geographic attributes such as soil quality, disease ecology and distance from a coast are correlated with levels of income per capita with negative attributes being correlated with lower levels of income for countries that are more tropical. Others demonstrated that heavy rainfall and the absence of frost in tropical climates impacts crops and agricultural productivity.<sup>2</sup> The empirical studies in this book have suggested that aspects of climate such as temperature, rainfall and humidity all impact development even after controlling for institutional or other intrinsic differences. Hence, geography is speculated to have a direct effect on income per capita by affecting health, human capital and productivity.

One of the most influential works in recent decades arguing a geography-based explanation for comparative differences across countries is Diamond (1997). As previously explained, Diamond presents a biogeographic framework which suggests that due to the availability of plants suited for cultivation, animals that could be easily domesticated, and an east-west axis of diffusion, Eurasia was naturally endowed with biogeographic advantages

which allowed it to be the first to achieve the agricultural revolution that generated food surpluses. The rest of the story is more familiar: the availability of an agricultural surplus allowed for the specialisation of other tasks to evolve within societies and led to the development of a non-producing class which allowed for the eventual creation and organisation of knowledge. Embedded in Diamond's analysis is the thread connecting cultural and societal differences to biogeography, one which I plan to pursue in the course of this chapter.

A formal test of Diamond's hypothesis has been conducted by economists in the process of explaining the Neolithic transition from hunting-gathering to agriculture, which is the fulcrum around which the divergent paths of economic development revolve.<sup>3</sup> The authors use biogeographical data to confirm the causal links in Diamond's theory between biogeographical endowment, technological advancement and current levels of income, and thereby refute the arguments posited by others that geography affects long-run levels of growth only via institutions.

To begin with, they construct a theoretical model linking present day income per capita to initial biogeographic endowments via differential periods of transitions to agricultural production and subsequent endogenous technological progress. The model is tested empirically using five geographic and biogeographic variables: size of continent, major axis of continent, climate, and number of animal and plant candidates for domestication. The factors implying causality are as follows: the larger the size of the landmass the greater the biodiversity and number of species available for domestication; the more pronounced the east-west axis the easier the diffusion of agricultural innovations between areas; and lastly temperate climates favour annual grasses like wheat and barley which were the earliest cultivated crops. Again, here is evidence pointing to societal effects of geography. A further contention is made that even after the transition to agriculture, the size, axis and climate of continents continued to exert an influence of development through disease ecology, differential rainfall patterns and soil quality and the ease with which technological diffusion could take place.

A subsequent study confirms the Diamond/Olsson-Hibbs sequence of events, even after controlling for institutional quality and other geographical factors.<sup>4</sup> In particular it reaffirms that the date of transition to agriculture is correlated with prehistoric biogeography (the availability of wild grasses and large domesticable animal species). Additional research verifies that the Neolithic transition was driven by geographic and

biogeographic conditions and that these variables are strongly correlated with population density in 1500. The authors argue, however, that these variables matter for economic performance in preindustrial times only through their effect on the timing of the adoption of agriculture.<sup>5</sup> As we pursue the idea of culture and its evolution later, we will have the opportunity to return to this vein of research.

### FROM GEOGRAPHY TO INCOME VIA INSTITUTIONS

In previous chapters we discussed an intensive debate by other economists arguing for the primacy of institutions over geography in determining the development path of countries.<sup>6</sup> A compromise or in-between approach allows for the case of geography influencing development, but only indirectly, through its effects on institutions.

This strand of research examines the colonial legacy of countries and argues that the disease environment which affected settler mortality had a direct impact on the types of institutions that the colonisers put in place.<sup>7</sup> In areas where settler mortality was high, the institutions were geared towards resource extraction since the colonisers had no intention of settling there and resulted in policies that strengthened the power of the state and the ruling elite at the expense of the masses. In areas where settler mortality was low, the colonisers exported similar institutions to the ones from their origin country which resulted in a more egalitarian distribution of resources and power. Once these institutions were in place they had a tendency to perpetuate even after the colonisers left, since the nature of the institutions strengthened the power of the elite and made it easier to maintain that supremacy. From this perspective, little or no attention is paid to the *pre*-existing society and institutions that prevailed in the territories that were conquered. The emphasis is all on explaining the institutions that evolved *post*-conquest. However, I believe that understanding the origins of the types of structures which were in place before the arrival of Europeans to the regions is of equal importance.

A parallel argument, yet one that stems from a separate rationale, suggests that geography through differential endowments was responsible for the varying institutions that developed in North and South America, including differences within northern and southern areas of the United States.<sup>8</sup> Land endowments, which led to the growing of crops such as sugarcane, cotton and tobacco, that were suitable for large-scale plantations, tended to reinforce monopoly control of land for the few ruling

elite. This resulted in in-egalitarian institutions in which the elite maintained their power at the expense of imported slaves and the indigenous population. In areas in the north where the endowments (land and climate) were suitable to the growing of grains which were efficiently produced on small-scale farms, the distribution of resources was more equitable. However, even in this thesis there is an underlying focus on the subsequent institutional structure that evolved in the region and less on the pre-existing conditions that it replaced.<sup>9</sup> One further extension suggests that the main avenue through which institutions were affected, according to the colonisation and endowment hypotheses, is through the establishment of differential laws and property rights.<sup>10</sup> But the main findings are the same as before – geography only affects current levels of development through the proximate impact it had on institutions.

Figure 5.1 summarises the research to date on the geography→ institutions→income hypothesis, including both the arguments for direct and indirect effects.

The geography→ institutions→income studies provide reasonable explanations regarding the differential impacts of colonisation and the consequences thereafter. However, they still leave the following fundamental question answered: Why were the colonisers from European (temperate) lands and the colonised in tropical lands? In other words what enabled one geographical region (defined by physical attributes such as climate, ecology and land endowments) to gain the technological superiority to conquer

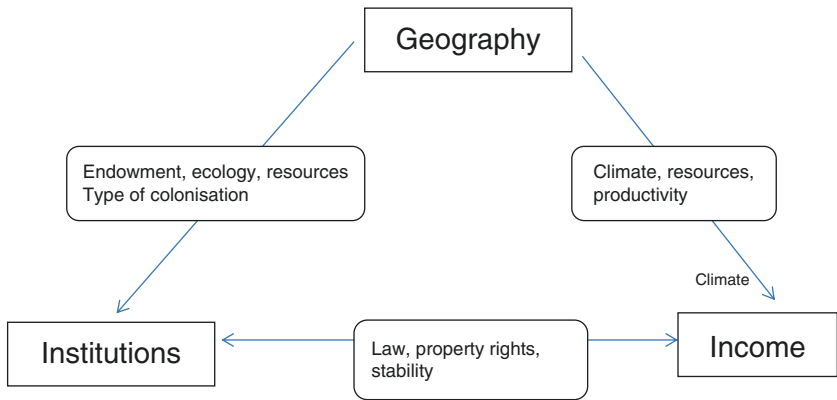


Fig. 5.1 The geography-institutions-income hypothesis

other geographical regions (defined by different physical attributes)? Presumably, the colonisers were able to assume their role because they already had institutions in place that allowed them to develop that advantage. A serious consideration of this issue renders the assumption of colonisation as an ‘exogenous’ factor (which is how it is perceived in these studies) questionable, if indeed it was an endogenous outcome of the superior institutions in place. The literature on the subject acknowledges the two way causality running between institutions and income for the era of modern growth, but by the same token it is misleading to ignore the fact that those same institutions were also responsible for *pre-colonial* economic development.

### IS CULTURE THE ADDITIONAL LINK?

The important piece of the puzzle then becomes to explain the ‘European lead’. To do so requires going back to the most fundamental building blocks of human society – cultural beliefs, norms and practices, which are the foundations upon which institutions are built. Current theories that appeal to cultural beliefs as the precursor to institutional arrangements suffer from the same problem outlined earlier – how did the beliefs evolve and where did they originate from? What causes different beliefs to develop in different regions? This leads to a quest to explain the earliest origins of human culture and civilisation and trace the divergence amongst societies that eventually enabled some to establish the lead that still exists to this date.

A recent paper provides a comprehensive review of the literature that has begun to study how intergenerationally transmitted characteristics may impact economic development either through biological or cultural channels.<sup>11</sup> One study demonstrates that after adjusting for ancestry, a long history of centralised states and early adoption of agriculture is positively associated with contemporary levels of per capita income.<sup>12</sup> It also finds that a population’s long familiarity with certain types of institutions and norms of behaviour, their culture, is important in accounting for comparative development.

Another study compares genealogical distances amongst populations and finds that divergences in human traits, habits and norms have created barriers to communication and imitation across societies.<sup>13</sup> Thus, human

traits may also hinder development as more closely related societies are more likely to learn from each other and adopt each other's innovations.

If one reviews the prevailing literature on this perspective, it becomes apparent that economists are setting this up as an alternative explanation to the geography hypothesis. Economists are mainly searching for direct effects of culture on income, and many of these empirical studies find evidence to support their claims while controlling for other factors. There are repeated references to the geography and institutions literature from a competing perspective and assertions that cultural traits have long-lasting effects on development, irrespective of geography. For example, the positive impacts of European populations are found to be long term even when they have moved from their countries of origin. Two points are worth noting here. As has been demonstrated by others, Europeans tended to migrate to climates that were similar to those in their home countries, so although they moved geographically, it was a lateral or parallel move. Secondly, and this is the path that I want to explore in this chapter, geography played a role in shaping the culture of Europeans and of the places they migrated to.<sup>14</sup>

In my view, geography and culture should not be pitched against each other in an either/or scenario. I believe a case can be made for culture to serve as an additional link that connects geography to income. An advantage of studying the evolution of culture and how it relates to comparative development is that starting with the origins of institutions will help us escape the problem of reverse causality that is normally encountered in this relationship. Since institutions and economic development enjoy a mutually reinforcing association, it can be hard to disentangle the effects of one upon the other. While culture and development obviously influence each other as well, our quest thus becomes to trace the evolution of culture in preindustrial societies and pinpoint its geographical influences. Luckily for us, anthropologists specialise in the study of preindustrial societies and biologists in theories of evolution. The task of the economist then becomes to borrow from the literature and find a way to connect and reconcile those theories with our own. Hence a reconfiguration of [Fig. 5.1.](#) is proposed in [Fig. 5.2.](#) Note that the directional arrows between culture and the other variables are still to be determined. That, in essence, is the focus of the remainder of the book.

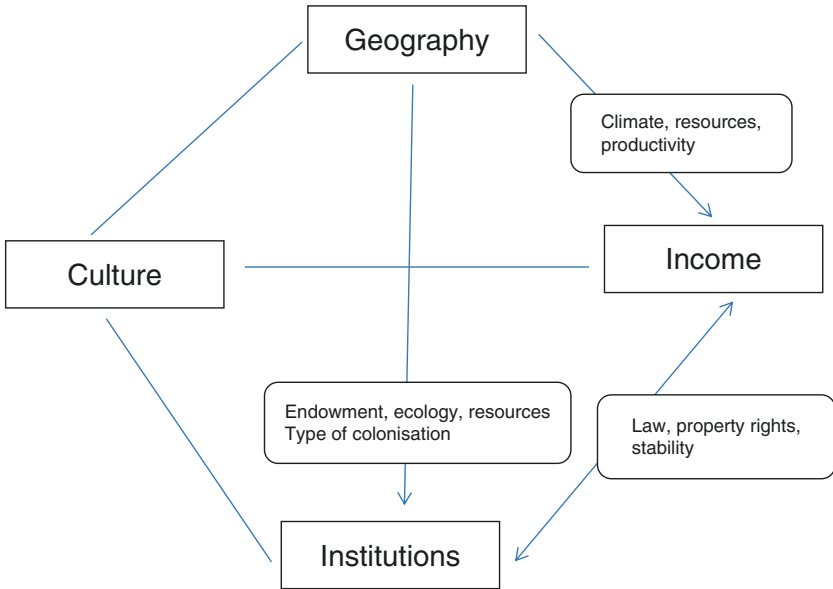


Fig. 5.2 Where does culture fit in?

Before beginning this journey it is useful to start with a definition of culture and the mechanisms of cultural evolution.

## CULTURE AND CULTURAL EVOLUTION

Let us begin with the definitions of the words ‘culture’ and ‘institutions’. Scholars from many disciplines often use both terms, sometimes interchangeably and it is important to be precise about what is being referred to. An interesting interpretation of culture from an economic perspective views it as a substitute for reason or cognitive thinking, thereby reducing cognitive transaction costs involved in human interactions.<sup>15</sup> The idea is that the social habits and routines that are developed as a result of culture, allow us to operate on (the equivalent of) an ‘auto-pilot’ mode in our daily interactions, eliminating the need to reinvent the wheel for each situation that we encounter. In this capacity culture serves the purpose of a public good and like most public goods is undervalued and underproduced.<sup>16</sup> [Tables 5.1](#) and [Tables 5.2](#)



**Table 5.1** Definitions of ‘Culture’

<i>Source</i>	<i>Definition</i>
Merriam-Webster <sup>a</sup>	The integrated pattern of human knowledge, belief, and behavior that depends upon the capacity for learning and transmitting knowledge to succeeding generations The customary beliefs, social forms, and material traits of a racial, religious, or social group; also: the characteristic features of everyday existence (as diversions or a way of life) shared by people in a place or time The set of shared attitudes, values, goals, and practices that characterizes an institution or organization
Evolutionary Biology	A system for the inheritance of acquired variation <sup>b</sup>
Anthropology	Acquired information, such as knowledge, beliefs and values, that is inherited through social learning and expressed in behaviour and artifacts <sup>c</sup>
Economics <sup>d</sup>	Decision-making heuristics Values and beliefs held by particular groups that are transmitted from one generation to another

<sup>a</sup><http://www.merriam-webster.com/dictionary/culture>

<sup>b</sup>Richerson and Boyd 1984.

<sup>c</sup>Mesoudi et al.,2004.

<sup>d</sup>Alesina and Giuliano 2015, 900.

**Table 5.2** Definitions of ‘Institutions’

<i>Source</i>	<i>Definition</i>
Merriam-Webster <sup>a</sup>	A custom, practice, or law that is accepted and used by many people A significant practice, relationship, or organization in a society or culture An established organization or corporation (as a bank or university) especially of a public character
Economics/Political Science <sup>b</sup>	Systems or mechanisms through which social choices are implemented and society’s behaviour is regulated Formal and informal constraints that govern human interaction

<sup>a</sup><http://www.merriam-webster.com/dictionary/institution>

<sup>b</sup>Alesina and Giuliano 2015, 902.

list several definitions of both culture and institutions, including the standard dictionary definition and the perspectives of evolutionary biologists and social scientists.

An examination of the definitions of culture reveals some common characteristics. There is an implied evolutionary element to the development of culture. In other words, culture doesn't just form in its entirety and then descend upon a population either exogenously or through adoption. It is inherited according to the biologists' definition, and there is a generational aspect to it. In other words it evolves. The other important feature is that it is the precursor to the formation of institutions. This latter point is more clearly seen in the second table which suggests that institutions are the manifestation of a particular culture and are embedded in it. As we will see later the two go hand in hand but since institutions are often viewed as the formal embodiment of a society's cultural values, it is important first to identify the influences that affect the development of culture.

Evolutionary biologists and psychologists view cultural evolution from a Darwinian perspective. Starting with the idea of culture as being an inherited system of beliefs and values, cultural evolution is thereby defined as the process by which the information in that cultural domain changes via 'cultural selection'.<sup>17</sup> Cultural selection is similar to natural selection except that it operates on the selective retention of favourable *cultural* traits amongst variants. This particular view of cultural evolution qualifies it as 'neo-Darwinian' since it mimics Darwin's theory of natural selection as applied to biological evolution. The two criteria that are essential for this theory to be valid are<sup>18</sup>:

1. That human culture displays variation
2. That variants of the culture are such that they will compete with each other for differential representation

A few differences between natural and cultural selection are worth mentioning. While biological variation occurs through random mutation, researchers suggest the possibility that cultural variation might be the result of deliberate action, what they call foresight, applied to solve a particular problem.<sup>19</sup> This is an important distinction to consider, especially as we make the case for geographical elements influencing the development of varying cultural traits across societies. This is not an exclusive assumption, in other words, all variation in culture is not the result of deliberate choices. As an example, the authors cite human creativity which results in accidental

discoveries. There is also the possibility that ‘smart variants’ might be at work, in which behaviour is guided by cognitive and cultural traits that are themselves the result of biological evolution.<sup>20</sup> However, the relative importance of directed and non-directed variation is not definitive in this model and the transmission of cultural traits takes place primarily through inheritance and adaptation to environmental conditions.

Since this topic is likely to be unfamiliar to most readers, it behooves us to spend some time understanding it. Competition between cultural variants (different expressions of culture) can be conceived of as competing in the same functional category (the practical use of that cultural trait).<sup>21</sup> An example would be written versus oral communication (the cultural variants) competing for the most effective methods of communication (the functional category) both within and across generations.<sup>22</sup>

An essential ingredient to the selection process is the inheritance of favourable traits. Once again the literature draws a distinction between biological and cultural selection in this respect. Biological selection is by nature hereditary and can only be passed from parent to offspring. However, cultural traits are not subject to such constraints and can be transmitted or replicated. Thus, the mechanism can be divided into two categories – vertical transmission from parent to offspring, which is analogous to biological inheritance, and horizontal transmission, which represents the distribution of traits within a single generation.<sup>23</sup> The authors note that there is considerable evidence for the importance of cultural inheritance and that cultural histories have been shown to condition the response of different societies to similar environmental conditions, even if the response is detrimental to the existence of that society. This helps to explain why cultural change is difficult and a slow moving process, something that we will refer back to later on in the book.

A separate strand in anthropology suggests the coevolution of genes and memes (defined as cultural units that represent distinct traits or practices) based on three different models of cultural distribution<sup>24</sup>:

1. Cultural diffusion (borrowing or diffusion of the meme from neighbours)
2. Local adaptations (the development of similar memes as a response to adaptation to similar natural and social environments)
3. Demic diffusion (the movement of people and their memes to new areas)

Using standard cross-cultural anthropological data on preindustrial societies, researchers have identified cultural and demic diffusion as explaining

the most number of similar semes amongst different societies. The cultural traits that were correlated with ecology were also correlated with demic diffusion, a finding that was explained as not unexpected, since people tend to move to areas with familiar ecologies and environments.<sup>25</sup> Interestingly, the economic category of traits fits this profile and includes characteristics such as the type of subsistence economy (hunting, gathering, fishing, animal husbandry and agriculture), the settlement pattern and the type and intensity of agriculture.<sup>26</sup> In another study, the characteristics that were best explained by local (environmental) adaptations were<sup>27</sup>:

1. the development of small versus large extended families
2. the democratic versus hereditary election of a headman
3. class elites based upon their control of scarce resources versus hereditary classes

The last two characteristics in particular raise the possibility of the subsequent evolution of particular types of institutions as a result of these adaptations.

Finally, and most significantly for our analysis, we arrive at the topic of adaptation. While both behavioural ecologists and evolutionary psychologists link cultural diversity to different environmental conditions, they do so through slightly different channels, one adaptive and the other evolutionary. Behavioural ecologists view the foraging behaviour of hunter-gather societies as a constrained optimisation problem, using economic concepts such as marginal analysis and opportunity costs in their analysis.<sup>28</sup> They argue for a resource-based interpretation of the behaviour observed in these societies, in which the under-accumulation of material possessions and systems of land tenure can be explained by resource distribution. Similarly, egalitarianism and an equitable distribution of food can be interpreted as reducing risk in times of food shortages. From this perspective, the location, reliability and robustness of natural resources is of primary importance in explaining these characteristics.

Human behavioural ecology parallels neo-Darwinian theories of cultural evolution in its belief that individuals have been selected to respond to environmental conditions in a way to enhance their fitness. Thus, it posits that much of the content of culture is a consequence of cost-benefit decisions by individuals to enhance their inclusive fitness.<sup>29</sup> Behavioural ecology has been applied to foraging theory, group and resource transfer, mating strategies (emergence of polygyny) and reproduction (birth spacing, differential investment in offspring, age specific schedules of mortality and fecundity).<sup>30</sup>

To the extent that the behaviour that emerges under optimisation is driven by environmental constraints, geography again plays a role in the emergence of specific cultural traits.

Let us now examine specific evidence to build the case for a geography-based explanation of cultural advancement where advancement can be thought of as an increase in cultural complexity.

## HOW GEOGRAPHY INFLUENCES CULTURE

There is a sizeable body of work which explores the influence of geographical features on cultural or societal traits. A survey of recent literature on economic development includes the importance of heredity and evolution and stresses that people and societies inherit their traits from their ancestors through a complex interaction of biological and cultural mechanisms, with an essential role played by environmental factors.<sup>31</sup> A couple of important points emerge from the analysis. First this provides support for Diamond's (1997) thesis regarding the persistent effects of biogeography on contemporaneous income. More specifically, technology and productivity have persistent effects even over very long time spans and societies that achieved early advances in those areas, determined by geographic advantages, are still the more advanced in the present day. Secondly, it is important to control for ancestry since the long-term effects are determined more by populations than location.<sup>32</sup> In a sense, this is similar to anthropological findings on cultural evolution that we encountered earlier where cultural traits were associated with both demic diffusion and ecology, since migration tends to occur between environments that are similar to each other. This suggests that after the initial development, cultural traits tend to follow a population rather than a location.

Evidence also links geography to the determination of specific types of cultural traits. The frequency of polygyny has been shown to be determined primarily by economy and ecology. Aspects of economy and ecology that are found to be correlated with the incidence of polygyny are plow agriculture, dependence on fishing, small islands, climate zone and female contribution to agriculture.<sup>33</sup> Anthropologists have also uncovered links between the environment and the frequency of polygyny. A specific look at two different communities from the same ethnic group but varying habitats found that the forest zone community had lower levels of polygyny than that living in the savannah.<sup>34</sup> The hypothesis is that forest communities have smaller units of autonomy (at the village level), while

savannah communities are integrated over a larger area. It follows then that savannah communities find it easier to migrate to newer lands and adapt to the environment which is homogenous. They are also able to maintain their political rights since integration is at a more global level. On the other hand, the same research showed that forest communities lose their rights by migrating. Together these findings are then used to suggest that since polygyny is facilitated by the acquisition of resources (to support a larger family), it is more prevalent in savannah as opposed to forest communities. Such conclusions are confirmed by other studies (using much larger anthropological data sets) which find that economic and ecological variables determine the frequency of polygyny while social structural variables determine its rules.<sup>35</sup> A link has also been uncovered between increased patrilineal social institutions and geographical regions corresponding to hot, arid, desert climate zones in North Africa, the Middle East and Central Asia.<sup>36</sup>

A specific focus on agriculture illustrates how the environment, representing favourable agricultural conditions or agricultural potential, is positively related to the presence of agriculture. In one study, three criteria define agricultural potential: favourability of the soil, weather and topography.<sup>37</sup> By examining a sample of societies that did not adopt agriculture, the study finds that in an unfavourable climate, the marginal productivity of agricultural activity is too low to justify it. Alternatively, the availability of resources might entail a comparative advantage in hunting and gathering which in turn allows some societies to specialise in those activities and trade for agricultural products. Regardless of the two explanations, the evidence suggests that geography in the form of either climate or resources plays a role in determining the adoption of agriculture by societies. An interesting corollary to this is the finding that rates of female participation in labour, as well as entrepreneurial and political activities are significantly lower for descendants of societies that practiced plough agriculture.<sup>38</sup>

While analysing an evolutionary approach to development, researchers observe that average amounts of work effort have increased during the progression from hunting and gathering to intensive agriculture. They believe that norms and expectations regarding work become embedded in cultures and together with human capital vary among societies with different modes of production.<sup>39</sup> Empirical evidence has shown that large state systems and high population densities which were characteristics of preindustrial societies that were based on intensive agriculture, facilitated

the transition to industrialisation. The beneficial features of these societies included exposure to large bureaucracies and systems of taxation, cultural attitudes towards commerce, increased autonomy at the household level and easier political integration.<sup>40</sup>

One particular study focuses on the economies of the Lele and Bushong who live on opposite sides of the river Kasai in the Congo rainforest.<sup>41</sup> Since their geospatial location is almost identical at 5 degrees latitude, they are subject to the same average annual temperature and rainfall. However, the two societies experience significant differences in soil, vegetation and drainage with the Lele being the unfortunate recipients of poor, sand-like permeable soils lacking rich mineral deposits which the Bushong enjoy. Anthropologists who have analysed these differences conclude that these differences led to a circle of reinforcing behaviour in which the initial disadvantages caused the Lele to be less invested in technology (the potential benefits were less) and resulted in a less productive economy which led to the development of cultural preferences and social systems that were not conducive to innovation and progress. In other words, the Lele society became accustomed to conditions in which low standards of living became the norm and the institutional structure made it difficult to overcome this barrier. Economists would draw parallels to the existence of multiple equilibria in which the Lele appear to be trapped in an equilibrium in which low levels of living prevail relative to the Bushong.

Further support for the role of agriculture in cultural evolution comes from evidence that the increasing agricultural efficiency through technological advancement is a major motivating force behind cultural evolution.<sup>42</sup> Complementary to the notion of neo-Darwinian evolution of specific cultural traits, anthropologists define a more general theory of cultural evolution as one of increasing cultural or societal complexity. This is reflected in differentiation which refers to the separating out of cultural features from one another, and in specialisation which refers to the elaboration of cultural systems and traits, where specialisation leads to more different cultural trait types and more forms of each type.<sup>43</sup>

Many studies have found effects of climate on cultural practices.<sup>44</sup> With respect to the sexual division of labour in agriculture, researchers believe that a shorter growing season based on the number of dry months is a strong predictor of female participation in agriculture, which is adversely affected when seasonal constraints exist and as others have also pointed out, may lead to an increase in the dominance of men over women.<sup>45</sup>

Palaeoenvironmental reconstruction has allowed researchers to examine the impact of climate and the environment on human evolution. Based on archaeological and palaeontological evidence they conclude that the settlement of colder, harsher climates was only possible through cultural and behavioural adaptations.<sup>46</sup> These led to the development of a more sophisticated material culture including shelters and specialised weapons for hunting.<sup>47</sup>

Economists who have studied culture argue that cultural assimilation and cultural diffusion offer competing benefits which are at times at odds with each other. Using theoretical models and testing them empirically they find that in societies that were geographically isolated, cultural assimilation created more homogenisation which was an efficient mechanism for passing down social capital from one generation to another.<sup>48</sup> The claim is that the passage of social capital then enabled such societies to operate in the most efficient way possible which was beneficial for agricultural societies; however, it also meant that they were not open to new ideas or innovations. On the other hand, their evidence also shows that societies in which cultural diffusion prevailed were the beneficiaries of new ideas and innovation and were thus able to expand their production possibilities and grow. Finally the conclusion drawn is that this type of development aided the transition from agriculture to industrialisation in those societies. To some extent these theories tend to run along the lines of the Diamond (1997) argument regarding the influence of geography to enhance or prevent the diffusion of technology across large land masses. Regardless, it still adds support to the case we are building for geography's influence over culture.

It is interesting that even psychologists have weighed in on the potential links between cultural traits and climate. Paternal investment theory posits the following chain of causation from climate to male dominance.<sup>49</sup> In colder climates, meeting basic survival needs – food, shelter and safety – is more difficult than in warmer climates. Hence, the theory suggests that males tend to participate in the caring of their offspring and seek fewer mates, and the resulting sacrifice involved results in the development of more cooperative behaviour. On the other hand in warmer climates, being able to meet survival needs more easily allows males to leave child-rearing primarily to women and seek independent goals such as multiple mates. This results in more competitive and dominant behaviour against other males and women. Evidence from various branches of psychology tends to support this idea of a movement along the spectrum from more caring and



involvement with offspring to less in males which coincides with a change from colder to warmer climates. Proponents of this theory claim that this type of competitiveness and masculinity is observed even today in citizens of warmer climates.<sup>50</sup>

Cross-cultural psychologists believe that cultural evolution arises from the complex interaction of ecology, social learning, institutions and psychology. In a recent study psychologists pinpoint specific cultural traits that might be influenced by economic activity. They hypothesise that different combinations of environments and technologies influence the cultural evolution of different forms of social organisation.<sup>51</sup> To show that environmental factors favour some types of family structures or forms of social organisation over others, they suggest the following chain of causality: geography determined which societies historically practiced different types of agriculture. The resultant production function then determined the collectivist or individualistic nature of the activity and thus one of the two traits became embedded as a societal trait and subsequently institutionalised. Differences in innovation can hence be linked to these two traits.<sup>52</sup>

Research on this topic starts out by examining the origin of individualist versus collectivist societies. In the past these findings focused on contrasting societies in the West and East leaving open the question of confounding influences. However, one particular study examined two separate regions within China which differed only in their agricultural ecology allowing one region to specialise in rice farming and the other in wheat.<sup>53</sup> The conclusion reached by the researchers is that differences between the two can be explained by the type of agriculture each society engaged in – wheat farming promoted individualism and rice farming promoted collectivism. The reasons for this have to do with the technology and mode of production that prevailed at the time. Rice farming, at least in the way it has been traditionally practiced, is a highly labour-intensive endeavour requiring intensive irrigation networks and cooperation and coordination between farmers, including labour exchanges. According to the authors, this fosters traits such as reciprocity and a preference for avoiding conflict. On the other hand, wheat farming is reliant on rainfall rather than irrigation as a water source and is also relatively less labour-intensive. As such, the authors believe that it encourages more independence and less collectivist ideology. Once again biogeographical variables are significant and directly influence how culture evolves.

There is a rich source of anthropological data which allowed me to pursue this line of inquiry further. In the next section I conduct some preliminary diagnostics to confirm an empirically verifiable link between geography and culture.

### PRELIMINARY EMPIRICAL EVIDENCE

I conducted a simple empirical study to establish the connection between geography and culture, where geography includes any ecological, topographical, environmental or resource-related features of the land.<sup>54</sup>

As opposed to the World Values Survey (WVS) which is the most commonly used database in the numerous studies by economists and psychologists on this topic, I used a widely used database in the anthropological literature known as the Standard Cross Cultural Sample (SCCS).<sup>55</sup> This is primarily a sample of preindustrial societies compiled using contributions from ethnographers around the world. It contains contributions by hundreds of researchers in as many publications on over 2000 cultural and societal variables.<sup>56</sup> There are 186 culturally independent units or societies covering six major geographical regions in the world including each of the continents.

Other studies of culture have focused on the relationship between culture and per capita income or culture and institutions and use the World Values Survey. However, because this survey is based on contemporary information it suffers from the problem of reverse causality, namely, higher levels of development can affect cultural values through economic incentives and cultural diffusion via globalisation. Thus, this type of database while widely used, is not appropriate for the questions that are asked in this chapter.

After sifting through the 2000 variables and running preliminary diagnostics on correlations, initially 43 were selected that were representative of geography, cultural complexity and social/economic norms. However, unlike economic data which is available at the country-wide level, this data is at the level of the societal unit. The location of each society in the data set can be pinpointed by latitude and longitude which allows it to be placed within the borders of a specific country and the data aggregated to the country-wide level. Where more than one society was identified for a particular country the simple mean was used to come up with one value for each variable for each country. Although this is not ideal, for the purposes of the study it

provides the best approximation to a single variable that can be used for cross-country comparisons.

The final data set consisted of 83 countries which are listed in Appendix C. From these, Canada and the United States were eliminated due to the range of indigenous cultures scattered through vast land areas, which would have exacerbated any problems arising from aggregation. North America also represents a region which has been inhabited for centuries by European immigrants and the influence of indigenous cultures has been suppressed for a long period of time so it would be unclear what the cultural variables for those two countries would be measuring.

The dependent variable culture is quantified by the variable cultural complexity. This variable in turn ranges from values of 10–50 with higher values denoting higher cultural complexity. The measure of cultural complexity consists of 10 groups of comparable traits, each ordered according to a five-point scale of relative complexity.<sup>57</sup> It is important to note that this is a relative measure and not an absolute one, since the societies are ordered with respect to one another. The 10 categories are writing and records, fixity of residence, agriculture, urbanisation, technological specialisation, land transport, money, density of population, level of political integration and, lastly, social stratification. The societal scores on each of the ten categories are then aggregated to compute the final score for cultural complexity.

Since cultural complexity plays a big role in the analyses to follow it is worth spending time discussing exactly what it captures. To be honest, it is an elusive concept to wrap one's brain around (at least for an economist). As just mentioned the index measures *relative* complexity, that is, the measurement of one society relative to another. However, the authors who introduced this construct do not provide a specific definition of it, perhaps because they didn't have one. Their paper was one of many in a debate about the relative importance of unilineal cultural evolution in which they questioned whether every society went through 'stages' of cultural adaptation.<sup>58</sup> This is evident in their brief test at the end where they examine the interrelationship of cultural complexity and descent. They discover that in fact cultural complexity seems to have a bimodal effect on the type of kinship. In simpler societies, bilateral kinship (everyone is a relative on both sides of the family) is the most common and then it becomes common again in highly complex societies. There is some impact on social organisation, in this example kinship, that alters it as the degree of complexity changes over time. It also indicates (the cases where both

patrilineal and matrilineal groups appear) that different groups which have similar levels of complexity may have different types of social organisation which is in contrast to the argument about a universal cultural evolution.<sup>59</sup>

Recall that recent literature on heredity and evolution stresses that people and societies inherit their traits from their ancestors through a complex interaction of biological and cultural mechanisms, with an essential role played by environmental factors. As already discussed, rates of female participation in labour, entrepreneurial and political activities are significantly lower for descendants of societies that practiced plough agriculture. In addition, psychological differences in analytical thinking and individualism have been used as an explanation for differences in innovation, with the differences ultimately traced to culturally transmitted institutions, and ultimately to environmental differences that influence the feasibility of rice agriculture.

Hence, on the weight of this evidence, geography as defined by climate, topography, environment and ecology among others, may have a powerful influence over the cultural traits that evolve within societies. To this end, my analysis attempts to shed light on some of these connections by testing their effects on cultural complexity. In addition, due to the links between income inequality and economic growth, the model is also tested using social stratification as a dependent variable.<sup>60</sup> The independent variables that are shown to be significantly related to cultural complexity and social stratification then form the basis for the cultural and geographical variables used in the rest of the study.

After further refinement based on their relevance in the literature, and on the availability of data for the 81 countries in the data set, five cultural/environmental variables were narrowed down as the independent variables: female economic power, the resource base (degree of stability of food resources), agricultural potential, extent of polygamy and contribution of agriculture to the local food supply.<sup>61</sup> The sixth variable in the model, 'tropical', is one that was used in the earlier study on climate and refers to the proportion of a country (by land area) that lies in the geographic tropics.<sup>62</sup>

To test for the impact of geography on culture, ordinary least squares (OLS) regression analysis was performed with cultural complexity as the dependent variable using robust estimates of variance. Since societal level (in)equality has been shown to be related to economic development as well, a separate regression using the same model was tested using social stratification as the dependent variable.

The results show that all the variables with the exception of female economic power have a significant effect on cultural complexity and in the expected direction.<sup>63</sup> Cultural complexity appears to be enhanced by a more stable resource base, higher agricultural potential and a greater contribution of agriculture to the food supply, reaffirming the findings of the previous studies mentioned that point to the importance of agricultural development. In addition, cultural complexity is lower for more polygamous societies and also for those with a greater proportion of land area in the tropics. Lastly, only the resource base is significant and positively related to social stratification.

Although arguments have been made in the past about studies of this nature suffering from endogeneity problems, a country's geographical characteristics are predetermined. Keep in mind that due to the fact that the data corresponds to *pre*industrial societies, the *current* level of development of a country should not impact the level of cultural complexity, solving the reverse causality issue that is featured in other studies using the World Values Survey. In other words, being tropical is associated with lower cultural complexity, not because of the lower level of economic development of tropical countries but instead to the more intrinsic reason of what 'being tropical' constitutes in terms of geographical constraints.

Having examined considerable multidisciplinary evidence linking geography and culture, we now turn to the connection between culture and institutions which is less well developed.

### FROM CULTURE TO INSTITUTIONS

Separating culture and institutions is difficult as many studies by economists and political scientists treat the two concepts as one. Some studies have developed both theoretical and empirical justifications for the codependency of the two constructs. Others emphasise the importance of culture in the evolution of institutions and thus suggest a link from one to the other. In these studies, culture is often defined or viewed as 'social capital', a concept that economists not surprisingly are more comfortable with.

A further corollary to the line of research discussed by cross-cultural psychologists in the previous section provides some insight as to how cultural traits might eventually become institutionalised. Recall that the research on psychological differences within China shows that a history of farming rice makes cultures more interdependent, whereas farming wheat makes cultures more independent.<sup>64</sup> A follow-up to this line of thinking

posits that these agricultural legacies continue to affect people in the modern world.

The mechanism through which this occurs as suggested by psychologists is as follows. Studies in societies characterised by high levels of individualism indicate that people view themselves as independent from others and as embodying positive attributes.<sup>65</sup> As a result they are willing to expand their networks and develop new relationships outside their own ancestral and religious groups. However, researchers find that in collectivist societies, people seek their identity through familial and ancestral networks which are associated with safety and security. Thus they are less likely to engage in the outward-looking behaviour fostered by individualism. The idea is that these traits then get embedded in the social and cultural fabric and influence the types of institutions that consequently develop.<sup>66</sup> Because individualism rewards personal accomplishments such as innovation, theoretical studies predict that it fosters higher rates of economic growth.<sup>67</sup>

Researchers find aspects of culture, trust, individualism and respect, to be significant in explaining regional differences in institutions and hence economic development in Europe. Trust and respect have been found to be strongly correlated with economic development and institutions as has a second trait that measures control or individual self-determination.<sup>68</sup> Others have used a combination of game-theoretical and sociological concepts to analyse the importance of culture in determining institutional structure by studying two pre-modern societies from the Muslim world and the Latin world. The cultural differences led the two societies to evolve along distinct paths of institutional structures which resemble those differentiating contemporary developing and developed countries.<sup>69</sup> These and numerous other studies imply causality between cultural traits and institutional development. However, a common feature of the research which performs empirical tests of these theories is that it uses answers to survey questions as the basis for the cultural codification. Although many of the papers recognise and acknowledge this and even attempt to correct for it, the fact remains that contemporaneous cultural values are influenced by numerous external factors other than institutions. Globalisation, modernisation and even economic development itself will influence the beliefs and values that societies embody. Thus data showing that levels of trust, generalised morality and individualism are highest in Northern European countries, the United States, Australia and New Zealand may in fact be reflecting the cultural values that evolve in richer societies.<sup>70</sup>

A recent survey of the literature suggests that the correct interpretation of the relationship between culture and institutions is not a causal one but instead an interactive one, whereby specific cultural values might emerge within a particular institutional structure but the efficacy with which institutions operate might also be affected by the cultural values that predominate in that society.<sup>71</sup> For example in countries where levels of trust are low, introducing the institutional framework of a modern financial system might not yield the same results as it would in other countries where issues of trust are not in question. The same logic might apply to a market system which relies on the notion of private property and on the enforcement of contracts. Issues of trust, especially corruption in the higher echelons of government, can hamper the workings of the market system and call for a higher level of regulation or intervention than might otherwise be desirable.

### WHAT WE HAVE LEARNED SO FAR

There are three specific questions that emerged from [Fig. 5.2](#):

1. Is culture influenced by geography and if so how?
2. Does culture affect institutions and if so how?
3. Does the impact of culture trickle all the way down to economic development and growth?

I have established connections between culture and geography and studied links between culture and institutions. The next chapter provides a more complete answer to the second question and closes the loop by examining the third relationship between culture and economic outcomes.

### NOTES

1. Bloom et al. [1998](#); Gallup et al. [1999](#).
2. Masters and MacMillan [2001](#).
3. Olsson and Hibbs [2005](#).
4. Bleaney and Dimico [2011](#).
5. Ashraf and Galor [2011a](#).
6. Rodrik and Subramanian [2003](#); Easterly [2002](#); Easterly and Levine [2003](#).
7. Acemoglu et al. [2001](#).

8. Engerman and Sokoloff 1997.
9. These two arguments have been revisited and examined by various authors. An excellent summary can be found in Easterly and Levine 2003.
10. Levine 2005.
11. Spolaore and Wacziarg 2013.
12. Putterman and Weil 2010.
13. Spolaore and Wacziarg 2009.
14. The Europeans transferred some cultural customs that had lasting legacies, even in countries in which they did not have permanent settlements. For example, the tradition of afternoon tea, drinking a hot beverage in the heat of the day, in South Asian countries has always been somewhat of a puzzle to me. My personal feeling is that we South Asians should renounce the practice as a remnant of our British colonial past and adopt *lassi* (a refreshing drink made from yoghurt which has cooling properties) as our national drink. The trouble is that there are many accoutrements (like *samosas* and *pakorras*) that go along with the South Asian tea time that would not pair equally well with *lassi*. I would imagine that as a society, we would not be willing to give up those accompaniments.
15. Grief 1994.
16. *Ibid.*
17. Mesoudi et al. 2004.
18. *Ibid.*
19. *Ibid*, 3.
20. *Ibid*, 3.
21. *Ibid*, 3.
22. The authors provide the example of different hammers in competition with each other for the most effective hammering. I used the example of communication since there are examples of cultures like the Aboriginal Australians who do not have written records because they relied on storytelling and oral histories.
23. *Ibid*, 5. The authors compare the second mechanism to that by which a pathogen is distributed across a population.
24. Hewlett et al. 2002.
25. Guglielmino et al. 1995.
26. *Ibid.*
27. Hewlett et al. 2002.
28. Winterhalder 2001.
29. Hames 2001.
30. For example, models of human behavioural ecology predict that polygyny occurs when males have monopoly over resources that are critical to female survival and reproduction. On the other hand polyandry occurs in inhospitable environments such as the Himalayas caused by the scarcity of



cultivable land and the high need for labour inputs (Borgerhoff Mulder and Schact 2012, 4).

31. Spolaore and Wacziarg. 2013.
32. *Ibid*, 362. An example of the importance of ancestry is provided with respect to agriculture. The Neolithic transition to agriculture provided experience that is captured in the historical characteristics of ancestors and is correlated with economic development.
33. White and Burton 1988.
34. Verdon 1983.
35. See White and Burton 1988, White et al. (1981) find higher levels of African polygyny in the savannah region.
36. DeMeo 2003.
37. Pryor 1986.
38. Alesina et al. 2013.
39. Putterman 2000.
40. *Ibid*.
41. Douglas 1997.
42. Levinson and Malone 1980.
43. *Ibid*
44. For example Whiting 1964 and White et al. 1981.
45. Burton and White 1984.
46. Elton 2008.
47. *Ibid*.
48. Ashraf and Galor 2011b.
49. This explanation of paternal investment theory and its connection to climate is from Vliert et al. 2000.
50. *Ibid*.
51. Talhelm et al. 2014.
52. See the discussion in the next section on the institutionalisation of these traits.
53. *Ibid*.
54. A brief synopsis of the results is also available in Khawar 2016.
55. See <http://www.worldvaluessurvey.org/> for the World Values Survey and Murdock and White 2006 for the Standard Cross Cultural Sample: online edition.
56. The database is the culmination of an additive process of contributions from hundreds of researchers, starting with Murdock and White 1969. The time period chosen corresponds that for which the earliest high quality ethnographic data is available, making this a data base primarily of preindustrial societies.
57. See Murdock and Provost (1973). This variable was developed by the authors and is part of the SSCS database.

58. [Ibid.](#)
59. Note that Murdock and Provost (1973) believe that their set of scales is valid but may not be necessarily useful (they then demonstrate one way that it could be with their brief examination of kinship). They were in particular responding to some ideas from Carniero (1970) who was strongly evolutionary in his thinking and techniques which used scale analysis to rank cultures.
60. Harriss (2003) examines the notion that increased stratification in the form of caste structures has a debilitating effect on economic development, using the case of India as an example.
61. Recall the importance of climate and resources on agriculture and the importance of agriculture on the development of societal traits discussed previously.
62. Recall that ‘tropicar’ is a measure constructed by Gallup et al. 1999. For a complete description of the variables used in this study and corresponding summary statistics please refer to Appendix J.
63. The results can be found in Appendix C, with the reported *P*-values corresponding to Hubert and White standard errors.
64. [Ibid.](#)
65. Heinrich 2014.
66. [Ibid.](#) The authors further theorise that these institutions shape the psychologies and brains of future generations as children adapt developmentally to the institutional environment in which they grow up. In particular, their evidence points to the possibility that these cultural psychologies and institutions influence rates of innovation, the formation of new institutions, and even the success of immigrants, exerting a long-lasting influence extending beyond the significance of the ecological causes themselves. They even go so far as to suggest that wheat farming may contribute to explaining the origins of WEIRD (Western, Educated, Industrialized, Rich and Democratic) psychology and the Industrial Revolution.
67. Alesnina and Guiliano 2015.
68. Tabellini 2008 and 2010.
69. Grief 1994.
70. The data referred to is that presented in Alesina and Guiliano 2015.
71. [Ibid.](#)

## Connecting the Arrows – Geography, Culture, Institutions and Economic Development

**Abstract** The threads from the previous chapters are tied together to suggest that geography, culture and institutions together play a pivotal role in influencing economic development outcomes. In addition to directly influencing output, geography has proximate effects via culture and institutions. Empirical analyses also verify that aspects of culture affect the quality of institutions and directly influence modern economic development. Since the cultural data used is for preindustrial societies it avoids the reverse influence of economic progress on cultural values. Together the findings help explain the early divergence in standards of living across the world and also why these disparities are persistent. They also suggest that successful policies aimed at improving development outcomes should reflect the geographical constraints and cultural and institutional frameworks in which they are to take effect.

**Keywords** Culture · Geography · Institutions · Economic development · Development policy

**JEL field codes** O1 · Z1

I have contended that the prevailing geography-institutions-income hypotheses have been able to explain the geographical basis for colonialism and its differential impacts on institutions but have not

addressed the question of what gave the colonisers their initial advantage to begin with (perhaps because that question was not asked). Thus colonialism has been assumed to be an exogenous force when it should be endogenous. This gave rise to another question to explain the forces that caused the initial divergence between the colonisers and the colonised and to understand the processes behind them. Culture may be part of the answer since neo-Darwinian theories of cultural evolution and recent research by psychologists have uncovered certain cultural traits that have developed by adapting to different environmental conditions.

In addition, recent studies by economists using biogeographical data show that initial biogeographic endowments had a crucial role to play in determining the transition from a hunter-gatherer to an agricultural surplus-producing economy. This transition is generally accepted as the historical event that made possible the social and technological advances leading up to the Industrial Revolution. The preliminary empirical analysis conducted using an anthropological data set in the previous chapter confirms that geography or ‘being tropical’ (as measured by the percentage of land in the geographic tropics) negatively affects the degree of societal or cultural complexity. This, together with the biogeographical studies and neo-Darwinian theories of cultural evolution, could help explain the initial divergence in development paths that took place between the colonisers and colonised and why these differences still exist today.

To establish the connection between culture and economic development, [Fig. 5.2](#) reminds us that we must consider the role of institutions. There are complex interactions between culture, institutions and geography and of course the level of development itself. I have already incorporated a discussion of the former in the previous chapter; next I will extend the analyses to investigate the effects of geography and culture on institutions using the same data that was used earlier.

## GEOGRAPHY AND INSTITUTIONS REVISITED

Separating culture and institutions is difficult as many studies by economists treat the two concepts as one. Some studies have developed both theoretical and empirical justifications for the co-dependency of the two constructs. Others emphasise the importance of culture in the evolution of institutions and the role that geography plays in developing institutions.

Throughout the text we have discussed the literature on this topic – a quick summary will suffice here.

Examining regional differences in income within Western Europe has led to the notion that culture and institutions interact to shape future institutions as well as influence incentives governing individual behaviour and thereby economic development.<sup>1</sup> Combining game-theoretical and sociological concepts reveals the theoretical importance of culture in determining institutional structure in two premodern societies from the Muslim world and the Latin world.<sup>2</sup> The analysis in [Chapter 4](#) explored the differences in resource endowments in the northern and southern United States which resulted in the emergence of different institutions. Work by other researchers examines differences across the Americas and cross-country studies show how geography directly influenced the institutional legacy of colonisation.

What becomes clear as one examines the growing body of work on the subject is that the relationship between all three of the constructs – geography, culture and institutions – is complex and inter-twined. In the previous chapter we used the Standard Cross-Cultural Sample (SCCS) to test the impact of geographical variables on aspects of culture and found them to be significant determinants. In the analysis to follow, I test the impact of culture and geography on institutions by combining the SCCS with the same cross-country data sets used in [Chapter 2](#).<sup>3</sup> In addition to culture and geography, I included standard control variables representing the initial levels of human capital and initial levels of economic development (since these variables have been established as influencing the quality of institutions). My geographical variables included the variable ‘tropical’ representing the proportion of a country’s land area in the geographic tropics and two variables from the SCCS database – stability of the resource base and agricultural potential. The cultural variables from the same data base were cultural complexity and social stratification.

As expected, countries with initially higher levels of income per capita developed better institutions. The stability of the resource base is also positive and significant. An initially puzzling result is that cultural complexity is highly significant and negatively related to institutional quality. To shed some light on this finding, the model was tested again, replacing social stratification for cultural complexity. The results revealed that social stratification is highly significant and negative. The negative effect of social stratification helped illustrate why cultural complexity might have a negative impact on institutional quality since higher values of cultural

complexity also correspond to higher values of social stratification. Overall, the most convincing case for the impact of geography on institutions is made by the stability of the resource base while the most significant finding is that social stratification has a negative effect on the quality of institutions.

### DOES CULTURE MATTER?

As a final step it is desirable to test whether culture is robust as a significant determinant of economic growth and development in the face of the other variables that have been proven to be important in our analysis, particularly geography and institutions. To this end I borrowed the same basic structure of the model used in [Chapter 2](#) and checked for the robustness of the cultural and geographical variables from the SCCS in two time periods.

As in the base model, being tropical has a negative impact on levels of average output which replicates previous findings.<sup>4</sup> However, when the variables from the SCCS are added, being tropical is no longer significant and cultural complexity proves to be highly significant and a positive predictor of higher income per capita. The analysis in [Chapter 5](#) showed that being tropical has a negative effect on cultural complexity; the diminished significance of the tropical effect now could be due to multicollinearity. The institutional variable is also positive and strongly significant but none of the other geographical variables, including agricultural potential and resource base, have predictive power.

The model was again tested by replacing cultural complexity with social stratification which turns out to be significant but negatively related to GDP per capita. This result reinforces other findings which have suggested a negative link between income inequality and output. In those studies the issue of causality has been harder to untangle while the result here is clearer because of the independence of the cultural variables. The findings also mirror the effects of these variables on institutional quality discussed in the previous section. From the geographical variables, being tropical has a negative effect, while the resource base has a positive impact but is significant in only one of the two time periods tested.

Lastly, the same analysis was conducted on growth rates of GDP per capita from 1960 to 1995. As expected, the initial level of economic development has a strong negative effect on growth rates since countries with lower GDP have more catching up to do. Some aspects of geography

remain significant as the authors of previous studies have demonstrated with landlocked countries having lower growth rates while institutions and openness are highly significant and positively related to growth. However, in this model when cultural complexity is included, being tropical is no longer significant while cultural complexity has a positive impact. The only other cultural/geographical variable of note is the stability of the resource base which appears to have a negative impact on growth.

These are preliminary findings and there is much that remains to be explained and explored with respect to the importance of culture. Nonetheless, it is difficult to ignore the primary results from the analyses which are that cultural complexity has a positive impact on both levels of development as well as rates of economic growth. Moreover, in the presence of cultural complexity, the explanatory power of the variable that captures the tropical effect disappears. The earlier analysis showed that tropical countries had lower levels of cultural complexity and now we find that lower levels of cultural complexity lead to lower levels of income and income growth. It appears that culture does matter for economic development.

So let us summarise our findings in these last two chapters. They constitute part of the effort to re-examine the geographical distribution of underdevelopment to try and pinpoint the reason(s) for that pattern. Instead of the traditional determinants that have been studied in the literature, the influence of culture was explicitly studied. On the basis of the analysis conducted, it appears that there is a geographical pattern to culture as defined by cultural complexity. Culture is influenced by geographical/environmental variables such as agricultural potential and resources. In addition, tropical countries tend to be lower on the scale of cultural complexity.

The question of whether culture affects institutions revealed that while culture does seem to influence institutional quality, the way it does is surprising. Cultures that are more complex have *lower* quality institutions. One would expect a positive relationship between institutional quality and cultural complexity. However, when the components of cultural complexity are disaggregated, it is discovered that social stratification, which is part of cultural complexity, has a negative effect on institutions. So perhaps the negative impact of cultural complexity is due to the effect of social stratification. This finding helps reconcile the earlier result and reinforces the importance of income inequality which has been pointed out in previous studies.

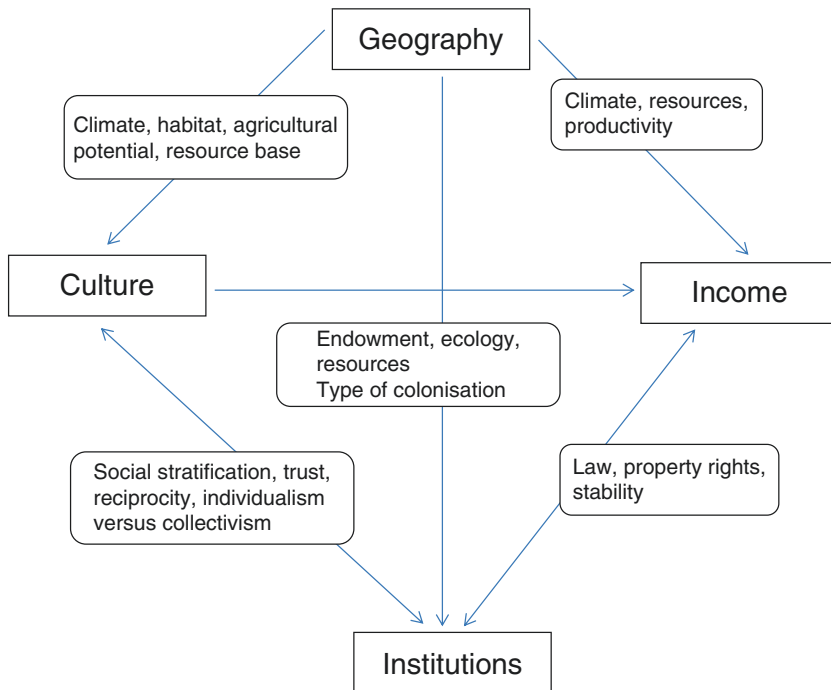
Lastly, the connection between culture and the aggregate level of average income was investigated. Most studies that examine the effect of institutions on GDP per capita suffer from an endogeneity problem since institutional quality is also dependent on levels of development. The cultural variables used in this chapter can be presumed to be independent of income levels since they pertain to preindustrial societies. The results demonstrate strong effects of culture on levels of GDP per capita with a weaker effect on growth rates of output. Disaggregating the cultural complexity variable further might shed some more light on which aspects of culture are most important.

### TYING IT ALL TOGETHER

I started out this quest by examining a map of the world and studying the distribution of average income across countries. That pattern, which has been studied previously in the literature, suggests a geographical cause for underdevelopment. Upon closer investigation however, it turns out that it is not the whole story but just a piece of the puzzle. Geography has a direct effect on economic activity but it has also has indirect, and some might say more pernicious effects, by influencing institutions and culture. However, even that finding is not sufficient to close the loop completely. To explain the formation of institutions that allowed one society to dominate another, one needs to go even further back to the cultural values and traits that enabled the development of those institutions. And here geography makes a comeback again as evidence from multiple disciplines, including the findings in this book, shows that ecological and environmental variables influence the development and adaptation of cultural traits. Thus, the variation in economic development across the globe might in some measure be traced back to cultural origins which are rooted in geographical factors.

A look at [Fig. 6.1](#), completed now with a link from culture to income, shows the circular relationships and the interdependence of the constructs upon one another. Note that although typically culture and institutions influence one another and culture is influenced by income, the cultural traits examined in this study have focused on preindustrial societies so that cause and effect is established in one direction only. An important feature of the diagram is the leading role that geography plays in influencing the other variables.





**Fig. 6.1** Connecting the arrows

The emphasis on institutions and their importance for economic growth makes it imperative that economists examine more thoroughly how institutions evolve. As we saw, culture is an integral part of this story and can determine the direction in and extent to which institutions will change. In turn, institutions play a role in determining the nature and direction of cultural evolution. Thus, an understanding of how culture evolves, which aspects of it are environmentally influenced, which aspects are slow to change and which aspects are more easily influenced by diffusion, is necessary for institutional change to be successful. Some degree of local adaptability based on cultural differences may be essential in order to ensure the appropriateness and stability of institutional reform.

In closing, it is worth reiterating that these findings do not give either geography or culture a deterministic role in shaping ‘path dependence’ for a country’s development. The examples of numerous successful countries

demonstrate that sound institutional reform, good governance and sensible policies can be implemented and can overcome disadvantages brought about by initial conditions. One of the arguments put forth in this book is that in some countries, geographical and environmental factors directly impact productivity, and also lead to the adoption of cultural traits that are less conducive towards modern economic growth. Such countries will need to focus even more on adapting technology and reforming institutional structures to overcome those constraints and foster development. At the same time, attempts to reform institutions have to be cognizant of the cultural values and beliefs that govern behaviour and interactions and shape those reforms accordingly. More research is needed to fully explore the dynamic between culture and institutions, especially along the recently suggested lines of coevolution. In addition, developing countries could benefit from more concerted research and development efforts aimed at addressing the constraints brought on by geography.

## NOTES

1. Tabellini 2010.
2. Grief 1994.
3. See Appendix C for details on the results.
4. See Appendix C for details on the results. The base model is the same one developed by Gallup et al. 1999. The OLS regressions were robust with P-values corresponding to Hubert and White standard errors; the number of observations falls quite substantially due to missing values when overlapping the Gallup et al. (1999) data with the SCCS variables.

# APPENDICES

## APPENDIX A

### *Description of Variables Used in the Data Set*

The following data is available from Gallup et al. (1999), which can be referenced for the original data sources. Most of the economic variables are from widely available previously published data sets. Gallup et al. used GIS mapping software to construct the geography variables such as Tropicar and Pop100km.

The following climate variables were calculated by me, based on data published by the National Climatic Data Center (NCDC (1997)):

***Meantemp*** – average temperature for a country in Fahrenheit. The raw data set lists average maximum and minimum monthly temperatures over a certain time period (which varies from station to station) for the months of January, April, July and October. These values are listed for every station for which observations are available for the particular country. I first calculated the mean monthly temperature by taking the mean of the maximum and minimum. Next I averaged over all 4 months and finally over all the stations in the country to come up with the country wide average.

***Extempdiff*** – the difference between the average extreme maximum and average extreme minimum temperature for a country, in Fahrenheit. Values for extreme maximum temperatures and extreme minimum temperature over a certain time period at a particular station are listed for every

**Table A1** Description of variables

<i>Variable</i>	<i>Description</i>
GDP65	Purchasing power parity (PPP) adjusted Gross Domestic Product (GDP) per capita in 1965.
GDPG6590	PPP adjusted growth rates of GDP per capita from 1965–90.
Instit	Quality of public institutions averaged over five indicators
Lifex65	The life expectancy at birth in 1965
Malaria	The malaria index in 1966 based on a digitized map of the extent of malaria and the proportion of falciparum malaria.
Open6590	Proportion of years from 1965–90 inclusive that a country was open to trade. Also known as the Sachs-Warner index of openness.
School	Number of years of secondary schooling for the population in 1965.
Pop100km	Proportion of a country's population in 1994 within 100 km of a coast or an ocean-navigable river.
Tropicar	Proportion of a country's land area within the geographic tropics.

station in the country. Hence, I first calculated the average of each extreme for the country as a whole by averaging over all the stations for that country. Next I simply subtracted to get the difference between the two average extremes.

*Avrain* – total annual rainfall in inches for the country. The raw data set lists total annual rainfall for each station averaged over a particular time period. I simply took the average of all the stations for a particular country.

*Rain2* – the value of avrain squared.

**Table A2** Correlations for climate variables and malaria index

	<i>Tropicar</i>	<i>Meantemp</i>	<i>Extempdiff</i>	<i>AvRain</i>	<i>Rain2</i>	<i>Malaria</i>
Tropicar	1.0000					
Meantemp	0.7790	1.0000				
ExTempDiff	-0.8515	-0.7855	1.0000			
AvRain	0.5615	0.4782	-0.6599	1.0000		
Rain2	0.4935	0.4643	-0.5989	0.9601	1.0000	
Malaria	0.6420	0.5741	-0.5154	0.2945	0.2591	1.0000

*Climate Values for Countries in Data Set*

<i>Country</i>	<i>Rain (inches)</i>	<i>Meantemp (Fahrenheit)</i>	<i>Exttempdiff (Fahrenheit)</i>
Argentina	19.84	58.56	91.72
Australia	26.38	69.25	80.62
Austria	29.7	48.44	112.5
Benin	52.4	77.75	30
Burkina Faso	40.8	81.5	69.5
Bangladesh	73.9	78.63	65
Bulgaria	22.3	53.44	117.5
Bolivia	29.67	58.56	62
Brazil	61.98	75.33	57.09
CAF	58.3	80.01	47.5
Canada	27.74	33.83	138.51
Switzerland	37.7	49.13	105.66
Chile	54.81	53.39	60.55
China	38.39	56.01	105.17
Cameroon	59.2	73.63	47.5
Congo	54.9	77.92	41.33
Colombia	102.38	70.78	25.15
Costa Rica	70.8	68.75	43
Germany	27.3	47.55	107.28
Denmark	24.95	46.44	96.5
Dominican R.	55.8	77.88	39
Algeria	9.86	70.36	91
Ecuador	38.74	64.75	52.97
Egypt	4.05	73.63	82
Spain	17.92	60.15	87
Finland	22.67	37.33	120
France	29.4	53.91	96.7
Gabon	80.4	77.88	34
UK	31.97	51.58	78.89
Ghana	41.85	78.69	45
Guinea	117	79.88	46.5
Gambia	51	78	61
GuineaBissau	85.9	79.75	47
Greece	20.63	64.57	84.25
Guatemala	51.8	67.5	49
Hong Kong	85.1	72.63	65
Honduras	96.1	78.25	38
Indonesia	111.93	80.39	30.43
India	87.82	75.57	68.92

*(continued)*

(continued)

<i>Country</i>	<i>Rain (inches)</i>	<i>Meantemp (Fahrenheit)</i>	<i>Extempdiff (Fahrenheit)</i>
Ireland	35.83	49.88	74.33
Iran	10.38	61.55	112
Israel	22.33	67.21	78
Italy	29.03	61.07	81.38
Jamaica	31.5	79.25	41
Jordan	10.9	63.38	88
Japan	57.76	54.33	89.4
Kenya	42.5	71.82	40.5
Korea,Rep	51.4	54.57	100.5
Sri Lanka	92.3	80.5	40
Morocco	17.3	64.63	84
Madagascar	35.2	73.67	53.66
Mexico	31.19	73.77	63.07
Mali	19.1	83.42	78.33
Mozambique	39.07	76.12	71.66
Mauritania	6.87	82.04	74
Mauritius	50.6	74	45
Malawi	45.6	73	51
Malaysia	124.5	81.09	32.67
Namibia	9.75	68.13	77
Nigeria	54.8	79.72	53.75
Norway	42.23	41.29	99.33
New Zealand	39.63	54.44	65.5
Pakistan	17.13	75.63	88.33
Panama	100	80.44	32.5
Peru	13.42	64.19	51.8
Philippines	79.8	80.75	37.5
P. New Guinea	88.6	81.08	35
Portugal	33.03	58.5	82
Paraguay	46.2	75.63	76
Senegal	25.8	79.69	61
Singapore	95	80.75	31
Sierra Leone	137.6	79.5	36
El Salvador	70	76.75	60
Sweden	22.63	39.45	114.57
Syria	10.1	65.04	99.34
Chad	22.4	82.58	73.67
Togo	31	77.88	36
Thailand	57.8	80.75	54
Trin. & Tob.	64.2	79.25	49

(continued)

(continued)

<i>Country</i>	<i>Rain</i> ( <i>inches</i> )	<i>Meantemp</i> ( <i>Fahrenheit</i> )	<i>Extempdiff</i> ( <i>Fahrenheit</i> )
Tunisia	11.6	65.69	91.5
Turkey	24.06	56.24	99.86
Taiwan	71.6	73.38	62.5
Uganda	53.45	72.81	47
Uruguay	43	63.38	83.5
USA	30.21	56.12	120.99
Venezuela	46.86	74.8	41.4
South Africa	18.94	63	75.14
Zambia	40.9	70.08	62.33
Zimbabwe	28	66.38	67

**Table A3** Dependent variable GDP per capita 1990

	(1) <i>GDP90</i>	(2) <i>GDP90</i>	(3) <i>GDP90</i>	(4) <i>GDP90</i>
Tropicar	-2299.33*** (3.58)	-802.53 (0.91)		
Pop100km	1038.74 (1.44)	974.877 (1.18)	-487.98 (0.62)	48.66 (0.06)
Open6590	4648.09*** (5.42)	3695.15*** (4.01)	2665.83*** (3.28)	2668.38*** (3.4)
Instit	1532.3*** (9.02)	1618.699*** (8.44)	1222.16*** (6.71)	1216.88*** (6.93)
Lifex65			154.19*** (4.35)	149.13*** (4.35)
School			1202.32*** (2.7)	1123.88** (2.61)
Meantemp		-88.09** (2.2)	-49.53* (1.68)	5.06 (0.14)
Extempdiff				36.99** (2.42)
Constant	-3562.49*** (3.2)	1479.5 (0.5)	-7726.22** (2.44)	-13854.96*** (3.49)
Number of Observations	97	81	73	73
R <sup>2</sup>	0.8674	0.8760	0.9143	0.9214

Numbers in parentheses are absolute values of t-statistics.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

**Table A4** Dependent variable log of GDP per capita 1990

	(5) <i>LGDP90</i>	(6) <i>LGDP90</i>	(7) <i>LGDP90</i>	(8) <i>LGDP90</i>
Tropical	-0.417** (2.17)	-0.21* (1.81)		
Pop100km	0.724*** (4.04)	0.21* (1.87)	0.267** (2.33)	0.245** (2.18)
Open6590	0.588*** (2.94)	0.355*** (3.06)	0.34*** (3.00)	0.3*** (2.7)
Instit	0.19*** (4.57)	0.109 (4.34)*	0.11*** (4.57)	0.117*** (4.84)
Meantemp	-0.0166*** (1.92)	-0.004 (0.74)		
LnLifex		2.45*** (8.26)	2.53*** (8.86)	2.67*** (9.17)
LnSchool		0.113** (2.44)	0.117** (2.58)	0.114** (2.55)
Extempdiff			0.005*** (2.98)	0.004* (1.79)
AvRain				-0.114** (2.39)
Rain2				0.000087** (2.5)
Constant	(7.84)*** (12.27)	-2.05 (1.62)	3.1*** (2.81)	-3.31*** (2.86)
Number of observations	81	73	73	73
R <sup>2</sup>	0.8065	0.9385	0.9392	0.9446

Numbers in parentheses are absolute values of t-statistics.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.



**Table A5** Dependent variable Growth rate of GDP per capita 1965–90

	(9) <i>GDPG6590</i>	(10) <i>GDPG6590</i>	(11) <i>GDPG6590</i>	(12) <i>GDPG6590</i>
Tropicar	-0.904*** (2.74)	-1.25*** (3.22)	-0.904** (2.31)	
LGDP65	-2.44*** (9.44)	-2.24*** (8.5)	-2.32*** (9.16)	-2.38*** (9.43)
Pop100km	0.998*** (2.73)	0.817** (2.16)	0.69* (1.9)	0.93*** (2.45)
Open6590	1.84*** (4.62)	1.985*** (5.02)	1.88*** (4.96)	1.77*** (4.72)
Instit	0.248*** (2.73)	0.24*** (2.66)	0.36*** (3.72)	0.375*** (3.94)
LnLifex	5.5*** (4.91)	5.31*** (4.86)	3.82*** (3.24)	4.07*** (3.45)
LnSchool	0.242 (1.49)	0.267* (1.69)	0.185 (1.2)	0.19 (1.24)
Meantemp		0.031* (1.78)	0.35** (2.1)	0.04** (2.25)
Malaria Index			-1.44** (2.71)	-1.55*** (3.0)
ExTempDiff				0.018** (2.4)
Constant	-3.76 (0.92)	-6.29 (1.49)	-0.37 (0.08)	-3.06 (0.65)
Number of observations	75	73	73	73
R <sup>2</sup>	0.7514	0.7594	0.7845	0.7859

Numbers in parentheses are absolute values of t-statistics.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

## APPENDIX B

### *Data Description and Sources*

The following five variables are from Mitchener and Maclean (2003). Details on estimation and sources can be found in their paper.

1. Labour Productivity (Price-adjusted personal income per worker) – this measure has been adjusted for price differences across states but

not across time periods, hence it is not a ‘real’ variable in the economic sense. Data for Oklahoma in 1880 was unavailable.

$\ln 1880$ ,  $\ln 1900$ ,  $\ln 1920$ ,  $\ln 1940$ ,  $\ln 1960$ ,  $\ln 1980$  – log of the labour productivity measure in each of the years denominated.

2. Cooling – The average number of cooling degree days (in the 100s) based on data from 1961–1990. This is computed as the number of days in which the average air temperature rose about 65°F times the number of degrees on those days which the average daily air temperature exceeded 65 over the year.
3. Mining – percentage of the workforce employed in mining in 1880.
4. Slavery – percentage of the 1860 population in slavery (total number of slaves as a percentage of the total population of each state in 1860).
5. Access – access to ocean, Great Lakes or river. An indicator variable which takes the value of one if a state borders the ocean/Great Lakes/river and zero if it does not.
6. The following are the new climate variables computed in this study:
7. RelHumAm – annual average relative humidity in the morning in percentage terms. The data is from the NCDC (National Climate Data Center) which is a part of the NOAA (National Oceanic and Atmospheric Administration), a branch of the United States Department of Commerce. The observations are for major cities in each state over a period ranging from 6 to 96 years. Monthly averages are used to compute the annual average for each city. The mean of the city averages is used to compute the state-wide average.
8. RelHumPm – annual average relative humidity in the afternoon in percentage terms. The data source and computation are as above.
9. Temp – annual average mean temperature in Fahrenheit. The data is calculated at the NOAA-CIRES CDC based on data obtained from NCDC and based on the period 1971–2000.
10. Precip – total annual precipitation in inches. The data is calculated at the NOAA-CIRES CDC based on data obtained from NCDC and based on the period 1971–2000.
11. SdPrecip – monthly standard deviation of precipitation. Average monthly precipitation was calculated from the annual data and the standard deviation computed.

The following is a matrix of correlation coefficients for the various climate variables:

	<i>Temp</i>	<i>cooling</i>	<i>relhumam</i>	<i>relhumpm</i>	<i>precip</i>	<i>sdprecip</i>
Temp	1.0000					
Cooling	0.8517	1.0000				
Relhumam	0.2452	0.0643	1.0000			
Relhumpm	-0.0177	-0.1040	0.8606	1.0000		
Precip	0.4947	0.2984	0.7313	0.6125	1.0000	
Sdprecip	0.7031	0.4441	0.4333	0.1468	0.4906	1.0000

**Table A6** Climatology of 48 states used in the study

<i>State</i>	<i>Temp (F)</i>	<i>Precip (inches)</i>	<i>SdPrecip</i>	<i>RelHumAm (%)</i>	<i>RelHumPm (%)</i>
AL	62.77	58.28	0.45	84.5	60.5
AZ	60.31	13.61	0.085	61	30.5
AR	60.42	50.78	0.535	84	60
CA	59.4	22.2	0.515	72.5	42
CO	45.15	15.97	0.01	73.5	38
CT	49.05	50.39	0.11	76	55.5
DE	55.27	45.68	0.185	78	55
FL	70.73	54.57	0.425	84.5	63.5
GA	63.51	50.72	0.63	86.5	55
ID	44.39	18.96	0.01	70.5	43.5
IL	51.74	39.32	0.385	82.5	61.5
IN	51.64	41.72	0.325	82.5	64
IA	47.81	34.05	0.145	83	63.5
KS	54.25	28.92	0.105	80	59.5
KY	55.59	48.98	0.305	83.5	63.5
LA	66.39	60.09	0.265	88	62.5
ME	40.97	42.28	0.025	79.5	60
MD	54.22	44.64	0.125	78	54
MA	47.86	47.88	0.06	76.5	57.5
MI	44.41	32.84	0.13	84	63.5
MN	41.16	27.44	0.045	82	64.5
MS	63.35	59.23	0.14	88	64
MO	54.45	42.23	0.43	81.5	63
MT	42.74	15.37	0	74	48
NE	48.77	23.63	0.03	79	58
NV	49.87	9.54	0.1	66.5	35
NH	43.8	43.42	0.01	82.5	68

(continued)

**Table A6** (continued)

<i>State</i>	<i>Temp (F)</i>	<i>Precip (inches)</i>	<i>SdPrecip</i>	<i>RelHumAm (%)</i>	<i>RelHumPm (%)</i>
NJ	52.65	47.15	0.115	77.5	54.5
NM	53.44	14.63	0.055	62.5	31
NY	45.35	41.9	0.125	80	59.5
NC	59.01	50.45	0.47	87.5	56.5
ND	40.43	17.82	0.03	80.5	61
OH	50.68	39.16	0.21	82	61
OK	59.54	36.55	0.285	80.5	59.5
OR	48.41	27.55	0.135	82	66
PA	48.77	43.02	0.06	81	56.5
RI	50.07	47.98	0.045	77	61
SC	62.42	49.84	0.515	84	55
SD	45.14	20.14	0.005	82.5	64.5
TN	57.57	54.22	0.265	84.5	59
TX	64.83	28.87	0.125	77	54.5
UT	48.64	12.26	0.115	67	43
VT	42.88	42.82	0.04	77	59
VA	55.11	44.39	0.245	80	58
WA	48.26	38.78	0.275	84.5	54.5
WV	51.72	45.3	0.015	83.5	59.5
WI	43.12	32.64	0.065	81.5	66
WY	41.98	12.97	0.005	71.5	46.5

**Table A7** OLS – Dependent variable: Log price-adjusted income per worker

	<i>Ln1880</i>	<i>Ln1900</i>	<i>Ln1920</i>	<i>Ln1940</i>	<i>Ln1960</i>	<i>Ln1980</i>
Mining	0.011** (0.005) [0.045]	0.007 (0.005) [0.114]	0.005 (0.003) [0.143]	0.002 (0.004) [0.578]	-0.000 (0.002) [0.954]	0.002 (0.002) [0.482]
Cooling	-0.006 (0.006) [0.329]	-0.004 (0.005) [0.488]	-0.004 (0.004) [0.261]	-0.010 <sup>†</sup> (0.005) [0.059]	0.001 (0.003) [0.676]	0.005 (0.003) [0.121]
Slavery	-0.015*** (0.004) [0.000]	-0.017*** (0.003) [0.000]	-0.011*** (0.002) [0.000]	-0.006** (0.003) [0.030]	-0.004** (0.001) [0.012]	-0.001 (0.002) [0.428]
Access	0.296* (0.15) [0.055]	0.235* (0.129) [0.076]	0.237*** (0.088) [0.010]	0.399*** (0.121) [0.002]	0.141** (0.063) [0.030]	0.124* (0.071) [0.090]
RelHumAm	-0.012	-0.014	-0.013**	-0.028***	-0.101**	-0.005

**Table A7** (continued)

	<i>Ln1880</i>	<i>Ln1900</i>	<i>Ln1920</i>	<i>Ln1940</i>	<i>Ln1960</i>	<i>Ln1980</i>
	(0.011)	(0.009)	(0.006)	(0.009)	(0.005)	(0.005)
	[0.278]	[0.148]	[0.040]	[0.003]	[0.030]	[0.302]
Constant	6.99***	7.231***	8.328***	9.187***	9.327***	10.109***
	(0.816)	(0.696)	(0.477)	(0.651)	(0.338)	(0.385)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
R <sup>2</sup>	0.70	0.77	0.78	0.60	0.44	0.17
Adjusted R <sup>2</sup>	0.66	0.74	0.75	0.55	0.37	0.07
No. of observations	47	48	48	48	48	48

Standard errors are in parentheses and *P*-values are shown in square brackets.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

**Table A8** Robust regressions – Dependent variable: Log price-adjusted income per worker

	<i>Ln1880</i>	<i>Ln1900</i>	<i>Ln1920</i>	<i>Ln1940</i>	<i>Ln1960</i>	<i>Ln1980</i>
Mining	0.004	0.007	0.005	0.003	-0.001	0.006**
	(0.004)	(0.004)	(0.003)	(0.004)	(0.002)	(0.002)
	[0.408]	[0.108]	[0.135]	[0.531]	[0.685]	[0.023]
Cooling	-0.010*	-0.001	-0.006*	-0.015***	0.005	0.012***
	(0.006)	(0.005)	(0.003)	(0.005)	(0.004)	(0.004)
	[0.099]	[0.811]	[0.097]	[0.003]	[0.180]	[0.005]
Slavery	-0.015***	-0.019***	-0.011***	-0.006**	-0.005***	-0.004**
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
	[0.000]	[0.000]	[0.000]	[0.034]	[0.006]	[0.050]
Access	0.283**	0.227*	0.270***	0.436***	0.155**	0.187***
	(0.137)	(0.125)	(0.083)	(0.115)	(0.068)	(0.068)
	[0.045]	[0.077]	[0.002]	[0.000]	[0.028]	[0.009]
RelHumAm	-0.033***	-0.013	-0.018***	-0.035***	-0.012**	-0.005
	(0.010)	(0.009)	(0.006)	(0.008)	(0.005)	(0.005)
	[0.002]	[0.160]	[0.004]	[0.000]	[0.015]	[0.334]
Constant	8.752***	7.184***	8.678***	9.755***	9.465***	9.937***
	(0.744)	(0.675)	(0.500)	(0.621)	(0.368)	(0.368)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
No. of observations	47	48	48	48	47	47

Robust standard errors in parentheses computed iteratively using Huber weights and biweights. *P*-values are shown in square brackets.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

## APPENDIX C

The following variables were selected from the Standard Cross-Cultural Sample (SCCS) database which was retrieved from <http://eclectic.ss.uci.edu/~drwhite/sccs/>. For details about the sources from which each variable in the database is constructed, consult the SCCS Codebook available at the same website.

**Table A9** Description of variables from the SCCS

<i>Variable</i>	<i>Description</i>
AGRICULTURE CONTRIBUTION	Contribution to the local food supply from agriculture – six point scale from ‘none’ to ‘primarily agricultural.’
POLYGAMY	Degree of polygamy present – four point scale from ‘primarily polygamous with some plural husbands’ to ‘> 20% plural wives’.
FEMALEPOWER	Female economic control of products of own labour – two indicator variables, 1 indicating ‘present’ and 2 indicating ‘absent’.
RESOURCEBASE	The availability of stable resources for food production. Three main categories – low, unstable, high. Classified according to a 12 point scale ranging from ‘hunting’ to ‘intensive agriculture, with plow’.
AGRICULTURAL POTENTIAL	A composite of three variables – land slope, suitability of soils for agriculture and agricultural potential of climate. 23 point scale, ranging from ‘poorest’ to ‘richest’ potential.
CULTURALCOMPLEXITY	Composite of 10 variables – writing and records, fixity of residence, agriculture, urbanization, technological specialization, land transport, money, density of population, political integration, social stratification. Each variable is coded on a 5 point scale. The sum of all 10 variable ranges from 10 ‘lowest’ to 50 ‘highest’.
SOCIALSTRATIFICATION	Representing class structure, indicative of the number of social classes present in the society. Five point scale ranging from ‘egalitarian’ to ‘five social classes or castes, with or without slavery’.

For the purposes of this study the variables above had to be modified as follows. Since the data from the SCCS is at the societal level, it had to be aggregated at the country level. This was done by taking the simple mean of the variables for the societies corresponding to the country where they were located. Geographical coordinates corresponding to latitude and longitude, which are part of the database, were used to determine the country in which to place the society.

The following data is available from Gallup et al. (1999), which can be referenced for the original data sources. Most of the economic variables are from widely available previously published data sets. Gallup et al. used GIS mapping software to construct the geography variables such as TROPICAR and COASTAL.

**Table A10** Description of other variables

<i>Variable</i>	<i>Description</i>
GDP65	Purchasing power parity (PPP) adjusted gross domestic product (GDP) per capita in 1965.
LGDP65	Log of PPP adjusted GDP per capita in 1965.
GDP90	PPP adjusted GDP per capita in 1990.
GDP95	PPP adjusted GDP per capita in 1995.
GDPG6590	PPP adjusted growth rates of GDP per capita from 1965 to 1990.
TROPICAR	Proportion of a country's land area within the geographic tropics.
LANDLOCK	Indicator for landlocked countries.
INSTITUTIONS	Quality of public institutions averaged over five indicators.
EDUCATION	Number of years of secondary schooling for the population in 1965.
COASTAL	Proportion of a country's population in 1994 within 100 km of a coast or an ocean-navigable river.
OPENNESS	Proportion of years from 1965 to 1990 inclusive that a country was open to trade. Also known as the Sachs-Warner index of openness.
LIFEEXPECTANCY	Life expectancy at birth in 1965.

Countries for which cultural and geographical variables were computed using the SCCS database are listed. The 186 societies in the data corresponded to the political boundaries of 83 countries. As mentioned previously, Canada and the United States were dropped from the analysis, due to the small population of indigenous peoples, relative to immigrants.

When combining the two data sets, cultural and economic, most of the countries for which economic data was lacking were the smaller Pacific island nations.

Country

Albania  
Algeria  
Angola  
Argentina  
Armenia  
Australia  
Benin  
Bhutan  
Bolivia  
Brazil  
Cameroon  
Chad  
Chile  
China  
Colombia  
Congo  
Costa Rica  
Ecuador  
Egypt  
Eritrea  
Ethiopia  
Fiji  
Finland  
French Polynesia  
French West Indies  
Gambia  
Georgia  
Ghana  
Guatemala  
Guyana  
Haiti  
India  
Indonesia  
Iran



Iraq  
Ireland  
Israel  
Italy  
Japan  
Kenya  
Kyrgyzstan  
Laos  
Malaysia  
Mali  
Marshall Islands  
Mexico  
Micronesia  
Mongolia  
Morocco  
Mozambique  
Myanmar  
Namibia  
New Zealand  
Nicaragua  
Niger  
Nigeria  
Pakistan  
Panama  
Papua New Guinea  
Paraguay  
Peru  
Philippines  
Russia  
Saudi Arabia  
Sierra Leone  
Solomon Islands  
Somalia  
South Korea  
Spain  
Sri Lanka  
Sudan  
Suriname  
Syria

Taiwan  
 Tanzania  
 Thailand  
 Turkey  
 Uganda  
 Vanuatu  
 Venezuela  
 Vietnam  
 Western Samoa  
 Zambia

**Table A11** Dependent variables cultural complexity and social stratification

<i>Independent variables</i>	<i>Dependent variable - Cultural complexity</i>	<i>Dependent variable -Social stratification</i>
FEMALEPOWER	-0.698 (0.201)	0.419 (0.309)
RESOURCEBASE	0.759* (0.054)	1.026* (0.064)
AGRICULTURALPOTENTIAL	0.877** (0.021)	-0.656 (0.188)
POLYGAMY	-1.89* (0.097)	0.317 (0.706)
AGRICULTURECONTRIBUTION	4.14*** (0.000)	-0.629 (0.353)
TROPICAR	-6.985*** (0.002)	1.884 (0.370)
CONSTANT	0.550 (0.919)	5.700 (0.343)
R-Squared	0.6932	0.4403
Number Of Observations	62	62

Numbers in parenthesis are *P*-values corresponding to Hubert and White standard errors.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

**Table A12** Dependent variable quality of public institutions

<i>Independent variables</i>	<i>Dependent variable – Institutional quality</i>	<i>Dependent variable – Institutional quality</i>
GDP65	0.0003** (0.017)	0.0005** (0.017)
EDUCATION	0.336 (0.150)	0.373 (0.150)
CULTURALCOMPLEXITY	-0.075*** (0.003)	
SOCIALSTRATIFICATION		-0.033*** (0.003)
RESOURCEBASE	0.199** (0.049)	0.148** (0.049)
AGRICULTURALPOTENTIAL	0.137 (0.255)	-0.007 (0.255)
TROPICAR	-1.279 (0.110)	-0.443 (0.110)
CONSTANT	3.985 (0.157)	4.008 (0.157)
R-Squared	0.5477	0.4807
Number of observations	48	48

Numbers in parenthesis are *P*-values corresponding to Hubert and White standard errors.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level

**Table A13** Dependent variable income per capita 1990

<i>Independent variables</i>	<i>Dependent variable – GDP per capita 1990</i>	<i>Dependent variable – GDP per capita 1990</i>	<i>Dependent variable – GDP per capita 1990</i>
GDP65	0.867*** (0.000)	0.911*** (0.000)	0.901*** (0.000)
COASTAL	1280.436* (0.093)	385.539 (0.624)	1187.492 (0.119)
LANDLOCK	848.683 (0.196)	829.027 (0.161)	1102.049* (0.088)
OPENNESS	3301.854*** (0.000)	3115.177*** (0.000)	3326.079*** (0.000)
INSTITUTIONS	535.5879*** (0.002)	659.227*** (0.000)	491.0736*** (0.006)
EDUCATION	-51.5706 (0.810)	48.041 (0.824)	64.952 (0.798)
LIFEEPECTANCY	62.415** (0.018)	93.329*** (0.002)	80.123*** (0.007)
CULTURALCOMPLEXITY		71.1366*** (0.001)	
SOCIALSTRATIFICATION			-49.211* (0.060)
RESOURCEBASE		-8.181 (0.894)	133.005 (0.139)
AGRICULTURALPOTENTIAL		-105.641 (0.245)	-29.331 (0.734)
TROPICAR	-2344.422*** (0.000)	-852.146 (0.306)	-1764.236** (0.048)
CONSTANT	-3847.722** (0.023)	-6876.189** (0.013)	-5300.08** (0.063)
R-Squared	0.9417	0.9494	0.9446
Number of observations	47	47	47

Numbers in parenthesis are *P*-values corresponding to Hubert and White standard errors.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

**Table A14** Dependent variable income per capita 1995

<i>Independent variables</i>	<i>Dependent variable – GDP per capita 1995</i>	<i>Dependent variable – GDP per capita 1995</i>	<i>Dependent variable – GDP per capita 1995</i>
GDP65	0.813*** (0.000)	0.917*** (0.000)	0.914*** (0.000)
COASTAL	2704.84** (0.020)	1519.746 (0.151)	2494.67** (0.017)
LANDLOCK	1687.101* (0.069)	1807.006** (0.034)	2242.905** (0.014)
OPENNESS	4082.469*** (0.000)	3855.931*** (0.000)	4204.108*** (0.000)
INSTITUTIONS	704.614*** (0.000)	828.612*** (0.000)	589.379*** (0.001)
EDUCATION	158.455 (0.589)	333.348 (0.332)	381.114 (0.378)
LIFEEPECTANCY	109.616** (0.012)	160.515*** (0.000)	152.229*** (0.000)
CULTURALCOMPLEXITY		91.069** (0.024)	
SOCIALSTRATIFICATION			-105.004* (0.057)
RESOURCEBASE		74.739 (0.414)	310.931** (0.040)
AGRICULTURALPOTENTIAL		-73.387 (0.420)	-7.7756 (0.937)
TROPICAR	-2979.813*** (0.000)	-747.145 (0.492)	-1723.365*** (0.062)
CONSTANT	-6136.873*** (0.009)	-12448.85*** (0.000)	-10652.98*** (0.000)
R-Squared	0.9448	0.9562	0.9547
Number of observations	47	47	47

Numbers in parenthesis are *P*-values corresponding to Hubert and White standard errors.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

**Table A15** Dependent variable growth rate income per capita 1965–90

<i>Independent variables</i>	<i>Dependent variable – Growth rate of GDP per capita 1965-90</i>	<i>Dependent variable – Growth rate of GDP per capita 1965-90</i>
LOGGDP65	-2.331*** (0.000)	-2.352*** (0.000)
COASTAL	-0.085 (0.922)	0.394 (0.585)
LANDLOCK	-1.780*** (0.004)	-1.436** (0.023)
OPENNESS	2.529*** (0.000)	2.610*** (0.000)
INSTITUTIONS	0.112 (0.390)	0.0475 (0.701)
EDUCATION	0.051 (0.809)	0.033 (0.880)
LIFEEXPECTANCY	0.115*** (0.000)	0.106*** (0.000)
CULTURALCOMPLEXITY	0.044* (0.10)	
SOCIALSTRATIFICATION		-0.023 (0.300)
RESOURCEBASE	-0.131** (0.012)	-0.048 (0.515)
AGRICULTURALPOTENTIAL	-0.086 (0.217)	-0.027 (0.617)
TROPICAR	-1.069 (0.204)	-1.646** (0.017)
CONSTANT	13.519*** (0.000)	14.253*** (0.000)
R-Squared	0.8119	0.8030
Number of observations	44	44

Numbers in parenthesis are *P*-values corresponding to Hubert and White standard errors.

\* Denotes significance at the 10% level.

\*\* Denotes significance at the 5% level.

\*\*\* Denotes significance at the 1% level.

## BIBLIOGRAPHY

- Acemoglu, Daron, Simon Johnson, and James A. Robinson. "The colonial origins of comparative development: An empirical investigation." *The American Economic Review* 91, no. 5 (2001): 1369–1401.
- Alesina, Alberto, and Paola Giuliano. "Culture and institutions." *Journal of Economic Literature* 53, no. 4 (2015): 898–944.
- Alesina, Alberto F., Paola Giuliano, and Nathan Nunn. "On the origins of gender roles: Women and the plough." *The Quarterly Journal of Economics* 128, no.2 (2013): 469–530.
- Alsan, Marcella. "The effect of the tsetse fly on African development." *The American Economic Review* 105, no. 1 (2014): 382–410.
- Alvi, Eskander, and Habibur Rahman. "US regional income and technology: A unit-root and cointegration study." *The Berkeley Electronic Journals in Macroeconomics* 5, no. 1 (2005).
- Ashraf, Quamrul and Oded Galor. "Dynamics and stagnation in the Malthusian Epoch." *American Economic Review* 101, no. 5 (2011): 2003–41.
- Ashraf, Quamrul, and Oded Galor. *Cultural diversity, geographical isolation, and the origin of the wealth of nations*. No. w17640. National Bureau of Economic Research, 2011.
- Azzoni, Carlos R. "Economic growth and regional income inequality in Brazil." *The Annals of Regional Science* 35, no. 1 (2001): 133–152.
- Barrios, Salvador, Luisito Bertinelli, and Eric Strobl. "Trends in rainfall and economic growth in Africa: A neglected cause of the African growth tragedy." *The Review of Economics and Statistics* 92, no. 2 (2010): 350–366.
- Barro, R. J. and X. Sala-I-Martin. *Economic growth*. New York: McGraw Hill, 1995.

- Barro, Robert J., and Xavier Sala-i-Martin. "Convergence." *Journal of Political Economy* 100, no. 2 (1992): 223–251.
- Barro, Robert J., Xavier Sala-i-Martin, Olivier Jean Blanchard, and Robert E. Hall. "Convergence across states and regions." *Brookings Papers on Economic Activity* 1991, no. 1 (1991): 107–182.
- Baumol, W. J. "Productivity growth, convergence and welfare: What the long-run data show." *American Economic Review* 76 (1986): 1072–1085.
- Bleaney, Michael, and Arcangelo Dimico. "Biogeographical conditions, the transition to agriculture and long-run growth." *European Economic Review* 55, no. 7 (2011): 943–954.
- Bloom, David E., Jeffrey D. Sachs, Paul Collier, and Christopher Udry. "Geography, demography, and economic growth in Africa." *Brookings Papers on Economic Activity* 1998, no. 2 (1998): 207–295.
- Borgerhoff Mulder, Monique, and Ryan Schacht. "Human behavioural ecology." *Encyclopedia of Life Sciences* (2012): 1–12.
- Bureau of Economic Analysis: retrieved at <http://bea.gov>
- Bureau of Labor Statistics: retrieved at <http://bls.gov>
- Burton, Michael L., and Douglas R. White. "Sexual division of labor in agriculture." *American Anthropologist* 86, no. 3 (1984): 568–583.
- Cardoso, Fernando Henrique, and Enzo Faletto. *Dependency and development in Latin America (Dependencia y desarrollo en América Latina, engl.)*. Berkeley and Los Angeles, CA: Univ of California Press, 1979.
- Carneiro, Robert L. "Scale analysis, evolutionary sequences, and the rating of cultures." *A Handbook of Method in Cultural Anthropology* (1970): 834–871.
- Carrington, William J., and Enrica Detragiache. "How extensive is the brain drain?" *Finance and Development* 36 (1999): 46–49.
- Coclanis, Peter A. "Tracking the economic divergence of the North and the South." *Southern Cultures* 6, no. 4 (2000): 82–103.
- Coelho, Philip RP, and Robert A. McGuire. "African and European bound labor in the British new world: The biological consequences of economic choices." *The Journal of economic history* 57, no. 01 (1997): 83–115.
- Colberg, Marshall Rudolph. *Human capital in southern development: 1939–1963*. Chapel Hill: University of North Carolina Press, 1965.
- Conkin, Paul K. "Hot, humid, and sad." *The Journal of Southern History* 64, no. 1 (1998): 3–22.
- Connolly, Michelle. "Human capital and growth in the postbellum south: A separate but unequal story." *The Journal of Economic History* 64, no. 02 (2004): 363–399.
- Craven, Avery. *Soil exhaustion as a factor in the agricultural history of Virginia and Maryland, 1606–1860*. Gloucester, Massachusetts: Peter Smith, 1926 (rptd ed. 1965).



- Crosby, Alfred W. *Ecological imperialism: The biological expansion of Europe, 900–1900*. Cambridge [Cambridgeshire]: Cambridge University Press, 1986.
- Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. “Temperature and income: Reconciling new cross-sectional and panel estimates.” *The American economic review* 99, no. 2 (2009): 198–204.
- Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. “Temperature shocks and economic growth: Evidence from the last half century.” *American Economic Journal: Macroeconomics* 4, no. 3 (2012): 66–95.
- Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. “What do we learn from the weather? The new climate–economy literature.” *Journal of Economic Literature* 52, no. 3 (2014): 740–798.
- DeMeo, James. “A ‘Saharasian’ climate-linked geographical pattern to the global cross-cultural data on human behavior.” *World Cultures* 14, no. 2 (2003): 111–143.
- Deschênes, Olivier, and Michael Greenstone. “Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US.” *American Economic Journal: Applied Economics* 3, no. 4 (2011): 152–185.
- D Eysberg, C. E. E. S. “The origins of the American Urban System: ‘Historical accident and initial advantage’.” *Journal of Urban History* 15, no. 2 (1989): 185.
- Diamond, Jared. *Guns, germs, and steel: The fates of human societies*. New York: WW Norton & Company, 1997.
- Douglas, Mary. “Lele Economy compared with the Bushong.” *Perspectives on Africa: A Reader in Culture, History, and Representation* 2 (1997): 101.
- Easterly, William. *The elusive quest for growth: Economists’ adventures and misadventures in the tropics*. MIT: MIT Press, 2002.
- Easterly, William and Ross Levine. “Tropics, germs and crops: How endowments influence economic development.” *Journal of Monetary Economics* 50 (2003): 3–39.
- Eckaus, Richard S. “The North-South differential in Italian economic development.” *The Journal of Economic History* 21, no. 03 (1961): 285–317.
- Elton, Sarah. “The environmental context of human evolutionary history in Eurasia and Africa.” *Journal of Anatomy* 212, no. 4 (2008): 377–393.
- Engerman, Stanley L. and Kenneth L. Sokoloff. “Factor endowments, institutions, and differential paths of growth among new world economies: A view from economic historians of the United States”. In *How Latin America fell behind: Essays on the economic histories of Brazil and Mexico 1800–1914*, ed. S. H. Habel, 260–304. Palo Alto, CA: Stanford University Press, 1997.
- Engerman, Stanley L., and Kenneth L. Sokoloff. “Institutional and non-institutional explanations of economic differences.” In *Handbook of new institutional economics*, eds. Claude Menard and Mary M. Shirley, 639–665. Springer: US, 2005.

- Eurostat (statistical office of the European Union). Retrieved at [http://ec.europa.eu/eurostat/statistics-explained/index.php/GDP\\_per\\_capita\\_consumption\\_per\\_capita\\_and\\_price\\_level\\_indices](http://ec.europa.eu/eurostat/statistics-explained/index.php/GDP_per_capita_consumption_per_capita_and_price_level_indices)
- Gallup, John Luke, and Jeffrey D. Sachs. "Agriculture, climate, and technology: Why are the tropics falling behind?." *American Journal of Agricultural Economics* 82, no. 3 (2000): 731–737.
- Gallup, John Luke, and Jeffrey D. Sachs. "The economic burden of malaria." *The American Journal of Tropical Medicine and Hygiene* 64, no. 1 suppl (2001): 85–96.
- Gallup, John Luke, Jeffrey D. Sachs, and Andrew D. Mellinger. "Geography and economic development." *International Regional Science Review* 22, no. 2 (1999): 179–232.
- Gifford Jr, Adam. "Being and time: On the nature and the evolution of institutions." *Journal of Bioeconomics* 1, no. 2 (1999): 127–149.
- Grief, Avner. "Cultural beliefs and the organization of society: A historical and theoretical reflection on collectivist and individualist societies." *Journal of Political Economy* 102, no. 5 (1994): 912–950.
- Guernier, Vanina, Michael E. Hochberg, and Jean-François Guégan. "Ecology drives the worldwide distribution of human diseases." *PLoS Biol* 2, no. 6 (2004): e141.
- Guglielmino, Carmela Rosalba, Carla Viganotti, Barry Hewlett, and Luigi Luca Cavalli-Sforza. "Cultural variation in Africa: Role of mechanisms of transmission and adaptation." *Proceedings of the National Academy of Sciences* 92, no. 16 (1995): 7585–7589.
- Gunther, William D., and Charles G. Leathers. "Trends in Income Inequality in the South, 1950 to 1970." *Growth and Change* 6, no. 2 (1975): 19–22.
- Haile, Menghestab. "Weather patterns, food security and humanitarian response in sub-Saharan Africa." *Philosophical Transactions of the Royal Society B: Biological Sciences* 360, no. 1463 (2005): 2169–2182.
- Harriss, John. "Institutions, politics and cultures: A Polanyian perspective on economic change." *International Review of Sociology* 13, no. 2 (2003): 343–355.
- Hall, Robert E., and Charles I. Jones. "Why do some countries produce so much more output per worker than others?." *The Quarterly Journal of Economics* 114, no. 1 (1999): 83–116.
- Hames, Raymond. "Human behavioral ecology." *International Encyclopedia of the Social and Behavioral Sciences* (2001): 6946–6951.
- Heinrich, Joseph (2014) "Rice, psychology and innovation." *Science* 344: 593–594.
- Hewlett, Barry S, Annalisa DeSilvestri, and C. Rosalba Guglielmino. "Sememes and genes in Africa 1." *Current Anthropology* 43, no. 2 (2002): 313–321.
- Hidalgo, F. Daniel, Suresh Naidu, Simeon Nichter, and Neal Richardson. "Economic determinants of land invasions." *The Review of Economics and Statistics* 92, no. 3 (2010): 505–523.

- Hirschman, Albert O. "A generalized linkage approach to development, with special reference to staples." *Economic development and cultural change* 25 (1977): 67.
- Hsiang, Solomon M. "Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America." *Proceedings of the National Academy of sciences* 107, no. 35 (2010): 15367–15372.
- Huntington, Ellsworth. *Civilization and climate*. New Haven, Connecticut: Yale University Press, 1922.
- Instituto Brasileiro de Geografia e Estatística (IBGE). Retrieved at <http://www.ibge.gov.br/english/estatistica/economia/>
- Istituto Nazionale di Statistica (ISTAT). Retrieved at <http://noi-italia2015.istat.it/>
- Kamarck, Andrew M. *Economics for the twenty-first century: The economics of the economist-fox*. Ashgate Pub Limited, 2001.
- Kamarck, Andrew M. *The tropics and economic development: A provocative inquiry into the poverty of nations*. Baltimore: Johns Hopkins University Press, 1976.
- Khawar, Mariam. "Climate and economic development: Further evidence in support of "the tropical effect"." *Journal of Economics and Development Studies* 2, no. 4 (2014): 77–89.
- Khawar, Mariam. "The impact of culture on economic growth and development." *International Advances in Economic Research* 22, no. 2 (2016): 245–246.
- Lafferty, Kevin D. "The ecology of climate change and infectious diseases." *Ecology* 90, no. 4 (2009): 888–900.
- Landes, David. S. *The wealth and poverty of nations: Why some are so rich and some so poor*. New York: Norton, 1998.
- Levine, Ross. "Law, endowments and property rights." *The Journal of Economic Perspectives* 19, no. 3 (2005): 61–88.
- Levinson, David, and Martin J. Malone. *Toward explaining human culture: A critical review of the findings of worldwide cross-cultural research*. New Haven, Connecticut: Human Relations Area Files, 1980.
- Masters, William A., and Margaret S. McMillan. "Climate and scale in economic growth." *Journal of Economic Growth* 6, no. 3 (2001): 167–186.
- Mesoudi, Alex, Andrew Whiten, and Kevin N. Laland. "Perspective: Is human cultural evolution Darwinian? Evidence reviewed from the perspective of The Origin of Species." *Evolution* 58, no. 1 (2004): 1–11.
- Mitchener, Kris James, and Ian W. McLean. "The productivity of US states since 1880." *Journal of Economic Growth* 8, no. 1 (2003): 73–114.
- Mitchener, Kris James, and Ian W. McLean. "US regional growth and convergence, 1880–1980." *The Journal of Economic History* 59, no. 04 (1999): 1016–1042.
- Montesquieu, Charles de S. *the spirit of the laws*. London: Nourse and Vaillant, 1748.

- Murdock, George P., and Caterina Provost. "Measurement of cultural complexity." *Ethnology* 12, no. 4 (1973): 379–392.
- Murdock, George P., and Douglas R. White. "Standard cross-cultural sample." *Ethnology* 8, no. 4 (1969): 329–369.
- Murdock, George and Douglas White. "Standard cross-cultural sample: On-line edition." Social Dynamics and Complexity, University of California, Irvine Working Paper Series, 2006. Retrieved online at [http://repositories.cdlib.org/imbs/socdyn/wp/Standard\\_Cross\\_Cultural-Sample](http://repositories.cdlib.org/imbs/socdyn/wp/Standard_Cross_Cultural-Sample).
- National Climatic Data Center (NCDC). (1997). National oceanic and atmospheric administration. Retrieved at: <https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets>
- National Oceanic and Atmospheric Administration. Retrieved at [www.noaa.gov](http://www.noaa.gov)
- Niemelä, Raimo, Mika Hannula, Sari Rautio, Kari Reijula, and Jorma Railio. "The effect of air temperature on labour productivity in call centres – a case study." *Energy and Buildings* 34, no. 8 (2002): 759–764.
- Nordhaus, William D. "Geography and macroeconomics: New data and new findings." *Proceedings of the National Academy of Sciences of the United States of America* 103, no. 10 (2006): 3510–3517.
- North, Douglass C. "Agriculture in regional economic growth." *Journal of Farm Economics* 41, no. 5 (1959): 943–951.
- Olsson, Ola, and Douglas A. Hibbs. "Biogeography and long-run economic development." *European Economic Review* 49, no. 4 (2005): 909–938.
- Pryor, Frederic L. "The adoption of agriculture: Some theoretical and empirical evidence." *American Anthropologist* 88, no. 4 (1988): 879–897.
- Putnam, Robert D., Robert Leonardi, and Raffaella Y. Nanetti. *Making democracy work: Civic traditions in modern Italy*. Princeton, New Jersey: Princeton University Press, 1994.
- Putterman, Louis. "Can an evolutionary approach to development predict post-war economic growth?." *Journal of Development Studies* 36, no. 3 (2000): 1–30.
- Putterman, Louis and David Weil. "Post-1500 population flows and the long-run determinants of economic growth and inequality." *Quarterly Journal of Economics* 125, no. 4 (2010): 1627–1682.
- Ram, Rati. "Tropics and income: A longitudinal study of the US states." *Review of Income and Wealth* 45, no. 3 (1999): 373–378.
- Richerson, Peter J., and Robert Boyd. "Natural selection and culture." *Bioscience* 34, no. 7 (1984): 430–434.
- Rivoli, Pietra. *The travels of a t-shirt in the global economy: An economist examines the markets, power, and politics of world trade. New preface and epilogue with updates on economic issues and main characters*. Hoboken, New Jersey: John Wiley & Sons, 2014.

- Rodrik, Dani, and Arvind Subramanian. "The primacy of institutions." *Finance and Development* 40, no. 2 (2003): 31–34.
- Rodrik, Dani, Arvind Subramanian, and Francesco Trebbi. "Institutions rule: The primacy of institutions over geography and integration in economic development." *Journal of economic growth* 9, no. 2 (2004): 131–165.
- Rothstein, Morton. "Antebellum wheat and cotton exports: A contrast in marketing organization and economic development." *Agricultural History* 40, no. 2 (1966): 91–100.
- Rubin, Julius. "the limits of agricultural progress in the nineteenth-century south." *Agricultural History* 49, no. 2 (1975): 362–373.
- Sachs, Jeffrey D. *Tropical underdevelopment*. No. w8119. National Bureau of Economic Research, 2001.
- Sala-i-Martin, Xavier. "The world distribution of income: Falling poverty and . . . convergence, period." *The Quarterly Journal of Economics* 121, no. 2 (2006): 351–397.
- Schlenker, Wolfram, and David B. Lobell. "Robust negative impacts of climate change on African agriculture." *Environmental Research Letters* 5, no. 1 (2010): 014010.
- Smith, James P. "Race and human capital." *The American Economic Review* 74, no. 4 (1984): 685–698.
- Spolaore, Enrico and Romain Wacziarg. "The diffusion of development." *Quarterly Journal of Economics* 124, no. 2 (2009): 469–529.
- Spolaore, Enrico and Romain Wacziarg. "How deep are the roots of economic development." *Journal of Economic Literature* 51, no. 2 (2013): 325–69.
- Tabellini, Guido. "Culture and institutions: Economic development in the regions of Europe." *Journal of the European Economic Association* 8, no. 4 (2010): 677–716.
- Tabellini, Guido. "Presidential address institutions and culture." *Journal of the European Economic Association* 6, no. 2-3 (2008): 255–294.
- Talhelm, Thomas, X. Zhang, Shige Oishi, Chen Shimin, D. Duan, X. Lan, and S. Kitayama. "Large-scale psychological differences within China explained by rice versus wheat agriculture." *Science* 344, no. 6184 (2014): 603–608.
- The Economist. 2015. "A tale of two economies." May 16th, 68.
- United States Census Bureau. Retrieved at [www.census.gov](http://www.census.gov)
- Van de Vliert, Evert, Esther S. Kluwer, and Richard Lynn. "Citizens of warmer countries are more competitive and poorer: Culture or chance?" *Journal of Economic Psychology* 21, no. 2 (2000): 143–165.
- Verdon, Michel. "Polygyny, descent, and local fission: A comparative hypothesis." *Journal of Comparative Family Studies* 14 (1983): 1–22.
- Welch, Jarrod R., Jeffrey R. Vincent, Maximilian Auffhammer, Piedad F. Moya, Achim Dobermann, and David Dawe. "Rice yields in tropical/subtropical Asia exhibit large but opposing sensitivities to minimum and maximum

- temperatures.” *Proceedings of the National Academy of Sciences* 107, no. 33 (2010): 14562–14567.
- White, Douglas R., and Michael L. Burton. “Causes of polygyny: Ecology, economy, kinship, and warfare.” *American Anthropologist* 90, no. 4 (1988): 871–887.
- White, Douglas R., Michael L. Burton, and Malcolm M. Dow. “Sexual division of labor in African agriculture: A network autocorrelation analysis.” *American Anthropologist* 83, no. 4 (1981): 824–849.
- Whiting, J. W. M. “The effects of climate on certain cultural practices”. In *Explorations in cultural anthropology*, eds. W. Goodenough, 511–544. New York: McGraw Hill, 1964.
- Winterhalder, Bruce. “The behavioural ecology of hunter-gatherers.” *Hunter-gatherers: An interdisciplinary perspective* 13 (2001): 12–39.
- Wolfe, Nathan D., Claire Panosian Dunavan, and Jared Diamond. “Origins of major human infectious diseases.” *Nature* 447, no. 7142 (2007): 279–283.
- Wright, Gavin. “New deal and the modernization of the south.” *Federal History* 2 (2010): 58.
- World Bank Development Indicators. Retrieved at [www.databank.worldbank.org](http://www.databank.worldbank.org).

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