THEORY AND EMPIRICS OF ROOT CAUSES OF ECONOMIC PROGRESS

by

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The work presented in Table 4.2A of Chapter 4 is part of a joint workshop paper entitled, "Institutions and Trade: Competitors or Complements?" co-authored with Steve Dowrick and Jane Golley. My contribution in this section is 60%. The rest of the thesis is my own original work. An earlier version of the work presented in Section 4.3 of Chapter 4 is published in volume 11 of the journal *Applied Economics Letters* in 2004 as a research article entitled "Deep Determinants of Economic Growth." This article is authored by me.

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"No new light has been thrown on the reason why poor countries are poor and rich countries are rich."

– Paul Samuelson (1976), Illogic of Neo-Marxian Doctrine, p. 107.

Abstract

The thesis revisits the debate over the relative contribution of root causes (institutions, geography, trade openness, religion and culture, and knowledge) in economic growth. The results show that institutions, market proximity, malaria and Catholicism have direct effects on economic progress. Catholicism is associated with poor institutions and is not good for trade. Malaria is the most important factor for Africa. The Africa result is explained by an overlapping generations model which shows that high malaria incidence encourages households to consume more at the current period and save less for the future which leads to a poverty trap. Among institutions, 'market creating institutions' and 'market stabilising institutions' are important. Strong 'market creating institutions' characterized by the adequate protection of private property and contract enforcement are growth enhancing. 'Market stabilizing institutions' that ensures macroeconomic stability and does not undertake distortionary policies boosts investor confidence and are also good for growth. I notice that there is a growth maximizing level of 'market regulation' beyond which it increases red tape and kills the incentive for investment. The effect of 'market legitimizing institutions' is statistically insignificant.

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LIST OF ABBREVIATIONS

CID……...Centre for International Development

EDGES…….Economic Development, Growth Economics and Sustainability

GDP…….Gross Domestic Product

GMM…….Generalised Method of Moments

HIEs……...High Income Economies

HIPC……..Heavily Indebted Poor Countries

ICRG…….International Country Risk Guide

IMF……International Monetary Fund

IV……...Instrumental Variable

LIEs……...Low Income Economies

LSM……..Log Settler Mortality

OLG……...Overlapping Generations Model

OLS……....Ordinary Least Squares

PRS……Political Risk Services

PWT……..Penn World Table

2SLS……...Two Stage Least Squares

WDI……..World Development Indicators

CHAPTER 1

INTRODUCTION

"Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia's or Egypt's? If so, what, exactly? If not, what is it about the 'nature of India' that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else." – Robert E. Lucas, Jr. (1988), On the Mechanics of Economic Development, p. 5.

Hidaya Mohamed is a fifth grade student. She dreams of going to the Benjamin Mkapa Secondary School, one of the better government schools in her town. But no one in her family has received secondary education before. Her older brother does not go to school and her sister is in a government primary school. Her mother, a single parent, earns a living selling maandazi (traditional buns) which is not enough to finance Hidaya's dream. "I don't think I can go there," reflects Hidaya. "My mother can't pay her contribution and I don't know who can help me."[1]

Hidaya's family resides in Tanzania. The income per capita in Tanzania today is $490, which is one-hundredth of what it is for Luxembourg, the richest nation in the world.[2] Tanzania is poor in spite of its rich natural resource endowments of diamonds, gold, iron ore, coal, natural gas and nickel. Tanzanian soil is suitable for coffee, cotton and clove plantation. In spite of all this, Tanzanian development record is disappointing. A colonial history marred with slave trade reveals a very sad tale of exploitation and underdevelopment. Even after independence in 1961 things didn't change by much. Almost all of the small and big development initiatives of the government in independent Tanzania culminated into disastrous failures. One of the better known accounts of disaster is that of the Morogoro Shoe Factory. The Morogoro Shoe Factory was established in Tanzania with

[1] Hidaya's story is quoted from an article titled "All these children want is a decent education" by Sakina Zainul Datoo published in the October 2003 edition of the journal "Africawoman" in page 3. The online source of this article is the following.
http://www.africawoman.net/newsdetails.php?NewsID=182&AuthorID=53&CountryID=12&NewsTypeID=6&IssueID=24

[2] These are figures for 2000 expressed in current "international" dollars adjusted for purchasing power parity (PPP) differences. The source is the Penn World Table 6.1 (Heston et al. 2002).

the help of the World Bank in the 1970s. It was endowed with labour, machinery and the latest shoe-making technology. But it hardly produced any shoes, only utilising 4% of its capacity, largely due to the absence of production incentives for the firm (Easterly 2001). The plant was not well designed either. It had aluminium walls and no ventilation system, which was unsuitable for the Tanzanian conditions. After two decades of struggle, production finally stopped in 1990.[3] Tanzania now stands as one of the poorest in the world struggling with poverty, high infant mortality, HIV/AIDS and malaria. By 2001, Tanzania accumulated external debt worth $6.7 billion which was cancelled under the Heavily Indebted Poor Country (HIPC) Program.[4] The Tanzanian economy at its current state cannot generate enough wealth to ensure a decent living standard for someone like Hidaya. Hidaya's story is not unique. There are many more like Hidaya in the poor tropics and sub-tropics whose minimum aspirations cannot be fulfilled because their respective economies fail to generate enough wealth for them.

The obvious question that follows is the most common yet crucial in the field of economic development. Why is there 100-fold difference in income per capita between Luxembourg and Tanzania? The question is common because it has been addressed by economists and scholars on numerous occasions over the last fifty years. It is crucial because it has the potential to improve living standards and reduce the proportion of people who are suffering from starvation, poverty and deprivation.

[3] The story of the Morogoro Shoe Factory is quoted from Easterly (2001), pp.68.

[4] The Heavily Indebted Poor Countries (HIPC) program was established in 1996 as a joint collaboration between the World Bank and the International Monetary Fund (IMF). The aim of the program is to reduce the excessive debt burdens faced by the world's poorest nations. In 1999, the international community endorsed enhancements to the HIPC initiative allowing more countries to qualify for HIPC assistance, accelerating and deepening the delivery of relief, and strengthening the link between debt relief and poverty reduction. As of September 2004, twenty seven countries are receiving debt relief under the initiative.

In the past, the main focus of the literature was to discover and evaluate proximate causes (physical capital accumulation, technological progress etc.). In recent years, however, economists have stressed the importance of root causes (institutions, human capital, religion and culture, openness to trade, and geography) in their quest for growth. Some recent studies of an empirical as well as a theoretical nature reports link between long-run economic progress and institutions. Rodrik et al. (2004) using the level regression model[5] show that institutions dominate the influence of both trade and geography as the fundamental determinant of long-run economic development. The title of their paper captures their conclusion: 'Institutions Rule'. Their result build on the findings of Acemolgu et al. (2001) which demonstrates the strong impact of institutions on economic development without claiming dominance. In this thesis I show that institutions don't rule. Malaria, market proximity, and Catholicism have direct effects on development. Malaria also explains the lack of development in Africa. One explanation of this can be that high incidence of malaria prevents African households from saving for the uncertain future. This proves costly for future growth and leads to a low level equilibrium trap. Among institutions I show that strong 'market creating institutions' characterized by the adequate protection of private property and contract enforcement are growth enhancing. The 'market stabilising institutions' that ensures macroeconomic stability and does not undertake distortionary policies boosts investor confidence and are also good for growth. I notice that there is a growth maximizing level of 'market regulation' beyond which it increases red tape and kills the incentive for investment. The effect of 'market legitimising institutions' is statistically insignificant. I also show that the 'instrumental variable estimation of a level

[5] Rodrik et al. (2004) uses log per capita GDP in 1995 as the dependent variable and measures of institutions, geography, and trade openness as explanatory variables.

regression model' approach adopted by the existing studies suffer from identification problems and omitted variable bias.

The analysis proceeds in six stages. In chapter 2, I trace out the transformation of the growth literature from 'factor accumulation' to 'deep structural determinants.' I start off with a brief illustration of the standard neoclassical growth model and derive the growth regression from it. I review the empirical literature that tests one of the major predictions of the growth model- 'given technology and initial income factor accumulation alone can explain all the variation in growth.' The key finding of all these studies is that factor accumulation explains only a small fraction of the variation. The general reaction to this is twofold. First, is an *ad hoc* expansion in the set of correlates to account for the residual variation. Second, is a move towards more structured growth empirics. I conclude this chapter by describing the broad theoretical basis behind the latter.

Chapter 3 reviews the theories of deep structural determinants. I critically review some of the prominent political economy models and theories of institutions. I also review works on trade openness, geography, religion and culture, and human capital.

In chapter 4, I discuss the empirics of deep structural determinants. I describe the existing levels empirical strategy and point out some of the major shortcomings of this approach. I show that this approach suffers from omitted variable bias and identification problems. I propose an alternative strategy of growth regression which reduces the omitted variable bias problem. I also control for school enrolment ratio in 1900 to tackle the identification problem. The key results from estimating an extended model are: a) log GDP per capita in 1820, 1870, 1900, 1950 and 1960 are statistically significant indicating that there is transitional dynamics which is neglected by the existing levels model; b) institutions, market proximity, disease and Catholicism have direct effects on development;

c) Catholicism is associated with poor institutions and is not good for trade; and d) malaria is the most important factor for the low income economies.

In chapter 5, I ask the question, 'Is Africa different?' The reason I ask this question is the unique history and geography of the continent. Slavery, high variability in rainfall, and deadly malaria are some of the unique structural features of Africa. Therefore, learning about the relative impact of these structural features on economic development has to be a substantial part of any answer to our question. The key result of this exercise is that malaria continues to influence African living standards. I find no evidence of slave trade influencing current development. The positive relationship between slave trade and current institutions as reported by Nunn (2004) is not supported by my results.

In chapter 6, I summarise the empirical evidence. I discuss some of the imminent causality issues related to the evidence and try to interpret them using a unifying structure. The structure describes the trajectory of capitalist development in Western Europe. I compare and contrast the Western European trajectory with the trajectories of Africa, China, India, and the Americas and try to find out what deep structural factors are behind the development or lack of development of these regions. The African case is also illustrated by an overlapping generations model where I show that high incidence of malaria has an adverse effect on household savings which dampens growth. I conclude this chapter with an attempt to relate these observations with the empirical evidence that I report in chapters 4 & 5.

The results in chapters 4 and 5 indicate the importance of institutions and malaria. In chapter 7, I look more closely at the contributions of institutions. The institutions and economic development literature including chapters 4 and 5 use a broad definition of institutions measured by the rule of law index. However, institutions can be classified into

the following four categories based on 'first-order economic principles'[6]- market creating institutions, market regulating institutions, market stabilising institutions, and market legitimising institutions. Market creating institutions protect property rights and enforce contracts; market regulating institutions deal with externalities, economies of scale, and imperfect information; market stabilising institutions ensure low inflation and macroeconomic stability; and market legitimising institutions manage redistribution and minimise social conflict. Rodrik and Subramanian (2003) is perhaps the first to classify institutions into these four different categories in the essay entitled, 'The Primacy of Institutions and what this does and does not mean.' I adopt this framework and estimate the relative contribution of each of these institutions using the dynamic panel data estimation method. The findings are – a) strong 'market creating institutions' improves growth; b) 'market stabilising institutions' that ensures macroeconomic stability and does not undertake distortionary policies boosts investor confidence and are also good for growth; c) there is a growth maximizing level of 'market regulation' beyond which it increases red tape and kills the incentive for investment; and d) the effect of 'market legitimising institutions' is statistically insignificant.

Finally, chapter 8 concludes the analysis with some implications. The results strongly suggest that malaria is one of the major barriers to growth in Africa. The overlapping generations model show that one explanation of this result is a low level equilibrium trap. This does make a strong case for aid to eradicate malaria from the continent. However, designing a "Big Push" style aid strategy may not work. Easterly (2006) points out that the "Big Push" strategy overlooks the unsolvable information and incentive problems associated with any large scale planning exercise and, therefore, are

[6]'First-order economic principles' are - protection of property rights, contract enforcement, effective regulation, sound money, rule of law and democracy and so on. The contribution of these principles is illustrated in Rodrik (2003).

likely to fail. In that case a more micro approach towards provisioning of aid may work better.

The empirical results in chapter 7 indicate that strengthening 'market creating institutions' and 'market stabilising institutions' have high dividends. However, one has to keep in mind that these numbers are only indicative of the average. We are correct on the average which does not necessarily mean that the same will follow for each individual observation. In other words, devising a 'Washington Consensus' style policy based on these results may not work for each and every country in the sample. Policies should be based on the first order economic principles and should also recognise the institutional history which may differ across countries. A perfect example is the development experiences of India and China. The world's largest democracy India's institutions are very much different from the institutions of communist China. However, both types of institutions yield high growth dividends – around 6-7% annually in India and 9-10% annually in China.

CHAPTER 2

IN SEARCH OF ANSWERS: FROM FACTOR ACCUMULATION TO DEEP STRUCTURAL DETERMINANTS

One of the major predictions of the neoclassical growth model is that given the level of technology and income at a particular point in time, and a common growth rate of technology, a country accumulating more physical and human capital grows faster than a country accumulating less of the same. Empirical evidence suggests that this is only a part of the story. In a simple regression model with two factors of production, physical and human capital and log initial income as an additional control, a large fraction of the cross-national growth variance remains unexplained. This leads to two types of reaction. First, a mad search for additional correlates of growth with the majority of the correlates having none or very little connection with theoretical models of optimizing behaviour. Second, a move towards more structured growth empirics with the primary objective of teasing out causality. The second approach is relatively recent and has gained a fair amount of acceptance of late. However, it remains a question how the literature has moved in this direction. To find an answer, we need to trace out the origin and the evolution of the growth regression. This is exactly what I seek to do in this chapter.

2.1 The Neoclassical Growth Model

I start off with an illustration of the standard neoclassical growth model and show how the growth regression emerges from it. An earlier version of this model was independently developed by Robert Solow (1956) and Trevor Swan (1956) which only focused on physical capital accumulation. This version is developed by Mankiw et al. (1992) who augment the original version with human capital to accommodate the ideas of knowledge based growth proposed and formalised by Paul Romer in the 1980s. The model is as follows.

The model considers an economy at a particular point in time t with the following constant returns to scale production technology producing income Y:

$$Y_t = F(K_t, H_t, E_t) = K_t^{\alpha} H_t^{\beta} E_t^{1-\alpha-\beta} \tag{2.1}$$

Where K_t and H_t are the stock of physical and human capital respectively, $E_t = A_t L_t$ is effective labour growing at the aggregate rate of exogenous population growth *n* plus technological progress *g*.

Dividing both sides by E_t and suppressing the time subscript *t*, I can rewrite the production function in per capita terms as follows.

$$y = k^{\alpha} h^{\beta} \tag{2.1a}$$

Where *k* and *h* are stocks of physical and human capital per efficiency unit of labour. It is assumed that a fixed proportion s_k and s_h of the per capita output *y* are invested in physical and human capital respectively. The evolution of the economy is determined by the following equations of motion. Both physical and human capital depreciates at an exogenous rate δ.

$$\dot{k} = s_k y - (n + g + \delta)k \tag{2.2}$$

$$\dot{h} = s_h y - (n + g + \delta)h \tag{2.3}$$

At steady state $\dot{k} = \dot{h} = 0$ and the long run steady state equilibrium values of per capita physical capital, human capital and output are given by

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n + g + \delta} \right)^{1/1-\alpha-\beta}, h^* = \left[\frac{s_k^{\alpha} s_h^{1-\alpha}}{n + g + \delta} \right]^{1/1-\alpha-\beta}, \& \; y^* = \left[\frac{s_k^{\alpha} s_h^{\beta}}{(n + g + \delta)^{\alpha+\beta}} \right]^{1/1-\alpha-\beta} \tag{2.4}$$

The unique steady state value is ensured by the Cobb- Douglas technology which guarantees that the Inada conditions are satisfied. By linearising around the steady state using the first order Taylor expansion and integrating, one can derive the following expression for country *i*:

$$\hat{y}_{iT} = \gamma_1 + \gamma_2 \ln y_{it} + \gamma_3 \mathbf{X}_{iT} \tag{2.5}$$

Where $\hat{y}_{iT} \equiv \frac{1}{T}\ln\left[\frac{y_{iT}}{y_{it}}\right]$ and the vector $\mathbf{X}_{iT}$ includes the investment rates in physical and human capital, rate of depreciation of capital, and the rate of growth of population. It follows from the model that the lower the level of initial output of a country, the higher will be its growth rate for a given value of $\mathbf{X}_{iT}$. In other words, all other factors remaining unchanged poor countries grow faster than the rich countries. Therefore the sign of γ_2 is negative. This is known as "conditional convergence" in the literature.

Therefore, the theory predicts that a part of the variation in cross-national income can be explained by the variation in investment rates in physical and human capital. In other words, the central problem in economic development is to understand the process of factor accumulation. This leaves us with an empirical question to answer. Is the prediction made by the theoretical model supported by the data? This is what motivated the expansion of the now voluminous empirical growth literature, which I discuss next.

2.2 Growth, Factor Accumulation, and the Measure of Our Ignorance

One can test the steady state properties of the neoclassical growth model by estimating equation 2.5 using regression techniques. In order to do that equation 2.5 is rewritten as follows:

$$\hat{y}_{iT} = \gamma_1 + \gamma_2 \ln y_{it} + \gamma_3 \mathbf{X}_{iT} + \varepsilon_{iT} \qquad (2.5a)$$

Where ε_{iT} is the unobserved residual. Many empirical growth studies estimate this model using a variety of techniques. Mankiw et al. (1992), Islam (1995), Caselli et al. (1996), King and Levine (1994), Hall and Jones (1999), and Easterly and Levine (2001) are among the most cited ones. The final conclusion however is loud and clear. The residual rather than factor accumulation accounts for most of the growth differences across nations.

This leads to two types of research strategy in the literature.

The first strategy is to increase the number of regressors to account for the omitted factors which explains the variance. The inevitable fallout of this line of research is a never ending list of regressors. This is useful if the regressors are derived from models of optimizing behaviour indicating the possibility of a strong causal relationship. Unfortunately this is not the case. The majority of the regressors are chosen on an *ad hoc* basis. As a result one can identify correlates but not causal relationships. The list of correlates includes physical capital investment, human capital accumulation, low income inequality, being located further from the tropics, less tropical diseases, low fertility, less government spending, trade policy openness, political freedom, British legal origin, rule of law, foreign direct investment, foreign aid, ethno linguistic fractionalisation etc. The list is growing over time and it is far from being exhaustive.

The second strategy is to look at the deep structural features of the economy. The idea is that the deep structural features influence proximate causes (factor accumulation) over the long horizon and shapes the long run economic performance of the economy. To put it more formally the 'proximate causes' are functions of 'deep determinants.' Following is the relationship in mathematical terms.

$$\mathbf{X}_{iT} \equiv \mathbf{F}(\mathbf{Z}_{iT}) \qquad (2.6)$$

Where $\mathbf{Z}_{iT}$ is a vector of 'deep determinants.' Sachs and Warner (1997a) and Bhattacharyya (2004) use this structure in their models. The 'deep structural determinants' are trade, institutions, geography, religion and culture, and knowledge. The listing of knowledge and human capital as a 'deep determinant' however is debatable. Rodrik et al. (2004), Acemoglu et al. (2001), and Bhattacharyya (2004) identify human capital as a proximate determinant. Glaeser et al. (2004) in the empirical literature and Mokyr (1990) in the economic history literature identify knowledge as a deep determinant. Given the weight

of evidence in some of the recent research, it is perhaps appropriate to classify it as a 'deep determinant.' Nevertheless, it is still open to question.

Therefore, one can rewrite (2.5a) as a reduced form regression:

$$\hat{y}_{iT} = \alpha \ln y_{it} + \gamma \mathbf{Z}_{iT} + \varepsilon_{iT} \qquad (2.7)$$

A standard way of estimating this equation is to regress $\mathbf{Z}_{it}$ on exogenous historical variables which may have influenced $\mathbf{Z}_{it}$ in the past and use the predicted value of $\mathbf{Z}_{it}$ from this regression to estimate (2.7). It may appear that this two-step procedure is a handy way to circumvent endogeneity problems however it has its own problems.[7] I will discuss more about this in chapter 4. This allows researchers to estimate the direct effect of 'deep structural determinants' on current growth.

The advantage of the structured growth empirics is that it is closer to theory and it gives us useful insights into the establishment of causality. This is perhaps one of the major reasons behind the majority of the recently published research taking up this approach. However, further work needs to be done to identify the chain of causation and supporting it with a general equilibrium model.

[7]The two-step procedure applied to levels regression suffers from identification problem.

CHAPTER 3

THEORIES OF DEEP STRUCTURAL DETERMINANTS

In this chapter I review the theories and empirics of deep structural determinants of economic progress. This provides a background for the empirical research reported in chapter 4. Theories of institutions, religion and culture, geography, trade and human capital and knowledge are reviewed. I include human capital and knowledge in this list in order to review the theories that strongly argue knowledge is an even deeper determinant than institutions or trade.

3.1 The Institutions Theory

"Little else is required to carry a state to the highest degree of opulence from the lowest barbarism, but peace, easy taxes and tolerable administration of justice; all the rest being brought about by the natural course of things" – Adam Smith (cited in Jones 1981, pp.253).

This is what Adam Smith had to say about the role of institutions in economic development. Even though many scholars have referred to the role of institutions time and again in their work, institution theory perhaps is most strongly associated with Nobel laureate Douglass North. According to North (1994), "institutions are humanly devised constraints that structure human interaction." He adds that they are made up of formal and informal constraints and they depend on the enforcement characteristic of these constraints. All these taken together form the incentive structure of the society. North (1989) argues that the long run economic performance of a society is shaped by its incentive structure. In this study, he looks at the effects of the United States Constitution, the British Common Law and the centralised enforcement mechanism of Spain on economic performance and argues that institutional differences do have economic consequences. The recent long-run growth empirics literature endorse this view (Hall and Jones 1999; Acemoglu et al. 2001; Rodrik et al. 2004). This explains why in the recent past the institutional view has received so much attention in the growth literature. Empirical studies on growth use the instrumental variable approach in order to estimate the relationship. This is essential in order to take

account of the possibility of reverse causality. In other words, as better institutions influence growth positively, it is also possible that faster growing economies can afford to develop better institutions.

Knack and Keefer (1995) and Hall and Jones (1999) are among the first to use institutions as one of the explanators of economic progress. They argue that Western Europeans are historically associated with high quality institutions characterised by protected property rights and efficient enforcement of contracts. Western Europeans also migrated and settled in large numbers in similar temperate climates. When they migrated, they carried these values and institutions with them. Therefore, it can be argued that more temperate the climate the better is the institutional quality. This allows Hall and Jones (1999) to use distance from the equator as an instrument for institutional quality. They also use the fraction of the population speaking English and the fraction of population speaking other Western European languages as alternative instruments for institutions. A high proportion of the population speaking English and other Western European languages is indicative of a significant presence of Western Europeans in that country and hence better institutional quality. Their study reports a strong positive effect of institutions on income per capita.

Acemoglu et al. (2001) put forward a strong argument in favour of the proposition that institutional quality is the fundamental determinant of economic development. They use European settler mortality as an instrument for institutional quality. They argue that Europeans resorted to different style of colonisation depending on the feasibility of settlement. In a tropical environment the settlers had to deal with the killer malaria and yellow fever and hence a high mortality rate. This prevented colonisers from settling in a tropical environment and resource extraction became the most important if not the only activity in tropical colonies. In order to support these activities, the colonisers in the tropics

and the sub-tropics erected institutions which were extractive in nature. On the other hand, in temperate conditions European settlers felt more at home and decided to settle. In these places they erected institutions characterised by strong protection of property rights and efficient enforcement of contracts. These institutions created by the colonizers have persisted in the colonies even after independence. Therefore, they look at the extent of European settler mortality in the past in order to use it as an instrument of the current quality of institutions. In a subsequent paper, Acemoglu et al. (2002) argue that the settlement decision of European settlers also depended on the rate of urbanisation prior to 1500, the start of the period of colonisation, and hence it can be used as an alternative instrument for institutions. According to this argument, a high density of population in the colonies ruled out any possibility of settlement for the settlers and they used the natives to erect extractive institutions without bothering about the overall protection of private property in the society. On the other hand, a low rate of urbanisation and low population density in the colonies encouraged the settlers to settle in large numbers and build institutions to protect property rights. They use the urbanisation rate in 1500 measured by the then density of population, as an instrument for institutions in this study. In both the cases they report strong effects of institutions on development.

Rodrik et al. (2004) also report strong effects of institutions on economic development. In a cross country regression with the level of income per capita as the dependent variable, they control for institutions, trade openness and geography and institutions comes out to be the only variable having a statistically significant relationship with income. In a similar exercise, Easterly and Levine (2003) report no direct effect of geography and policy on economic performance if institutional quality is present as a control. They find that the only channel through which geography affects income is

institutional quality. They use geographic endowment measures as their geography variable.

Many more including the abovementioned empirical studies identify institutions as one of the important correlates of growth. This is perhaps convincing enough to say that institutions matter. However, the question that still remains is how institutions affect economic performance. I discuss three important papers that deal with this issue. They are as follows.

One of the early works on this issue is by Engerman and Sokoloff (2001). In their study they trace the origins of the contrasting growth experiences of the North and the South Americas. They argue that the settlement colonies of the North and the South Americas differed significantly in terms of factor endowments creating incongruous initial conditions. The initial conditions have influenced the growth path of these two continents that ensued via economic and political institutions. The incongruity in the initial conditions thus explains the variability in their growth performance.

Engerman and Sokoloff (2001) write, "…a hemispheric perspective across the range of European colonies in the New World indicates that although there were many influences, the factor endowment or initial conditions more generally had profound and enduring impacts on the evolution of economic institutions, on the structure of the colonial economies, and ultimately on their long-run paths of institutional and economic development. While all began with an abundance of land and other resources relative to labour, at least after the initial depopulation, other aspects of their factor endowments varied – contributing to extreme differences in the distributions of land holdings, wealth, and of political power."

They argue that the climatic conditions of the North were favourable to mixed farming of grains and livestock which exhibited limited economies of scale in production.

This encouraged the development of small family-size farms and a relatively homogeneous population in terms of the distribution of wealth and political power. The result was better institutions favouring broader access to economic opportunities, more extensive domestic markets, and better overall growth. The South and the Caribbean in contrast were endowed with vast mining resources and climates and soil conditions conducive to commercial crops like sugar, tobacco, and cotton. To exploit these resources which exhibit large economies of scale it was efficient on the part of the colonizers to set up large mining firms and plantations run with cheap slave labour. This led to the establishment of a society where a large section of the population remained impoverished with no political or economic rights whatsoever, whereas a small section, the political and economic elite, took control of all the wealth. The high level of inequality in the distribution of wealth and political power created institutions which are extractive, exploitative and extremely unjust. These institutions persisted over time causing persistent inequality and lack of growth. The highly concentrated landholdings and extreme inequality in Mexico, Colombia, and Peru during the colonial period are supportive of their story.

In a recent paper, Acemoglu et al. (2004) formalise some of the ideas of Engerman and Sokoloff's (2001) using a schematic model. Following is a discussion of that model.

Acemoglu et al. (2004) argue that a nation's economic and political institutions are broadly endogenous. They are at least in part determined by the society or a segment of it. They distinguish between two components of political power – *de jure* and *de facto*. They define *de jure* political power as the power that originates from formal political institutions in the society – for example: the Monarch, Democracy, Autocracy or Dictatorship etc. *De facto* political power on the other hand originates from informal political institutions which often challenge the formal ones – for example: economic and social interest groups etc. They assert that the existing political institutions at the current period determine the

distribution of *de jure* and *de facto* political power in the society. The strength of *de facto* political power also depends upon the distribution of resources in that period. This shapes economic institutions of that period and political institutions of the future. Current economic institutions influence current economic performance and the future distribution of resources. Future distribution of resources and future political institutions in turn influence subsequent distribution of political power, economic institutions, and economic performance. The following schematic diagram summarizes the link.

$$\left\{\begin{matrix} PI_t \Rightarrow djPP_t \,\&\, dfPP_t \\ DR_t \Rightarrow dfPP_t \end{matrix}\right\} \Rightarrow \left\{\begin{matrix} EI_t \Rightarrow Y_t \,\&\, DR_{t+1} \\ PI_{t+1} \end{matrix}\right\} \qquad (3.1)$$

Where $PI, DR, djPP, dfPP, EI, \&Y$ are political institutions, distribution of resources, *de jure* political power, *de facto* political power, economic institutions, and economic performance respectively.

In another related paper Acemoglu et al. (2005) explore the origin of capitalist institutions in early modern Europe which can be cited as further evidence to the hypothesis that economic and political institutions influence economic performance and vice versa. They describe the interactive role of trade and institutional development in stimulating economic growth in certain Western European countries from the sixteenth century onwards. They assert that Atlantic trade and colonial activity enriched and strengthened commercial interests groups both economically and politically in these countries (most notably Britain and the Netherlands), which then demanded and obtained institutional reforms to protect their property rights, which enabled them to trade and invest more, triggering a circular and cumulative pattern of economic growth. However, this was not the case with some of the early starters in the colonization process notably Portugal and Spain. Even though they managed to expand their trading and ransom seeking activities rapidly by exploiting their early mover advantage, their growth was not sustainable. A major part of

the explanation is the traders failing to secure their rights from the Monarch. The Monarch and the clergy in Portugal and Spain remained firmly in control of the activities of the trading companies never allowing them to accumulate de facto political power to challenge the existing institutions. As a result the incentive to undertake investments in physical and human capital eroded fast and the growth was short lived.

A further extension of the political power theory is presented by Acemoglu and Robinson (2000). Their argument is akin to the Marxist theory of capitalist-workers class struggle. Marx argued that capital accumulation and the associated decline of the surplus of capitalists would intensify exploitation of the workers which would lead to intense class struggle between the capitalists and the workers that would eventually terminate the class society. Acemoglu and Robinson (2000) accepts the basic premise of this theory and argue that social and political reforms in Western Europe during the nineteenth century were an outcome of deliberate concessions made by the elite designed to avert political instability, expropriation, and possibly a revolution. As a result of these concessions inequality reduced in the western society which created the necessary precondition for the development of property rights institutions protecting private property which translated into faster economic growth in the periods that followed. However this theory is not free from its critiques. Galor and Moav (2006) come up with an alternative model to explain the termination of the class society. They argue that it was not class struggle but human capital and knowledge that brought about the demise. I discuss the findings of this study in detail in section 3.5.

3.2 The Religion and Culture Theory

"Respect the altar of every belief. Spanish America, limited to Catholicism to the exclusion of any other religion, resembles a solitary and silent convent of nuns…To exclude different religions in South America is to exclude the English, the Germans, the Swiss, the North Americans, which is to say the very people this continent most needs. To bring them without

their religion is to bring them without the agent that makes them what they are."- Juan Bautista Alberdi (cited in Landes 2000, p.5)

Juan Bautista Alberdi, a distinguished Argentine of the nineteenth century, believed that religion and culture plays the most significant role in shaping the economic destiny of a nation. This is what he wrote in 1852, half a century before Max Weber's remarkable work *The Protestant Ethic and the Spirit of Capitalism.*

In this section I discuss some of the notable theories that link religion, culture, and economic performance. I classify the religion and culture theory into four broad categories. I name them as follows: the Protestant work ethic view, the religious intolerance view, the collective belief view and the trust view.

The Protestant work ethic view is due to Max Weber and it goes back to the early 20th century when he published his thesis titled *The Protestant Ethic and the Spirit of Capitalism*. Weber (1930) argues that the epoch-making Protestant Reformation changed societal outlook and sowed the seeds of modern capitalism. Protestantism's emphasis on industry, thrift and frugality along with its moral approval of risk taking and financial self-development created a social environment conducive to investment and the accumulation of private capital. This became an inspirational force in transforming traditional societies into modern capitalist ones. Catholicism on the other hand considered trade and accumulating riches to be sinful, an attitude which was quite inimical to economic progress. Samuelsson (1993) points out that Weber's theory hardly applies to Lutheranism, which retained the traditional attitudes of Catholicism towards trade and commerce at least at the time of its inception. But, it undoubtedly applies to Calvinism which supports trade and commerce. One of the central themes of Calvinism is predestination. According to this belief, some individuals are chosen and saved by God while the others are not. This process of selection by God is predestined and unalterable. Calvin in his discourses did not mention who had

been chosen. Therefore, the only practical way for the followers of Calvin to breed hope of attaining salvation is by performing intense worldly activities. Weber (1930, pp.69), also cited in Acemoglu et al. (2004, pp.15), states that, "however useless good works might be as a means of attaining salvation, they are indispensable as a sign of election. They are the technical means, not of purchasing salvation, but of getting rid of the fear of damnation." Calvin's doctrine encourages economic activity but condemns enjoying the fruits of such activity by means of leisure. The followers of Calvin consider morality to be a virtue not because it can bring salvation but because it helps in acquiring moral credit. All these characters of Calvinism are essential preconditions for economic progress and this is how, according to Weber (1930), Calvinism influences economic performance. Given the provocative nature of Weber's thesis, it is not hard to understand that it fails to achieve universal acceptance. In an influential study on religion and growth, Tawney (1926) rejects Weber's view. He argues that the English economy took off in the 16th century when the religious influence in the society was replaced by secular attitudes.

The religious intolerance view is due to Landes (1998) which adds another dimension to the theory that links religion and economic performance. In his book *The Wealth and Poverty of Nations*, he argues that the profit motive of the entrepreneurial class coupled with invention and productivity gain is the core in achieving material progress. Therefore, it is crucial for religious beliefs and practices within the society to encourage hard work and not inhibit rational and scientific thought and profit making. He uses the example of 18th century Britain to illustrate the effect of Protestant work ethics and values on economic performance. According to his thesis, Britain's numerous scientific successes after the industrial revolution were made possible due to the supportive and tolerant role played by the church. In contrast, the orthodoxy of the Catholic Church in Portugal and the culture of intolerance diffused by the Catholic Church in Spain and Italy strangulated

scientific thinking and halted progress even though they were the first to make significant progress in cartography and ocean navigation. The infamous "Roman Inquisition" in the 16th century Europe is a testimony of religious intolerance and orthodoxy of the Catholic Church which virtually stalled the European renaissance. To summarise, Landes (1998) maintains that the culture of intolerance in Catholicism and Islam limits the potential of a country to grow. Protestantism, on the other hand, facilitates economic growth by encouraging hard work and showing a more tolerant attitude towards scientific research.

The collective belief view is due to Avner Grief. Grief (1994) holds that different cultures and religions generate different sets of beliefs about how people behave and people's behaviour has a direct role in shaping economic performance. According to his argument, this can generate different growth equilibria across the globe even with the same set of institutions. These beliefs can also influence institutional quality in the long run and affect economic performance indirectly.

Finally, the trust view is due to Putnam (1993). He holds that the Catholic tradition emphasizes vertical bonds with the Church which tends to undermine horizontal bonds with fellow citizens. This reduces the level of trust in the society and increases the transaction costs of economic exchange. Therefore, Catholicism has a negative effect on institutions and hence a negative effect on growth. Trust also has a direct impact on creditworthiness. Lack of trust in the society creates a creditor unfriendly environment that limits economic progress. The creditor unfriendly environment is also due to the anti-usury culture prominent in the Catholic tradition (Stulz and Williamson 2001).

3.3 The Geography Theory

"…the striking differences between the long-term histories of peoples of the different continents have been due not to innate differences in the peoples themselves but to differences in their environments…if the populations of Aboriginal Australia and Eurasia

could have been interchanged during the Late Pleistocene, the original Aboriginal Australians would now be the ones occupying most of the Americas and Australia, as well as Eurasia, while the original Aboriginal Eurasians would be the ones now reduced to downtrodden population fragments in Australia." – Jared Diamond (1997), Guns, Germs and Steel, p.405.

In this section I discuss the theories that link geography with development. I classify the existing theories of geography into five different categories. They are as follows: the climate view, the agriculture view, the market proximity view, the disease view, and the sophisticated geography view.

The climate view holds that the population in the tropics is not industrious enough largely due to the energy sapping heat. Natural availability of food in abundance also makes tropical people idle. This has a direct and negative effect on human productivity and hence economic growth (Montesquieu 1748). In a recent study, Parker (2000) supports Montesquieu's argument. According to his thesis, an individual's desire to maximize utility is dependent on motivation, homeostasis and neural, autonomic, and hormonal adjustments. These physiological factors are governed by the hypothalamus. The activity of the hypothalamus is heavily dependent on thermodynamics. In hot conditions, the hypothalamus secretes hormones which negatively affect motivation and enterprise; whereas in the cold climate individuals are naturally hard working. These tendencies affect the steady state level of income in these two regions. The average steady state income in the cold climate is naturally higher than the average steady state in the hot climate. Hence, climate explains two thirds of the per capita income differences between the tropics and the temperate. Economists are reluctant to pick up this view perhaps because of its racist undertone (Easterly and Levine 2003).

The agriculture view is due to Gallup and Sachs (2000). This view maintains that high relative humidity and high night time temperature in the tropics cause high plant

respiration and slows down plant growth. They argue that the deficiency in plant growth in the tropics is also related to the lack of nutrients in tropical soil. Humid tropical soils (alfisols, oxisols and ultisols) are typically low in nutrients and organic matters. This limits plant growth and also causes soil erosion and acidification. In addition the lack of frost allows a greater number of pests to survive and breed. These factors have a debilitating impact on agricultural productivity and inhibit economic progress. In addition to this, an alternative and sophisticated agriculture view exists due to Diamond (1997). According to this view, prior to the period of colonization, Europeans used technology which was specifically designed to suit the temperate conditions. In the late 18^{th} and early 19^{th} century, when the Europeans embarked on a colonisation drive, they introduced these technologies in the colonies. They worked well in the colonies with temperate conditions but failed to deliver the same goods in the tropical environment. This explains the low productivity of tropical agriculture and hence slow economic progress.

The market proximity view is due to Sachs and Warner (1995b), Sachs and Warner (1997b), and Gallup et al. (1998). There is no disagreement within the economics community that trade and commerce generates wealth and prosperity (Smith 1776). One of the important preconditions for trade is easy access to major markets. According to the market proximity view, unfavourable geographic location characterised by no or limited access to ports or ocean navigable waterways, being landlocked, is a major impediment to trade and commerce. Access to port or major markets in this situation often involves crossing international boundaries which makes the cost of transportation relatively high and limits international trade. Absence of international trade in these economies confines all commercial activities into small internal markets. This causes an inefficient division of labour and underdevelopment. If one looks at inland Africa which is also one of the poorest areas in the world, it is quite evident that most of the countries of this region are

landlocked. This prevents these countries from effectively participating in international trade because transport costs are too high (Sachs and Warner 1997b).

The disease view is due to Gallup and Sachs (2001), Bloom and Sachs (1998) and Gallup et al. (1998). According to this view, infectious malaria has a debilitating effect on human productivity and directly affects economic performance. Gallup and Sachs (2001) point out that the countries with intensive malaria grow 1.3 percentage point slower per person per year than countries without malaria and a 10 percentage point reduction in malaria might result in a 0.3 percentage point increase in annual per capita income growth. Bloom and Sachs (1998) also claim that the high incidence of malaria in sub-Saharan Africa reduces the annual growth rate by 1.3 percentage point a year. In other words, eradication of malaria in 1950 would have resulted in a doubling of current per capita income. Sachs (2003a) and Batten and Martina (2005), in their empirical studies report strong and negative effect of malaria on economic progress even after controlling for institutions and openness.

Finally, the sophisticated geography view is due to Jared Diamond (1997). Diamond in his book entitled 'Guns, Germs and Steel' asks the question: why did history unfold so differently on different continents? He argues that geography and biogeography moulded the contrasting fates of human lives in different continents. In summary his hypothesis is as follows.

He argues that geography has endowed mankind with different sources of food and livestock. The Eurasian climate, especially south west Asia which he calls the 'Fertile Crescent'[8], was best suited for the growth of maximum number of edible wild grains and large mammals. Early hunter-gatherers living in this region domesticated these wild grains

[8]The Fertile Crescent spans a part of the modern day Israel, Palestine, and Jordan valley. For further reference see map in Diamond (1997) p. 135.

and adopted a sedentary agriculture based lifestyle. They domesticated the large mammals for meat, milk and muscle power which they could use in farming. The use of large mammals in agriculture immensely improved farm productivity yielding more and more food surplus. This technology and knowledge spread all across Eurasia along the same latitude. Close contact with the large mammals also led to frequent outbreaks of epidemic diseases among the human population in this region. This helped Eurasians to develop immunity to many of these diseases over the long run. The gift of food surplus and a sedentary lifestyle allowed them to invest more time into the development of guns, steel swords, ocean going ships etc. The societal structure became hierarchical and far more complex than the hunter-gatherers.

This however was not the case in other continents. In places like New Guinea humans were left with very limited choice of food. No wild grains or large mammals were available for domestication. So humans in the New Guinea remained hunter-gatherers. In the Americas corn was the major grain that was domesticated. Other grains were not available. The continent also lacked large mammals for domestication. The only available option was the llama which is weak and yields less meat and milk than cow, goat or sheep. The indigenous American population were also not familiar with horses and they lacked immunity from the fatal Eurasian diseases. As a result the Europeans faced little or no resistance from the indigenous American population in their colonial conquest. The Aztecs, the Incas, and the Mayas were fighting an unequal battle with the Europeans powered with guns, steel swords, horses, and germs. More than two thirds of the population were wiped out by a smallpox epidemic when they first came into contact with the Europeans. Riding on the power of guns, germs and steel the Europeans colonized most of the known world getting access to a large pool of resources which helped them to develop an advanced industrialised society. The Americas, Australia, and New Zealand gained from European

migration and the migration of European technology along with them. The rest of the world remained largely impoverished and the gap widened over time with the development of more and more advanced technology in the west.

3.4 The Trade Openness Theory

"The greatest improvement in the productive power of labour, and the greater part of the skill, dexterity, and judgement with which it is any where directed, or applied, seem to have been the effects of the division of labour…This division of labour, from which so many advantages are derived, is not originally the effect of any human wisdom, which foresees and intends that general opulence to which it gives occasion. It is the necessary, though very slow and gradual, consequence of a certain propensity in human nature which has in view no such extensive utility; the propensity to truck, barter, and exchange one thing for another" – Adam Smith [1776 (1960)], Wealth of Nations, Chapters I & II, pp.7 &17.

The openness view of development at least goes back to Adam Smith. Smith (1776) argues that openness to trade increases the size of the market which raises the possibility of greater division of labour. Division of labour in turn improves productivity and productivity improvement induces faster economic growth.[9]

The neo-classical theory however holds a slightly different view. According to this theory, reduction in trade barriers opens up the possibility of a more efficient exploitation of comparative advantage through reallocation of factors. Labour and capital move towards their highest valued uses improving overall productivity and the welfare of the economy. Growth takes place in the economy due to transitional dynamics. In other words, growth lasts only for the duration of the transitional period and stops after the economy reaches its new steady state levels of capital and output per worker.

Another significant theory in the openness and growth literature is the technology transfer view. According to the closed economy neo-classical growth models, given the

[9] Yang and Borland (1991) uses a growth model to formalise Adam Smith's notion of division of labour.

technology level at a particular point in time a country accumulating more physical and human capital grows faster than a country accumulating less of the same but all of them converge to the same long run steady state equilibrium rate of growth (Solow 1956; Swan 1956; Mankiw et al. 1992). In this model, income per capita can grow in the long run only when there is exogenous technological progress. In real life we hardly observe convergence of income. In contrast, what we notice is that the rich economies are growing faster than the poor ones and the gap between the rich and the poor is widening over time.[10] Coe and Helpman (1995) points out that this gap is due to variable rate of technological progress. They find evidence that technology catch up or R&D spillover bridges this gap. Dowrick and Rogers (2002), on the other hand, reports that the gap is due to variable rates of capital accumulation as well as technological progress. Howitt (2000) builds a theoretical model to show that because of technology transfer, R&D performing countries converge to parallel growth paths whereas others stagnate. Several others including Coe and Helpman (1995) identify trade openness as a medium of technology transfer. In other words, what these studies argue is that the follower economies adopt technology and knowledge developed in the advanced economies and the transfer takes place largely through international trade. Therefore, effective participation in international trade and opening up by reducing trade restrictions exposes economies to new knowledge and new technology which helps them to grow in the long run.

Other influential studies in the openness and growth literature are Sachs and Warner (1995a) and Frankel and Romer (1999).

Sachs and Warner (1995a) use the growth accounting approach to show that trade openness is the key determinant of growth. They calculate trade openness using

[10] This is disputed by many if we consider the last 50 years. World income distribution has increased over the last 50 years especially with the impressive growth performances of India and china over the last two to three decades. But the diverging trend certainly holds over a longer period.

information on average tariff levels, non-tariff barriers, black market premium, state monopoly on major exports etc. Their regression results suggest, on the average, "open" economies grow somewhere between 2 to 3 percentage point faster than "closed" economies.[11] Their study however is not free from criticism. Rodrik and Rodriguez (2000) show that the Sachs and Warner measure of openness suffers from over reliance on the black market premium and state monopoly on major exports criterion.

Frankel and Romer (1999), on the other hand resort to level accounting using instrumental variable regressions to conclude that trade openness is a key factor influencing economic development. They construct an instrument by separating out the influences of income, population size and land area which they call the constructed openness. This variable they claim yields more accurate estimates of the relationship between openness and per capita income. They report a strong and positive effect of openness on income per capita.

Even though there has been a fair bit of agreement about trade openness' association with growth for at least the last couple of decades, recently these results have come under fire from a series of papers. These papers argue that trade openness loses importance once institutional quality is introduced as a control in a regression framework. Rodrik et al. (2004) reach a similar conclusion which we have discussed before. One possible explanation is openness enhancing institutional development. Therefore, a regression model with openness and institutions as controls is not picking up any individual effect of openness on income as it is operating through the institution channel. This view is supported by Wei (2000) who suggest that more open countries face greater losses from corruption than less open ones as the loss from corruption is higher in case of foreign

[11] Wacziarg and Welch (2003) improve the Sachs and Warner (1995a) measure and extend it to the 1990s. Their measure however is not free from the basic criticisms of Rodrik and Rodriguez (2000).

transactions. Therefore, open countries have a higher incentive to develop better institutions. Another explanation comes from Dollar and Kraay (2003). They argue that cross-country regressions of log-level per capita GDP on instruments of institutions and openness do not reflect the relative importance of these variables in the long run. The high correlation between institutions and openness does not allow regression models to estimate the actual relationship. According to their analysis, regression of changes in decadal growth rates on instrumented changes in trade and changes in institutional quality shows a significant effect of trade openness on growth. They report that trade openness and institutions are important for economic growth in the very long run, but trade has a relatively larger role over institutions in the short run. They do not control for geography, religion and culture. Also, their study explains changes in growth rates rather than growth itself and growth accelerations are hard to observe in the long run (Jones 1995). This also brings about the question whether the spurt in growth rate that comes out of changes in institutions and openness is a mere impulse which tapers off in the long run or something that is sustainable.

3.5 The Knowledge and Human Capital Theory

"Technological progress predated capitalism and credit by many centuries, and may well outlive capitalism by at least as long." - Joel Mokyr (1990), The Lever of Riches, p. 6.

The knowledge and human capital theory of development is due to Joseph A. Schumpeter. In his book entitled *The Theory of Economic Development* he describes the notion of 'creative destruction' and how it is central to the process of economic development. He argues that the entrepreneurs in a capitalist economy are constantly looking for new ideas which will render their rivals' ideas obsolete. A product developed from the new idea will be able to capture the entire market and allow the firm to enjoy monopoly profit. This continuous process of 'creative destruction' raises a firm's output.

The possibility of enjoying monopoly profits creates an incentive for rival firms to invest in R&D and innovate and the process continues. The increase in R&D activities in the economy creates positive externalities and reduces the cost of R&D for an individual firm. The economy grows powered by the increase in knowledge capital and R&D.

Even though Schumpeter (1934) talks about R&D, he focuses mainly on the role of innovation rather than invention. Joel Mokyr (1990) on the other hand argues that inventions and innovations are complements and both play an important role in economic development. In his book entitled *The Lever of Riches* he defines invention as, "an increment in the set of the total technological knowledge of a given society, which is the union of all sets of individual technological knowledge" (Mokyr 1990, p. 10). He argues that invention in itself may not be a meaningful concept, but without it, it is impossible to develop an application which has immediate commercial usage. On the other extreme, without innovation, an inventor will have little economic incentive to pursue new ideas.

In part III of his book he goes on to argue that the complementarity between invention and innovation explains why many societies failed to be technologically creative. Invention requires individual brilliance and an inventor expects social recognition of her work. Therefore, a society more receptive to new ideas and willing to reward human inquiry is more likely to produce more scientists and researchers. Innovation, on the other hand, requires interaction with other individuals and an in depth knowledge of the market. Hence, it is more of a social and economic nature. Therefore, a society willing to encourage business enterprise is more likely to produce more innovations. However, either of them cannot survive independently in the long run. A society has to fulfil multiple conditions to generate both invention and innovation. He supports his argument using evidence from the Chinese and the European history of technology.

Even though China entered the early modern era as a technology leader of the world, soon afterwards it lost its advantage to Europe and suffered a technological slowdown. Europe, on the other hand, acquired most of the early technologies from China and the east through direct and indirect means and went on to develop them further which led to the industrial revolution. Mokyr asks the question why does this happen? His explanations are as follows. First, social groups trying to sabotage and block new technology were far less powerful in Europe than in China. Second, a market for technology developed fairly rapidly in early modern Europe which created an economic as well as socially rewarding environment for the scientists and innovators. This encouraged private initiatives in the development of new technology. Therefore, the change in the character of the state did not affect investments in technology by much. Even if it did, it led to a decline of that state in the European economic hierarchy. This made every state or monarch in early modern Europe conscious of the costs of conformism. In contrast, Chinese scientific activities and technology development were largely state sponsored. This prevented the development of private initiatives and hence a technology market. A change in the character of the state often led to hostile behaviour towards innovation and nonconformism. The abrupt ending of the famous Cheng Ho voyages in 1433 is a classic illustration. A change in the ruler and internal power structure in the Ming Dynasty in 1433 led to the closing down of shipyards and production of ocean-going junks. The continuous threat to potential innovators from rival power groups had perhaps forced them to shy away from novel ideas.

Even though Mokyr identifies technology and knowledge as the central factor, he does not rule out the role of culture and institutions in shaping technology. I will discuss this further in chapter 4.

Glaeser et al. (2004) goes even further to claim that human capital is more fundamental than institutions. They challenge the Acemoglu et al. (2001) institutions theory which says that in temperate conditions European settlers felt more at home and decided to settle. In these colonies they brought Western values and institutions along with them when they migrated which are favourable to capitalism. In contrast, Glaeser et al. (2004) argue that the decision to settle in temperate conditions does not tell us anything definitive about what the Europeans brought with them when they migrated. It can well be human capital and ideas and not institutions. In other words, they argue that institutions have only a second order effect on economic performance and the first order effect comes from human and social capital which shape both institutional and productive capacities of a society. They call this the 'Lipset-Przeworski-Barro' view of the world.

Another strong supporter of the human capital view is Galor and Moav (2006). They provide a counterargument to the political power and institutions theory of Acemoglu et al. (2004) and Acemoglu and Robinson (2000).[12] Galor and Moav (2006) argue that it wasn't concessions by the elite that lead to the demise of the class society. It was the investments in human capital by the capitalists to sustain their profit rates that caused the gradual dismantling of the class society.

Their version of the story goes as follows. After the industrial revolution in the late eighteenth and early nineteenth century Europe, production was heavily dependent on capital and labour. The ownership of capital was with the capitalists whereas the ownership of labour was with the workers. This created the class society characterised by a social division in line with the ownership of the factors of production. However in the later half of the nineteenth century the character of capitalist production experienced a change.

[12] I have discussed the political power and institutions theory of Acemoglu et al. (2004) and Acemoglu and Robinson (2000) in section 3.1.

Capitalists started realising the increasing importance of technology and human capital in production. They noticed that the productivity of a skilled worker is three or four times more than an average unskilled worker. Therefore investments in human capital and technology became crucial for the sustenance of profit rates of the capitalists. These investments in mass schooling by the Capitalists paid dividends in the long-run by generating positive externalities for R&D and faster economic growth.

Galor and Moav (2006) also provide empirical evidence in favour of their theory using the voting patterns of the legislators on England's education reform, the Balfour Act of 1902. This bill was meant to create a publicly supported secondary school system. They show that legislators' support for this bill is positively correlated with the industrial skill-intensity level of the counties. Legislators representing counties with high industrial skill-intensity level overwhelmingly supported this bill whereas the others didn't. By assuming that the legislators received financial backing from the industrialists of their respective counties, they argue that this result reflects the eagerness of the capitalists owning skill intensive industries to invest in human capital.

Many others debate this view. Both Acemoglu et al. (2001) and Rodrik et al. (2004) put human capital in their list of proximate determinants rather than a fundamental determinant of economic progress. The literature however is yet to arrive at a consensus.

CHAPTER 4

EMPIRICS OF DEEP STRUCTURAL DETERMINANTS

In this chapter I start off in section 1 by introducing the standard levels model that has been used in the empirical literature lately. I point out that this model suffers from an identification problem and omitted variable bias. The way I define the identification problem here is quite different from the generic definition of the same in econometrics. The instrumental variable estimation in Rodrik et al. (2004) and Acemoglu et al. (2001) makes use of more exogenous instruments and exogenous variables than suspected endogenous variables making it an overidentified system. However their claim that the correlation between current institutions and log setter mortality instrument can be described by a unique story lacks support. Log setter mortality turns out to be correlated with current schooling and the relationship is independent of the correlation between log setter mortality and institutions. This is what I refer to as the identification problem. In section 2, I propose an alternative empirical model to tackle the omitted variable bias and identification problem. I call this the 'modified level regression model.' I estimate this model using the standard instrumental variable method. The major findings are; 1) Malaria explains a significant proportion of the variation in the steady state level of income across countries; 2) Malaria dominates over institutions in a sample of low income economies (LIEs). In section 3, I show that the LIE result is driven by the African economies. Section 4 concludes.

4.1 Limitations of the Existing Empirical Literature

The levels framework adopted by Rodrik et al. (2004) and other recent papers[13] centers on a cross-country regression where the dependent variable is the current level of economic development, typically measured by the natural logarithm of real GDP *per capita*, $\ln y_{iT}$, where i indexes countries and T indicates the year. The explanatory variables

[13] Examples of papers using the levels approach are Acemoglu et al. (2001), Glaeser et al. (2004) and Sachs (2003a).

consist of a measure of the 'quality' of contemporary institutions, I_{iT}, and a vector of other explanatory variables, $\mathbf{W}_{iT}$. The other explanatory variables include log trade share in the current period and latitude:

$$\ln y_{iT} = \eta I_{iT} + \mathbf{\Phi W}_{iT} + \varepsilon_i \qquad (4.1)$$

It is apparent that this model which is known as the levels regression model is nested within the growth specification reported in (2.7)[14], since it can be rewritten as:

$$\ln y_{iT} = (1+\alpha T)\ln y_{it} + \eta I_{iT} + \mathbf{\Phi W}_{i\tau} + \varepsilon_i \qquad (4.2)$$

Where $\gamma = [\eta \; \mathbf{\Phi}]$, $\mathbf{Z_{iT}} = \begin{bmatrix} I_{iT} \\ \mathbf{W_{iT}} \end{bmatrix}$, and $1+\alpha T = 0$. The null hypothesis, H_0: $(1+\alpha T) = 0$, reduces (4.2) to the levels regression, whilst rejection of the null favours the growth specification.

The economic intuition behind this test is that the levels regression is implicitly explaining the steady state distribution of income levels. This assumption is explicit in the augmented Solow-Swan model derived by Mankiw et al. (1992) who use investment rates as the proximate determinants of the neo-classical steady state. Mankiw et al. (1992) go on to show that if economies are not in their steady states, the transitional dynamics of the neo-classical model are captured by the addition of the 'initial' income level in a growth regression.[15] If economies actually are in steady-state, as explained by the right-hand-side variables in equation (4.1), then the addition of the lagged dependent variable, as in equation (4.2), should add no explanatory power.

I test the null hypothesis by adding an initial income term into Rodrik et al.'s (2001) levels specification. The results are reported in Table 4.1. In all the four regressions using

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[14] The growth specification is $\hat{y}_{iT} = \alpha \ln y_{it} + \gamma \mathbf{Z}_{iT} + \varepsilon_{iT}$ where $\hat{y}_{iT} \equiv \frac{1}{T}[\ln y_{iT} - \ln y_{it}]$.

[15] A similar point has been made by Caselli et al. (1996) and by Sachs (2003).

1820, 1870, 1900, and 1950 level of log per capita GDP as initial income[16] I observe that the initial income term is statistically significant. This indicates that the standard levels framework neglects the role of transitional dynamics and the coefficient estimates suffer from omitted variable bias.

Table 4.1. **Omitted Variable Test: OLS Regressions**

Dependent Variable	**Log per Capita GDP in 2000**			
	OLS obs=44	OLS obs=52	OLS obs=35	OLS obs= 108
Log Initial Income (1820)	0.35** (0.1599)			
Log Initial Income (1870)		0.36** (0.1949)		
Log Initial Income (1900)			0.46** (0.1705)	
Log Initial Income (1950)				0.598*** (0.0858)
Rule of Law (2001)	0.78*** (0.0780)	0.60*** (0.1345)	0.399*** (0.1325)	0.49*** (0.0936)
Average Log Trade Share	-0.043 (0.1150)	0.043 (0.1376)	-0.133 (0.1526)	0.15* (0.1013)
Latitude	-0.003 (0.0046)	0.001 (0.0053)	0.006 (0.0070)	0.01** (0.0040)
R^2	0.8303	0.7522	0.7992	0.8181

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% level respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. The standard errors reported in the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

The levels framework also suffers from more fundamental problems. It ignores the process of development. This failing is obscured by the fact that Rodrik et al. (2004) follow Acemoglu et al. (2001) in using a plausible historical story to motivate the use of an historical variable – the mortality rate amongst European colonial clergy and military in the 18th and 19th centuries – to act as an instrumental variable in estimating the impact of current institutions on the current level of development. A short version of the story is as follows.

[16] The data on GDP per capita in 1820, 1870, 1900, and 1950 are from Maddison (2004). For more details see Data Appendix.

Europeans chose to settle in colonies where the climate was relatively hospitable, bringing with them traditions and expectations of European institutions, particularly in relation to property rights (at least the property rights of the settlers). These expectations were conducive to 'good' institutions being established and continued throughout the colonial and post-colonial periods. On the other hand, where mortality was high, Europeans would not settle, and the colonial authorities would impose authoritarian rule and set up extractive institutions which continued to have an influence through the institutions of post-colonial society. A more detailed version of the story is presented in section 3.1.

This is a plausible story. It provides an explanation why settler mortality might be correlated with current institutional quality in countries which were subjected to European colonisation. But it may not be a historical explanation for the huge differences that we observe in current levels of development. In order to establish a causal relationship between settler mortality and current institutions, one has to show at the least that the settler mortality variable is not correlated with any of the other probable deep factors. If this is not the case, then one can put forward another story to justify the correlation which leads to a problem of identification. This is what I observe when I put Rodrik et al.'s (2004) model (equation 4.1) to test.

I start off by re-estimating the levels model and I observe that Rodrik et al.'s (2004) claim of 'institutions rule' is supported by the regression results. This is reported as Model (1) in Table 4.2A. Then I replace one of the explanatory variables Rule of Law in 2000 by Total Years of Schooling in 2000 and re-estimate the model using the instrumental variable method with the same set of instruments as Rodrik et al. (2004). This yields a positive and statistically significant coefficient estimate for Total Years of Schooling in 2000. The results are reported in Panel A, Table 4.2A.

Table 4.2A: **Identification Problems in Levels Specification of Rodrik et al. (2004)**

Dependent Variable	**Log per Capita GDP in 2000**			
Estimation Method and Sample Size	Model (1)		Model (2)	
	OLS obs=111	2SLS obs=65	OLS obs=89	2SLS obs=53
Panel A: OLS and Second Stage 2SLS Results				
Rule of Law (2001)	0.802*** (0.092)	1.45*** (0.238)		
Total Years of Schooling (2000)			0.271*** (0.0923)	0.329*** (0.0257)
Average Log Trade Share	-0.003 (0.119)	-0.487 (0.276)	0.067 (0.093)	0.078 (0.156)
Latitude	0.013** (0.0055)	-0.01 (0.0132)	0.017*** (0.0037)	0.012** (0.0058)
R^2	0.7313		0.8261	
Hausman test (p-value)	0.000		0.019	

Panel B: First Stage Regressions				
Dependent Variables	Rule of Law (2001) obs=76	Average Log Trade Share obs=76	Total Years of Schooling (2000)	
			obs=56	obs=56
Log Settler Mortality	-0.25*** (0.1039)	-0.072 (0.0727)	-1.32*** (0.2243)	-0.83*** (0.1923)
ENGFRAC	0.95*** (0.3311)	0.41** (0.2299)	2.05** (0.8444)	1.1* (0.6263)
EURFRAC	0.18 (0.2197)	-0.22 (0.1540)	1.44** (0.5645)	1.33*** (0.4949)
CONST	0.008 (0.0057)	0.024*** (0.0039)	0.002 (0.0164)	-0.026* (0.0141)
Latitude	0.02** (0.0088)	-0.005 (0.0056)	0.014 (0.0199)	-0.01 (0.0200)
Rule of Law (2001)				1.29*** (0.2949)
R^2	0.5472	0.4488	0.7311	0.8061

Notes: ***, **, and * indicates significance level of 1%, 5%, and 10% respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. The standard errors are heteroskedasticity robust. All the regressions reported above are carried out with an intercept. The instruments used for the Hausman test[17] are Log Settler Mortality, ENGFRAC, EURFRAC and CONST.

[17] For a detailed discussion of Hausman test, see Technical Appendix TA3, p. 174.

This implies that the instrumental variables used in Rodrik et al. (2004) do not uniquely identify Rule of Law. The first stage regression results provide further evidence which is reported in Panel B of the table. The instrumental variables (log settler mortality, ENGFRAC, and EURFRAC) which are meant to serve as instruments for Rule of Law are also correlated with Total Years of Schooling in 2000. The regression estimates reported in Column 4 of Panel B shows that log settler mortality is negatively associated and ENGFRAC & EURFRAC are positively associated with the dependent variable Total Years of Schooling in 2000. One may argue that this association is due to the positive correlation between Rule of Law and Total Years of Schooling. In other words, countries with strong rule of law are expected to have a better educated population and hence high level of schooling. This claim is not supported by the regression reported in column 4 of Panel B. The negative relationship between log settler mortality and total years of schooling remains unaffected when we add rule of law as an additional control into the model in column 3. The partial R^2 calculations reveal that 36% of the variation in total years of schooling is explained by log settler mortality whereas 27% is explained by rule of law. This implies that the relationship between log settler mortality and Total Years of Schooling is independent and even stronger than the correlation between Total Years of Schooling and Rule of Law. One can very well argue in favour of the Glaeser et al. (2004) story based on this result which says that the important factor that European settlers took with them was human capital when they migrated and not institutions.

A similar problem is observed in another influential work, Acemoglu et al. (2001). Table 4.2B provides an illustration of the problem.

Table 4.2B: **Identification Problems in Acemoglu et al. (2001)**

Dependent Variable	**Log per Capita GDP in 1995**		
	Original Model obs = 65	Model with Schooling obs = 57	
Panel A: 2SLS Results			
Average Protection against Expropriation	0.96*** (0.2227)		
Total Years of Schooling (1995)		0.341*** (0.0326)	
Latitude	0.002 (0.0128)	0.009 (0.0068)	
Panel B: First Stage Regressions			
Dependent Variables	Average Protection against Expropriation obs=67	Total Years of Schooling (1995)	
		obs=57	obs=51
Log Settler Mortality	-0.47*** (0.1448)	-1.69*** (0.2229)	-1.29*** (0.2379)
Latitude	0.02 (0.0155)	0.02 (0.0231)	0.005 (0.0214)
Average Protection against Expropriation			0.658*** (0.1831)
R^2	0.2553	0.6129	0.6970

Notes: ***, **, and * indicates significance level of 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are the respective standard errors. All the regressions reported above are carried out with an intercept. Log Settler Mortality is used as an instrument for Average Protection against Expropriation.

When I replace the Average Protection against Expropriation measure in the Acemoglu et al. (2001) specification by Total Years of Schooling in 1995 and re-estimate the model using an instrumental variable method[18] , I observe that the coefficient on Total Years of Schooling in 1995 is positive and statistically significant. The results are reported in Panel A of Table 4.2B. This implies that like Rodrik et al. (2004) the instrumental variables used in Acemoglu et al. (2001) do not uniquely identify the measure of Average Protection against Expropriation. The first stage regression results provide further evidence which is reported in Panel B of the table. The log settler mortality variable, which is meant to serve as an instrument for the Average Protection against Expropriation measure, is also

[18] The set of instruments used are the same as the original paper.

correlated with Total Years of Schooling in 1995. The regression estimates reported in Panel B shows that log settler mortality is negatively associated with Total Years of Schooling in 1995. One may argue that this association is due to the positive correlation between Average Protection against Expropriation measure and Total Years of Schooling. However, this claim is not supported by the regression reported in column 3 of Panel B. The negative relationship between log settler mortality and Total Years of Schooling remains unaffected when I add Average Protection against Expropriation measure as an additional control into the first stage regression. This implies that the relationship between log settler mortality and Total Years of Schooling is independent of the correlation between Total Years of Schooling and Average Protection against Expropriation measure.

Therefore, it is apparent that the levels regression suffers from an identification problem. This is partly due to its neglect of the dynamics. The 'modified level regression' model which I introduce in the following section can serve as an alternative. This model recognises the role of the initial condition in explaining the dynamics. I also control for human capital to tackle the identification problem of the levels framework. However, it does not answer all the questions about dynamics. More detailed empirics using time series data is perhaps the way to go in the future.

4.2 Modified Level Regression Model and the Empirics

This section deals with the model and the empirics. I introduce the model first and then follow it up with a discussion on the data, the estimation strategy, and the results.

4.2.1 The Model

I estimate the growth specification outlined in equation (4.2) by using the following regression model.

$$LOGGDPPC_i = \alpha_1 + \alpha_2 Y_{0i} + \alpha_3 INS_i + \alpha_4 INT_i + \alpha_5 GEO_i + \alpha_6 REL_i + \alpha_6 ER_i + \varepsilon_i \qquad (4.3)$$

Where LOGGDPPC, $Y_{0,}$ INS, INT, GEO, REL, and ER are log per capita GDP in 2000, log initial income (1960), institutions, openness, geography, religion, and human capital variables respectively. I call this a 'modified level regression' model.[19]

The 'modified level regression' takes into account the role of 'transitional dynamics' by controlling for initial income (1960). This reduces the degree of omitted variable bias on the coefficients of deep factors. The model also tackles the identification problem of the levels framework by taking into account the independent role of past levels of human capital in explaining the differences in current pre capita GDP.

4.2.2 The Dataset

The analysis is based on a dataset which consists of per capita GDP levels, measure of institutions, measures of geography, a measure of openness, measures of religion, and a measure of human capital in (up to) 180 countries. Since I am combining data from different sources, I have to deal with different numbers of observations for different variables. In some cases, the regressions cover as few as 10 observations. The data typically also come from different years. In case of institutional measures I use averages in order to capture the long run effect. The definitions and sources of all the variables are summarised in the Data Appendix. Table 4.3 presents the summary statistics of these measures.

I divide the dataset into seven major parts depending upon the variable that they are measuring. They are as follows: measures of economic development, measure of institutions, measures of geography, measures of religion, measures of openness and trade, measure of human capital, and the instruments. Following is a brief outline of each of them.

[19]It is also a growth model.

Table 4.3. **Summary Statistics**

Variables	Number of obs.	Mean	Standard Deviation	Minimum	Maximum
Measure of Institutions					
Rule of Law Index	171	0.0015	0.9441	-2.19	2.37
Measures of Geography					
Distance	178	19.6293	17.0873	0	63.89
Malaria Risk	160	0.3678	0.4390	0	1
Yellow Fever Risk	154	0.1262	0.2271	0	0.65
Land Area within Tropics	146	0.4991	0.4779	0	1
Soil Suitability	154	13.3965	9.8512	0	55.07
Land Area within 100km of Ocean or Ocean-Navigable River	146	46.0343	37.604	0	100
Measures of Religion					
Catholicism	174	31.3805	36.1243	0	97.3
Islam	174	22.0817	34.749	0	99.8
Measure of Openness and Trade					
Log of Trade Share	146	4.0914	0.6384	2.58	5.76
Measure of Human Capital					
Enrolment Ratio in 1900	88	32.34	26.37	0.1	95
Measures of Economic Development					
Log Initial Income (1820)	50	6.58	0.3893	5.98	7.52
Log Initial Income (1870)	60	6.88	0.5668	5.98	8.09
Log Initial Income (1900)	39	7.46	0.6096	6.30	8.41
Log Initial Income (1950)	136	7.29	0.9446	5.67	10.32
Log Initial Income (1960)	115	6.3153	0.8647	4.72	8.23
Log per Capita GDP in 2000	147	8.588	1.1177	6.19	10.799
Instruments for Institutions					
Log Settler Mortality	79	4.6818	1.2070	2.15	7.99
ENGFRAC	148	0.0967	0.2697	0	1
EURFRAC	148	0.2726	0.4064	0	1
Log Population Density in 1500	96	0.4639	1.5163	-3.83	4.61
Instrument for Geography					
Malaria Ecology	160	3.8682	6.6141	0	31.55
Instrument for Openness					
Constructed Openness	146	27.0440	28.9076	2.3	281.29

Notes: For a detailed discussion of the definition and source of these variables, see Data Appendix.

Economic development is measured by the level of per capita GDP in 2000. I also use the level of GDP per capita in 1960 as the initial level of development.

The average rule of law index is a measure of institutional quality. In particular, it measures the overall institutional quality and the quality of governance in a particular country. The range of this index varies from -2.5 to 2.5 with higher values implying better institutional quality. I use average value of this index from 1998 through to 2000 for each of the 171 countries as the measure. The data show that Somalia has the weakest institutions in the world and Singapore has the strongest institutions.

In case of geography, I use five different measures: distance, malaria risk, land area within tropics, soil suitability and land area within 100km of ocean or ocean-navigable river.

Distance is a measure of the distance from the equator. Following the argument of Sachs (2003a) I use this as a measure of climate. The greater the distance from the equator, the further the country is from the tropics and more temperate or cold it is. I exploit data from 178 countries.

Malaria risk measures the share of population at risk from malaria in 160 countries in the year 1997. I use this as a measure of disease burden. A higher value indicates greater risk for the population. Typically, tropical and sub-tropical countries register higher risk of malaria and the risk of malaria declines in the temperate climates.

Land area within the geographical tropics is used as a measure of the effects of geography on agricultural productivity. This is calculated as a proportion. A higher value implying that a higher proportion of the countries land is tropical in nature and therefore, the country's agriculture is expected to have tropical characteristics marked by slow and low plant growth. I use soil suitability as an additional measure of agriculture. Ukraine registers as the country with highest proportion of suitable soil.

Finally, I use land area within 100km of ocean or ocean-navigable river as a measure of market proximity. The higher the proportion of land within 100km of ocean or ocean-navigable river, the greater is the chance of an economy to participate in maritime trade and have more access to larger markets. A bulk of the sub-Saharan economies is observed to be landlocked.

In measuring religion I use the proportion of population following Catholicism and Islam in the year 1980 as a measure of the same respectively. The data shows Spain, Ireland, Portugal and the most of Latin America to be predominantly Catholic and the Middle East, Indonesia, Pakistan and some of the ex-Soviet republics to be predominantly Islamic.

I measure openness to trade by using the log value of the actual trade share from Frankel and Romer (1999). They calculate the actual trade share by taking the percentage of imports plus exports to GDP in 1985 from 146 countries. The higher the trade share, the more open is the economy. Singapore is observed to be the most open economy in the world and Myanmar is the most closed.

The human capital measure is from Benavot and Riddle (1988). They record data on the primary school enrolment ratio in 1900. I use this as proxy measure of historical human capital attainment. The data shows that in the United States 95% of the relevant school going population were enrolled in primary school in 1900 whereas in Equatorial Guinea the same number was as low as 0.1%.

I also use four instruments for institutions and one each for openness and the disease measure of geography.[20] Log settler mortality, ENGFRAC, EURFRAC, and log population density in 1500 are used as instruments for average rule of law index. Malaria ecology is used as an instrument for malaria risk and constructed openness is used as an

[20] For a more detailed discussion of the instruments, see section 4.2.4.

instrument for the openness measure. Data on settler mortality is restricted to 79 countries; all of them are former European colonies. Mali, Gambia and Nigeria were among the countries with very high European settler mortality whereas Canada, Australia and the United States were among the countries with low settler mortality. This is an extended version of the original Acemoglu et al. (2001) sample which has 64 observations. The extended version is also compiled by Acemoglu et al. (2001).

The pairwise correlations are reported in Table 4.4. It shows that better institutions, less disease, better agriculture and soil conditions, more trade and higher initial income are all positively associated with development. This is also revealed in the scatter plots (Figure 1A-I).

Figure 1A. **Log per Capita GDP in 2000 and Log Initial Income**

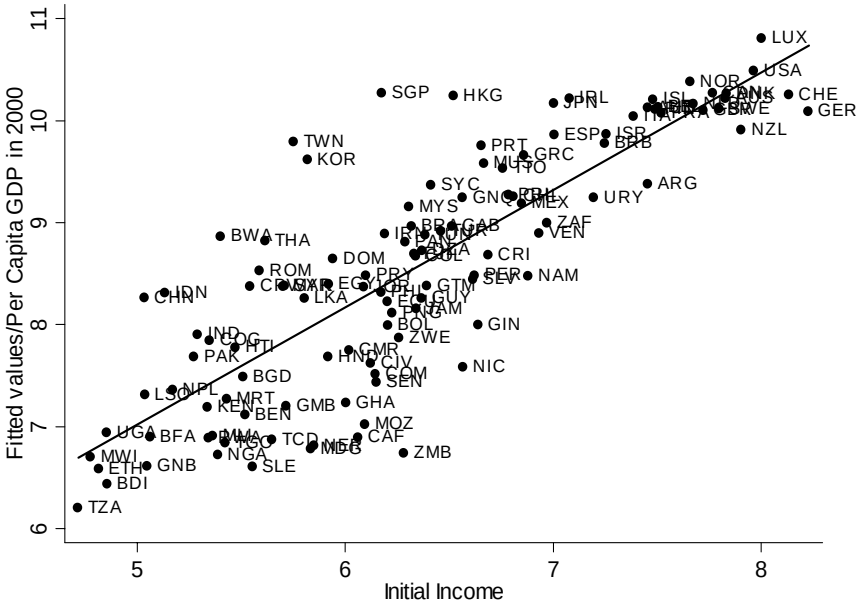

Figure 1B. **Log per Capita GDP in 2000 and Rule of Law**

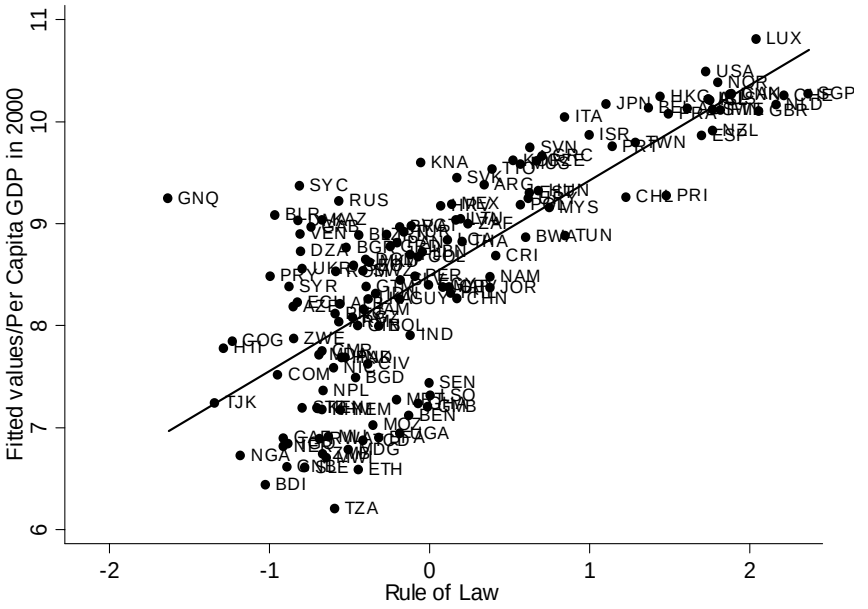

Figure 1C. **Log per Capita GDP in 2000 and Malaria Risk**

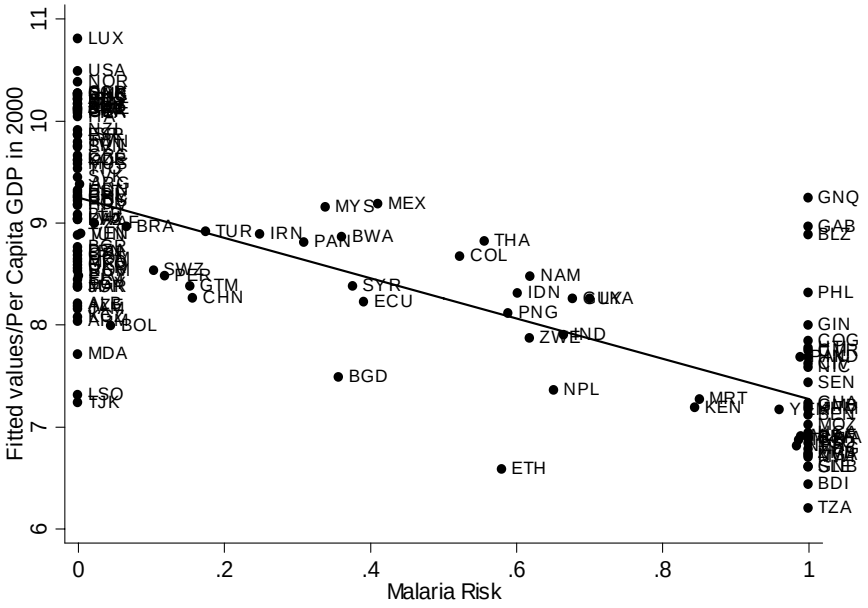

Figure 1D. **Log per Capita GDP in 2000 and Distance**

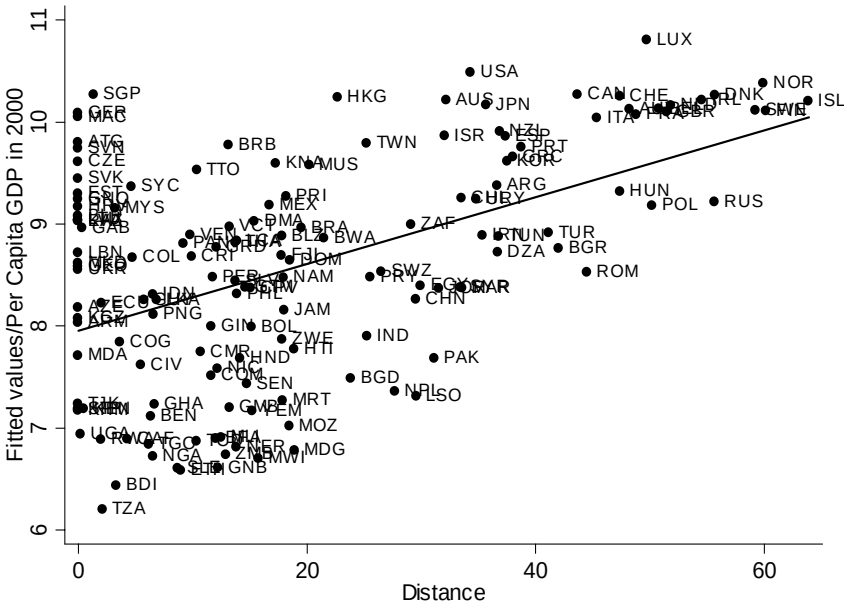

Figure 1E. **Log per Capita GDP in 2000 and Land Area within 100km of Ocean**

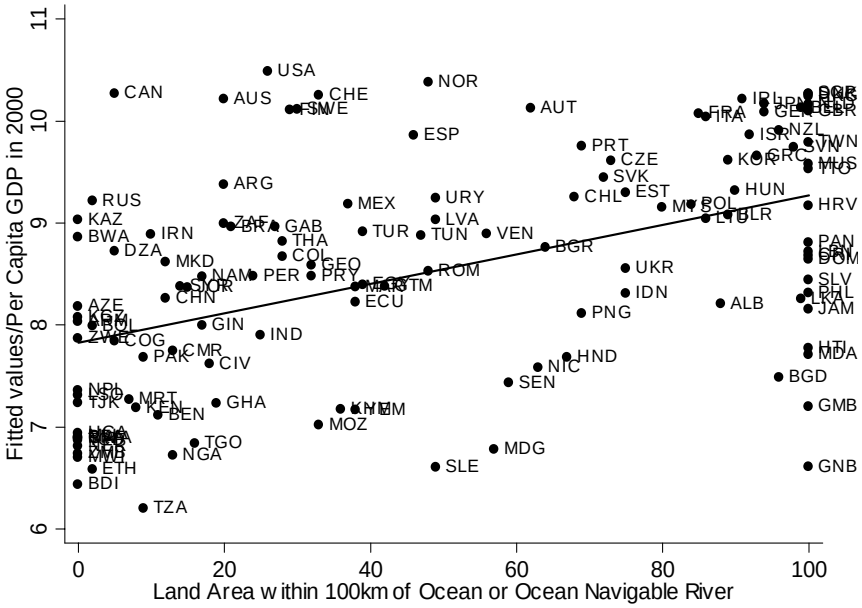

Figure 1F. **Log per Capita GDP in 2000 and Land Area within Tropics**

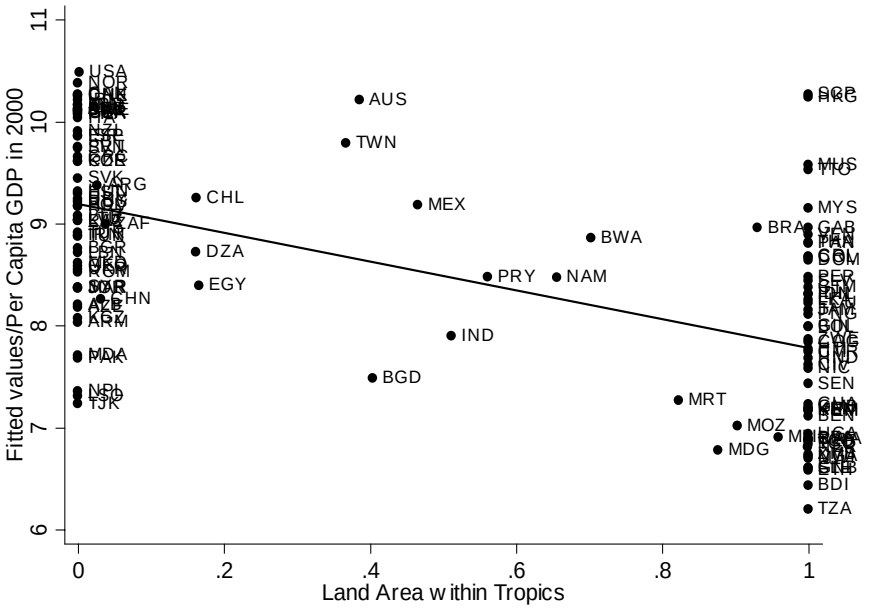

Figure 1G. **Log per Capita GDP in 2000 and Log Trade Share**

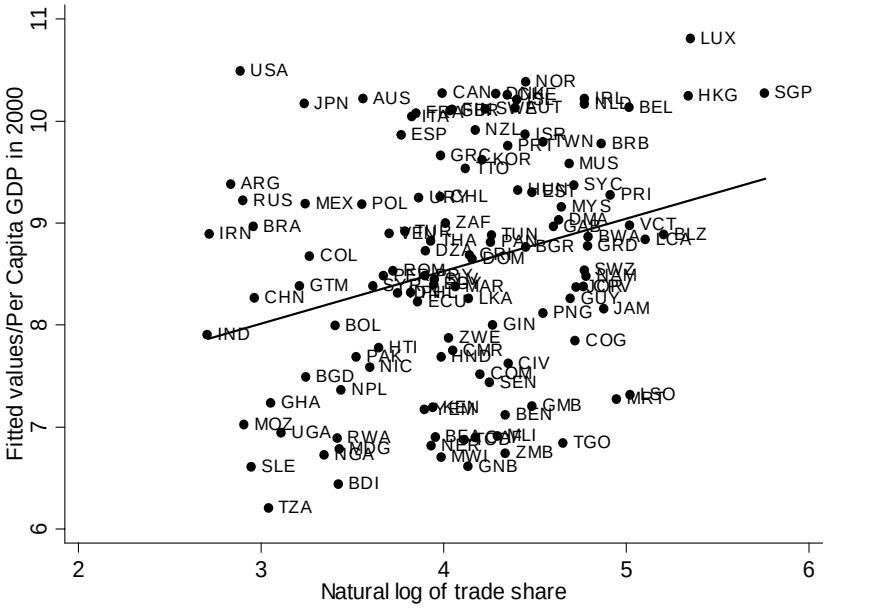

Figure 1H. **Log per Capita GDP in 2000 and Catholicism**

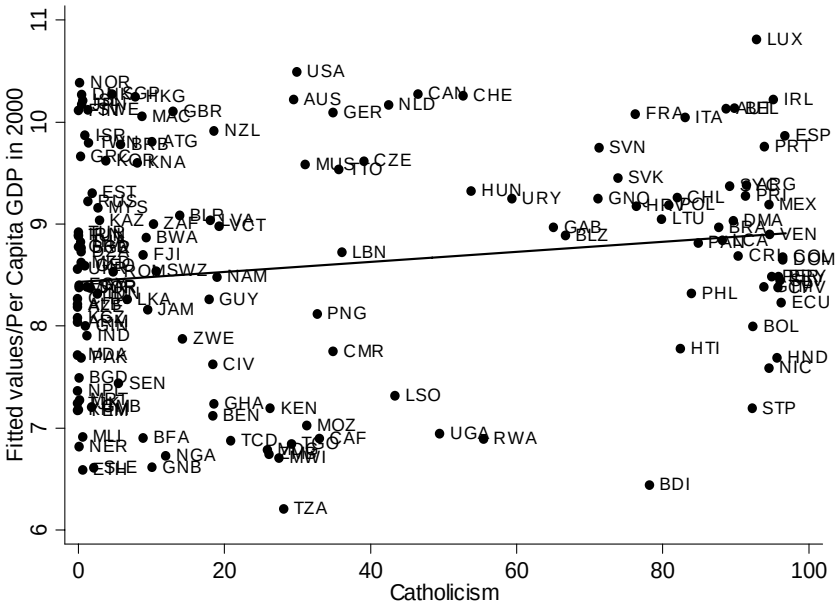

Figure 1I. **Log per Capita GDP in 2000 and Enrolment Ratio in 1900**

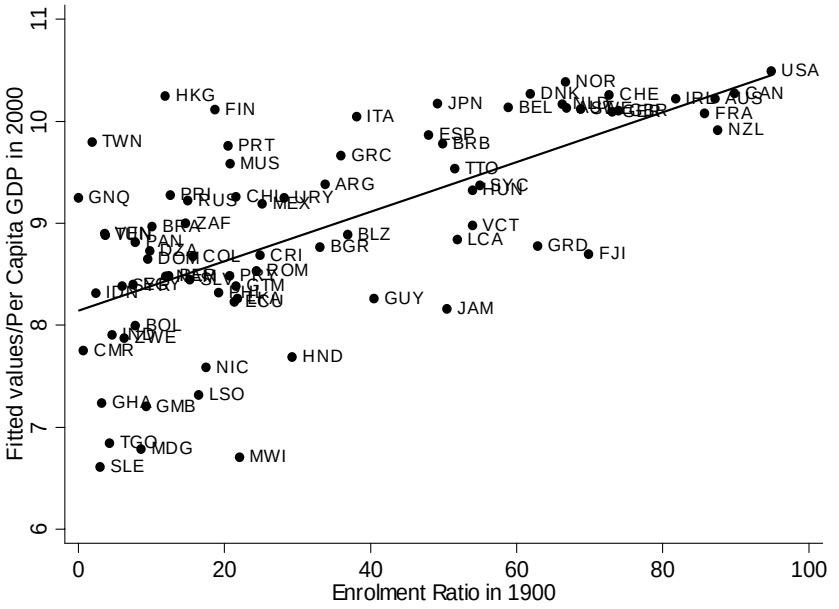

***Table 4.4*. Pairwise Correlation of the Major Variables (obs=99)**

	Log per Capita GDP in 2000	Log Initial Income (1960)	Average Rule of Law Index	Distance	Malaria Risk	Land Area within Tropics	Land Area within 100km of Ocean or Ocean-Navigable River	Log of Trade Share	Primary Enrolment Ratio in 1900	Catholicism	Islam
Log per Capita GDP in 2000	1.0000										
Log Initial Income (1960)	0.8182	1.0000									
Average Rule of Law Index	0.8439	0.7387	1.0000								
Distance	0.6931	0.6298	0.6837	1.0000							
Malaria Risk	-0.8299	-0.6265	-0.6551	-0.6647	1.0000						
Land Area within Tropics	-0.6210	-0.4975	-0.5993	-0.8956	0.6493	1.0000					
Land Area within 100km of Ocean or Ocean-Navigable River	0.4758	0.3431	0.3896	0.2096	-0.3874	-0.0854	1.0000				
Log of Trade Share	0.2573	0.1629	0.3310	0.0907	-0.1831	0.0101	0.3128	1.0000			
Enrolment Ratio in 1900	0.7073	0.7783	0.7613	0.6522	-0.4504	-0.5681	0.2025	0.1415	1.0000		
Catholicism	0.1331	0.2374	-0.0160	-0.0857	-0.1445	0.1473	0.1417	-0.1382	0.0208	1.0000	
Islam	-0.3178	-0.3310	-0.2768	-0.0500	0.2190	-0.0458	-0.2145	-0.0062	-0.3452	-0.5104	1.0000

4.2.3 The Problem of Endogeneity in Estimating the Model

One of the most important issues in a regression model is the issue of endogeneity or two way causality. Coefficient estimates of a regression model with an endogeneity problem are biased. The 'modified level regression' model (equation 4.3) is not free from this problem. One cannot rule out the possibility of two way causality between the dependent variable and institutions, openness, and geography if malaria is used as a measure of geography in the model. In addition, there is also the issue of two way causality between institutions and integration, and institutions and malaria. It is also possible that a third factor is driving the changes in both the dependent as well as the explanatory variable. This section discusses more about these problems.

As I have mentioned in the previous section, the average rule of law index is used as a measure of institutions. This measure is expected to be endogenous. The overall rule of law situation in an economy may be better due to higher per capita income rather than the other way round (Rodrik et al. 2004). Higher income may allow this economy to spend more on policing and law and order enforcement. Hence, economic development becomes a cause of institutional development rather than an effect. Better institutions also allow the economy to be open and effectively participate in international trade (Rodrik et al. 2004).

Religion, on the other hand, can be considered as exogenous even though North (1994) talks about economic progress influencing informal rules and culture of a society in the future. The religion variable is measured in 1980 and the per capita GDP is measured in 2000. Therefore, following North's argument we can suggest that it is less likely that the per capita GDP in 2000 will affect religious memberships of 1980. But religion does have direct effects on institutions and openness. Religion influences institutional quality through its effect on social capital (Grief 1994). Influence of a religion on trade works through the attitude of that particular religion towards trade and commerce. Certain religious cultures

may breed xenophobia and are hostile to market and trade in general as opposed to the more sympathetic position taken by the others. According to this theory, a country dominated by a more open religious belief is expected to trade more compared to a country which is dominated by a religion which preaches isolation from the rest of the world (Landes 1998). Religious intolerance can also strangulate research in science and technology which has a direct and negative impact on economic progress (Landes 1998).

Almost all the measures of geography that I use can be considered as exogenous except malaria risk (Rodrik et al. 2004). Distance, which affects climate, may have a direct effect on development through its impact on morbidity and the ability to work (Montesquieu 1748). On the other hand, land area within the geographical tropics and soil suitability, which are measures of agriculture, may affect economic progress through their direct impact on agricultural productivity. The market proximity measure can impact economic performance directly by reducing the cost of transport. It can also positively influence growth performance by increasing the opportunity to trade which translates into productivity gains through the process of the division of labour. In addition to the direct effects of geography on growth and openness, the economic history literature emphasizes that geography also influences institutional quality. Geographical endowment of natural resources may create a situation of extreme inequality within the society which stalls the development of institutions which promote investments and growth (Engerman and Sokoloff 1994; Easterly and Levine 1997). The only possible candidate for endogeneity is malaria risk. One of the arguments that favour reverse causality is as follows. The rich economies can afford to invest in the research and development of drugs that cures or minimises the effect of diseases. They can also afford to invest in preventive measures such as drainage, mosquito nets etc. This holds independent of the debilitating effect of malaria

on human productivity. Therefore, one cannot consider disease as an exogenous factor affecting development, but in fact it can be the effect of lack of development.

The measure of openness is also a suspect of two way causality. It is not only the case that the open economies are more prosperous than the closed ones; prosperous economies are observed to be more open (Frankel and Romer 1999). A commonly used argument for reverse causality in this case is the following. In poor countries, tax on trade is perhaps the easiest and the fastest source of revenue for the government. Therefore, they tend to be closed. Whereas, in rich countries there are alternative sources of revenue for the government and therefore the government tend to impose less tax on trade.

Trade openness also affects institutional quality. Krueger (1974) shows how trade openness affects institutional quality by reducing rent seeking and corruption.

Finally, the school enrolment ratio in 1900, the proxy measure of human capital as a deep determinant can be treated as exogenous since one would expect the reverse causality problem between current per capita GDP and the enrolment ratio in 1900 to be insignificant.

I use formal statistical tests following Hausman (1978) to check for the endogeneity of these variables. This test compares OLS and 2SLS estimates of a model. In the presence of endogeneity the difference between the 2SLS estimates and the OLS estimates are significantly different in statistical terms and the test concludes that the OLS specification is biased and 2SLS is the way to go. If the difference is not statistically significant then the test fails to reject the null of exogeneity and concludes that given the model specification OLS is not biased.[21] Even though it appears to be an ideal statistical method to determine whether a specification suffers from endogeneity or not, the test actually has several shortcomings. The small sample properties of this test are poor as this is a large sample test

[21] For a more detailed description of the test consult Technical Appendix TA3, p. 174.

which relies on asymptotic properties and in a small sample the test outcome is often biased. The test also depends on the quality of instruments. In the presence of weak instruments, the test is biased and is likely to fail to reject the null. The reason is quite intuitive. With weak instruments, the 2SLS estimates are not likely to be significantly different from their OLS counterparts and the test always fails to reject the null. This may lead to the erroneous conclusion that the explanatory variables of the model are not endogenous. Therefore the test results should be treated with caution.

4.2.4 Tackling the Endogeneity Problem by using Instruments

The endogeneity issues discussed in the previous section can be tackled empirically by using the instrumental variable technique. In an instrumental variable estimation, endogenous explanatory variables are replaced by their predicted values using suitable instruments. These instruments have to be correlated with the endogenous variables but uncorrelated with the error term of the primary regression. This technique of using instruments in a regression model yields consistent estimates. The first stage equations, when malaria risk is used as the geography variable are as follows.

$$INS_i=\beta_1+\beta_2\, INI_i+\beta_3\, CONST_i+\beta_4\, ME_i+\beta_5\, REL_i+\beta_6\, ER_i+\beta_7\, Y_{0i}+\varepsilon_1 \qquad (4.4)$$

$$INT_i=\theta_1+\theta_2\, CONST_i+\theta_3\, INI_i+\theta_4\, ME_i+\theta_5\, REL_i+\theta_6\, ER_i+\theta_7\, Y_{0i}+\varepsilon_2 \qquad (4.5)$$

$$GEO_i=\lambda_1+\lambda_2\, ME_i+\lambda_3\, INI_i+\lambda_4\, CONST_i+\lambda_5\, REL_i+\lambda_6 ER_i+\lambda_7 Y_{0i}+\varepsilon_3 \qquad (4.6)$$

Where INI_i refers to the instruments of institutions, $CONST_i$ refers to constructed openness and ME_i refers to the malaria ecology for country i. They are used as instruments for institution, openness and malaria risk respectively. In the above case the GEO variable is in fact malaria.

As I have stated earlier in section 4.2.2, I use four instruments for institutions. They are as follows: log settler mortality, ENGFRAC, EURFRAC, and log population density in

1500. I have already outlined the rationale for using these variables as instruments for institutional quality in section 3.1 of chapter 3.

Following Sachs (2003a) I use malaria ecology as the instrument for malaria risk. Rodrik et al. (2004) expresses serious concerns about the endogeneity of this instrument. They argue that the original source of the index (Kiszewski et al. 2004) is written for a public health audience and has no discussion of exogeneity. However, according to Sachs (2003a), malaria ecology is ecologically based and built upon climatology and vector conditions on a country by country basis, and is therefore exogenous to public health interventions and economic conditions. Hence, it can serve as a valid instrument for malaria risk.

I use constructed openness as an instrument for openness to trade. Constructed openness is the natural logarithm of predicted trade shares computed by Frankel and Romer (1999) from a bilateral trade equation involving pure geography variables. According to their study, a country's geographic characteristics are a powerful determinant of its ability to trade which are also independent of its wealth. Therefore, it is free from influences of government policies and income.

Finally, I perform formal tests to check the strengths of these instruments following Hausman (1978) and Stock and Yogo (2002). Hausman (1978) uses the 'overidentification test' and Stock and Yogo (2002) uses an F test. The F test statistic is described in Technical Appendix. I also report the partial R^2 of the instruments and other explanatory variables in the first stage regressions. This tells us how much of the variation in the suspected endogenous variable is explained by the instruments and other exogenous variables.

4.2.5 Regression Results

I estimate equation 4.3 using OLS and instrumental variable methods. The results are as follows.

The OLS estimates reported in Table 4.5 indicate that institutions have positive and statistically significant impact on per capita GDP in 2000. This is reflected in all the model specifications that I report in Table 4.5. Among the geography variables distance (which is a measure of climate) and land area within tropics (which is a measure of agriculture) register positive effects on current per capita GDP but are only weakly significant at the 10% level. Land area within 100km of ocean and ocean navigable waterways (which is a market proximity measure) is also positively related to current per capita GDP and the relationship is statistically significant at the 5% level. Malaria (which is a measure of diseases) on the other hand has a statistically significant (at the 1% level) negative relationship with the current per capita GDP. Trade openness, primary school enrolment in 1900, and religion appear to have effects which are insignificantly different from zero. The regressions also yield statistically significant coefficient estimates for the initial income variable which are positive and less than 1 in magnitude. This shows that there is evidence of 'transitional dynamics' in the data. However, there is a caveat to all this. The OLS estimates may not reveal the true picture due to obvious problems of endogeneity. But one can comment depending on these numbers that the results are far from Rodrik et al.'s (2004) claim, "The Institutions Rule." It is not only institutions but market proximity, land area within tropics, and malaria; all can explain the differences in current level of development. However, this may not hold if the estimates are biased. To check, one needs to look at the instrumental variable estimates.

I re-estimate the model using 2SLS which is reported in Table 4.6. I also report the first stage information of these regressions and partial R^2 between the suspected endogenous variables and their instruments in Tables 4.6A and 4.6B respectively.

Table 4.5. **Determinants of the Level of Development: OLS Estimates**

Dependent Variable	Log per Capita GDP in 2000								
	Model (1) obs= 66	Model (1a) obs= 66	Model (2) obs= 65	Model (2a) obs= 65	Model (3) obs=63	Model (3a) obs= 63	Model (3b) obs= 63	Model (4) obs= 63	Model (4a) obs= 63
Log Initial Income (1960)	0.58*** (0.1619)	0.62*** (0.1683)	0.40*** (0.1524)	0.40*** (0.1578)	0.58*** (0.1587)	0.61*** (0.1645)	0.60*** (0.1566)	0.62*** (0.1283)	0.64*** (0.1367)
Average Rule of Law Index	0.40*** (0.1589)	0.38*** (0.1611)	0.45*** (0.0947)	0.45*** (0.0935)	0.50*** (0.1529)	0.46*** (0.1559)	0.54*** (0.1356)	0.56*** (0.1255)	0.54*** (0.1259)
Distance	0.01* (0.0061)	0.01* (0.0060)							
Malaria Risk			-1.03*** (0.1839)	-1.03*** (0.1855)					
Land Area within Tropics					-0.35* (0.2274)	-0.36* (0.2392)			
Soil Suitability							0.007 (0.0060)		
Land Area within 100km of Ocean or Ocean-Navigable River								0.003** (0.0018)	0.003** (0.0018)
Log of Trade Share	0.10 (0.1341)	0.10 (0.1356)	-0.04 (0.0938)	-0.04 (0.0932)	0.08 (0.1350)	0.08 (0.1367)	-0.04 (0.1166)	-0.01 (0.1353)	-0.01 (0.1331)
Enrolment Ratio in 1900	3e-04 (0.0038)	1e-05 (0.0039)	3e-04 (0.0029)	3e-04 (0.0029)	-0.003 (0.0035)	-0.003 (0.0036)	-4e-04 (0.0031)	-0.002 (0.0031)	-0.002 (0.0033)
Catholicism	0.002 (0.0015)		-2e-04 (0.0012)		0.002 (0.0015)		0.001 (0.0015)	7e-04 (0.0016)	
Islam		-0.001 (0.0031)		-3e-04 (0.0023)		-0.002 (0.0033)			3e-04 (0.0038)
R^2	0.7924	0.7892	0.8833	0.8833	0.8145	0.8127	0.8139	0.8116	0.8112
F test (p value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. The standard errors are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

Model 1 in Table 4.6 uses distance as a measure of geography. Institutional quality is instrumented by log settler mortality, ENGFRAC, EURFRAC, and log population density in 1500 and log trade share is instrumented by Frankel and Romer (1999) constructed trade share (CONST) instrument. Institutional quality and Catholicism has positive and statistically significant coefficient estimates in this model. The coefficient on institutions is significant at 5% level whereas the coefficient on Catholicism is only significant at 10% level. The coefficients on distance, initial income, primary enrolment ratio in 1900, and trade openness are insignificantly different from zero. One standard deviation increase in the rule of law index (which is 0.9) keeping other factors unchanged increases the steady state level of per capita GDP of an average country approximately by 2.5 fold. One standard deviation increase in Catholicism (which is 36%) keeping other factors unchanged on the other hand increases the steady state level of per capita GDP of an average country approximately by 1.2 fold.

This model appears to be the closest to Rodrik et al.'s (2004) 'core specification.' Rodrik's specification only includes institutions, distance, and log trade share. But here I also include initial income, Catholicism, and primary school enrolment ratio in 1900 as additional controls. The coefficient estimate on institutions in Rodrik's model is significantly different from the same in Model 1. Rodrik reports a coefficient estimate of 1.98 whereas the Model 1 reports it as 1.03. This indicates that there is significant upward bias in Rodrik's estimate, because of a positive correlation between the institutions measure and his omitted variables namely log initial income and primary school enrolment ratio in 1900. I also conduct a simple t-test to check whether our estimate is significantly different from Rodrik et al. (2004). The test rejects the null that they are identical at the 5% level of significance against a two sided alternative. As we have mentioned earlier, the coefficient

estimate of Catholicism is positive and statistically significant in Model 1. Therefore, the findings do not support Rodrik et al.'s (2004) conclusion that "The Institutions Rule."

Model 2 uses malaria as a measure of geography instead of distance.[22] Institutions and log trade share are instrumented by the same instruments as in case of Model 1. Malaria is instrumented by malaria ecology which is a vector based measure and does not depend on public policy. The coefficient estimates on initial income and institutions are positive and statistically significant. The coefficient on malaria on the other hand is negative and statistically significant. A one standard deviation increase in institutional quality (which is 0.9) keeping other things fixed increases the steady state level of per capita GDP by 2.2 fold. A one standard deviation decline in malaria (which is 0.44) keeping other things fixed increases the steady state level of per capita GDP by twofold. Therefore, the steady state effects of institutions and malaria have a similar degree of explanatory power in the data. This is something worth noting as it says it is not only institutions but it is also malaria which can do a lot of explaining. I will get into the roots of this malaria result later in this chapter.

Model 3 uses land area within tropics (agriculture measure) as a measure of geography. This measure is treated as exogenous and institutions and log trade share are the only variables that are instrumented. The coefficients on initial income, institutions, and Catholicism are positive and statistically significant in this case. The rest are insignificantly different from zero. The impact of one standard deviation increase in institutional quality is about 3.1 fold in this case. I also use soil suitability as an alternative measure of agriculture but the coefficient estimate on this variable is insignificantly different from zero.

[22] The robustness and sensitivity analysis of Model 2 which is the preferred specification is dealt with in the Technical Appendix TA1 (p. 172).

Finally, Model 4 uses land area within 100km of ocean or ocean navigable waterways (measure of market proximity) as a measure of geography. This variable is also treated as exogenous. In this case the coefficients on institutions, initial income, and Catholicism are the only statistically significant ones. The standardised coefficient of institutions increases to 3.14 in this case.

The coefficients on trade openness in all the models reported in Table 4.6 are statistically insignificant and in six out of nine cases they have a negative sign. Therefore it is fair to conclude that there is no direct effect of trade on per capita GDP when it is pitted against institutions, geography, religion, and human capital.

Catholicism registers a statistically significant and positive effect in case of Models 1, 3, & 4. This is in sharp contrast with the Weber (1930) and Landes (1998) views. But, there is enough factual evidence to support the positive relationship. Huntington (1991) explains that the Catholic Church in the 1960s switched from being a powerful force against liberalism to a powerful force in favour of democratisation. In the last 30 years, most of the countries that have democratised including Portugal, Spain, Poland, Hungary, the Philippines, Argentina, Brazil and Mexico are Catholics.[23] One of the major contributions of the Second Vatican Council also known as the Vatican II, which took place in 1962, is to open up dialogues with other religious denominations. The Church also became more tolerant and sympathetic towards women's rights. These efforts presumably reduced the overall level of socio-religious intolerance (which is dubbed as a source of poor culture and hence harmful to economic progress by David Landes) and improved the overall level of trust in these countries. This in turn generated a positive effect on the

[23] Exception to this is the democratisation in Africa in the 1990s which are not associated with Catholicism.

overall economy. However, it is worth mentioning that this effect is not robust to all specifications.

The impact of Islam is observed to be insignificantly different from zero. Therefore, no consistent empirical evidence is found favouring the Landes (1998) view.[24]

Log initial income is statistically significant in six out of the nine specifications indicating that 'transitional dynamics' are important. This is further evidence that the standard levels approach suffers from omitted variable problem. The evidence however is not robust across all specifications.

The Enrolment ratio in 1900 is statistically insignificant in all the specifications and hence it is fair to conclude that human capital gets trumped by institutions and geography variables.

In Table 4.6A I report the first stage regressions of the 2SLS estimates.

The first stage regressions of Model 1 shows that other things remaining unchanged log settler mortality is negatively associated with current institutions and the relationship is statistically significant at the 5% level. It also shows that countries that were richer in 1960 have better current institutions; countries that are open to trade due to their geography and demography have better institutions; countries that are further from the tropics have better institutions; and countries that are predominantly Catholic have poor institutions. All these relationships are statistically significant. There is also a positive and statistically significant relationship between constructed openness and trade and a negative and statistically significant relationship between log settler mortality and trade.

[24] Consult section 3.2 for a review of the David Landes view.

Table 4.6. **Determinants of the Level of Development: 2SLS Estimates**

Dependent Variable	Log per Capita GDP in 2000								
	Model (1) obs= 39	Model (1a) obs= 39	Model (2) obs= 39	Model (2a) obs= 39	Model (3) obs=38	Model (3a) obs= 38	Model (3b) obs= 38	Model (4) obs= 38	Model (4a) obs= 38
Log Initial Income (1960)	0.26 (0.3942)	0.23 (0.6157)	0.29* (0.1879)	0.27* (0.1832)	0.38** (0.187)	0.53*** (0.1922)	0.31 (0.3203)	0.41** (0.2125)	0.45** (0.2098)
Average Rule of Law Index	1.03** (0.4981)	1.67** (0.8124)	0.89*** (0.3173)	0.86*** (0.3178)	1.25*** (0.4614)	1.06*** (0.3684)	1.13*** (0.3986)	1.27*** (0.4514)	1.50** (0.6131)
Distance	0.003 (0.0162)	-0.02 (0.0319)							
Malaria Risk			-1.61*** (0.3238)	-1.70*** (0.3310)					
Land Area within Tropics					-0.06 (0.4801)	0.81 (0.8541)			
Soil Suitability							0.001 (0.0074)		
Land Area within 100km of Ocean or Ocean-Navigable River								-0.001 (0.0052)	0.002 (0.0049)
Log of Trade Share	0.08 (0.2627)	-0.24 (0.4367)	-0.08 (0.1685)	-0.11 (0.1617)	0.03 (0.3375)	-0.54 (0.5830)	-0.27 (0.2623)	0.07 (0.3912)	-0.33 (0.4202)
Enrolment Ratio in 1900	-0.004 (0.0067)	-0.01 (0.0139)	0.004 (0.0049)	0.001 (0.0057)	-0.005 (0.0081)	-0.02 (0.0174)	0.001 (0.0077)	-0.005 (0.0077)	-0.01 (0.0097)
Catholicism	0.006* (0.0038)		0.004 (0.0032)		0.007* (0.0048)		0.003 (0.0040)	0.007* (0.0047)	
Islam		-0.003 (0.0087)		-0.005 (0.0035)		-0.001 (0.0115)			-0.004 (0.0074)
Endogeneity test (p)	0.0052	0.0049	0.0089	0.0061	0.0204	0.0362	0.0322	0.0051	0.0086
Overidentification test(p)	0.5531	0.4261	0.5406	0.3930	0.3150	0.3262	0.4120	0.6523	0.5842

Notes: ***, **, and * indicates significance level of 1%, 5%, and 10% respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. The standard errors are heteroskedasticity robust. The p-values of the endogeneity test and the overidentification test is also reported. All the regressions reported above are carried out with an intercept. The instruments used for Models (1), (2), (3) & (4) are log settler mortality, ENGFRAC, EURFRAC, log population density in 1500 and Constructed openness. Rule of law, Malaria Risk, and Log Trade Share are treated to be endogenous. For Model (2) additional instrument 'malaria ecology' is used.

Table 4.6A. **Determinants of the Level of Development: 2SLS Estimates (First Stage Information)**

Dependent Variables	Model (1)		Model (2)			Model (3)		Model (4)	
	Average Rule of Law Index	Log of Trade Share	Average Rule of Law Index	Malaria Risk	Log of Trade Share	Average Rule of Law Index	Log of Trade Share	Average Rule of Law Index	Log of Trade Share
	obs=41	obs=42	obs=41	obs=41	obs=41	obs=40	obs=40	obs=40	obs=40
Log Settler Mortality	-0.18**	-0.23**	-0.26**	0.13**	-0.13	-0.23**	-0.22**	-0.21**	-0.17**
	(0.1083)	(0.1005)	(0.1384)	(0.0789)	(0.1133)	(0.1117)	(0.1019)	(0.1097)	(0.1021)
Constructed Openness	0.011*	0.034***	0.006	-0.004	0.04***	0.013**	0.035***	0.005	0.03***
	(0.0073)	(0.0056)	(0.0075)	(0.0041)	(0.0065)	(0.0074)	(0.0063)	(0.0088)	(0.0079)
Log Initial Income (1960)	0.42**	-0.03	0.57***	-0.30**	0.02	0.41**	0.08	0.57***	0.07
	(0.2355)	(0.2424)	(0.2281)	(0.1427)	(0.2144)	(0.2453)	(0.2505)	(0.2124)	(0.2129)
Distance	0.02**	-0.003							
	(0.0117)	(0.0074)							
Catholicism	-0.004**	-0.002	-0.005**	0.001	-0.003**	-0.005*	-0.002	-0.006***	-0.002*
	(0.0025)	(0.0021)	(0.0027)	(0.0016)	(0.0018)	(0.0029)	(0.0024)	(0.0020)	(0.0016)
Malaria Ecology			0.01	0.026**	-0.03*				
			(0.0186)	(0.0110)	(0.0191)				
Land Area within Tropics						-0.29	0.17		
						(0.3362)	(0.2407)		
Land Area within 100km of Ocean or Ocean-Navigable River								0.003	0.004*
								(0.0029)	(0.0025)
Enrolment Ratio in 1900	0.006	-0.002	0.005	0.005	-0.002	0.007	-0.003	0.005	-0.004
	(0.0057)	(0.0047)	(0.0060)	(0.0039)	(0.0043)	(0.0059)	(0.0046)	(0.0061)	(0.0047)
F value	39.61[a]	9.98	31.90[a]	35.10[a]	9.6	35.97[a]	9.76	28.5[a]	8.88
R^2	0.7191	0.5155	0.6998	0.6027	0.5185	0.7245	0. 4735	0.7241	0.5093

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. "a" indicate that the instrument pass the Stock and Yogo (2002) test for weak instruments with a maximal bias of 0.05 of the 2SLS estimator relative to the OLS at 5% level of significance. The critical value of F is 13.97 for Model (1), (3) & (4) and 12.2 for Model (2). Since, all the instruments of average rule of law are highly correlated, we only report the first stage regressions for settler mortality. All the other instruments except constructed openness pass the Stock and Yogo (2002) test for weak instruments with the same level of bias. The standard errors reported in the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

Table 4.6B. **Determinants of the Level of Development: Partial R^2 (First Stage Regressions)**

Dependent Variables	Model (1)		Model (2)			Model (3)		Model (4)	
	Average Rule of Law Index	Log of Trade Share	Average Rule of Law Index	Malaria Risk	Log of Trade Share	Average Rule of Law Index	Log of Trade Share	Average Rule of Law Index	Log of Trade Share
	obs=41	obs=42	obs=41	obs=41	obs=41	obs=40	obs=40	obs=40	obs=40
Log Settler Mortality	0.088**	0.145***	0.108**	0.082**	0.034	0.137**	0.129**	0.110**	0.087**
Constructed Openness	0.056*	0.433***	0.021	0.027	0.481***	0.074*	0.369***	0.007	0.244***
Log Initial Income (1960)	0.089**	0.0004	0.169***	0.142**	0.0005	0.081**	0.003	0.178***	0.003
Distance	0.078**	0.0026							
Catholicism	0.078**	0.019	0.115**	0.005	0.055**	0.088*	0.032	0.200***	0.034
Malaria Ecology			0.015	0.12**	0.057*				
Land Area within Tropics						0.031	0.012		
Land Area within 100km of Ocean or Ocean-Navigable River								0.029	0.079*
Enrolment Ratio in 1900	0.044	0.007	0.028	0.018	0.008	0.053	0.013	0.029	0.022

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a one sided alternative. The partial R^2 indicates the proportion of variation in the dependent variable that is explained by the explanatory variables when other things are held constant. Multiplying them by 100% will give percentages.

The first stage regressions of Model 2 show similar pattern. Log settler mortality and Catholicism are negatively associated with institutions whereas the partial correlation with initial income is positive. In the case of the malaria regression, malaria ecology instrument is positively associated with current measure of malaria whereas initial income is negatively associated. Log settler mortality is also positively associated with the current measure of malaria. Finally, the trade share regression shows that log trade share is positively associated with its instrument constructed trade share and negatively associated with Catholicism. It also shows that high malaria incidence is associated with low levels of trade.

The first stage regressions of Models 3 & 4 show similar patterns as the institutions and trade share regressions of Models 1 & 2. The general pattern that stands out of the first stage regressions is as follows. The instruments are associated with their target endogenous variables in a way predicted by the theory. Countries that were rich in the past have better current institutions and they suffer less from malaria now. Catholic countries have poor institutions and they also trade less. However, the negative relationship between Catholicism and trade is not robust across all specifications.

The negative association between Catholicism and institutions, and Catholicism and trade obviously begs further explanation even though they are similar to the findings of La Porta et al. (1999). The association seems to be somewhat paradoxical. If Catholicism has a positive effect on economic progress then one should expect Catholicism to have positive effects on factors that help economic progress (like institutions and trade). But this is not what is observed. A possible explanation of this apparent paradox can be the following. The Catholic Church has opposed trade and

private property throughout history (Weber 1930; Landes 1998, pp. 175-177).[25] This attitude has been adopted in the institutional structure of many of the Catholic countries in the past and some element of it persisted over time. Hence, these negative attitudes are still prevalent in the institutional structure of these countries, but they no longer apply to the post Vatican II Catholic people. In short, the first stage regressions are picking up the negative effects of certain dimensions of the culture of regions predominantly Catholic that originated in the past probably due to negative influences of Catholicism and survived over the years in their institutional structure and not because of Catholicism per se now. The positive effects of possible attitudinal changes among Catholics are observed in the 2SLS results reported in Table 4.6.

The instruments used in the 2SLS regressions perform well. The overidentification test p-values reported in Table 4.6 suggest that they are not endogenous. The first stage regressions reported in Table 4.6A pass the Stock and Yogo (2002) F statistic criteria on 5 out of 9 occasions indicating that the instruments are not weak. The partial R^2 reported in Table 4.6B show that log settler mortality explains 8.8% of the variation in institutions in the case of the first stage regressions for Model 1. Constructed openness on the other hand explains 43% of the variation in log trade share. In case of Model 2, 12% of the variation in malaria is explained by malaria ecology. All these results are indicative of the fact that the instruments do fairly well in their task of providing an exogenous source of variation which is correlated with the suspected endogenous variables but uncorrelated with the error term.

In order to dig deeper into the malaria result I ask a further question. Is the finding a reflection of the overall variation in the data or is it largely driven by the significant

[25] This is also confirmed by our result that trade is negatively related to Catholicism.

presence of the Low Income Economies (LIEs) in the sample? A closer look at the dataset reveals that 26 out of 39 observations used in Model 2 of Table 4.6 are from LIEs.[26] Estimating the same model using a sample of LIEs show that malaria is the only variable with statistically significant coefficient estimates. This is reported in Table 4.7. The impact of one sample standard deviation reduction in malaria (which is 0.44) on steady state per capita GDP is 1.7 fold. This is less than the pooled sample estimate of a twofold increase. However this is the only variable that can change the steady state level of per capita GDP in LIEs. Estimating the same regression on a sample of High Income Economies (HIEs) fails to yield meaningful estimates because of very few degrees of freedom. The regression relies on as few as 13 observations.[27] The OLS estimates with the HIE sample however shows that diseases are no longer important. It is only institutions that matter. The partial R^2 of the OLS estimates reported in Table 4.7A show that in a pooled sample 28% of the variation in per capita GDP is explained by institutions and about 41% by malaria. Whereas in a sample of LIEs the explanatory power of institutions is statistically insignificant and 43% of the variation is explained by malaria. In a HIE sample the situation reverses and institutions perform 34% of the explaining and the contribution of malaria is statistically insignificant. Based on the evidence therefore it is fair to conclude that the major effect of malaria on per capita GDP comes from the LIEs. Institutions become more important in a sample of HIEs.

[26] The World Bank classifies economies into different income categories using Gross National Income per capita. We use this classification to divide our sample into two groups. The low income economies (which is the low and lower middle income economies according to the World Bank list) and the rest are taken to be high income economies. The source of this classification is the following web page. http://www.worldbank.org/data/aboutdata/errata03/Class.htm

[27] Not reported because it is not meaningful anyway.

Therefore, one can put forward the following hypothesis with some caution to explain this correlation.[28] Disease is the most important factor at a low level of development. Overcoming diseases ensures a basic minimum level of labour productivity and from then on institutions become important. Sachs tacitly refers to this hypothesis in his essay on the role of diseases. It is worth quoting from Sachs (2003b) directly:

"The barriers to economic development in the poorest countries today are far more complex than institutional shortcomings. Rather than focus on improving institutions in sub-Saharan Africa, it would be wise to devote more effort to fighting AIDS, tuberculosis, and malaria; addressing the depletion of soil nutrients; and building more roads to connect remote populations to regional markets and coastal ports. In other words, sub-Saharan Africa and other regions struggling today for improved economic development require much more than lectures about good governance and institutions."

[28] The observed correlation in the LIE sample can be due to the small sample size or the observed variation is too limited.

Table 4.7. **Determinants of the Level of Development: The Case of Low Income Economies (LIEs)**

Dependent Variable	Log per Capita GDP in 2000				
	OLS			2SLS	
	Pooled Sample obs=66	Restricted Sample (LIEs) obs=32	Restricted Sample (HIEs) obs=34	Pooled Sample obs= 39	Restricted Sample (LIEs) obs=26
Log Initial Income (1960)	0.40***	0.51***	0.13	0.29*	0.15
	(0.1524)	(0.1771)	(0.1415)	(0.1879)	(0.4091)
Average Rule of Law Index	0.45***	0.23	0.41***	0.89***	0.83
	(0.0947)	(0.2050)	(0.1103)	(0.3173)	(0.7267)
Log of Trade Share	-0.04	-0.12	0.02	-0.08	-0.45
	(0.0938)	(0.1585)	(0.1073)	(0.1685)	(0.3345)
Malaria Risk	-1.03***	-0.87***	-0.05	-1.61***	-1.17***
	(0.1839)	(0.2011)	(0.6148)	(0.3238)	(0.5040)
Catholicism	-2e-04	-1.6e-04	-0.002*	0.004	0.001
	(0.0012)	(0.0022)	(0.0013)	(0.0032)	(0.0041)
Enrolment Ratio in 1900	3e-04	0.002	0.003	0.004	0.02
	(0.0029)	(0.0083)	(0.0029)	(0.0049)	(0.0139)
R^2	0.8833	0.6742	0.7841		
F test (p value)	0.0000	0.0000	0.0000		
Instruments				Log Settler Mortality, ENGFRAC, EURFRAC, Constructed Openness, Malaria Ecology	

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% level respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. LIEs and HIEs signify low income economies and high income economies respectively. For the 2SLS regression on the high income economies malaria no longer remains significant. The 2SLS regression on the high income economies does not yield meaningful estimates due to the problem of degrees of freedom. There are only 13 observations for the HIEs and hence not reported here. The standard errors reported in the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

***Table 4.7A.* Partial R^2 of OLS Estimates (Reported in Table 4.7)**

Dependent Variable	Log per Capita GDP in 2000		
	Pooled Sample obs=66	Restricted Sample (LIEs) obs=32	Restricted Sample (HIEs) obs=34
Log Initial Income (1960)	0.155***	0.246***	0.034
Average Rule of Law Index	0.283***	0.048	0.344***
Natural log of Trade Share	0.004	0.021	0.001
Malaria Risk	0.413***	0.430***	0.0003
Catholicism	0.0004	0.0002	0.088*
Enrolment Ratio in 1900	0.0002	0.002	0.034

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a one sided alternative. The partial R^2 indicates the proportion of variation in the dependent variable that is explained by the explanatory variables when other things are held constant. Multiplying the numbers by 100% will give the percentages.

This is also reflected in the empirical findings of Bloom et al. (2003). They show that the data on economic development has twin peaks which indicates that there are multiple equilibria. They show that the lower peak can be best explained by geography. They also show that this is not just geography per se, but the poverty trap emerging out of it.

However, just by looking at the log settler mortality data (which is an instrument in the 2SLS regression) one may suspect that the strong negative correlation between malaria and current per capita GDP in LIEs is driven by the large proportion of high malaria and low per capita GDP African economies in the sample. To find out the true picture I perform some quick statistical analysis which in fact confirms the suspicion. There is a strong association between malaria and low per capita GDP when the sample size is reduced down to African LIEs. The next section presents this finding and discusses its possible implications.

4.3 Is There Any Connection Between LIEs and Africa?

A quick check of the sample that the 2SLS regression (see Table 4.7) on LIEs uses reveals that 10 out of 26 observations are African LIEs, which is approximately 39% of the sample.

Table 4.8. **Determinants of the Level of Development: The Case of LIEs in Africa**

Dependent Variable	Log per Capita GDP in 2000	
	OLS obs=15	2SLS obs=10
Log Initial Income (1960)	0.9*** (0.1827)	1.19** (0.3228)
Average Rule of Law Index	0.055 (0.2167)	-0.07 (0.1725)
Log of Trade Share	0.15 (0.1981)	0.35 (0.2452)
Malaria Risk	-0.9*** (0.2653)	-0.98*** (0.2902)
Catholicism	-3e-05 (0.0080)	-0.005 (0.0085)
Enrolment Ratio in 1900	0.01 (0.0172)	-0.04 (0.0221)
R^2 F test (p value)	0.9282 0.0004	
Instruments		Log Settler Mortality, ENGFRAC, EURFRAC, Constructed Openness, Malaria Ecology

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% level respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. The 2SLS regression may not yield meaningful estimates due to the problem of degrees of freedom. There are only 10 observations for this regression. The standard errors reported in the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

The regression estimates reported in Table 4.8 show that malaria risk is the only explanator that has a statistically significant coefficient estimate when the sample is exclusively of LIEs from Africa.

Based on these results, is it fair to conclude that the root of Africa's development problem is malaria? The answer is an emphatic no. The correlation between malaria and the level of GDP can be due to some omitted factor specific to Africa which moves in the same direction as malaria. For instance, the history of slave trade in Africa may be the true reason

for the continent's lack of development. Malaria being an outcome of the lack of development will also share a high positive correlation with the slave trade variable. Therefore, running a regression of current per capita GDP on malaria without controlling for the correlation between slave trade and current per capita GDP will lead to the error of attributing the movement in per capita GDP data that is due to slave trade to malaria. A proper analysis of the true causes should involve estimation of a model which controls for all the relevant variables. This is what I intend to do in chapter 5.

4.4 Summary

To sum it up, this chapter shows that the levels regression strategy used by the recent studies suffer from omitted variable bias and identification problem. The omitted variable problem originates from neglecting the role of 'transitional dynamics.' The identification problem is due to the strong correlation between the historical instruments of institutions and schooling. As an alternative to the levels regression approach, I propose the transformed growth regression which I call the 'modified levels model.' This model controls for log initial income (1960) and primary enrolment in 1900 reducing the degree of omitted variable bias and eliminating the possibility of an identification problem. The regressions show that 'institutions don't rule.' Malaria and Catholicism are important correlates of development. The correlation between Catholicism and development however is not robust. Catholicism is associated with poor institutions and is not good for trade. The explanatory power of institutions and malaria are almost equal in the pooled sample. Malaria however is the most important factor for the LIEs. The results also show that the malaria result in a LIE sample is driven by the large proportion of African economies in the sample. This certainly makes sense given the enormity of the malaria problem of that continent. Malaria kills 1-2 million Africans every year, out of a continent-wide total of

roughly 9 million deaths per year.[29] However, this does not convincingly reject all the other competing theories which may be correlated with both malaria and the current level of development. In order to present a more convincing evidence of cause and effect I construct a model which controls for all the variables relevant to Africa's development or lack of development. I estimate this model to confirm that malaria does matter when a host of other relevant factors are controlled for. This is to be investigated in chapter 5.

[29] See Bloom and Sachs (1998).

CHAPTER 5

COLONIAL INSTITUTIONS, GERMS OR FORCED MIGRATION: AN ANALYSIS OF THE ROOT CAUSES OF AFRICAN UNDERDEVELOPMENT

". . . In Africa, especially in tropical Africa, which a capitalistic imperialism threatens and has, in part, already devastated, man is incapable of reacting against unnatural conditions. In those regions man is engaged in a perpetual struggle against disease and an exhausting climate, which tells heavily upon childbearing; and there is no scientific machinery for salving the weaker members of the community."- Edward Morel (1903), The Black Man's Burden, republished in Snyder (1962), p.163.

Even though the continent of Africa is endowed with vast reserves of natural resources, it has struggled perpetually to deliver material goods to its populace. This is perhaps the most puzzling and yet the most sought after question of our time which has intrigued statesmen, activists, academics and many others. The comparative growth studies of the 1980s and the 1990s have consistently reported negative influence of Africa dummy on development. What is it about Africa that restricts economic development there? Is it the long history of slave trade, or the legacy of extractive colonial institutions, or malaria - a precise answer still eludes us.

In the previous chapter I have shown that malaria is an important correlate of lack of development in Africa. However, the model that I have used does not control for factors that can be correlated with both malaria and the level of development. This can actually inflate the coefficient estimates on malaria - showing it to be much bigger than what it actually is. In this chapter I estimate a more complete reduced form model which controls for all the relevant omitted factors which are often Africa specific. The aim is to contribute to an answer to the question that I posed in the previous paragraph.

The structure of the chapter is as follows. In the first section I review different theories of African underdevelopment. I exclude human capital (which was included in the model presented in chapter 4) as a possible explanator because of two reasons. The first is the lack of data on primary enrolment ratio in 1900. Including primary enrolment ratio in

1900 as an explanator reduces the sample size to 12. The second is the lack of statistical support for enrolment ratio as an explanatory variable. In none of the regressions reported in chapter 4, primary enrolment ratio in 1900 turns out to be statistically significant – be it the pooled sample, the LIE sample or the Africa sample. The theories of deep factors relating to Africa are not always economic as they are drawn from various other disciplines. However, the economic implications of them are not out of context and therefore discussed in quite detail. In the second section I lay out the structure of the empirical model, discuss the data and related issues, and report the regression results. The third section concludes.

5.1 Theories of African Underdevelopment

5.1.1 The Institutions Theory

A great deal of research in recent years suggests that institutions are the key for economic development. Institutions shape the incentive structure for factor accumulation and technology development which is critically important for a country's economic progress. Therefore, success or failure in development can be traced back to the success or failure in institution building. I have reviewed the relevant literature that deals with this view in section 3.1. This view however is also relevant for Africa (Easterly and Levine 1997; Herbst 2000; Acemoglu et al. 2001; Acemoglu et al. 2002). The institutions school argue that the weak institutions in Africa largely explain her state of underdevelopment. Following is a discussion of this literature.

Easterly and Levine (1997) use several indicators of public policy which can also be categorised as institutional measures even though they were not explicit about this in their study. They argue that the lack of growth in Sub-Saharan Africa is associated with poor public policy such as low schooling, political instability, underdeveloped financial systems, high government deficits, and insufficient infrastructure. They link the choice of poor

public policies on the part of the African governments to Africa's high ethnic fragmentation. In other words, they argue that high ethnic fragmentation increases polarization and the degree of social conflict in terms of policy choice in African societies. This increases the cost of conflict resolution. The government often fails to internalise these costs and selects socially sub-optimal policies. This is perhaps the first systematic attempt to explore African institutional weaknesses and the reason behind it in our profession. Even though Easterly and Levine (1997) were the first to apply this idea in Africa, it is older than this. Alesina and Tabellini (1989) and Alesina and Drazen (1991) theoretically modelled this idea almost a decade before their article was published.

Herbst (2000) also seeks an explanation for institutional weakness in Africa. Robinson (2002) provides an excellent review of Herbst's book. Herbst's work predominantly focuses on the following questions. Why states are so ineffective in Africa? Why African states are often plagued by chaos and lawlessness? He comes up with an interesting answer.[30] He argues that in Africa, labour was scarce and not land which is reflected by the low population density figures across the continent. Therefore, the pre-colonial states in the continent did not fight over land but they fought over people. This explains why property rights over people were so well defined in the form of slavery whereas property rights over land were not as many of the lands were held communally. This implies that it was not necessary for the pre-colonial states to defend a well defined territory as there was no fierce competition over land. In other words, there was less need to invest in defence and maintain bureaucracies. Therefore, tax collection in these states were poor and often absent. This allowed African states to survive without having to engage in institution building (tax collection, invest in defence, maintain bureaucracies, and provide

[30] Herbst's thesis is not standalone. Bates (1983) and Stevenson (1968) also provide some tentative evidence within Africa which is in agreement with the population density argument of the thesis.

rule of law) which made them very fragile. The trend of almost no external threat coupled with low population density persisted during the colonial period. Therefore the colonizers had little incentive to develop institutions either. After independence the situation did not change. The United Nations decision to enforce the colonial boundaries as national boundaries and the Cold-War politics reinforced this trend. Hence, what we observe now is the weak institutions of contemporary Africa. Herbst's argument is an extension of the work done by Max Weber on the development of European states.

Even though Herbst's thesis has received kudos for its intuitive appeal, it is still not free from criticism. Robinson (2002) criticises Herbst for not emphasizing the impact of colonialism on institutions and state formation in Africa. He also adds that the relationship between population density and institution building gets a bit unclear particularly in case of Africa when one takes into account the 'reversal of fortune' effect and the impact of colonialism (Acemoglu et al. 2001; Acemoglu et al. 2002). The following paragraph deals with this theory in more detail.

Acemoglu et al. (2002) observes that the relatively prosperous and densely populated areas of the world outside Europe prior to 1500 are relatively poorer now whereas the less prosperous and sparsely populated regions outside Europe before 1500 are relatively prosperous at present. This empirical fact is termed by Acemoglu et al. (2002) as the 'reversal of fortune.' They argue that this is because of the nature of colonial policy pursued by the European colonizers. In colonies with high population density prior to 1500, the European colonizers faced relatively more resistance from the natives which ruled out the possibility of settlement and hence they erected extractive institutions without bothering about the overall protection of private property. On the other hand, in colonies with low population density prior to 1500 the European colonizers faced less resistance from the natives and decided to settle and erect institutions with better protection of private property.

This argument may not be true in case of Africa. The African continent has always been a place with low population density. In spite of the low population density the colonizers decided not to settle in Africa and build 'institutions of plunder' instead.[31] The answer to this apparent paradox perhaps lies in the argument of Acemoglu et al. (2001). Acemoglu et al. (2001) argues that one of the key factors that influenced the decision of not settling in Africa by the European colonizers was the continent's disease environment which is well reflected by the settler mortality figures from the colonial records. They use settler mortality data mostly constructed out of the historian Philip Curtin's work on the disease environment of the European colonies to establish a statistically significant inverse relationship between the disease environment and institutional quality. As Robinson (2002) puts it, these factors are not taken into account in Herbst's story.

5.1.2 The Slave Trade Theory

The theories of the impact of slave trade on Africa's current development can be classified into two broad categories. They are as follows; the depopulation view, and the socio-political view.

The strong proponents of the depopulation view are the historians Joseph Inikori and Patrick Manning. Gemery and Hogendorn (1979) also adds an alternative dimension to the view basing their argument on trade theory. Following is a discussion of the theories.

Inikori (1992) argues that the slave trade out of Africa during the period 1450 to 1870 resulted into massive depopulation of the continent. The population all throughout this period remained way too low to trigger division of labour, growth in internal trade, specialisation and diversification, transformation of the technology and organisation of production in the manufacturing sector. As a result, manufacturing in pre-colonial Africa

[31] The exceptions are the settler colonies of South Africa, Zimbabwe, Namibia, and Kenya.

could not develop beyond the handicraft stage. In the agricultural sector, the effects were more immediate. The low ratio of population to cultivable land encouraged dispersed settlements all throughout the continent particularly in sub-Saharan Africa. The population moved towards extensive rather than intensive form of agriculture which made subsistence and local self-sufficiency predominant. This had a dampening effect on technology adoption and production organisation in the long run. African agriculture largely remained primitive and under commercialised during this period.

Fage (1978) and Lovejoy (1982) strongly disagree with Inikori's view. They argue that Inikori's claim of an absolute decline in the African population due to slave trade is unfounded. Fage (1978) also adds that the trade had a minimal impact demographically. However, Manning (1981, 1982) and Thornton (1980) show that the demographic effects are significant no matter what the absolute totals are.

Manning (1981, 1982) adds another dimension to the depopulation view. He shows that the African continent faced with an increasing demand for slaves from the new world reacted by increasing the supply of slaves. This increase in availability of slaves also raised the African demand for slaves. Africans preferred female slaves whereas young age male slaves were exported across the Atlantic to work in the plantations. This engendered huge imbalance in African sex ratios which had a long term impact on the continent's demographic structure. According to his estimates, the continent's population was held in check during the eighteenth and the nineteenth century by the slave trade restricting economic progress.

Finally, Gemery and Hogendorn (1979) adds that the mass removal of working age population from the continent caused an implosion of the African production possibility frontier as the lost labour input affected virtually all production choices. This resulted into unambiguous reduction in welfare of the continent. The secular decline in welfare

continued over more than two centuries plunging the continent into economic backwardness.

The major contributors to the socio-political view are Inikori (1977, 1992), Manning (1981, 1982), and Miller (1988).

Inikori (1992) argues that a vast majority of slaves that were exported were free individuals captured by force. The capture took a number of forms notably kidnapping, raids organised by the state, warfare, pawning, via the judicial procedures, tributes etc. Firearms were imported from the Europeans in exchange for slaves particularly during the period 1750 to 1807 which were used for capturing more slaves (Inikori 1977). Rodney (1966) and Meillassoux (1976) show that increase in the Atlantic salve trade led to more capturing and expansion of the African salve trade often marred by violence. Lovejoy (1994) shows that warfare, raiding and kidnapping were the means of enslavement for more than three quarters of the slaves captured during 1805 to 1850 from Central Sudan. The judicial process became a tool for enslaving people within the community (Klein 2001). Klein (2001) observes that judicial penalties in the form of compensation, exile or beatings were converted to enslavement. Inikori (2000) argues that the increase in the trade for captives institutionalised banditry and corruption for more than three hundred years in the continent which retarded socio-economic development.

Curtin (1975) partially disapproves of Inikori's view. He argues that it is improper to view conflicts that arose from political causes in Africa in the same light as those that originated from purely economic motives such as the slave trade. Inikori (1992) however questions the usefulness of this dichotomy as these relationships were far more complex. According to his view, "attempts to establish any form of simplistic relationship are therefore misleading" Inikori (1992, pp. 26).

Manning's work focuses on Dahomey which is roughly the area around the Bight of Benin during the period 1640 to 1860 (Manning 1981, 1982). He observes that the immense increase in slave prices with a price elasticity of supply of 1.5 created the incentive for capturing more slaves. Institutions were set up during 1640 to 1670 in this area which was conducive to capturing slaves. The institutions included warfare, raiding, kidnapping, judicial procedures, and tributes. Manning (1982) writes, "These structures further reinforced a willingness to tolerate or justify the enslavement of one's enemies or even one's own" (pp.9). In case of Dahomey, the state became an active participant in the collection and delivery of slaves which is an evidence favouring Inikori's argument.

Miller (1988) gives an account of the deadly nature of the process of capture in Angola. He writes that warfare and violence stimulated the capture of slaves in West Central Africa often capturing slaves in exhausted, shaken or physically wounded condition. Populations were raided consistently by stronger neighbours and harassed and driven out from their homes and land. Gemery and Hogendorn (1979) adds that the culture of raiding and warfare created a distinct minority class in the African society who became far more powerful than the rest of the population both in economic as well as political terms. The slave traders of Africa started enjoying European goods, currency, and guns in return for slaves. They made significant gains from trade at least in the short run even though everyone was unambiguously worse off in the long run due to the implosion of the production possibility frontier (Gemery and Hogendorn 1979). The extreme inequality of wealth distribution tilted the existing institutions in favour of the slave traders which created the foundation for further inequality in the future. This is consistent with the theory of institutions, inequality and growth proposed by Engerman and Sokoloff (1994) and Acemoglu et al. (2004) with respect to the new world. These institutions persisted all throughout the pre-colonial period further intensifying the problem. After colonisation, the

colonial powers did not interfere with the existing extractive institutions of the natives. It was reinforced by them instead (Robinson 2002). Persistence of weak institutions had a negative impact on the long run economic development of the continent.

5.1.3 The Malaria Theory

The malaria view can be categorised into two broad categories. The first deals with the economic burden of malaria in contemporary Africa, and the second deals with the historical impact of malaria and diseases on the continent's long run economic development. I call the former the 'contemporary malaria view' whereas the latter the 'historical malaria view.'

The 'contemporary malaria view' is due to Sachs (2003b). According to this view, malaria dramatically lowers labour productivity, the return on foreign investment and raises transaction cost of international trade limiting development which is typically observed in sub-Saharan Africa. I have discussed this view in sections 3.3 and 4.2.5.

Sachs (2003a) in a cross-country empirical study shows that institutions do matter but not exclusively.[32] He highlights the prevalence of malaria as another important factor which should not be underestimated. In a series of studies Bloom and Sachs (1998), Gallup et al. (1998), and Gallup and Sachs (2001) show that infectious malaria has a debilitating effect on human productivity and directly affects economic performance. Sachs et al. (2004) argue that with malaria and subsequent low productivity of labour an agricultural labour in sub-Saharan Africa cannot generate enough marketable surpluses which also limits the prospect of market development. Markets even if it develops remain concentrated at a very local level. This is indicative of a situation of 'low level equilibrium trap' in these economies.

[32] Section 3.3 also reviews these studies.

Acemoglu et al. (2003) strongly disagrees with Sachs' view. They argue that disease environment influence the balance of power between previously isolated populations when they come into contact. The local disease environment influence the colonization strategy and settlement decision which sets up the path for future institutional development (Acemoglu et al. 2001, 2002). Therefore, disease environment affect the level of development indirectly through institutions. I call this the 'historical malaria view.' This view is also closely related to the historian Phillip Curtin's work on epidemiology of the new world and Africa (Curtin 1968). In this article, Curtin shows that epidemiological factors have influenced economic decisions and economic patterns of the new world (particularly tropical America) and Africa.

Another angle within the 'historical malaria view' is a line of argument that is strongly pursued by a section of the historians. Miller (1982) uses Portuguese traveller records, missionary and church documents to show that frequent epidemics of malaria and yellow fever caused massive depopulation in the agriculturally marginal zones of West-Central Africa. Dias (1981) in a similar study of nineteenth and twentieth century Angola argues the same. They observe that the effect of disease, epidemics and famines were far more powerful than the slave trade in depopulating the region. According to their view, the increase in slave trade was an outcome of local epidemiology and poor agriculture rather than strong Atlantic demand.

Miller (1982) writes, "The slave trade appears in some ways less a cause of depopulation than a consequence of it when viewed in terms of droughts and demographic changes in West-central Africa."

Hence according to his view disease environment had direct effects on the demography and economic development of the region. Inikori (1992) and Manning (1981, 1982) however provides evidence to show that these effects were not strong enough to have

a larger impact on the African population compared to the strong Atlantic demand for slaves.

5.2 The Model and the Empirics

5.2.1 The Model

I estimate the following reduced form model to test the strength of the theories that I have discussed above.

$$LOGGDPPC_i=\alpha_1+\alpha_2 Y_{0i}+\alpha_3 INS_i+\alpha_4 LOGSLVX_i+\alpha_5 MAL_i+\alpha_6 REL_i+\alpha_7 INT_i+\varepsilon_i \quad (5.1)$$

Where LOGGDPPC, Y_0, INS, LOGSLVX, and MAL are log per capita GDP in 2000, log initial income (1960), institutions, log slave export, and malaria variables respectively. I also control for religion (REL) and trade openness (INT). This model is an extension of the model 4.3. Slave export is the additional Africa specific variables. I leave out primary enrolment ratio as a control because it drastically reduces the sample size and it also never comes out to be statistically significant when estimated using a full cross-country sample (see result tables in chapter 4).

I use average rule of law index as a measure of institutions. The slave exports measure is reconstructed following Nunn (2004). Inclusion of malaria is due to Sachs (2003a). The following subsection presents a more detailed discussion of the data.

5.2.2 The Dataset

The analysis is based on a dataset which consists of per capita GDP levels, measure of institutions, measure of slave export, and measure of malaria risk in (up to) 49 countries in Africa. The definitions and sources for all the variables used in this study is summarised in the Data Appendix. Table 5.1 presents the summary statistics of each of the variables used in the study. I divide the dataset into seven major parts depending upon the variable that they are measuring. They are as follows: measure of economic development, measure of institutions, measure of slave export, measure of malaria risk, measure of religion,

measure of trade openness, and the instruments. The sources of the economic development measure, institutions measure, malaria risk measure, religion measure, and trade openness measure are the same as the variables used in chapter 4. This section provides a brief description of each of these measures.

Economic development is measured by the level of per capita GDP in 2000 and in 1960. The data is from Penn World Table 6.1. The data for Angola, Zaire, and Sudan is from the World Development Indicator (WDI). For Sudan the initial income data is the 1975 level. This is done to avoid losing these countries as observations in the cross-section regression. These nations actively participated in the slave trade and therefore leaving them out would amount to throwing away crucial information which can explain the cross-national variation in the current level of development. According to these figures, Tanzania is the poorest country in Africa in 2000 whereas Botswana is the richest.

I use the average rule of law index as a measure of institutional quality. The average rule of law index measures the overall institutional quality and the quality of governance in a particular country. The range of this index varies from -2.5 to 2.5 with higher values implying better institutional quality. An average value of this index from 1998 through to 2000 is used for each country as it was the case in chapter 4. The data shows that Somalia has the weakest institutions and Tunisia has the strongest institutions in Africa.

Slave exports data is reconstructed using the Nunn (2004) methodology. Nunn (2004) uses 'shipping records' and 'ethnicity records' of slaves to construct the cross-country series of slave exports. The 'shipping record' is typically the number of slaves exported to the new world and other destinations from African ports. The 'shipping record' for the Atlantic Slave trade is available from Eltis et al. (1999) CD-ROM and Elbl (1997). Eltis et al. (1999) CD-ROM covers the period 1527 to 1866 whereas Elbl (1997) covers the period 1450 to 1521. Data on Indian Ocean slave trade is obtained from Austen (1979) for

the period before 1769, Martin and Ryan (1977) for the period 1770 to1799, and from Austen (1988) for the period 1800 to 1899. Data on Trans-Saharan slave trade comes from Austen (1992) and for Red Sea slave trade comes from Austen (1988). These figures are also listed in Nunn (2004)'s data appendix. Nunn also looks at several historical records to make a conjecture about the ethnicity and country of origin of these slaves. This is what he calls the 'ethnicity record.' Ethnicity record gives the information on ethnic and country origins of some of the slaves exported to the Americas and other parts during this period. Out of this slave sample, Nunn (2004) generates estimates of proportional representation of each country. He then distributes the sample from 'shipping records' to each country using these proportions. The information on the proportions is also available from his data appendix. I follow the same procedure and end up with a distribution which has a similar ordering as Nunn (2004). Nigeria comes out as the highest exporter of slaves. I have to reconstruct the data since Nunn's numbers are yet to be published. This data is also a natural candidate of measurement error which is also discussed in section 5.2.4.

Malaria risk measures the share of population at risk from malaria in a particular country in the year 1997. I use data from 49 countries with a higher value indicating greater risk for the population. This series is the same as the one used in the previous chapter. Most of the countries in the sample registers high malaria incidence except Algeria, Tunisia and Mauritius.

Religion measures are the same as in chapter 4. The numbers show that the 95.9% of the population in Cape Verde Island are Catholic and 99.8% of the population in Somalia are Muslim.

The trade openness measure is also the same as in chapter 4. Lesotho is the country with highest trade share and Mozambique trades the least.

Table 5.1. **Summary Statistics**

Variables	Number of obs.	Mean	Standard Deviation	Minimum	Maximum
Measures of Economic Development					
Log per Capita GDP in 2000	43	7.48	0.831	6.19	9.24
Log Initial Income (1960)	43	5.74	0.592	4.72	6.98
Measure of Institutions					
Average Rule of Law Index	49	-0.596	0.619	-2.19	0.853
Measure of Slave Export					
Log Slave Export	42	-1.83	2.78	-9.21	1.66
Measure of Malaria					
Malaria Risk	49	0.808	0.353	0	1
Measures of Religion					
Catholicism	47	24.06	25.99	0	95.9
Islam	47	34.16	36.98	0	99.8
Measure of Openness and Trade					
Log of Trade Share	46	4.06	0.58	2.91	5.03
Instruments for Institutions					
ENGFRAC	47	0.005	0.019	0	0.09
EURFRAC	47	0.024	0.103	0	0.7
Log Population Density in 1500	45	0.888	1.30	-1.97	4.61
Instrument for Malaria					
Malaria Ecology	49	10.59	8.28	0	31.55
Instrument for Slave Exports					
Distance from the coast	46	502.13	374.27	35.29	1319.58
Instrument for Trade Openness					
Constructed Openness	46	22.50	14.48	8.68	70.97

Notes: For a detailed discussion of the definition and source of these variables, see Data Appendix.

I use three instruments for institutions - ENGFRAC, EURFRAC, and log population density in 1500. They are picked from the standard set of instruments used for institutions. The reason for not using the log settler mortality instrument is the small sample size of the regression when it is included in the set of instruments. For malaria risk, I use malaria ecology as an instrument. Distance from the coast is used as an instrument for slave exports.

The pairwise correlations between these variables are reported in Table 5.2. It shows that better institutions, less malaria, less slave exports, more trade, and Islam are all

positively associated with current level of development in Africa. This however is the unconditional correlation between these variables.

5.2.3 Endogeneity Issues

Coefficient estimates of a regression model with two way causality or endogeneity problem are biased. In the above model (equation 5.1), one cannot rule out the possibility of two way causality between the dependent variable per capita GDP in 2000 and the explanatory variables institutions, malaria and openness to trade. It is also possible that a third factor is driving the changes in both the dependent as well as the explanatory variable leading to a problem of identification. Following is a discussion of these issues. The arguments here are similar to the ones discussed in section 4.2.3.

The average rule of law index which is a measure of overall institutional quality is expected to be endogenous. A reasonably developed economy is expected to develop better institutions rather than better institutions causing development (Rodrik et al. 2002). In other words, economic development is a cause of institutional development rather than an effect.

Malaria risk is also a possible candidate for endogeneity. One of the arguments that favour reverse causality is as follows. The rich economies can afford to invest in the research and development of drugs that cures or minimises the effect of malaria. They can also invest in public health programs to destroy mosquito habitat and wipe out malaria altogether. Singapore is a good example of this. Therefore, I consider malaria risk to be endogenous.

Rich countries trade more and the countries that trade more become rich – the causality can run both ways. Therefore the openness to trade variable is also endogenous.

Table 5.2. **Pairwise Correlation of the Major Variables (obs=36)**

	Log per Capita GDP in 2000	Log Initial Income (1960)	Average Rule of Law Index	Log Slave Exports	Malaria Risk	Log Trade Share	Catholicism	Islam
Log per Capita GDP in 2000	1.0000							
Log Initial Income (1960)	0.7364	1.0000						
Average Rule of Law Index	0.3862	0.3420	1.0000					
Log Slave Exports	-0.3686	-0.3650	-0.1558	1.0000				
Malaria Risk	-0.6646	-0.3412	-0.3937	0.4222	1.0000			
Log Trade Share	0.3647	0.3105	0.2091	-0.1405	-0.1157	1.0000		
Catholicism	-0.1817	-0.1783	-0.3812	-0.1638	0.3590	-0.1303	1.0000	
Islam	0.1645	-0.0102	0.1897	0.2893	-0.3102	0.1442	-0.7246	1.0000

Among the other explanatory variables religion (both Catholicism and Islam) and initial income (1960) can be treated as exogenous.

Formal statistical tests following Hausman (1978) are used to check for endogeneity of these variables. However Hausman test is not full proof because of the shortcomings that I have discussed in the previous chapter. The Technical Appendix provides a detailed description of the test.

5.2.4 Measurement Error and Unobserved Country Characteristics

Another potential source of bias in the coefficient estimates is the unobservable country characteristics. If a country chooses slave trade and demonstrates extreme reliance on warfare and violence because of some unobserved characteristics inherent in its culture and if these characteristics are still persisting, then it is impossible to identify econometrically the partial effects of the trade on its current level of development. The size of the estimates will be biased away from zero as the coefficient will account for the unobserved country effect plus the true effect of slave trade (Nunn 2004).

The other potential source of bias is the measurement error. In Nunn's (2004) methodology, it is assumed that the slaves exported from a particular port in Africa are coming from the country where the port is plus from the close neighbouring countries inland. This method always leaves a possibility of under-representation of slaves from the inland (Nunn 2004). This under-sampling of slaves from the interior will lead to OLS estimates that are biased towards zero (Nunn 2004).

Given these two potential biases, it is unclear which way the aggregate bias will affect the coefficient estimate. The best possible way to tackle this ambiguity is to use instrumental variables (IV). I use distance from the coast as instrument for slave trade. This is discussed in detail in the following section.

5.2.5 The Instruments

The endogeneity issues discussed in section 5.2.3 can be tackled empirically by using the instrumental variable technique which I have discussed in details in section 4.2.4. The first stage regressions for this exercise are as follows.

$$INS_i=\beta_1+\beta_2\, INI_i+\beta_3\, ME_i+\beta_4\, DC_i+\beta_5\, REL_i+\beta_6\, CONST_i+\beta_7\, Y_{0i}+\varepsilon_1 \quad (5.2)$$

$$LOGSLVX_i=\theta_1+\theta_2\, INI_i+\theta_3\, ME_i+\theta_4\, DC_i+\theta_5\, REL_i+\theta_6\, CONST_i+\theta_7\, Y_{0i}+\varepsilon_2 \quad (5.3)$$

$$MAL_i=\lambda_1+\lambda_2\, INI_i+\lambda_3\, ME_i+\lambda_4\, DC_i+\lambda_5\, REL_i+\lambda_6\, CONST_i+\lambda_7 Y_{0i}+\varepsilon_3 \quad (5.4)$$

$$INT_i=\varphi_1+\varphi_2\, INI_i+\varphi_3\, ME_i+\varphi_4\, DC_i+\varphi_5\, REL_i+\varphi_6\, CONST_i+\varphi_7 Y_{0i}+\varepsilon_4 \quad (5.5)$$

Where INI_i refers to instruments for institution, DC_i refers to distance from the coast, $CONST_i$ refers to constructed openness, and ME_i refers to the malaria ecology for country i. They are used as instruments for institutions, slave trade, trade openness and malaria risk respectively.

I use three instruments for institutions. They are: ENGFRAC, EURFRAC, and log population density in 1500. I exclude European settler mortality from the set since it drastically reduces the sample size. I also use malaria ecology as an instrument for malaria risk. The logic behind using these variables as instruments are discussed in chapters 3 and 4.

I use distance from the coast as an instrument for log slave exports. The rational behind this is the following. It is expected that greater the distance from the coast, the lower is the volume of slave exports. The obvious reason being the cost of capturing and transporting slaves to the coast increases with distance (Nunn 2004).

I use formal statistical tests following Hausman (1978) to check for the validity of the instruments.[33]

[33] See Technical Appendix TA3 (p. 174) for further information on these tests.

5.2.6 Regression Results

The ordinary least square estimates of the model reported in Panel A of Table 5.3 shows that malaria has a negative coefficient estimate and initial income has a positive coefficient estimate. Both the estimates are statistically significant at the 1% level. It also shows that log trade share and Catholicism are positively related to the current level of development. The relationship however is statistically significant only at the 10% level. The coefficient estimates on institutions and slave trade are insignificantly different from zero. In a separate specification replacing Catholicism by Islam I find that the effect of the Islamic faith on current development is insignificantly different from zero. This specification is reported in the second column of the table.

The 2SLS estimates[34] show similar pattern[35] as its OLS counterpart except log trade share is no longer statistically significant. The effect of a one sample standard deviation (0.353) decline in malaria risk is a 1.8 fold increase in current per capita income. This effect is almost equal in magnitude to the standardised coefficient estimate of malaria (2, see page 64) in a pooled sample (see Model 2, Table 4.6 of chapter 4). This implicitly shows how much the effect of malaria in a pooled sample is driven by Africa. The partial R^2 calculations show that 55% of the variation in log GDP per capita in Africa is explained by malaria. The only difference between Model 2 of chapter 4 and this model is that institutions are no longer statistically significant.

The impact of one standard deviation (26%) increase in catholic faith is a 1.3 fold increase in the current per capita GDP. This is close to the 1.2, the value of standardised coefficient reported in chapter 4 (see Model 1, Table 4.6 of chapter 4).

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[34] The robustness and sensitivity analysis of these estimates are reported in the Technical Appendix TA2 (p. 173).

[35] Malaria and initial income are the only statistically significant variable. Institutions and slave export are statistically insignificant.

I replace Catholicism by Islam and re-estimate the model. The standardised coefficient on malaria increases to 2.35. I also find evidence of conditional convergence since the coefficient estimate on the initial income (1960) variable is statistically significant, positive, and less than 1.

The empirical evidence is in sharp contrast to the Nunn's (2004) baseline model estimates. Nunn reports a negative and statistically significant relationship between slave exports and current per capita GDP. He also shows that this effect disappears once he controls for institutions leading him to believe that the effect of slave trade works via institutions. His story is the following. In Africa, the long history of slave trade has systematically weakened its institutional structure. Many of these weaknesses have persisted over time and influenced institutional performance till date which also determines economic outcome. In other words, the legacy of slave trade and conflict is discernible in current African institutions and takes its toll on the current economic performance. Nunn's story however is not supported by the data once the effects of malaria, trade openness, and religion are controlled for. It turns out that malaria is the only variable that can explain the lack of development in the continent and the relationship is robust.

The first stage regressions reported in Panel B shows that log population density in 1500, malaria ecology, and Catholicism are good predictors of current institutions. High population density regions in 1500 tend to have bad current institutions. This supports Acemoglu et al. (2002)'s theory.[36]

Conducive environment for the malaria vector produces poor institutional outcome. This also supports Acemoglu et al. (2001)'s theory.

[36] They argue that that these places were colonized for extractive purposes which led the colonizers to set up extractive institutions. These institutions have persisted over time and have high level of influence on current institutions.

Table 5.3. **Determinants of African Development**

Panel A: The Model				
Dependent Variable	**Log per Capita GDP in 2000**			
	OLS estimate obs= 36	OLS estimate obs= 36	2SLS estimate obs= 36	2SLS estimate obs= 36
Log Initial Income (1960)	0.69*** (0.1254)	0.66*** (0.1244)	0.66*** (0.1079)	0.54*** (0.2043)
Average Rule of Law Index	0.18 (0.1295)	0.10 (0.1056)	0.38 (0.4160)	-0.35 (0.7779)
Log Slave Export	0.03 (0.0250)	0.02 (0.0239)	0.06 (0.0485)	0.11 (0.1048)
Malaria Risk	-1.35*** (0.1707)	-1.20*** (0.1530)	-1.64*** (0.5734)	-2.43** (1.369)
Log Trade Share	0.20* (0.1160)	0.19* (0.1294)	0.18 (0.2946)	0.53 (0.5913)
Catholicism	0.007* (0.0049)		0.01* (0.0065)	
Islam		-0.001 (0.0021)		-0.006 (0.0063)
R^2	0.8393	0.8112		
Endogeneity test (p)			0.2776	0.1948
F test (p-value)	0.0000	0.0000		
Instruments			ENGFRAC, EURFRAC, Log Population Density in 1500, Malaria Ecology, Distance from the coast, Constructed openness.	

Panel B: The First Stage Regressions				
Dependent Variables	Average Rule of Law Index obs= 39	Malaria Risk obs= 39	Log Slave Export obs= 36	Log Trade Share obs= 39
Log Population Density in 1500	-0.08* (0.0635)	-0.01 (0.0396)	0.50** (0.2816)	-0.2*** (0.0608)
Distance from the coast	-3e-05 (0.0002)	2e-05 (0.0001)	-0.004*** (0.0009)	3e-04 (0.0003)
Malaria Ecology	-0.02** (0.0101)	0.03*** (0.0055)	0.22*** (0.0394)	-0.01 (0.0099)
Constructed Openness	0.01 (0.0073)	0.003 (0.0037)	-0.01 (0.0282)	0.03*** (0.0071)
Log Initial Income (1960)	0.02 (0.1333)	-0.06 (0.0936)	-1.23** (0.6179)	0.16 (0.1371)
Catholicism	-0.01*** (0.0039)	0.008*** (0.0019)	0.01 (0.0190)	-0.004 (0.0038)
R^2	0.3847	0.5953	0.6435	0.4116
F value	2.93	7.33	9.7	6.0

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. The standard errors reported in the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept. None of the first stage regressions pass the Stock and Yogo (2002) test for weak instruments with a maximal bias of 0.05 of the 2SLS estimator relative to the OLS at 5% level of significance.

A large proportion of the population practicing Catholic faith also produces poor institutional outcome which is what I reported in chapter 4.

Malaria ecology is a strong predictor of malaria. The coefficient estimate is positive and it is statistically significant at the 1% level. This is not a surprising result. One would expect that the proportion of population exposed to malaria should be correlated with the two principal components of the malaria ecology measure - the abundance of malaria carrying mosquito species and the appropriate temperature conditions for their survival.

Catholicism also predicts malaria risk. The regression shows that the population of predominantly catholic countries in Africa are more at risk of having malaria. However, this correlation may not be indicative of a causal relationship.

The log slave export regression shows that it is positively correlated with log population density in 1500 and malaria ecology and negatively correlated with distance from the coast and initial income. All the relationships are statistically significant. The positive correlation with the population density is indicative of the fact that the high population density areas in 1500 experienced more intensive slaving than the low population density areas.

One can interpret the positive correlation between slave export and malaria with a view strongly advocated by historians Joseph Miller and Jill Dias.[37] They argue that protracted rainy season after long droughts always brought malaria and severe food shortages in West Central Africa especially Angola. Malaria and food shortages made the local population vulnerable to the attacks of slave raiders. Therefore it is not surprising that there is a positive correlation between malaria ecology and slave trade.

The negative correlation between slave export and distance from the coast is quite intuitive. The further a country is from the coast the less is the probability of it being affected by slave raids. However this average relationship should not be interpreted as

[37] See Miller (1982) and Dias (1981).

counter evidence to the historically well documented episodes of inland slave raids in the West and West Central Africa which started taking place during the 18th and 19th century.

The negative correlation between log per capita GDP in 1960 and slave trade implies countries that have less per capita GDP in 1960 exported more slaves in the past. The regression however does not establish any causal relationship.

Finally, the log trade share regression shows that constructed openness can predict log trade share. The relationship between constructed openness and log trade share is positive and is statistically significant at the 1% level. This confirms Frankel and Romer (1999) findings.

Log population density in 1500 also predicts log trade share. High population density areas in 1500 trade less now. This is in conformity with the intuition put forward by the 'gravity model.' Areas with high population density in 1500 are expected to have high population density till the present date. The 'gravity model' suggests that areas with high population density tend to trade more internally than externally. Therefore, areas with high density population should trade less if one is solely considering external trade. Since the high density population areas in the past are positively correlated with the high density population areas of the present, therefore there should be a negative correlation between the population density of the past and the trade share of the present.

The partial R^2 of the first stage regressions reported in Table 5.3A shows that log population density in 1500 which is an instrument for institutions explain approximately 5% of the variation in institutions. However, it is statistically significant and has the right sign as predicted by the theory.

Malaria ecology which is an instrument for malaria risk explains 49% of the variation in malaria risk. It is also statistically significant and posses the right sign.

The other instruments such as distance from the coast and constructed openness explains 33% of the variation in log slave export and 27% of the variation in log trade share respectively. They are also statistically significant and posses signs as predicted by the theory.

***Table 5.3A.* Partial R^2 of the First Stage Regressions (Reported in Table 5.3)**

Dependent Variables	Average Rule of Law Index obs= 39	Malaria Risk obs= 39	Log Slave Export obs= 36	Log Trade Share obs= 39
Log Population Density in 1500	0.0482*	0.0028	0.0955**	0.2336***
Distance from the coast	0.0437	0.0009	0.3246***	0.0361
Malaria Ecology	0.1299**	0.4902***	0.5063***	0.0614
Constructed Openness	0.0374	0.0196	0.0058	0.2700***
Log Initial Income (1960)	0.0007	0.0196	0.1205**	0.0388
Catholicism	0.1900***	0.2941***	0.0205	0.0333

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a one sided alternative. The partial R^2 indicates the proportion of variation in the dependent variable that is explained by the explanatory variables when other things are held constant. Multiplying the numbers by 100% will give the percentages.

These correlations definitely make them eligible to be valid instruments. However, applying a stricter criterion to determine weak instruments developed by Stock and Yogo (2002) reveal that the instruments jointly fail the test.

Based on the OLS and 2SLS estimates it is perhaps fair to conclude that malaria has a strong negative effect on current level of development in Africa and the relationship is robust across different specifications. This relationship however is conditional on controls. The coefficient estimates on institutions and slave export are insignificantly different from zero which rules out the presence of any direct effects of these two variables on current per capita GDP. Catholicism is positively related to development however the relationship is

statistically significant only at the 10% level. There is evidence in favour of transitional dynamics and the data also shows that predominantly catholic countries have poor institutions in Africa. There is no evidence of indirect effects of slave trade and institutions on the current level of development.

5.3 Summary

Finally, the question remains- what does this all mean? The evidence confirms my initial conjecture[38] that the dominance of malaria in a sample of LIEs is driven by the African economies. In this chapter I show that this holds even when I control for log slave trade (which is a historical factor specific to Africa), institutions, log trade share, religion and log initial income.

One interpretation of this result is the poverty trap argument developed by Jeff Sachs and other which I have already discussed in section 5.1.3. The data definitely shows strong support in favour of this argument. However, the precise mechanism through which diseases affect development is yet to be sorted out. This is an area which needs further work.

[38] See chapter 4.

CHAPTER 6

FROM 'INSTITUTIONS RULE' TO 'DISEASES DOMINATE': WHAT DOES THIS ALL MEAN?

The evidence that I have presented so far does identify the most important deep factors that can explain the difference in living standards across nations. But this does not tell us anything about the mechanism through which these factors influence living standards. When Acemoglu et al. (2001) and Rodrik et al. (2004)[39] argue that institutions are the fundamental determinant of living standards then the obvious question is via which channel it had or continues to have an impact. They may argue that the settler mortality story[40] provides some explanation about the mechanism. But perhaps it is too simplistic an explanation for a full picture story of such a complex process. When Sachs (2003a) asserts that malaria ecology and disease environment are the most important determinant based on his empirical result, one may ask the question is the result showing historical influence or current influence. These questions are also relevant for the results that I have presented in chapters 4 and 5. Unfortunately there are no easy ways to answer these questions. But unless we answer them, we won't be able to make sense out of the empirical results.

This chapter attempts to give meaning to the results using a method which may not satisfy the empiricists because of its somewhat speculative nature. The strategy is as follows. First, I put forward a unifying structure which describes the process of development in Western Europe. Then I compare and contrast the Western European trajectory with the trajectories in Africa, China, India, and the Americas. The African trajectory is explained using an overlapping generation model. The purpose of this exercise is to find out how the deep structural factors have influenced the process of development or lack of development in these regions. In the end, I make an attempt to relate these theoretical observations with the empirical evidence of chapters 4 and 5.

[39] Rodrik et al. (2004) claims 'institutions rule' whereas Acemoglu et al. (2001) stresses on the importance of institutions without claiming dominance.

[40] This story is reviewed in chapter 3, section 3.1.

The organisation of this chapter is as follows. The first section lays down the unifying structure for Western Europe. The second section compares and contrasts the structure with the trajectories of Africa, China, India, and the Americas. The third section relates the structure with the empirical results. The fourth section concludes.

6.1 A Unifying Structure for Western Europe

It is perhaps not inappropriate to divide the process of economic development in Western Europe into four different stages. The first stage is the era of Malthusian cycle in which geography and epidemic diseases played a crucial part in determining food production. The widely known economic as well as social impact of the 'Black Death' and other epidemic diseases that hit Western Europe during the fourteenth century is a testimony of the power of geography and germs. The second stage is characterised by conflict, militarism and increase in food production and population density. The third stage is the period of an increased demand for wealth. This epoch is characterised by state investments into daring expeditions to acquire wealth and resources from foreign lands to finance the soaring costs of war. Finally, the fourth stage is the stage of change in the nature of the state leading to rapid technological progress, industrial revolution, mass production, and the rise of the capitalist system.

In this section I will illustrate each of these stages using historical examples from Western Europe. I will provide simple economic intuition wherever applicable. I will try to link each of these stages using simple economic intuition. I will avoid using what economists love most – models. The reason is somewhat obvious as these stages may well have taken place because of historical accidents.

In order to describe the first stage, one can think of a food production function which makes use of land, labour, human capital, technology, and climate. Land is fixed and is owned by the small state or group. The entire population supplies labour except the elite.

Human capital is defined as the knowledge required to make use of the existing technology successfully. Technology signifies the development of new tools and it is spasmodic. Climate is exogenously given. Labour supply is affected by the disease environment with high incidence of diseases resulting into less labour supply. In this kind of world, an increase in food production because of the positive effects from all of these factors results into an increase in the population. Increased population raises the demand for food. However, there is a limit to what a fixed amount of land can yield given technology, climate, and diminishing returns to labour and human capital. Therefore, a food crisis ensues and eliminates a large proportion of the population. This cycle repeats itself in the absence of technological progress. In addition to this natural cycle, food production is also constrained by geography. Frequent epidemic diseases reduce labour supply constraining food production. The use of very simple and climate dependent technology also constraints food production. This is what Thomas Malthus described as the principle of population in his famous essay in 1750. This process took place in Western Europe approximately during the thirteenth and the fourteenth century when it was ruled by the small and medium sized feudal states. Robbins (1928) provides evidence of a Europe which is close to what I have described above. In her paper on the impact of Black Death in France and England, she records that France was hit by famine on at least fifteen occasions during the fourteenth century.[41]

In stage two, the production of food may rise due to technological progress. New technology may evolve due to indigenous effort or due to technology transfer or can be completely serendipitous. At least in case of Western Europe we know that most of the early technologies were acquired from the Chinese or the Arabs or from ancient Rome (Mokyr 1990). There is support for this in Diamond (1997) as well.

[41] See Robbins (1928), p. 453.

He writes, "Until the proliferation of water mills after about A.D. 900, Europe west or north of the Alps contributed nothing of significance to Old World technology or civilization; it was instead a recipient of developments from the eastern Mediterranean, Fertile Crescent, and China. Even from the A.D. 1000 to 1450 the flow of science and technology was predominantly into Europe from the Islamic societies stretching from India to North Africa, rather than vice versa."[42]

The Western Europeans acquired irrigation and water supply technologies from Persia and the Arab world. Thomas Glick in his book entitled *Irrigation and Society in Medieval Valencia* argues that many of the early irrigation techniques arrived in Spain with the Islamic invasion.[43] The Spaniards adopted this technology which spread to the other parts of Europe later. Dams were also built by the Arabs in Spain for the purpose of irrigation during this period. This is evident from Donald Hill's work on the history of technology. Hill (1984) writes, "Many dams were built by the Muslims in southern Spain, mainly for irrigation but also for water supply and water power. There was, for example, a series of dams in the region of Valencia."[44] The arrival of new technology increases agricultural production by manyfold and creates a situation of food surplus. The food surplus also increases fertility and reduces mortality raising the total population. Rising population puts pressure on land and other resources inducing the state to get involved into territorial conflicts. This is what we observe during the age of the Crusades when Europe engaged herself into repeated conflicts and wars. The state also gained more in terms of tax revenue in the event of an increased agricultural yield. A significant proportion of this revenue is spent into the development of new weapons and the military. The logic is simple. More lethal weapons and a well nourished army can win battles and winning battles

[42] See Diamond (1997), pp. 409-410.
[43] See Glick (1970), p. 176, the section on the diffusion of irrigation techniques.
[44] Hill (1984), p. 58.

was crucial to the very existence of the state. The state investment in military technology creates positive externality for civilian R&D leading to more breakthroughs in technology for agriculture and crafts. New technology in agriculture and craft results into steady growth in output and population causing more territorial conflict. This pattern is observed till the fifteenth century in Western Europe when the states become stronger and stronger. However, the increased frequency of military conflict did put enormous pressure on the state's exchequer forced her to look for alternative and richer sources of revenue. Perhaps, this is what led Western Europe to the stage three.

Stage three signifies a state in which investments in maritime expeditions in order to hunt for alternative sources of wealth and resources become extremely important. Michael Beaud (2000) describes this process in his book. He writes, "Monarchs greedy for greatness and wealth, states battling for supremacy, merchants and bankers encouraged to enrich themselves: these are forces which inspired trade, conquests, and wars."[45] These investments lead to the discovery and conquest of new land. The prevailing mercantilist philosophy[46] induces explorers to search for bounty in these newly discovered lands and bring them back to their motherland. This is what Hernan Cortez did when his band of conquistadors came in contact with Montezuma's Aztecs in the new world. Similar was the fate of Atahualpa's Inca when Francisco Pizzaro's army of two hundred conquistadors defeated them in Cajamarca in 1532. The Capture of Atahualpa by Pizzaro's men yielded the largest ransom recorded in human history. The ceaseless pillage of wealth and precious stones from the new land triggers inflation in the home country as too much money chase too little goods. To counter inflation, the state imposes restrictions on imports but encourages exports so that the state does not run out of wealth. This policy leads to the

[45] See Beaud (2000), p. 14.

[46] The major argument of the mercantilist philosophy is that a nation's wealth depends on the amount of precious metal it has.

expansion of maritime trade and commerce. The 'no import' ideology also boosts domestic manufacturing providing it with a large domestic as well as overseas market. Outward orientation and trade in manufacturing leads to specialisation, division of labour and increased gains from trade. The nature of the distribution of gains from trade changes the structure of the political economy. Two distinct patterns emerge. The first is an absolutist state which takes control of all types of accumulation. The second is a type of state which allows private accumulation by the bourgeoisie such as money lending, trading of precious metals, real estate etc. In an absolutist state no change occurs in the institutional structure. However, in the second type of state institutional changes take place which are favourable to capitalism. The increase in wealth of the bourgeoisie due to private accumulation provides them with *de facto* political power. The bourgeoisie invests in private manufacturing and trade which generates more wealth for the future. This further strengthens their *de facto* political power. The bourgeoisie with their new found political power starts demanding institutional change by challenging the authority of the monarchs. They demand protection of private property and a more equitable distribution of political power. If the *de facto* political power of the bourgeoisie is greater than the *de jure* political power of the monarchs then the will of the bourgeoisie prevails over the will of the monarchs. This leads to the establishment of institutions which protects private property and political rights of the bourgeoisie. Democratic institutions are established to cement the power of the bourgeoisie and also to make sure that the monarch cannot take over power in the future.

This pattern of institutional development is observed in Western Europe from sixteenth century onwards. The Spanish and Portuguese monarchs were absolutist in nature and they centralised the process of manufacturing and trade discouraging private enterprise (Acemoglu et al. 2005). This prevented the development of institutions which provides

incentive to private investment. However, in Britain and in the Netherlands, the state allowed private enterprise which led to the Civil War in 1642 and Glorious Revolution in 1688 in Britain and the Dutch war of independence which began in the 1570s. Describing the events in Britain and the Netherlands Acemoglu et al. (2005) writes,

"The victory of Parliament in the Civil War and after the Glorious Revolution introduced major checks on royal power and strengthened the rights of merchants. After the Civil War, the fraction of MPs who were merchants increased dramatically."[47]

"Dutch merchants always had considerable autonomy and access to profitable trade opportunities. Nevertheless, prior to the Dutch Revolt, the Netherlands (in fact, the entire Duchy of Burgundy) was part of the Habsburg Empire, and the political power of Dutch merchants was limited…. The critical improvement in Dutch political institutions was therefore the establishment of the independent Dutch Republic, with political dominance and economic security for merchants, including both the established wealthy regents and the new merchants immigrating from Antwerp and Germany."[48]

The stage four signifies more private as well as state investments in technology which leads to the development of the factory system and industrial revolution. The institutional changes of stage three creates the ideal incentive structure for private investments in technology development and fixed capital. This induces rapid technological progress. The rapid improvement in technology increases the cost of moving information relative to the cost of moving people (Mokyr 2001). This leads to the rise of the factory system and a consequent breakdown of the cottage industry. Such pattern is observed in Britain during the period of Industrial Revolution (1760-1830). The period of Industrial Revolution is signified by rapid improvements in technology and sustained economic

[47] See Acemoglu et al. (2005), p. 564.
[48] See Acemoglu et al. (2005), p. 566.

growth. Even though the revolution started in Britain, the new ideas and technology soon migrated to the other parts of Western Europe. However, the economic benefits remained contingent on the nature of the states. The benefits for the states with absolutist institutions were lot less than the benefits for the states with non-absolutist institutions. Powered with capitalist institutions Britain remained the top gainer and the gap between Britain and the rest of Western Europe increased over time. Maddison (2004) figures show that the difference between GDP per capita of Britain and Spain increased from 397 Geary-Khamis dollars to 698 Geary-Khamis dollars[49] over the period 1700 to 1820.

Therefore, in sum the story that I want to get across is as follows. Western Europe managed to beat the constraints imposed by its geography on food production early on and started her journey on an independent growth trajectory. Availability of food increased population density which caused territorial conflicts and war. Ceaseless conflicts induced more investment in military technology. The conflicts also put enormous pressure on the finances of the state. The state commissioned daring naval expeditions to search for bounty so that it can finance its military expenditure and avarice. These expeditions brought wealth from overseas which also caused inflation. In order to remedy inflation and also to abide by the principles of mercantilist philosophy, the state restricted imports of foreign goods and promoted exports of domestically manufactured goods. This induced specialisation and division of labour in the domestic economy. Institutional changes followed depending upon the initial distribution of the gains from trade. A non-absolutist state allowed bourgeois accumulation which increased the power of the bourgeoisie resulting into major institutional changes favourable to capitalism. In contrast, an absolutist state allowed very little or no bourgeois accumulation which arrested the prospect of any institutional change. The states with capitalist institutions attracted private investments into production and

[49] These are measured in 1990 international Geary-Khamis dollars.

technology building. This led to rapid technological progress, the rise of the factory system, and industrial revolution.

6.2 What was Different in Africa, China, India, and the Americas?

Africa

Africa has a long history of diseases. Epidemic diseases such as small pox, measles, yellow fever, cholera, tuberculosis, malaria, typhus were always been a part of African life. Many of these diseases and some new killers[50] play a significant role in African life till date. Africa has also been a subject of huge climatic variations. Long dry seasons were followed by considerably humid periods with strong rain (Miller 1982). These factors have impacted in the past and still continue to impact Africa's growth trajectory. If one seeks an explanation in terms of the broad structure that I have outlined in the previous section, the obvious question to ask is at what stage the African economics went wrong? My answer is stage one. How it happens to be stage one? The intuitive explanation is as follows.

Geography has always constrained food production in Africa. Long stretches of drought causing major reductions in cultivation has always weakened African population making them a subject of malnutrition. Malnutrition made them vulnerable to epidemic diseases. A return of the rain also brought diseases along with it further weakening the labour force an important input for food production.

Miller (1982) writes, "Outbreaks of diseases paralleled the chronology of drought in an epidemiological sequence familiar from many other regions. Africans weakened by malnutrition and exhausted by dispersal into the bush or by flight into lowland became particularly vulnerable to endemic pathogens."[51]

[50] HIV AIDS is an example.
[51] See Miller (1982), pp. 22-23.

A Portuguese observer in eighteenth century Angola commenting on the increase in disease incidence after the rain writes, "Rain brings food in abundance but leaves no one alive to eat it."[52] This situation was further complicated by the African involvement in the slave trade. Africa had a long history of slavery as a social institution. However, it was never commercialised in such a large scale prior to the European engagement.[53] Slave trade led to depopulation of the continent reducing food production further (Inikori 1992).[54] However, the fact is even without depopulation Africa struggled to produce more than subsistence level of food grains. This restricted Africa from attaining stages two, three and four and move towards the development of a fully home grown capitalist system. The engagement with the Europeans during the sixteenth century and formal colonization during the nineteenth century aborted the independent trajectory of institutional development in Africa. In the colonies with high European mortality rate the colonizers erected extractive institutions. The slave trade encouraged the African elites to go for violent slave raids inland which institutionalised the culture of violence and lawlessness in certain parts of the continent. Many of these institutional features have persisted over time and still exist in the economic and political institutions of modern Africa. These weak institutions continue to influence the economic performance of the continent. Coupled with diseases and geographic constrains, poor institutions perhaps explains the bulk of the African growth tragedy.

Let me introduce an overlapping generation model to explain the story that I have laid down above. The idea in this model is that the direct relationship between the rate of time preference and diseases at the representative household level is perhaps the best

[52] Cited in Miller (1982), p.23.

[53] The Islamic slave trade started in A.D. 700. But it never reached the epic proportion of the Atlantic slave trade.

[54] The historians are yet to reach any agreement on this. For alternative views see Lovejoy (1982).

explanator of the African situation. In other words, households living in an environment where malaria incidence and death rate is typically high will choose to save less for the future and this affects economic progress adversely. The following is the model.

I consider a closed overlapping generation economy consuming and producing a single homogeneous product. This can be thought of as a representative economy in the continent of Africa or the whole continent itself. A typical household in this economy comprises of both young and old members and each member of the household lives for only two periods. The young members of the household work in the first period and retire in the second period when they are old, and then they die. The members of this household consume in both periods and the consumption in the second period is supported by their savings in the first period. Therefore at each point in time, members of only two generations are alive. Each individual within the household maximises their lifetime utility which depends on consumption in the two periods of life. In order to maintain simplicity of the structure, I assume away the possibility of bequests or any altruistic behaviour.

The lifetime utility of a representative individual of generation t can be expressed as follows:

$$u_t = \frac{c_{1t}^{1-\theta} - 1}{1-\theta} + \phi\left(\frac{1}{1+\rho}\right)\left(\frac{c_{2t+1}^{1-\theta} - 1}{1-\theta}\right), \theta > 0, \rho > 0, \phi \in [0,1] \qquad (6.1)$$

where c_{1t} and c_{2t+1} are the consumption of generation t when young and old respectively and ρ is the exogenously determined pure rate of time preference.

The survival probability to the old age ϕ of the representative individual depends on the unfavourable geography vector, $\mathbf{\Gamma}$.[55]

[55] One argument made by Chakraborty and Das (2005) in a recent paper is that the households can influence ϕ by investing in health. However, in this case we assume that increase in ϕ requires huge investment which is often beyond the scope of a private investor or a household. This is because malaria is predominantly geographic in nature and its reduction would require considerable public health intervention.

$$\phi = \phi(\boldsymbol{\Gamma}) \in [0,1] \tag{6.2}$$

$\boldsymbol{\Gamma}$ is exogenous to the model and shares an inverse relationship with ϕ. If $\boldsymbol{\Gamma}$ is too high then ϕ can be too low.

Using equation (6.2) one can rewrite the lifetime utility of the representative individual as follows:

$$u_t = \frac{c_{1t}^{1-\theta} - 1}{1-\theta} + \sigma(\Gamma)\left(\frac{c_{2t+1}^{1-\theta} - 1}{1-\theta}\right) \tag{6.3}$$

where $\sigma(\Gamma) = \dfrac{\phi(\Gamma)}{1+\rho}$ is the effective rate of time preference. If $\boldsymbol{\Gamma}$ is too high then σ is too low.

The representative individual supplies one unit of labour inelastically when young and receives a wage income w_t. Therefore the budget constraint faced by this individual in period t is given by the following expression.

$$c_{1t} + s_t = w_t \tag{6.4}$$

Where s_t is the amount of grain saved in period t. The saved grain also grows at a rate r_{t+1} when planted. Therefore in period t+1the individual consumes the amount saved in period t plus the growth in the grains. So the consumption in the second period is as follows.

$$c_{2t+1} = (1 + r_{t+1})s_t \tag{6.5}$$

Using (6.5) one can rewrite the budget constraint as

$$c_{1t} + \frac{c_{2t+1}}{1 + r_{t+1}} = w_t \tag{6.6}$$

Each individual treats w_t and r_{t+1} as given and maximises their lifetime utility subject to the budget constraint. This yields the following Euler equation.

$$\frac{c_{2t+1}}{c_{1t}} = \left[\sigma(1+r_{t+1})\right]^{\frac{1}{\theta}} \tag{6.7}$$

Using (6.6) and (6.7) and solving for c_{1t} and c_{2t+1} yields

$$c_{1t} = w_t\left[1-\frac{1}{\sigma^{-\frac{1}{\theta}}\left(1+r_{t+1}\right)^{1-\frac{1}{\theta}}+1}\right] \text{ and } c_{2t+1} = w_t\left[\frac{1+r_{t+1}}{\sigma^{-\frac{1}{\theta}}(1+r_{t+1})^{1-\frac{1}{\theta}}+1}\right] \tag{6.8}$$

I assume that the representative household uses a Cobb-Douglas technology to produce the grains and the factors of production are paid according to their marginal product. The production function is represented as follows.

$$y_t = Ak_t^{\alpha} \tag{6.9}$$

Where $y_t \,\&\, k_t$ are per capita output and per capita capital stock respectively. In this economy, net investment has to be equal to total income less consumption. Therefore, capital stock in this economy evolves as follows.

$$K_{t+1} - K_t = AK_t^{\alpha}L_t^{1-\alpha} - \delta K_t - c_{1t}L_t - c_{2t}L_{t-1} \tag{6.10}$$

I assume that the economy starts off with an initial capital stock K_1 that is owned by the L_0 elderly in period 1. Also each individual want to end up with no assets when they die. This yields the result that the savings of the young this period is equal to the next period's capital stock. Hence we have the following relationship.

$$K_{t+1} = s_t L_t \forall t \geq 2 \tag{6.11}$$

In this economy, the population grows at a rate n. Then using the above relationship and logarithmic preferences[56] I get the steady state value of per capita capital stock as

$$k^* = \left[\frac{(1-\alpha)A\sigma}{(1+n)(1+\sigma)}\right]^{\frac{1}{1-\alpha}} \tag{6.12}$$

[56] Logarithmic preference implies $\theta = 1$

It is evident from the above equation that a high value of σ increases the steady state level of per capita capital stock and hence enhances growth. In Africa due to the high incidence of killer malaria and other diseases, one would expect $\mathbf{\Gamma}$ to be very high and σ to be fairly low. The economy in this case is in danger of getting trapped into a low income, low capital stock equilibrium which I have described as stage one in section 6.1. This result is also in line with the empirical findings of Bloom et al. (2003). They show that economies experience lack of growth not due to geographical bottlenecks per se but due to the poverty trap situation emerging out of the bottleneck. This perhaps explains the situation in Africa which is supported by the empirics in chapter 5.

Another observation is that if contemporary Africa is stuck at stage one due to diseases and other geographic constraints then the data is going to show a strong correlation between the current level of development and these factors. The correlation between institutions and other factors will not be visible if it is a poverty trap situation similar to stage one. This is precisely what the data shows.

China

The case of China is somewhat surprising. The Chinese were at the forefront of the Old World technology and knowledge till the mid fifteenth century. Cast iron, compass, gunpowder, paper, printing, and many others were first invented in China. The Chinese also invented sophisticated irrigation canals which increased rice production by many fold (Diamond 1997). Despite this long list of technological breakthroughs why do the Chinese failed to achieve the same heights as Western Europe? Why did they waste their early technological advantage? Why is it Britain and not China progressed towards building an industrial society? The answer lies with Chinese institutions. The following paragraph attempts to provide an intuitive explanation in terms of the broad structure.

Food production developed in China as early as 7500 B.C. (Diamond 1997, p. 100). By the start of the millennium, Chinese agriculture was able to support large population and the hierarchical structure of the Chinese society was comparable to the social institutions of stage two and three of the proposed broad structure. One can claim that by the fourteenth and the fifteenth century China has taken significant steps towards reaching stage four. The treasure fleets of the early fifteenth century, the discovery of gunpowder and compass suggests that the Chinese were incredible close to make it to stage four. However, the question remains what went wrong. The fate of the treasure fleet after it returned in 1433 gives us a clue to the answer.[57] After the return of the fleet in 1433, the composition of the Chinese state changed significantly. The previously powerful eunuchs were overthrown by their opponents within the Chinese court. The eunuchs were in favour of technology, scientific discovery, and daring expeditions. The commander of the treasure fleet Cheng Ho was himself a eunuch. When their opponents assumed power, they aborted all the activities that the eunuchs were involved in, either directly or indirectly. Gradually they dismantled the entire infrastructure that was put in place to encourage these activities. The absolutist nature of their regime also did not allow private initiatives into these activities. In this way the absolutist regime destroyed all the institutional incentives for technological research and China went backwards in the next five hundred years. This is a perfect example of the theoretical claim that bad institutions can destroy all the incentives for economic progress even when the region is endowed with the right geography.

Again in terms of the regression results this shows that escaping the poverty trap is a necessary but not sufficient condition for development. The Chinese case fits well with the pooled sample estimates in chapter 4. Institutions do have a positive impact on development.

[57] For a more comprehensive account of this event see Diamond (1997) or Landes (1998).

India

India was an exporter of industrial goods and an importer of primary and intermediate goods when Sir Thomas Roe visited the court of the Mughal emperor Jahangir in 1615.[58] The structure of the Mughal Empire was already very hierarchical with power concentrated in the hands of the minority elites. It also generated enormous amount of wealth. In support of this fact Landes (1998) writes,

"India also had a large and skilled industrial workforce, whose products circulated throughout the region. As a result, the Indian yielded a substantial surplus that supported rulers and courts of legendary opulence."[59]

Therefore, it is perhaps fair to say that the Mughal Indian society achieved living standards and institutional structure comparable to the stage three of the proposed broad structure. However, this pattern reversed as the British started gaining more political control during the late eighteenth century. The obvious question that one would like to ask is why?

The answer is not as complicated as it may seem. Acemoglu et al. (2002) talks about an institutional reversal that brought about this change. Their definition of institutional reversal however is very broad. They argue that the British colonizers never considered India and other tropical colonies as possible settlements and therefore they erected extractive institutions in these colonies. These extractive institutions reversed the trend of economic performance. In case of India however it wasn't only the lack of settlement opportunities that persuaded the British colonizers to erect extractive institutions. It was also a direct result of the then prevailing political economy in both the countries. Dutt (1992) argues that strong parliamentary lobbying by the British cotton

[58] Sir Thomas Roe was the emissary of King James I and he gained for the British the right to establish a factory at Surat, a port city where the British East India Company's ships first arrived in India.

[59] See Landes (1998), p. 156.

manufacturers against the import of Indian textile forced the East India Company to resort to policies which led to a systematic destruction of the Indian textile industry. He writes, "Even in 1813, witness after witness in the Select Committee of the House of Lords testified that free Indian textile imports (of both finer and coarser varieties) would damage British industry."[60] The British East India Company resorted to policies of imposing internal tariffs and transit duties on Indian goods, dislocation and direct exploitation of the artisans, and forceful reduction of market demand to destroy the industry.[61] Indian textile also lost their overseas market due to the imposition of high import tariffs in Britain.

The Company had an influence on the land tenure system and property rights during that time. In many areas the existing landlords received proprietary rights in land. The Company extracted rents from them without caring much about investment. The landlords passed on this burden of rent to the farmers and the poor farmers struggled to make investments in capital and technology. This system of rent seeking significantly reduced agriculture productivity and trapped farmers into a vicious cycle of poverty. One such institution is the Permanent Settlement concluded by the Cornwallis administration in 1793. It was a grand contract between the Company government and the Bengal landlords. Under the contract, the landlords were admitted into the colonial state system as the absolute proprietors of landed property and the government was barred from enhancing its revenue demands from the landlords. This arrangement institutionalised the alliance between the landlords and the colonial rulers. It also legitimised rent seeking. In a recent study, Banerjee and Iyer (2006) show that these institutional arrangements had and continue to have a significant impact on economic outcome within India. Areas where proprietary

[60] See Dutt (1992), pp. 148-149.

[61] According to Dutt (1992), many artisans were subjected to flogging, imprisonment, and worse (cutting off the thumbs of winders of raw silk has been documented). The domestic demand for textile also reduced significantly due to the decline of the Indian royal courts, as they were the major buyers of the quality products.

rights were given to the landlords have significantly lower agricultural investments and productivity than areas where rights were given to the cultivators.

Therefore, colonisation by the British led to institutional reversal which prevented India from reaching the stage four and develop a home grown efficient capitalist system. The progressive forces within the Indian society which had the capacity (at least theoretically) to push the economy towards large scale industrialisation were systematically destroyed by the existing polity. The domestic extractive institutions were allowed to continue and it strengthened the feudal landlords both economically and politically. These institutional changes systematically destroyed the incentives for private investments into land, capital, and technology. As the incentives changed, so do the comparative advantage. India soon became a net exporter of raw materials and primary products and a net importer of industrial goods. What ensued is two centuries of deindustrialisation and economic slowdown.

It is true that not all of this is reflected in the regression results of chapter 4. What this shows however is the importance of institutions once the economy manages to escape the geographical constraints. This fits perfectly with the positive correlation between institutions which is a product of the institutional history of the country and economic development.

The Americas

When the Europeans first arrived to the Americas in the late fifteenth century, the indigenous American civilization of the Incas and the Aztecs were quite developed both economically and politically. The Incas and the Aztecs developed agriculture which was capable of supporting large population. Their political structures were also very advanced and somewhat similar to the Europeans. The majority of the political power was concentrated in the hands of the minority elites and the ruling nobility. If one wants to

make a comparison between the then states of the Europeans and the indigenous Americans, one would be able to point out that there were certain things that the indigenous Americans were able to achieve and there were certain things that they failed to achieve. Whatever it may be, it is secondary to my focus. The important issue is that the European arrival stalled the independent process of development in the Americas. The indiscriminate massacre of the indigenous population and epidemic diseases such as small pox contracted from the Europeans rapidly reduced the indigenous population to an inconsequential level. This allowed the Europeans to grab more indigenous land and erect institutions which are along the lines of institutions in Western Europe. However, in case of the Spanish colonies in South America, the Spanish colonial rulers continued with the Inca tribute system and other rent seeking institutions for their own benefit. Engerman and Sokoloff (2001) argue that the institutional differences between the North and the South Americas after the European conquest stems from the factor endowment of the two continents. The following is their theory.

They argue that the factor endowment in the South supported resource extraction and rent seeking. Huge reserves of precious metals supported mining. The climate in many of the southern colonies was suited for growing sugar which can be efficiently produced in large plantations. To enjoy economies of scale and extract maximum value, the owners of mines and plantations employed large population of slave labour. These labourers had no rights and no assets. This contributed to the extreme differences in the distributions of landholding, wealth, and political power which shaped future institutions in the South. In contrast, the factor endowment in the Northern colonies supported small family-sized farms and farming of grains and livestock. This led to the development of a society with relatively equitable distribution of wealth and political power and institutions which honours private

property rights. Better institutions of the North contributed to her development as an advanced capitalist society whereas for the South it was always a struggle thereafter.

This shows that two different style of colonization policies and hence institutions created two different types of capitalist societies in the Americas after the European conquest. Many of the old indigenous institutions were replaced after the conquest. The economic performance of the two continents thereafter depended on the new institutions. The Engerman and Sokoloff (2001) theory shows that the difference in living standards of the two continents can be explained by institutional differences which have its root in the respective factor endowments. In the regression analysis I do not take into account the effects of factor endowments in institutions building. But the results show that there is positive correlation between institutions and the level of development on the average when I consider a sample which includes countries from both the Americas.

6.3 Does These Observations Match with the Cross-Country Empirics?

Asking the above question in itself may horrify historians as they may find the research strategy extremely oversimplified. There is no doubt that basing ones judgement on the historical process of development on a single cross-section regression is dangerously oversimplified. However, relating the partial correlations with the historical facts can give us an extra insight or two when there is an urgent need to make the extra step to resolve the causality issues. Therefore, it is worth asking this question even though it may not yield a precise answer.

In this section I try to relate the outlined broad structure which I have presented in the previous section with the regression results. Can the results explain the dynamics of the process? The answer is no but the historical facts and the broad structure can give me some hint on why there is correlation in the data in the way it is.

The results reported in chapters 4 and 5 shows that both institutions and diseases are important explanators in a sample of former European colonies. However when we restrict the sample into African economies, malaria becomes the only significant explanator. This is consistent with the historical evidence and the broad structure.

The human population in Western Europe, China, India, and the Americas experienced relatively less geographical constraints on agriculture which enabled them to escape Malthusian cycles (which I have called stage one in the broad structure) and move towards capitalism. Once the Malthusian cycle was broken, it became more important to have the right institutions which would help the progress towards capitalism. Western Europe was more successful than China, India, and South Central America in this regard and the data shows this pattern. Lack of appropriate institutions created high level of inequality in the distribution of wealth and political power in the society which in turn destroyed the incentives for future investments in physical and human capital. These institutions persisted over time and still affect the economic performance of these regions. All this is reflected by the pooled sample estimates.

In contrast the disease environment constrained agricultural production by much more in Africa and it remained trapped into the Malthusian cycle of stage one for a long time. Even today Africa suffers from high disease incidence and chronic poverty. It reduces the years of healthy life expectancy and the productivity of labour. It may also affect growth indirectly by delaying the process of demographic transition. With high infant mortality and low life expectancy economic agents may focus more on the quantity of babies produced rather than their quality. This slows down human capital accumulation which has a high growth cost in the long-run. The lack of rule of law and ceaseless conflicts complicates the situation of poverty trap even further. However the data does not show any systematic effect of rule of law on income.

Of course not all of this mechanism is explained by the regressions. The regressions only show the net effect of these factors on income. To untangle the mechanism empirically one needs to develop better datasets with more historical information. One also needs to apply better estimation techniques linking multiple factors. This is something that has received some attention lately.[62] However, there is a lot that remains to be done in this area.

Finally, to summarise it is perhaps fair to say that the colonies which escaped the stage one either did well or stagnated depending on the quality of their institutions. Countries with high disease incidence struggled to escape the poverty trap. Weak institutions also added to their problem. Hence, it is not just 'institutions rule' or 'diseases dominate.' The conclusion depends on the continent's institutional history and geography.

6.4 Summary

In this chapter I try to marry the empirical results with historical evidence. I try to describe the development of Western Europe by using a broad structure. I divide the process of development of Western Europe into four different stages. I compare and contrast the European development process with the development processes in Africa, China, India, and the Americas using the broad structure. I also formalise the African development process using an overlapping generation model. Then I show that the historical evidence roughly matches with the empirical findings. Therefore, the outcome of the empirics is not just 'institutions rule' or 'diseases dominate.' It depends on the history and geography of the continent that the country belongs to.

[62] See Acemoglu et al. (2005).

CHAPTER 7

WHICH INSTITUTIONS MATTER MOST FOR GROWTH?

"The philosophers have only interpreted the world in various ways; the point is to change it."- Karl Marx (1888), Theses on Feuerbach

Chapters 4 and 5 show the importance of institutions and malaria in explaining a large proportion of the variation in economic development. However, it does not say exactly which institutions matter. To find out we need to go beyond the framework of using the rule of law index as an overall measure of institutions.[63]

The first attempt in this direction is Acemoglu and Johnson (2005). They distinguish between 'property rights institutions' and 'contracting institutions' and test the relative contributions of each of these institutions on long-run economic development. Using the instrumental variable approach similar to their earlier work (Acemoglu et al. 2001) they find that the 'property rights institutions' have a first order effect on economic development whereas the 'contracting institutions' impact indirectly. However, it appears that their study suffers from identification problems. The log settler mortality instrument used to identify the contribution of 'property rights institutions' is also correlated with human capital and the correlation is independent of the correlation between the first two variables.

In this chapter I revisit the debate over the relative contribution of different types of institutions in economic growth. Instead of adopting Acemoglu and Johnson's (2005) narrow classification of 'property rights institutions' and 'contracting institutions' I adopt Rodrik and Subramanian's (2003) much broader and exhaustive classification of market creating, market regulating, market stabilising, and market legitimising institutions. I identify a proxy measure of each of these institutions and test their relative contribution to growth. In contrast to the commonly used instrumental variable method of estimation, I use

[63] Rodrik et al. (2004) also uses the rule of law index as an overall measure of institutions.

the GMM.[64] The advantage of using panel data is that it can exploit the time variation in the data. It also can be interpreted as a method which takes into account the role of history.

The results show that strong 'market creating institutions' characterized by the adequate protection of private property and contract enforcement are growth enhancing. The 'market stabilising institutions' that ensures macroeconomic stability and does not undertake distortionary policies boosts investor confidence and are also good for growth. I also notice that there is a growth maximizing level of 'market regulation' beyond which it increases red tape and kills the incentive for investment. The effect of 'market legitimising institutions' is statistically insignificant.

The chapter is organised as follows. The first section presents the growth model which includes four different institutions as the variables of interest and schooling, trade and initial income as control variables. The exclusion of malaria from this set is due to the lack of relevant time series information on the variable. The four different institutions are market creating, market regulating, market stabilizing, and market legitimizing institutions. This classification is adopted from the following review articles - Rodrik (2000) and Rodrik and Subramanian (2003). The second section discusses a recently published related article by Acemoglu and Johnson. Acemoglu and Johnson (2005) examine the relative impact of property rights institutions and contracting institutions on income levels in 1995 using the instrumental variable strategy as they have done in their earlier works. I show that this work suffers from identification problem. In the third section I propose the generalised method of moments (GMM) strategy to estimate the dynamic panel data model and discuss the data. Section 4 presents the regression results and section 5 concludes.

[64] It is perhaps appropriate to clarify at this point that econometrically the instrumental variable method using a cross-section dataset is a special case of GMM. However, what we refer to here is a method of estimation using a cross-section dataset (instrumental variable method) vis-a-vis a method of estimation of a dynamic model using panel dataset (GMM).

7.1 The Model

I start with equation (2.7), the growth specification that I derived in chapter 2. The only difference between equation (2.7) and this model is η_i, the unobserved country specific effect which I do not include in the cross-section equation (2.7). The following is the model:

$$\hat{y}_{iT} = \alpha y_{it} + \gamma \mathbf{Z}_{iT} + \eta_i + \varepsilon_{iT} \qquad (7.1)$$

Where $\hat{y}_{iT} \equiv \frac{1}{T-t}[y_{iT} - y_{it}]$, the term y_{it} represents log GDP *per capita* in some initial year t, $\mathbf{Z}_{iT}$ is a vector of 'deep determinants' which includes trade, institutions, and schooling. Malaria is excluded from this set due to the non availability of relevant time series data on the variable.

One can decompose $\mathbf{Z}_{iT}$ into a vector of institutions $\mathbf{I}_{iT}$ (variables of interest) and a vector of other controls $\mathbf{X}_{iT}$ and rewrite the model as follows:

$$\hat{y}_{iT} = \alpha y_{it} + \beta \mathbf{I}_{iT} + \phi \mathbf{X}_{iT} + \eta_i + \varepsilon_{iT} \qquad (7.2)$$

Where $\gamma = (\beta \phi)$.

Most empirical work linking institutions and economic development implicitly or explicitly assumes that the institutions persist. Acemoglu et al. (2001, 2002), and Banerjee and Iyer (2005) all identify extractive colonial institutions as the root cause of the current economic plight of the former colonies using this assumption. Even though these studies strongly argue in favour of this assumption[65], evidence showing otherwise is not rare. Glaeser et al. (2004) shows that many of the institutions measures used by Acemoglu et al. (2001) and Rodrik et al. (2004) are highly volatile which leads them to believe that they are

[65] See Acemoglu et al. (2001, 2002) and Acemoglu and Johnson (2005).

outcome measures rather than measures of deep determinants.[66] Real world examples of this volatility are not difficult to find. Haiti has swung between democracy and dictatorship over the last three decades frequently changing its constitution and other institutions. The situations in Afghanistan, Liberia, and Sierra Leone are not too different either. This volatility however cannot be solely attributed to the current institutional performance. Some component of it certainly has its roots in the colonial past and colonial institutions. Therefore, to explain this phenomenon one needs to develop a framework which takes account of both volatility and persistence in institutions.

One way to handle this is to divide the data generating process of institutions into two components – the time invariant country specific component which is deep, and the time varying component which is also an outcome of the time invariant component. In notational terms this implies $\mathbf{I}_{iT}$ has two subcomponents - a time invariant and country specific component $\bar{\mathbf{I}}_i$, and a time varying component $\mathbf{I}^o_{iT}$ which is the outcome of $\bar{\mathbf{I}}_i$. I assume that all standard measures of institutions can be theoretically subdivided into these two components even though it may be practically impossible to identify them separately. I also assume that $\bar{\mathbf{I}}_i$ and $\mathbf{I}^o_{iT}$ are correlated even though it may not be possible to determine the degree of correlation.

Therefore, by incorporating $\mathbf{I}_{iT} = \bar{\mathbf{I}}_i + \mathbf{I}^o_{iT}$ we can rewrite the model as

$$\hat{y}_{iT} = \alpha y_{it} + \beta \mathbf{I}^o_{iT} + \beta \bar{\mathbf{I}}_i + \phi \mathbf{X}_{iT} + \eta_i + \varepsilon_{iT} \qquad (7.3)$$

Combining $\beta \bar{\mathbf{I}}_i$ and η_i we get

[66] Glaeser et al. (2004) shows that Acemoglu et al. (2001) and Rodrik et al. (2004) uses measures of institutions from the ICRG and PRS database and these measures do not reflect anything permanent or durable features of the institutions. They are rather measures of policy outcome. It is important to note that the permanency or the depth of the deep factors, in particular institutions, has been relied on to justify the use of historical instruments like log settler mortality, log population density in 1500 etc.

$$\hat{y}_{iT} = \alpha y_{it} + \beta \mathbf{I}^{o}_{iT} + \phi \mathbf{X}_{iT} + \mu_i + \varepsilon_{iT} \qquad (7.4)$$

Where $\mu_i = \beta \overline{\mathbf{I}}_i + \eta_i$

The institutions vector $\mathbf{I}_{iT}$ includes market creating, market regulating, market stabilising, and market legitimising institutions.

Market creating institutions are those that protect property rights and ensure that the contracts are enforced. Rodrik and Subramanian (2003) calls them market creating since, in their absence, either the markets do not exist or they perform very poorly. In a recently published article Acemoglu and Johnson (2005) also uses these two variants of institutions. They however call them property rights institutions and contracting institutions. The theory behind these institutions is also associated with North (1981). North argues that good institutions simultaneously provide checks against expropriation of private property by the government or other powerful political groups and supports private contracts. This ensures that a broad cross section of the society have incentives to invest and take part in economic life. This is essential for the creation of a market.

Market regulating institutions are those that prevent market failure and help to sustain the growth momentum over the long-run. These institutions aim to stop any market participant from engaging in fraudulent or anti-competitive behaviour, to reduce the risk of imperfect information, and to minimise the overall transaction costs of economic exchange in a market. From a firm's point of view, these institutions help them to internalize technological and other non-pecuniary externalities by reducing transaction costs. Anti-trust laws, financial and securities regulatory authorities are good examples of regulatory institutions. Rodrik (2000) argues that one of the preconditions of a successful market economy is effective regulatory vigilance. Otherwise, the growth momentum can easily be lost over the long-run.

Market stabilizing institutions are those that build resilience towards shocks, reduce inflationary pressure, minimise macroeconomic volatility and avert financial crises. The recent experiences in Latin America and in South East Asia indicate that financial markets are inherently volatile and financial instability can easily transmit into the real economy resulting into a larger crisis in the absence of appropriate and effective stabilisation institutions. A high inflation rate and increased macroeconomic volatility not only affects the living standard of the household, but it also affects the firm by limiting credit availability and increasing the cost of credit. Therefore, the role of the central bank is paramount in terms of stabilising the economy in the event of a shock.

Market legitimising institutions are those that handle redistribution, manage social conflict, and provide social protection and insurance in the event of a shock. In a modern market economy idiosyncratic risk to income and employment are widespread. An economy experiencing sustained economic growth coupled with rapid technological progress is often observed to change its focus from a low skilled sector to a high skilled one. This is also accompanied by obvious changes in the labour demand. The demand for high skilled workers dominates over the demand for low skilled ones resulting into massive job cuts in the low skilled sector. This affects income and welfare of low skilled workers. Redistribution, social protection and insurance are critically important in this situation to avoid social conflict. This redistributive role is being performed by market legitimising institutions in order to make market economy compatible with social stability and social cohesion. Examples of market legitimising institutions include democracy, free election, pension systems, unemployment insurance schemes, and other social funds.

7.2 Recently Published Related Work

Acemoglu and Johnson (2005) examine the relative impact of property rights institutions and contracting institutions on long-run economic growth. They estimate a

model with log GDP per capita in 1995 as the dependent variable and property rights institutions and contracting institutions as explanatory variables using the cross-section instrumental variable approach. They use log settler mortality as an instrument for property rights institutions and British legal origin as an instrument for contracting institutions. Their results show that property rights institutions have a first-order effect on long-run economic growth. Contracting institutions however does not have direct effects. They also show that the result is robust even when they control for religion, latitude, and log inflation.

Table 7.1: **Identification Problems in Acemoglu and Johnson (2005)**

Dependent Variable	**Log per Capita GDP in 1995**		
	Model (1) obs=41	Model (2) obs=43	Model (3) obs=39
Panel A: Second Stage of 2SLS			
Legal Formalism	0.06 (0.1735)	0.40** (0.1712)	0.18** (0.0880)
Constraint on Executive	0.77*** (0.1869)		
Average Protection against Expropriation		1.12*** (0.2159)	
Total Years of Schooling (1995)			0.42*** (0.0583)

Panel B: First Stage for Property Rights Institutions (Protection against Expropriation or Executive Constraint) and Total Years of Schooling (1995)				
Dependent Variables	Constraint on Executive obs=41	Average Protection against Expropriation obs=43	Total Years of Schooling (1995)	
			obs=55	obs=51
Log Settler Mortality	-0.91*** (0.2104)	-0.70*** (0.1467)	-1.51*** (0.2339)	-1.32*** (0.2241)
English Legal Origin	-0.28 (0.4617)	0.46* (0.3237)	0.26 (0.4925)	-0.43 (0.4896)
Constraint on Executive			0.27** (0.1501)	
Average Protection against Expropriation				0.72*** (0.1892)
R^2	0.3285	0.4238	0.6356	0.7016

Notes: ***, **, and * indicates significance level of 1%, 5%, and 10% respectively against a one sided alternative. Figures in the parentheses are the respective standard errors. All the regressions reported above are carried out with an intercept. English Legal Origin is used as an instrument for Legal Formalism.

This study like Rodrik et al. (2004) and Acemoglu et al. (2001) also suffers from identification problem. A regression analysis similar to what I have done in Table 4.2 shows that the log settler mortality instrument is correlated with the total years of schooling in 1995 and the correlation is independent of the correlation between total years of schooling and property rights institutions.

The specification in Model (1) of Table 7.1 is identical to the specification reported in column (1) of Table 4 in Acemoglu and Johnson (2005).[67] They use Legal formalism and constrained on the executive as measures of contracting institutions and property rights institutions respectively. The instruments used for contracting and property rights institutions are English legal origin and log settler mortality respectively. By re-estimating the model using their definition of the variables I find a similar answer. Constraint on the executive has a strong positive effect and the coefficient estimate is statistically significant at the 1% level. Estimating the same model using an alternative measure of property rights institutions (protection against expropriation) also confirms findings in column (5) of Table 4 in Acemoglu and Johnson (2005). But if I replace property rights institutions with total years of schooling and re-estimate the model using the same set of instruments, then schooling comes out to be statistically significant (see Model (3) in Table 7.1). This implies that the instruments can predict schooling as good as they predict property rights institutions. One may argue that this is happening because of the strong correlation between schooling and property rights institutions. A closer look at the first stage regressions involving total years of schooling reveal otherwise. The correlation between schooling and log settler mortality is independent of the correlation between schooling and property rights institutions (see the 3rd and 4th column of Table 7.1, Panel B). The partial R^2 calculations of these first stage regressions also show that the 45% of the variation in schooling is

[67] See p. 972 of Acemoglu and Johnson (2005).

explained by log settler mortality whereas 6% of the variation is explained by executive constraints and 23% by expropriation risk.

Therefore this gives us a clear message. Their result suffers from identification problems and does not reveal the true contribution of property rights institutions and contracting institutions to economic development. This is largely due to the use of the log settler mortality instrument.

7.3 Estimation Strategy and Data

7.3.1 Estimation Strategy

To estimate equation (7.4) I use the Blundell and Bond (1998) dynamic panel data estimation method. This method takes into account the time series variation in the data which helps to explain the dynamics. The endogeneity problems are taken care of by using lagged values of institutions and other control variables as instruments. It also takes into account the role of history without using any historical instruments and yields consistent estimates.

In order to demonstrate how this method takes care of history, let's rewrite equation (7.4) as follows:

$$y_{iT} = ((T-t)\alpha + 1)y_{it} + (T-t)\beta \mathbf{I}^{o}_{iT} + (T-t)\phi \mathbf{X}_{iT} + \mu_i + \varepsilon_{iT} \qquad (7.5)$$

Estimating the above equation using the pooled cross-section method will yield biased estimates since y_{it} is correlated with the composite error term.[68] One may argue why not eliminate the country specific fixed effect by differencing the data. However, differencing the data has its own problems.

[68] To be more accurate y_{it} is correlated with $\bar{\mathbf{I}}_i$ and hence μ_i.

Let us assume that $t = T\text{-}1$.[69] Now by first differencing equation (7.5) I get the following:

$$\Delta y_{iT} = (\alpha + 1)\Delta y_{iT-1} + \beta \Delta \mathbf{I}^{o}_{iT} + \phi \Delta \mathbf{X}_{iT} + \Delta \varepsilon_{iT} \qquad (7.6)$$

Expanding this yields

$$y_{iT} - y_{iT-1} = (\alpha + 1)[y_{iT-1} - y_{iT-2}] + \beta[\mathbf{I}^{o}_{iT} - \mathbf{I}^{o}_{iT-1}] + \phi \Delta \mathbf{X}_{iT} + [\varepsilon_{iT} - \varepsilon_{iT-1}] \quad (7.7)$$

The terms y_{iT-1} and ε_{iT-1} are clearly not independent from each other implying that Δy_{iT-1} and $\Delta \varepsilon_{iT-1}$ are correlated. Hence, least square estimation of this equation will yield biased estimates. Therefore, some sort of instrumental variable approach is required so that the instrument is correlated with Δy_{iT-1} but uncorrelated with $\Delta \varepsilon_{iT}$. One such approach is the Arellano and Bond (1991) difference GMM estimator. The estimator exploits the following theoretical moment conditions.

$$E(\mu_i) = E(\varepsilon_{iT}) = 0, E(\mu_i \varepsilon_{iT}) = 0, \& E(\varepsilon_{iT} \varepsilon_{iT-s}) = 0 \forall s \geq 2 \qquad (7.8)$$

In other words, it uses lagged levels of y_{iT}, $\mathbf{I}_{iT}$, and $\mathbf{X}_{iT}$ as instruments. However, when the explanatory variables are persistent over time then the lagged levels of these variables are weak instruments for first difference. Blundell and Bond (1998)[70] mitigate this problem by using an additional moment condition. This also becomes necessary when the sample size is small. The additional moment condition is the following:

$$E[\mu_i(\varepsilon_{iT} - \varepsilon_{iT-1})] = 0 \qquad (7.9)$$

In other words, the Blundell and Bond (1998) method uses current differences and lagged levels of explanatory variables as instruments. Since it uses lagged levels of the explanatory variables as instrument, therefore, the instrument matrix should include $\bar{\mathbf{I}}_i$

[69] In fact in my data $t = T\text{-}5$. I am assuming $t = T\text{-}1$ to simplify the algebra.

[70] For a detailed discussion on Blundell and Bond (1998) estimation, see Technical Appendix TA6 (p. 175).

which is a component of $\mathbf{I}_{iT-k}$ where $k \geq 1$.[71] This implies that $\mathbf{I}_{iT}^{o}$, the outcome component of the current measures of institutions are instrumented by $\bar{\mathbf{I}}_{i}$, the deep historical component of the current measures of institutions. This takes into account the role of history in the evolution of these deep factors over time. The advantage of this method over the cross-section instrumental variable method is that it manages to overcome the identification problem. The lagged institutions identify the current institutions whereas the lagged schooling identifies the current schooling.

The consistency of this GMM estimator depends on the validity of the instruments. There are two specification tests suggested by Arellano and Bond (1991) and Blundell and Bond (1998) which can check the validity of the instruments.

The first is the Sargan test of over-identifying restrictions, which checks whether the instruments as a group appear exogenous. The Sargan test statistic is not robust to heteroskedasticity and autocorrelation. An alternative is Hansen's J statistic which is robust to heteroskedasticity and autocorrelation and hence I use this variant of the test.

The second test examines the hypothesis that the error terms are not second-order serially correlated. A rejection of the null hypothesis implies that the lags of the dependent variables are endogenous and hence bad instruments. The outcomes of these tests are reported in the results table.

Therefore, it appears from the above discussion that the growth regression model as opposed to the levels framework of Rodrik et al. (2004) and Acemoglu and Johnson (2005) can take care of both institutional persistence and institutional volatility. The Blundell and Bond (1998) estimation method also overcomes the identification problem of the commonly used cross-section instrumental variable method.

[71] For a more general discussion on the instrument matrix of the Blundell and Bond (1998) estimator, see Technical Appendix TA6. For a more detailed review of GMM estimation in empirical growth models see Bond et al. (2001).

7.3.2 The Dataset

The dataset for the analysis include measures of per capita GDP growth and levels, measures of institutions, measure of schooling, and trade share. The data covers the period 1980 to 2004 and approximately five year averages are calculated to smooth out business cycle fluctuations. The 1980 data point is the average over the period 1980-82, the 1985 data point is the average over the period 1983-87, the 1990 data point is the average over the period 1988-1992, the 1995 data point is the average over the period 1993-97, the 2000 data point is the average over the period 1998-2001, and the 2004 data point is the average over the period 2002-2004. There are missing observations in the dataset and hence the panel is unbalanced. But the problem of missing observations is fairly minor.

The GDP per capita purchasing power parity (PPP) measured at constant 2000 international dollars data is obtained from the World Development Indicator (WDI) online database. This gives information for 127 countries. The reason behind using WDI data instead of Penn World Table is the larger time coverage of the former. WDI data allows me to extend the study to 2004. Annualised growth rates are calculated using the formula $\hat{y}_{iT} \equiv \frac{1}{5}(y_{iT} - y_{iT-5})$. In the process of calculating growth rate, I lose the 1980 observation. Otherwise the data on growth rates are fairly complete.

I use four measures of institutions. The Law and Order index measures the effectiveness of market creating institutions. A high Law and Order score implies better protection of private property and efficient enforcement of contracts. The assessment is made on a six point scale with a high score implying better law and order. The index is available from 1984 so I can only compute five data points for Law and Order.

An index which takes into account regulation in the credit market, labour market, and business in general measures the effectiveness of market regulating institutions. It

comes in five year intervals and covers the period 1980 to 2004. The effectiveness is measured on an eleven point scale ranging from 0 to 10 with a high score implying fewer regulations. One can debate whether fewer regulations imply better regulatory institutions. It can very well be the case that fewer regulations imply more foul play eventually leading to a market failure. However, the publishers of the data claim that fewer regulations can increase transparency in the system and reduce the amount of red tape which will allow regulatory institutions to function efficiently. In fact the regression analysis shows that there is an optimal level of regulation for growth. This measure is obtained from Gwartney and Lawson. (2005).

An index which takes into account: a) average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years, b) standard inflation variability in the last five years, and c) recent inflation rate measures the effectiveness of the central bank is the measure of market stabilising institution. This measure also ranges from 0 to 10 with a high score implying more sound money. It comes in five year intervals and covers the period 1980 to 2004. The source of this measure is Gwartney and Lawson. (2005).

Finally, democracy index from the Polity IV dataset measures the effectiveness of market legitimising institutions. Similar to the regulation and stabilization index, this measure also ranges from 0 to 10 with a high score implying more democratic system. Democracy data covers the period 1980 to 2004.

The schooling measure is from the Barro and Lee (2000) dataset. It measure the average schooling years in the total population. The schooling data spans the period 1980 to 2000 and therefore the 2004 data point is missed out in this case.

The trade share measure that I use for this chapter is from WDI except a few exceptions which I have mentioned in the Data Appendix. This is done to maintain parity

with the GDP per capita data. It is one of the simplest measures of trade openness where trade is expressed as a share of GDP.

Table 7.2. **Summary Statistics**

Variables	Number of obs.	Mean	Standard Deviation	Minimum	Maximum
Economic Growth and Development					
Growth $(\hat{y}_{iT})$	629	0.014	0.031	-0.10	0.35
Log Initial Income (y_{iT-5})	629	8.4	1.13	6.01	10.88
Trade Openness					
Log Trade Share of GDP (LTRS)	754	4.19	0.59	2.43	6.01
Market Creating Institutions					
Law and Order (LO)	507	3.7	1.5	0.3	6
Market Regulating Institutions					
Regulation of Credit, Labor, Business (MR)	616	5.6	1.1	2.5	8.8
Market Stabilizing Institutions					
Sound Money Index (SM)	634	7.5	2.5	0	9.8
Market Legitimizing Institutions					
Democracy Index (DEMOC)	659	5.0	4.1	0	10
Schooling					
Total Years of Schooling (TYS)	482	5.4	2.9	0.4	12.3

Notes: For a detailed discussion of the definition and source of these variables, see Data Appendix.

More detailed description of the dataset including sources is available from the Data Appendix. Table 7.2 presents the descriptive statistics for all of these variables.

The correlation matrix is presented in Table 7.3. The pairwise correlation shows that all the institution measures, schooling, and log trade share are positively correlated with growth.

Table 7.3. **Pairwise Correlation (obs=323)**

	Growth $(\hat{y}_{iT})$	Log Initial Income (y_{iT-5})	Law and Order (LO)	Democracy (DEMOC)	Sound Money Index (SM)	Regulation of Credit, Labor, Business (MR)	Total Years of Schooling (TYS)	Log Trade Share of GDP (LTRS)
Growth $(\hat{y}_{iT})$	1.0000							
Log Initial Income (y_{iT-5})	0.1887	1.0000						
Law and Order (LO)	0.3631	0.7243	1.0000					
Democracy (DEMOC)	0.1639	0.6824	0.5321	1.0000				
Sound Money Index (SM)	0.3075	0.2753	0.3770	0.1796	1.0000			
Regulation of Credit, Labor, Business (MR)	0.1812	0.4437	0.4287	0.5066	0.4089	1.0000		
Total Years of Schooling (TYS)	0.3071	0.8511	0.7217	0.6237	0.2746	0.4899	1.0000	
Log Trade Share of GDP (LTRS)	0.1729	0.1250	0.1969	0.0626	0.2707	0.2740	0.1497	1.0000

7.4 Regression Results

Main Results:

The model is estimated by using the Blundell and Bond (1998) generalised method of moments (GMM). In columns (1), (2), (3), and (4) of Table 7.4 the institutions measures are used one at a time. Column (1) shows that market creating institutions (law and order) has positive and statistically significant effects on growth. However, the specification fails the Hansen test and hence the estimates are not reliable.

The specification presented in column (2) shows that there is no direct relationship between market regulating institutions and growth when the effect of other institutions are not controlled for.

The specification in column (3) uses strong money index (market stabilising institutions) as a proxy measure of institutions and finds it to be statistically significant. The specification however fails the Hansen test and the test for AR (2) in the residuals.

Column (4) uses democracy (market legitimising institutions) as a proxy measure of institutions showing democracy has no direct effect on growth.

Column (5) presents the preferred specification. In this specification I control for all the four different types (market creating, market regulating, market stabilising, and market legitimising) of institutions. The regression shows that law and order (market creating institutions), strong money index (market stabilising institutions), and total years of schooling positively impacts growth and the coefficient estimates are statistically significant. A one sample standard deviation (1.5 point) increase in law and order on its own increases annual growth on the average by 0.8% approximately.[72] Holding all other factors constant a similar increase (2.5 point) in strong money index increases annual

[72] The coefficient estimates relate exactly to equation 7.4 with the dependent variable $\hat{y}_{iT} \equiv \frac{1}{5}(y_{iT} - y_{iT-5})$.

growth by 0.8%. The coefficients on the regulation of credit, labour, and business (market regulating institutions) and democracy index (market legitimising institutions) are statistically insignificant. The institutions measures are jointly significant at the 1% level (see p-value of the joint F test).

This shows that the 'market creating institutions' (protection of private property and contact enforcement) and the 'market stabilising institutions' matters the most among all other institutions when it comes to economic growth.

Poor quality of property rights protection and contract enforcement dampens the incentive to invest and often crowds out investment from the domestic economy. The lack of private property protection raises the cost of foreign investment discouraging foreign investors to invest. The complete absence or the presence of a weak contract enforcement mechanism causes organisational inefficiency (Williamson 1985) and raises the operating costs of investments eating up re-investable surpluses. The risk related to asymmetric information also gets bigger if the contract enforcement mechanism is weak.

The positive coefficient on strong money index (market stabilising institutions) implies that the overall macroeconomic environment is crucial for growth. In an integrated world economy - both economically and financially - the real dangers from a shock are more potent than ever before. In the event of a shock a well functioning market stabilising institution resorts to policies which minimise the cost to the economy without affecting investor confidence. It also refrains from undertaking distortionary macroeconomic policies such as high inflation, large budget deficits, and overvalued exchange rate which can destroy incentives for investment in the long run. Therefore it is important for the central bank, treasury and other market stabilising institutions to get things right at least on the average to generate economic growth. Acemoglu et al. (2003) argues that these institutional performances can be traced back to the colonial institutions. Countries that were settler

colonies inherited better institutions from their colonial past and delivers better macroeconomic policies. Whereas countries that were non-settler colonies inherited extractive institutions from their colonial past and delivers poor and distortionary macroeconomic policies. They use the 2SLS strategy and the log settler mortality instrument to establish causality. This has obvious problems of identification similar to what I have demonstrated in section 7.2.[73] In contrast, this exercise takes care of history by using the lagged values of 'market stabilising institutions' as instruments.[74] However, the role of history cannot be separately identified from good policy. Therefore, ideally it should be interpreted as the effect of the institutional change over the last two decades which has its origin both in history and in current policy.

[73] For a summary of the shortcomings of this study see Technical Appendix TA7 (p.177).

[74] This refers to $\overline{\mathbf{I}}_i$ in the model.

Table 7.4. **Relative Contribution of Institutions to Economic Growth: Blundell and Bond GMM Estimates**

	Dependent Variable: Annualised Growth $(\hat{y}_{iT})$							
	(1)	(2)	(3)	(4)	**(5)**	(6)	(7)	(8)
Institutions								
Law and Order (LO)	0.004**				0.005**	0.005**	0.005***	0.005***
	(0.0020)				(0.0020)	(0.0020)	(0.0018)	(0.0018)
Regulation of Credit, Labour, Business (MR)		-0.001			-0.003	0.023	-0.003	0.023
		(0.0029)			(0.0024)	(0.0153)	(0.0025)	(0.0148)
Sound Money Index (SM)			0.003***		0.003***	0.002**	0.003***	0.002**
			(0.0009)		(0.0009)	(0.0009)	(0.0009)	(0.0009)
Democracy Index (DEMOC)				4e-04	-3e-04	-0.001	0.001	3e-04
				(0.0011)	(0.0009)	(0.0010)	(0.0021)	(0.0021)
Other Controls								
Log Initial Income (y_{iT-5})	-0.005	-0.005	-4e-04	-0.011	-0.01*	-0.012**	-0.008	-0.01*
	(0.0080)	(0.0080)	(0.0070)	(0.0084)	(0.0063)	(0.0059)	(0.0063)	(0.0059)
Total Years of Schooling (TYS)	0.004	0.007**	0.005*	0.01**	0.006**	0.007***	0.005**	0.006***
	(0.0029)	(0.0034)	(0.0028)	(0.0038)	(0.0026)	(0.0024)	(0.0025)	(0.0024)
Log Trade Share (LTRS)	0.028**	0.029**	0.015**	0.017**	0.008	0.005	0.008	0.005
	(0.0109)	(0.0111)	(0.0077)	(0.0082)	(0.0058)	(0.0058)	(0.0055)	(0.0053)
MR^2						-0.002*		-0.002*
						(0.0013)		(0.0013)
$DEMOC^2$							-1e-04	-1e-04
							(0.0002)	(0.0002)
Specification tests (p values)								
Joint F test (Institutions)					0.0027	0.0079	0.0030	0.0044
Hansen test	0.060	0.109	0.009	0.157	0.351	0.670	0.776	0.966
Test for AR(1) in residuals	0.001	0.001	0.000	0.001	0.001	0.002	0.001	0.002
Test for AR(2) in residuals	0.291	0.325	0.032	0.251	0.174	0.166	0.175	0.174
Observations/Countries	348/87	363/93	369/93	370/95	323/83	323/83	323/83	323/83

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Standard errors are reported in the parenthesis. Hansen test is the test of the H_0: the instruments as a group are exogenous. Hansen test statistic from two step Arellano & Bond estimations is reported which is robust to heteroskedasticity or autocorrelation. Arellano and Bond AR(1) & AR(2) tests in residuals are also reported. Note that to pass these tests, one has to reject the null of no AR(1) and fail to reject the null of no AR(2).

Regulation of credit, labour, and business (market regulating institutions) do not matter for growth. This is what comes out of the linear specification reported in column (5). However, when nonlinearity is introduced in the model in column (6), I observe that the coefficient estimate on the market regulating institutions squared is negative and statistically significant. The coefficient on the linear term is positive. This implies that there is a particular level of regulation that maximises growth. That level turns out to be 4.93 which lie well within the sample range of the market regulating institutions variable (which is 0 to 10). The optimal level of regulation is obtained by equating the partial derivative of growth with respect to MR to zero. This implies that too much or too little regulation is not good for growth. Too little regulation encourages anti-competitive behaviour among the firms and can lead to market failure. Too much regulation on the other hand can lead to red tape which has tangible costs to the economy. The nonlinear effect of regulation on growth is preserved even when I control for nonlinearities in democracy index in column (8).

Observing that democracy (market legitimising institutions) does not matter in the linear specification we try to check for nonlinearity in a similar fashion as in the case of 'market regulating institutions'. Column (7) estimates show that there is no evidence of nonlinearity as far as democracy is concerned. This implies that democracy is not a necessary condition for economic growth. An economy can generate steady economic growth even without a democratic polity if the dictatorial state honours private property right, enforces contracts, and handles the macroeconomic situation judiciously. The Chinese case is perhaps a good example of this. I will discuss more about this in the next section.

Table 7.5. **Robustness Check: Estimating the Model using Alternative Methods**

	Dependent Variable: Annualised Growth $(\hat{y}_{iT})$				
	Cross-section OLS	Pooled OLS	Fixed Effect	GMM Arellano & Bond	GMM Blundell & Bond
Log Initial Income (y_{iT-5})	-0.01***	-0.01***	-0.05***	-0.08***	-0.01*
	(0.0046)	(0.0025)	(0.0059)	(0.0117)	(0.0063)
Law and Order (LO)	0.005**	0.005***	0.004***	0.004**	0.005**
	(0.0023)	(0.0012)	(0.0013)	(0.0015)	(0.0020)
Regulation of Credit, Labour, Business (MR)	-0.003	-0.001	0.001	0.004**	-0.003
	(0.0028)	(0.0015)	(0.0018)	(0.0021)	(0.0024)
Sound Money Index (SM)	0.003**	0.002***	8.5e-04	1e-05	0.003***
	(0.0013)	(0.0005)	(0.0006)	(0.0007)	(0.0009)
Democracy Index (DEMOC)	0.001	3e-04	4e-04	8e-05	-3e-04
	(0.0008)	(0.0005)	(0.0005)	(0.0007)	(0.0009)
Total Years of Schooling (TYS)	0.003*	0.003***	0.003*	0.002	0.006**
	(0.0016)	(0.0009)	(0.0017)	(0.0029)	(0.0026)
Log Trade Share (LTRS)	0.002	0.003	0.024***	0.022***	0.008
	(0.0032)	(0.0024)	(0.0057)	(0.0070)	(0.0058)
Specification tests (p values)					
Hansen test				0.0004	0.351
Test for AR(1) in residuals				0.0191	0.001
Test for AR(2) in residuals				0.344	0.174
F test that all μ_i=0			0.0000		
F test for overall significance	0.0000	0.0000			
R^2	0.4011	0.2211			
Observations/Countries	--/80	323/--	323/83	240/83	323/83

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% respectively against a two sided alternative. Standard errors are reported in the parenthesis. Hansen test is the test of the H_0: the instruments as a group are exogenous. Hansen test statistic from two step Arellano & Bond estimations is reported which is robust to heteroskedasticity or autocorrelation. Arellano and Bond AR(1) & AR(2) tests in residuals are also reported. Note that to pass these tests, one has to reject the null of no AR(1) and fail to reject the null of no AR(2). Also note that I have used annualized growth rate as the dependent variable in case of the cross-section OLS which is calculated by the formula $\frac{1}{24}\ln(y_{2004}/y_{1980})$.

Robustness:

To check the robustness of the preferred specification reported in column (5) of Table 7.4, I re-estimate the model using cross-section OLS, pooled OLS, fixed effects, and GMM Arellano and Bond methods. This is reported in Table 7.5. The motivation behind doing this is from the recent Monte Carlo findings of Hauk and Wacziarg (2004). They show that in the presence of measurement error and unobserved heterogeneity fixed-effect estimator will tend to inflate the 'conditional convergence' coefficient (the coefficient on initial income) and bias the other coefficients towards zero. When the measurement error is random and there is unobserved heterogeneity then the cross-section OLS performs the best in a Monte Carlo experiment. One likely reason can be that it forces the errors to zero on the average if the time dimension of the sample is relatively large. Many of the variables used in this study are likely candidates of measurement error as there is a possibility of 'halo' effect (see Dollar and Kraay 2003),[75] data misreporting, problems related to index numbers etc. Therefore, it makes perfect sense to check how the estimates behave when alternative estimation techniques are used.

The coefficient on law and order is identical in cross-section OLS, pooled OLS, and GMM Blundell and Bond. The fixed effect estimate biases it towards zero. This is also consistent with the Monte Carlo findings. However in all the cases the estimates are statistically significant.

The effect of strong money index is identical in both the cross-section OLS and the GMM Blundell and Bond. The fixed effect estimate suffers from attenuation bias and is

[75]The 'halo' effect implies that countries with higher income are more likely to be deemed by assessors to have better institutions and other macroeconomic indicators as they are observed to be rich. This may lead to a systematic bias in the measures in favour of the world's rich economies.

insignificantly different from zero. The coefficient estimates are statistically significant except in the case of fixed effects and GMM Arellano and Bond estimators.

Democracy index and regulation index are statistically insignificant across all the methods of estimation except the Arellano and Bond GMM case in which the latter is statistically significant.

The coefficient estimate on initial income remains identical in case of cross-section OLS, pooled OLS, and GMM Blundell and Bond. The GMM Arellano and Bond estimates are not reliable as they fail the specification tests. This may be due to the weak instrument problem that this estimator faces in a small sample.[76] The fixed effect estimate is inflated as predicted by the Monte Carlo findings of Hauk and Wacziarg (2004).

Therefore, in sum the results show that market creating and market stabilising institutions are important for growth. Too much or too little regulation is not good for growth and there exists a growth maximising level of regulation. Democracy does not seem to matter. The main result is also robust across different estimation methods.

7.5 Summary

This chapter estimates the relative contribution of 'market creating', 'market regulating', 'market stabilising', and 'market legitimising' institutions using the GMM. 'Market creating institutions' protect property rights and ensure contract enforcement; 'market regulating institutions' deal with externalities, economies of scale, and imperfect information; 'market stabilising institutions' ensure low inflation and macroeconomic stability; and 'market legitimising institutions' manage redistribution and minimise social conflict. I find that strong 'market creating institutions' and 'market stabilising institutions' are growth enhancing. Protection of private property creates incentives for investment

[76] It is also worth noting that if the Arellano and Bond moment conditions are rejected by a Sargan or Hansen test, then the Blundell and Bond estimator is also invalid since it uses the same moment conditions, as well as extra ones.

whereas strong contract enforcement mechanism raises the organisational efficiency in the economy and both boosts growth. Strong 'market stabilising institutions' minimises macroeconomic volatility and policy distortions and attracts more investments which generates growth. It appears that too much or too little regulation is not good for growth. The inevitable fallout of too little regulation is anti competitive behaviour whereas too much regulation leads to red tape. 'Market legitimising institutions' does not seem to matter for growth. This is perhaps because the 'market legitimising' functions can also be performed by non-democratic institutions.

A panel data approach is used rather than a cross-section approach because the latter suffers from identification problems. The identification problem happens because of the correlation between the oft used log settler mortality instrument and current schooling and this correlation is independent of the correlation between institutions and current schooling. The identification problem is taken care of by controlling for schooling in a growth regression model. The GMM strategy also allows me to make use of the time variation in the data.

The instrumental variable method relies heavily on the assumption of institutional persistence. Even though this appears to be a plausible assumption, examples of institutional volatility are not uncommon. Therefore, one needs to account for both features of institutions in a framework. The GMM method allows me to do that. The use of lagged levels of explanatory variables as instruments for current differences of the same accounts for the role of history on current institutional outcomes.

CHAPTER 8

CONCLUSIONS

The major results that come out of the analysis are as follows. The empirical results in chapters 4 and 5 shows that institutions, market proximity, malaria, and Catholicism have direct effects on development. Catholicism is associated with poor institutions and is not good for trade. Malaria is the most important factor for the African economies. Malaria impacts African development through discouraging economic agents to save for the future. High discount rate on future consumption due to malaria and the resulting lack of saving translates into a situation of poverty trap.

Among the institution variables, strong 'market creating institutions' and 'market stabilising institutions' are growth enhancing. I also observe that there is an optimal level of regulation that the 'market regulating institutions' can impose in order to maximise growth. 'Market legitimising institutions' does not seem to matter. It also appears from the analysis that the levels regression technique adopted by most of the existing studies suffers from omitted variable bias and identification problems.

Even though we learn more about which institutions matter and which doesn't for growth, the results should not be interpreted as a recipe for economic growth. They are indicative of the average relationship which does not necessarily mean that they can predict individual cases. Therefore designing macroeconomic policy based on these results may not yield the desired result for each and every country. Policies have to be tied to the first order economic principles and recognise the local conditions of the region. Two perfect examples of these contrasting features are China and India. China's conscious policy of opening the economy may be well grounded in first order economic principles (protection of property rights, contract enforcement, effective regulation, sound money, rule of law and democracy and so on), but the Chinese way of doing things is quite different from the rest of the world. Even though the communist state did not change its laws to allow private property rights, it devised novel institutional arrangements such as the Township Village Enterprises (TVEs)

to substitute the formal property rights institutions and perform the same tasks.[77] These types of quasi capitalist institutions are helping China to grow as fast as 10% per annum over the last two decades. India's institutions on the other hand are much closer to the mainstream with constitutional protection of private enterprise, contract enforcement etc. However, India's growth has been steady but moderate in comparison to China over the same period. This tells us that Washington Consensus type policies may not be as successful as policies which are based on the first order economic principles but at the same time takes into consideration local history and culture.

The Africa result does make a strong case for aid. However, resorting to big push style policy of aid may not be as effective as a micro level policy. Any big push style policy relies on planning and any planning exercise disregards the often unsolvable information and incentive problems attached with it (Easterly 2006). In particular, the incentive of the aid worker and the information problems associated with the aid infrastructure are often overlooked in a macro level planning. Therefore, these aspects need to be looked at while designing a policy and in order to make it effective. A step by step approach seems to be a way to go rather than a holistic approach.

Like any other research, this thesis also raises many questions for the future. Even though the empirical results show that institutions are one of the root causes of economic development, it is based on the assumption that they persist over time. This part of the story is yet to be established. Even though quite a few influential studies (Banerjee and Iyer (2005), Acemoglu et al. (2001)) report evidence of institutional persistence, evidence of lack of persistence is not hard to find.[78] Further research is needed to explain under what

[77]The TVEs are owned by the local communities and they are keen to ensure prosperity of the TVEs as their equity stake generates direct revenues for them (Rodrik 2003, Qian 2003). Qian (2003) observes that the TVEs were the growth engine of China until the mid 1990s.

[78] See Glaeser et al. (2004).

condition institutions persist and under what condition they don't. It also remains to be seen how much of the institutional persistence or lack of persistence can be explained by culture, ethnolinguistic fractionalisation, and inequality. It also begs an explanation why institutions differ. Is it because of the influence of tradition and culture or is it because of inequality and its impact on the political economy of the country? These are questions that can be thought of as possible extensions of the topic that I have dealt with in the thesis.

Finally, going back to the fundamental question that any piece of research has to face – what is the significance of this work? Of course it does not provide us with a magic formula to bridge the gap between the rich and the poor and not to mention the Holy Grail. However, it does flag the importance of history, geography, politics, and culture in economic development. A better understanding of the interconnection between these factors may increase our knowledge of how countries grow. The work presented here suggests that this is perhaps the way to go.

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TECHNICAL APPENDIX

TA1. Robustness and Sensitivity Analysis of Model 2 in Chapter 4

I check the sensitivity of the Model 2 estimation results to outliers. I take out one observation at a time and estimate the model 39 times and evaluate the statistical significance and the range of the coefficient estimates. Following is the result of this test.

Table TA1. Robustness and Sensitivity Analysis of Model 2 in Chapter 4

Dependent Variable	Log per Capita GDP in 2000			
	Estimates with Full Sample (obs=39)	Truncated Sample (obs=38)		
		Maximum	Minimum	Statistical significance
Log Initial Income (1960)	0.29* (0.1879)	0.37	0.22	At least at 10% level in 31 out of 39 times
Average Rule of Law Index	0.89*** (0.3173)	0.95	0.84	At least at 5% in all the cases
Malaria Risk	-1.61*** (0.3238)	-1.78	-1.55	At least at 5% in all the cases
Natural log of Trade Share	-0.08 (0.1685)	-0.04	-0.088	Not statistically significant
Enrolment Ratio in 1900	0.004 (0.0049)	0.005	0.003	Not statistically significant
Catholicism	0.004 (0.0032)	0.004	0.003	Not statistically significant

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% level respectively against a one sided alternative. The standard errors of all the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

Therefore the above results show that the major conclusions coming out of Model 2 in chapter 4 is not dependent on the outliers and is fairly robust. In the pooled regression I report that malaria risk has a negative effect and institutions have a positive effect on current GDP level and the relationships are statistically significant at the 1% level against a two sided alternative. In all the robustness regressions this pattern holds and the coefficient estimates are statistically significant at least at the 5% level. The maximum and minimum estimates are also close to the full sample estimate. Initial income is statistically significant at the 10% level in 31 out of 39 regressions which gives fairly robust evidence in favour of transitional dynamics.

TA2. Robustness and Sensitivity Analysis of the Model in Chapter 5

I check the sensitivity of the core specification estimated in chapter 5 in this section. I take out one observation at a time and estimate the model 36 times and evaluate the statistical significance and the range of the coefficient estimates. Following is the result of this test.

Table TA2. Robustness and Sensitivity Analysis of the Model in Chapter 5

Dependent Variable	Log per Capita GDP in 2000			
	Estimates with Full Sample (obs=36)	Truncated Sample (obs=35)		
		Maximum	Minimum	Statistical significance
Log Initial Income (1960)	0.66*** (0.1079)	0.71	0.61	At least at 5% level in all cases
Average Rule of Law Index	0.38 (0.4160)	0.43	0.32	Not statistically significant
Log Slave Export	0.06 (0.0485)	0.11	0.05	Not statistically significant
Malaria Risk	-1.64*** (0.5734)	-1.52	-1.71	At least at 5% level in all cases
Log Trade Share	0.18 (0.2946)	0.089	0.23	Not statistically significant
Catholicism	0.01* (0.0065)	0.012	0.01	At least at 10% level in 28 out of 36 cases

Notes: ***, ** and * indicates significance level of 1%, 5% and 10% level respectively against a one sided alternative. The standard errors of all the regressions are heteroskedasticity robust. All the regressions reported above are carried out with an intercept.

The tests show that the major conclusions coming out of the preferred specification in chapter 5 is not dependent on the outliers and is fairly robust. In the full sample regression I report that malaria risk has a negative effect on current per capita GDP in Africa and the relationship is statistically significant at the 1% level against a two sided alternative. Institutions, trade openness, and log slave exports are insignificantly different from zero. In all the robustness regressions this pattern holds and the coefficient estimate on malaria is statistically significant at least at the 5% level. The maximum and minimum estimates are also close to the full sample estimate. Initial income is statistically significant at the 5% level in all the 39 robustness regressions which provides robust evidence in

favour of transitional dynamics. This shows that the malaria result of chapter 5 is robust and not dependent on the outliers.

TA3. The Hausman Test for exogeneity

Step (i): Estimate the following first stage regressions and get the residuals.

$$INS_i=\beta_1+\beta_2\, INI_i+\beta_3\, CONST_i+\beta_4\, ME_i+\beta_5\, REL_i+\beta_6\, ER_i+\beta_7\, Y_{0i}+r_1 \quad (T1)$$

$$INT_i=\theta_1+\theta_2\, CONST_i+\theta_3\, INI_i+\theta_4\, ME_i+\theta_5\, REL_i+\theta_6\, ER_i+\theta_7\, Y_{0i}+r_2 \quad (T2)$$

$$MAL_i=\lambda_1+\lambda_2\, ME_i+\lambda_3\, INI_i+\lambda_4\, CONST_i+\lambda_5\, REL_i+\lambda_6 ER_i+\lambda_7 Y_{0i}+r_3 \quad (T3)$$

Where $Y_{0,}$ INS, INT, MAL, REL, and ER are initial income (1960), institutions, openness, malaria, religion, and enrolment ratio variables respectively. INI_i refers to the instruments of institutions, $CONST_i$ refers to constructed openness and ME_i refers to the malaria ecology for country i. They are used as instruments for institution, openness and malaria risk respectively.

Step (ii): Estimate the following regression and test $H_0:\alpha_8=\alpha_9=\alpha_{10}=0$ against the alternative that at least one of them is not equal to zero. Failing to reject the null implies that INS, INT, and MAL are not endogenous.

$$LOGGDPPC_i=\alpha_1+\alpha_2 Y_{0i}+\alpha_3 INS_i+\alpha_4 INT_i+\alpha_5 MAL_i+\alpha_6 REL_i+\alpha_7 ER_i+\alpha_8 r_1+\alpha_9 r_2+\alpha_{10} r_3+\xi \quad (T4)$$

LOGGDPPC here is the log per capita GDP in 2000.

TA4. The Overidentification Test

Step (i): Estimate the following regression using 2SLS estimation method.

$$LOGGDPPC_i=\alpha_1+\alpha_2 Y_{0i}+\alpha_3\, INS_i+\alpha_4\, INT_i+\alpha_5 MAL_i+\alpha_6\, REL_i+\alpha_7 ER_i+r_1 \quad (T5)$$

Step (ii): Estimate the following regression using OLS and calculate nR^2.

$$r_1=\psi_1+\psi_2 SM_i+\psi_3 ENGFRAC_i+\psi_4 EURFRAC_i+\psi_5 CONST_i+\psi_6 ME_i+\psi_7 Y_{0i}+\psi_8 REL_i+\psi_9 ER_i+v \quad (T6)$$

Step (iii): $nR^2 \sim \chi^2$ with N degrees of freedom where N = [number of instruments – number of exogenous variables]. If $nR^2 > \chi^2_{critical}$ then we reject H_0 : that all the instruments are jointly exogenous.

TA5. The Test for Weak Instruments (F statistic test)

This test is due to Stock and Yogo (2002). This test checks the maximum bias that a 2SLS estimator can afford relative to OLS when a particular instrument is used at the 5% level of significance. We fix the desired level of bias as 5% in this paper. We look at the first stage F statistic and compare it with Table 1 in Stock and Yogo (2002). The first stage F statistic exceeding the tabulated value implies that the null of weak instrument is rejected. Failing to reject the null implies that the bias is too big and the instrument used is weak. This test is an extension of Staiger and Stock's (1997) rule of thumb which suggests that in case of a 2SLS regression with one endogenous variable, the instruments are deemed to be weak if the first stage F is less than 10.

TA6. Blundell and Bond Dynamic Panel Data Estimation

This appendix provides a brief description of the Blundell and Bond GMM estimator. For more details see Blundell and Bond (1998) and Blundell et al. (2000).

Consider

$$y_{it} = x_{it}'\beta + \mu_i + \varepsilon_{it} \text{ where } t = 1, 2, ..., T \qquad \text{(T7)}$$

i and *t* are country and time indices, y_{it} is the dependent variable and x_{it} is the row vector of order *k* of explanatory variables including the lagged dependent variable, β is a column vector of parameters of order *k*, μ_i is a country specific fixed effect potentially correlated with x_{it} and ε_{it} is a residual potentially correlated with x_{it} . To eliminate the fixed effect I take first differences which yield the following:

$$\Delta y_{it} = \Delta x_{it}'\beta + \Delta\varepsilon_{it} \text{ where } t = 2, 3, ..., T. \qquad \text{(T8)}$$

If Δx_{it} is correlated with $\Delta \varepsilon_{it}$, the standard OLS estimator will be biased and inconsistent. However, if one assumes that there exists a set of instruments which satisfies the following vector of moment conditions of order *q*, defined as:

$$E(z_{it}' \Delta \varepsilon_{it}) = 0 \text{ provided } q \geq k \qquad \text{(T9)}$$

Then one can obtain a consistent GMM estimator of β by minimizing the following quadratic form.

$$J(\hat{\beta}_{GMM}) = \bar{g}(\hat{\beta}_{GMM})' W_N^{-1} \bar{g}(\hat{\beta}_{GMM}) \qquad \text{(T10)}$$

Where $\bar{g}(.)$ is the sum over the sample moment conditions of the form in (T9) and W_N^{-1} is a weight matrix. The Arellano and Bond (1991) procedure is to use lags of x_{it} as instruments for the differenced equation (T8). The instrument matrix in this case is:

$$\mathbf{z_i} = \begin{bmatrix} x_{i1} & 0 & 0 & \dots & 0 & \dots & 0 \\ 0 & x_{i1} & x_{i2} & \dots & 0 & \dots & 0 \\ . & . & . & \dots & . & \dots & . \\ 0 & 0 & 0 & \dots & x_{i1} & \dots & x_{iT-l} \end{bmatrix} \begin{matrix} t = 1+l \\ t = 2+l \\ . \\ t = T \end{matrix} \qquad \text{(T11)}$$

Where *l* is the lag length in use. As discussed in the text, the resulting differenced GMM estimator often performs poorly because of weak instruments. Blundell and Bond (1998) proposed combining the differenced equation (T8) with the levels equation (T7), for which lagged differences of the explanatory variables may serve as valid instruments. The vector of moment conditions is then defined as:

$$E(\mathbf{z_i^+ u}) = 0 \text{ where } \mathbf{u_i} = \begin{bmatrix} \Delta \varepsilon_{\mathbf{i}} \\ \varepsilon_{\mathbf{i}} \end{bmatrix} \qquad \text{(T12)}$$

and

$$\mathbf{z}_\mathbf{i}^{+} = \begin{bmatrix} \mathbf{z}_\mathbf{i} & 0 & 0 & \ldots & 0 \\ 0 & \Delta x_{i1} & 0 & \ldots & 0 \\ 0 & 0 & \Delta x_{i2} & \ldots & 0 \\ . & . & . & \ldots & . \\ 0 & 0 & 0 & \ldots & \Delta x_{i,T-l} \end{bmatrix} \begin{matrix} . \\ t = 1+l \\ . \\ . \\ t = T \end{matrix} \qquad \text{(T13)}$$

The GMM estimates are then obtained by minimizing (T10).

TA7. Identification Problems in Acemoglu et al. (2003)

Acemoglu et al. (2003) argue that the fundamental cause of post-war instability in many of the LDCs is institutional. They show that the volatility in per capita GDP growth and other macroeconomic indicators have a strong negative relationship with institutions. They argue using the settler mortality instrument that this negative relationship has its roots in the colonial institutions. They also show that this finding is robust when they control for religion, latitude, initial income, log inflation etc.

However this finding also suffers from the identification problem that I have documented before. In the following table I outline the problem using a particular measure of volatility – the standard deviation of GDP per capita growth (1970-1998). In column I of panel A it is observed that initial executive constraint which is a measure of institutions in 1950, 1960, and 1970 negatively impacts volatility in output growth in the following two decades. This implies that institutional weaknesses in the past lead to higher volatility in the current growth rate. This result holds when I control for latitude. But if I replace initial constraint on the executive by total years of schooling in 1960 then the same negative relationship is observed even though this time between schooling and volatility. This is indicative of the identification problem similar to Acemoglu et al. (2001), Rodrik et al. (2004), and Acemoglu and Johnson (2005) which I have discussed before. The first stage regressions in panel B show that the log settler mortality instrument is not only correlated with initial constraint on the executive but it is also correlated with schooling. The

correlation between schooling and log settler mortality is independent of the correlation between schooling and initial constraint on the executive.

Table TA3: **Identification Problems in Acemoglu et al. (2003)**

Dependent Variable	**Standard Deviation of GDP per Capita Growth (1970-1998)**		
	Model (1) obs=71	Model (2) obs=52	
Panel A: Second Stage of 2SLS			
Initial Constraint on Executive	-0.46** (0.1941)		
Total Years of Schooling (1960)		-0.56*** (0.1603)	
Latitude	-0.04 (0.0214)	0.03 (0.0231)	
Panel B: First Stage for Initial Constraint on Executive and Total Years of Schooling (1960)			
Dependent Variables	Initial Constraint on Executive obs=71	Total Years of Schooling (1960)	
		obs=52	obs=49
Log Settler Mortality	-0.85*** (0.1957)	-1.2*** (0.2208)	-0.94*** (0.2685)
Latitude	-0.003 (0.0216)	0.05** (0.0223)	0.05** (0.0224)
Initial Constraint on Executive			0.23* (0.1339)
R^2	0.2590	0.5387	0.5718

Notes: ***, **, and * indicates significance level of 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are the respective standard errors. All the regressions reported above are carried out with an intercept. Log Settler Mortality is used as an instrument for Initial constraints on executive.

DATA APPENDIX

Chapter 4

Measures of Economic Development

Variable name	Description	Source
Log per Capita GDP in 2000	Natural log of real GDP per capita in 2000. Real GDP figures are measured in US $ in current prices and the figures are PPP converted. For Botswana, Cambodia, Fiji, Guyana, Mauritania, Namibia and Papua New Guinea I use 1999 values as an approximation. For Central African Republic, Haiti, Puerto Rico and Taiwan I use 1998 values.	Penn World Table (PWT) 6.1 Heston et al. (2002)
Log Initial Income (1820)	Natural logs of per capita GDP (1820) in 1990 international Geary-Khamis dollars	Maddison (2004)
Log Initial Income (1870)	Natural logs of per capita GDP (1870) in 1990 international Geary-Khamis dollars	Maddison (2004)
Log Initial Income (1900)	Natural logs of per capita GDP (1900) in 1990 international Geary-Khamis dollars	Maddison (2004)
Log Initial Income (1950)	Natural logs of per capita GDP (1950) in 1990 international Geary-Khamis dollars	Maddison (2004)
Log Initial Income (1960)	Initial Level of per capita GDP (1960) in natural logs and PPP figures	Penn World Table (PWT) 6.1 Heston et al. (2002)
Stage dummy	=1 for Low Income Economies (LIE) =0 for High Income Economies (HIE)	World Bank classification

Measure of institution

Variable name	Description	Source
Average Rule of Law Index	This variable measures the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies. The main focus of this index is on "inputs" required for the government to be able to produce and implement good policies and deliver public goods. This variable ranges from -2.5 to 2.5 where higher values equal higher government effectiveness. This variable is measured as the average from 1998 through 2000.	Kaufman et al. (2003)

Measures of religion

Variable name	Description	Source
Catholicism	Identifies the percentage of population of each country being Catholic in 1980.	LaPorta et al. (1999)
Islam	Identifies the percentage of population of each country being Muslim in 1980.	LaPorta et al. (1999)

Measure of openness and trade

Variable name	Description	Source
Log of Trade Share	Natural log of Trade share calculated by taking log values of figure obtained by dividing volume of trade with GDP	Frankel and Romer (1999)

Measure of human capital

Variable name	Description	Source
Enrolment Ratio in 1900	It is the ratio of the number of students enrolled at the primary level and the relevant school age population.	Benavot and Riddle (1988)

Measures of geography

Variable name	Description	Source
Distance	Absolute distance from the Equator measured in Latitude	Hall and Jones (1999)
Malaria Risk	Percentage of the population at risk of malaria transmission in 1994.	Glaeser et al. (2004)
Land Area within Tropics	The proportion of country's land area within the geographical tropics.	Gallup et al. (1998)
Soil Suitability	Soil suitability is an estimate of the percentage of each soil type that is very suitable, moderately suitable and unsuitable for each of six rainfed crops.	Center for International Development, *Geography Data sets.*
Land Area within 100km of Ocean or Ocean-Navigable River	Proportion of countries total land area within 100 km of the ocean or ocean-navigable river, excluding coastline above the winter extent of sea ice and the rivers that flow to this coastline.	Gallup et al. (1998)

Instrument of openness

Variable name	Description	Source
Constructed Openness	Natural log of constructed openness calculated by filtering actual trade share from the influence of geographic factors using a bilateral trade equation which is also known as the gravity model.	Frankel and Romer (1999)

Instruments of institution

Variable name	Description	Source
Log Settler Mortality	Natural log of estimated European Settler Mortality Rate in colonies and settlements	Acemoglu et al. (2001)
ENGFRAC	It is one of the "first" language variables, corresponding to the fraction of the population speaking English	Hall and Jones (1999)
EURFRAC	It is one of the "first" language variables, corresponding to the fraction of the population speaking one of the major languages of Western Europe: English, French, German, Portuguese, or Spanish.	Hall and Jones (1999)
Log Population Density in 1500	Total population divided by total arable land in 1500 A.D. Source: McEvedy and Jones (1978) as cited in Acemoglu, et al. (2002).	McEvedy and Jones (1978)

Instrument of malaria

Variable name	Description	Source
Malaria Ecology	Malaria Ecology (ME) pop-weighted, Sept 2003 version. This variable provides an instrument for malaria risk that controls for the fact that causation may run not only from malaria to income but also from income to malaria. The basic formula for ME includes temperature, species abundance, and vector type (the type of mosquito). The underlying index is measured on a highly disaggregated sub-national level, and then is averaged for the entire country. Because ME is built upon climatological and vector conditions on a country-by-country basis, it is exogenous to public health interventions and economic conditions.	Kiszewski et al. (2004)

Chapter 5

Measures of Economic Development

Variable name	Description	Source
Log per Capita GDP in 2000	Natural log of real GDP per capita in 2000. Real GDP figures are measured in US $ in current prices and the figures are PPP converted. For Botswana, Mauritania and Namibia we use 1999 values as an approximation. For Central African Republic I use 1998 values. For Angola, Zaire, and Sudan I use log per capita GDP (PPP adjusted and measured in current US$) from World Development Indicator (WDI).	Penn World Table (PWT) 6.1 Heston et al. (2002)
Log Initial Income (1960)	Initial Level of per capita GDP (1960) in natural logs and PPP figures. Data on Sudan is from WDI and is approximated by the 1975 level.	Penn World Table (PWT) 6.1 Heston et al. (2002)

Measure of institutions

Variable name	Description	Source
Average Rule of Law Index	This variable measures the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies. The main focus of this index is on "inputs" required for the government to be able to produce and implement good policies and deliver public goods. This variable ranges from -2.5 to 2.5 where higher values equal higher government effectiveness. This variable is measured as the average from 1998 through 2000.	Kaufman et al. (2003)

Measures of religion

Variable name	Description	Source
Catholicism	Identifies the percentage of population of each country being Catholic in 1980.	LaPorta et al. (1999)
Islam	Identifies the percentage of population of each country being Muslim in 1980.	LaPorta et al. (1999)

Measure of openness and trade

Variable name	Description	Source
Log Trade Share	Natural log of Trade share calculated by taking log values of figure obtained by dividing volume of trade with GDP	Frankel and Romer (1999)

Measure of slave exports

Variable name	Description	Source
Log Slave Exports	This is natural log of the normalised estimate of total number of slaves exported from Africa during the period 1400-1899. The number of slave exports are normalised by the country size. The figure includes the Atlantic slave exports, the Indian ocean slave exports, the Trans Saharan slave exports, and the Red sea slave exports. I use Nunn (2004)'s methodology outlined in its data appendix to back out the numbers. The other sources that I have used following Nunn (2004) is Elbl (1997); Eltis et al. (1999); Austen (1979); Austen (1988); and Austen (1992). I have divided each of these numbers by the corresponding country size measured in km^2. The country size data is from CID geography dataset.	Nunn (2004)

Instruments of institutions

Variable name	Description	Source
ENGFRAC	It is one of the "first" language variables, corresponding to the fraction of the population speaking English	Hall and Jones (1999)
EURFRAC	It is one of the "first" language variables, corresponding to the fraction of the population speaking one of the major languages of Western Europe: English, French, German, Portuguese, or Spanish.	Hall and Jones (1999)
Log Population Density in 1500	Total population divided by total arable land in 1500 A.D. Source: McEvedy and Jones (1978) as cited in Acemoglu, et al. (2002).	McEvedy and Jones (1978)

Measure of malaria

Variable name	Description	Source
Malaria Risk	Percentage of the population at risk of malaria transmission in 1994.	Glaeser et al. (2004)

Instrument of malaria

Variable name	Description	Source
Malaria Ecology	Malaria Ecology (ME) pop-weighted, Sept 2003 version. This variable provides an instrument for malaria risk that controls for the fact that causation may run not only from malaria to income but also from income to malaria. The basic formula for ME includes temperature, species abundance, and vector type (the type of mosquito). The underlying index is measured on a highly disaggregated sub-national level, and then is averaged for the entire country. Because ME is built upon climatological and vector conditions on a country-by-country basis, it is exogenous to public health interventions and economic conditions.	Kiszewski et al. (2004)

Instrument of slave exports

Variable name	Description	Source
Distance from the coast	Mean distance to nearest coastline measured in kilometres.	Centre for International Development, *Geography Datasets*

Chapter 7

Measures of Economic Development

Variable name	Description	Source
Growth $(\hat{y}_{iT})$	Calculated using the formula $\hat{y}_{iT} \equiv \frac{1}{5}(y_{iT} - y_{iT-5})$ for 127 countries. The data used is GDP per capita PPP (constant 2000 international $). The raw GDP per capita numbers are averaged first and then logged and differenced to obtain growth rates. 1980 value is the average over the period 1980-82, 1985 is the average over the period 1983-87, 1990 is the average over the period 1988-1992, 1995 is the average over the period 1993-97, 2000 is the average over the period 1998-2001, and 2004 is the average over the period 2002-04.	WDI Online, The World Bank Group
Log Initial Income (y_{iT-5})	Log GDP per capita PPP (constant 2000 international $). The numbers are averaged first and then logged. 1980 value is the average over the period 1980-82, 1985 is the average over the period 1983-87, 1990 is the average over the period 1988-1992, 1995 is the average over the period 1993-97, 2000 is the average over the period 1998-2001, and 2004 is the average over the period 2002-04. For Angola, Cape Verde, Guinea, Equatorial Guinea, and Grenada the 1980 data is from Penn World Table (PWT) 6.1. For Poland, Sao Tome & Principe, and Tanzania the 1980 and 1985 data is from PWT. For Romania and Taiwan the 1980-2000 data is from PWT.	WDI Online, The World Bank Group
Log GDP per Capita in 1995	Log GDP per capita in 1995 measured in PPP US $.	WDI Online, The World Bank Group

Measure of Trade Openness

Variable name	Description	Source
Log Trade Share (% of GDP) (LTRS)	This is a direct measure of trade calculated by dividing the volume of trade by GDP and then taken log. They are also calculated as five year averages. For Angola, Cape Verde, Guinea, and Equatorial Guinea the 1980 data is from PWT6.1. For Poland and Romania the 1980 & 1985 data is from PWT6.1 and for Singapore and Taiwan the 1980-2000 data is from PWT6.1.	WDI Online, The World Bank Group

Measure of Market Regulating Institutions

Variable name	Description	Source
Regulation of Credit, Labor, & Business (MR)	This is a composite measure that takes into account credit market regulations, labor market regulations, & business regulations. The measure ranges from 0 to 10 with a high score implying fewer regulations. The measure comes as five year averages. I use 1980, 1985, 1990, 1995, 2000 & 2004 values. The 2004 value is averaged over the period 2001-03.	Gwartney and Lawson. (2005)

Measure of Market Stabilizing Institutions

Variable name	Description	Source
Sound Money Index (SM)	This measure takes into account the following. a) Average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years, b) Standard inflation variability in the last five years, and c) Recent inflation rate. It ranges from 0 to 10 with a high score implying more sound money. The measure comes as five year averages. I use 1980, 1985, 1990, 1995, 2000 & 2004 values. The 2004 value is averaged over the period 2001-03.	Gwartney and Lawson. (2005)

Measure of Market Creating Institutions

Variable name	Description	Source
Law and Order (LO)	Law and Order are assessed separately. The Law subcomponent is an assessment of the strength and impartiality of the legal system and the Order subcomponent is an assessment of popular observance of the law. The assessment is made on a six point scale with a high score implying better law and order. The five year periodic averages are calculated. 1980 value is the average over the period 1980-82, 1985 is the average over the period 1983-87, 1990 is the average over the period 1988-1992, 1995 is the average over the period 1993-97, 2000 is the average over the period 1998-2001, and 2004 is the average over the period 2002-04.	PRS Group (2005) ICRG
Average Protection against Expropriation	Risk of "outright confiscation and forced nationalization" of property. This variable ranges from zero to ten where higher values are equals a lower probability of expropriation. This variable is calculated as the average from 1985 through 1995.	PRS Group, September 1999
Constraint on Executive	A seven category scale, 1 to 7, with a higher score indicating more constraint. Acemoglu and Johnson (2005) calculates average value from 1990 to 2000.	Polity IV dataset
Legal Formalism	The index measures substantive and procedural statutory intervention in judicial cases (check case) at lower level civil trial courts, and is formed by adding up the following indices: i) professional vs layman, ii) written vs oral elements, iii) legal justification, iv) statutory regulation of evidence, v) control of superior review, vi) engagement formalities and vii) independent procedural actions. The index ranges from 0 to 7, where 7 implies a higher level of control or intervention in the judicial process.	Djankov et al. (2003)

Measure of Market Legitimizing Institutions

Variable name	Description	Source
Democracy Index (DEMOC)	Democracy measures the effectiveness of democratic institutions. It ranges from 0 to 10 with a high score implying more democratic system. The five year periodic averages are calculated in the same way as WDI.	Polity IV dataset

Measure of Schooling

Variable name	Description	Source
Total Years of Schooling (TYS)	Average schooling years in the total population. This is measured at five year intervals from 1980-2000.	Barro and Lee (2000)
Total Years of Schooling (1995)	Average schooling years in the total population in 1995.	Barro and Lee (2000)
Total Years of Schooling (1960)	Average schooling years in the total population in 1960.	Barro and Lee (2000)

Instruments

Variable name	Description	Source
Log Settler Mortality	Natural log of estimated European Settler Mortality Rate in colonies and settlements	Acemoglu et al. (2001)
Legal Origin (British)	Legal origin of the Company Law or Commercial Code of each country. The English Common Law dummy.	LaPorta et al. (1999)

Technical Appendix 7 (TA7)

Variable name	Description	Source
Standard Deviation of GDP per Capita Growth (1970-1998)	Standard deviation of GDP per capita growth rate calculated following Acemoglu et al. (2003)	WDI Online, The World Bank Group
Initial Constraint on Executive	A seven category scale, 1 to 7, with a higher score indicating more constraint. This is an average of 1950, 1960, and 1970 level calculated following Acemoglu et al. (2003).	Polity IV dataset

LIST OF COUNTRIES

AGO	Angola	ECU	Ecuador	KEN	Kenya	ROM	Romania
ALB	Albania	EGY	Egypt	KHM	Cambodia	RUS	Russia
ARG	Argentina	ESP	Spain	KNA	St. Kitts & Nevis	RWA	Rwanda
ARM	Armenia	ETH	Ethiopia	KOR	Korea, Republic of	SDN	Sudan
AUS	Australia	FIN	Finland	LBR	Liberia	SEN	Senegal
AUT	Austria	FJI	Fiji	LKA	Sri Lanka	SGP	Singapore
BDI	Burundi	FRA	France	LSO	Lesotho	SLE	Sierra Leone
BEL	Belgium	GAB	Gabon	MAR	Morocco	SLV	El Salvador
BEN	Benin	GBR	United Kingdom	MDA	Moldova	SOM	Somalia
BFA	Burkina Faso	GEO	Georgia	MDG	Madagascar	STP	Sao Tome and Principe
BGD	Bangladesh	GER	Germany	MEX	Mexico	SUR	Suriname
BGR	Bulgaria	GHA	Ghana	MLI	Mali	SVK	Slovak Republic
BOL	Bolivia	GIN	Guinea	MLT	Malta	SWE	Sweden
BRA	Brazil	GMB	Gambia, The	MNG	Mongolia	SWZ	Swaziland
BRB	Barbados	GNB	Guinea-Bissau	MOZ	Mozambique	SYC	Seychelles
BUR	Myanmar	GNQ	Equatorial Guinea	MRT	Mauritania	SYR	Syria
BWA	Botswana	GRC	Greece	MUS	Mauritius	TCD	Chad
CAF	Central African Republic	GRD	Grenada	MWI	Malawi	TGO	Togo
CAN	Canada	GTM	Guatemala	MYS	Malaysia	THA	Thailand
CHE	Switzerland	GUY	Guyana	NAM	Namibia	TTO	Trinidad &Tobago
CHL	Chile	HKG	Hong Kong	NER	Niger	TUN	Tunisia
CHN	China	HND	Honduras	NGA	Nigeria	TUR	Turkey
CIV	Cote d'Ivoire	HRV	Croatia	NIC	Nicaragua	TWN	Taiwan
CMR	Cameroon	HTI	Haiti	NLD	Netherlands	TZA	Tanzania
COG	Congo, Republic of	HUN	Hungary	NOR	Norway	UGA	Uganda
COL	Colombia	IDN	Indonesia	NZL	New Zealand	URY	Uruguay
COM	Comoros	IND	India	OMN	Oman	USA	USA
CPV	Cape Verde	IRL	Ireland	PAK	Pakistan	VEN	Venezuela
CRI	Costa Rica	IRN	Iran	PAN	Panama	VNM	Vietnam
CYP	Cyprus	IRQ	Iraq	PER	Peru	ZAF	South Africa
DEU	Germany	ISL	Iceland	PHL	Philippines	ZAR	Congo, Dem. Rep.
DJI	Djibouti	ISR	Israel	PNG	Papua New Guinea	ZMB	Zambia
DMA	Dominica	ITA	Italy	POL	Poland	ZWE	Zimbabwe
DNK	Denmark	JAM	Jamaica	PRI	Puerto Rico		
DOM	Dominican Republic	JOR	Jordan	PRT	Portugal		
DZA	Algeria	JPN	Japan	PRY	Paraguay		

Chapter 5

AGO	Angola
BDI	Burundi
BEN	Benin
BFA	Burkina Faso
BWA	Botswana
CAF	Central African Republic
CIV	Cote d'Ivoire
CMR	Cameroon
COG	Congo, Republic of
COM	Comoros
CPV	Cape Verde
DJI	Djibouti
DZA	Algeria
EGY	Egypt
ETH	Ethiopia
GAB	Gabon
GHA	Ghana
GIN	Guinea
GMB	Gambia, The
GNB	Guinea-Bissau
GNQ	Equatorial Guinea
KEN	Kenya
LSO	Lesotho
MAR	Morocco
MDG	Madagascar
MLI	Mali
MOZ	Mozambique
MRT	Mauritania
MUS	Mauritius
MWI	Malawi
NAM	Namibia
NER	Niger
NGA	Nigeria
RWA	Rwanda
SEN	Senegal
SDN	Sudan
SOM	Somalia
SLE	Sierra Leone
STP	Sao Tome and Principe
SWZ	Swaziland
TCD	Chad
TGO	Togo
TUN	Tunisia
TZA	Tanzania
UGA	Uganda
ZAF	South Africa
ZAR	Congo, Dem. Rep.
ZMB	Zambia
ZWE	Zimbabwe

AGO	Angola	ETH	Ethiopia	LSO	Lesotho	SVK	Slovak Republic
ARG	Argentina	FIN	Finland	LUX	Luxembourg	SWE	Sweden
ATG	Antigua	FJI	Fiji	MAR	Morocco	SWZ	Swaziland
AUS	Australia	FRA	France	MDG	Madagascar	SYC	Seychelles
AUT	Austria	GAB	Gabon	MEX	Mexico	SYR	Syria
BDI	Burundi	GBR	United Kingdom	MLI	Mali	TCD	Chad
BEL	Belgium	GER	Germany	MOZ	Mozambique	TGO	Togo
BEN	Benin	GHA	Ghana	MRT	Mauritania	THA	Thailand
BFA	Burkina Faso	GIN	Guinea	MUS	Mauritius	TTO	Trinidad &Tobago
BGD	Bangladesh	GMB	Gambia, The	MWI	Malawi	TUN	Tunisia
BLZ	Belize	GNB	Guinea-Bissau	MYS	Malaysia	TUR	Turkey
BOL	Bolivia	GNQ	Equatorial Guinea	NAM	Namibia	TWN	Taiwan
BRA	Brazil	GRC	Greece	NER	Niger	TZA	Tanzania
BRB	Barbados	GRD	Grenada	NGA	Nigeria	UGA	Uganda
BWA	Botswana	GTM	Guatemala	NIC	Nicaragua	URY	Uruguay
CAF	Central African Republic	GUY	Guyana	NLD	Netherlands	USA	USA
CAN	Canada	HKG	Hong Kong	NOR	Norway	VCT	St.Vincent & Grenadines
CHE	Switzerland	HND	Honduras	NPL	Nepal	VEN	Venezuela
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CYP	Cyprus	JAM	Jamaica	PRY	Paraguay		
DMA	Dominica	JOR	Jordan	ROM	Romania		
DNK	Denmark	JPN	Japan	RWA	Rwanda		
DOM	Dominican Republic	KEN	Kenya	SEN	Senegal		
DZA	Algeria	KNA	St. Kitts & Nevis	SGP	Singapore		
ECU	Ecuador	KOR	Korea, Republic of	SLE	Sierra Leone		
EGY	Egypt	LCA	St. Lucia	SLV	El Salvador		
ESP	Spain	LKA	Sri Lanka	STP	Sao Tome and Principe		