THREE ESSAYS ON DETERMINANTS AND IMPACT OF INSTITUTIONAL QUALITY

By

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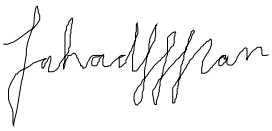
DECLARATION

I certify that the contents of this thesis are my own work except where otherwise acknowledged.



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ABSTRACT

A sizeable recent literature has convincingly demonstrated that the quality of institutions is a fundamental determinant of economic growth. However, there is still much debate on the determinants of institutional quality and the channels through which it influences economic policies and growth. This thesis aims to contribute to this debate by focusing on three selected themes. The three papers are enveloped in a stage-setting survey of the wider literature on institutional change and economic growth, and a concluding chapter which summarizes the key findings and makes suggestions for further research.

The approach of the three papers is empirical in nature, but the model formulation is well informed by the relevant theory. The empirical analysis is based on annual panel data covering a large number of countries at varying stages of development and the models are estimated using state-of-the-art econometric methodology, paying particular attention to potential endogeneity of the explanatory variables.

The first paper (Chapter 2) investigates the implications of the composition of government revenue for the quality of political institutions. It is found that an increase in tax revenue increases political openness, whereas higher natural resource rents are detrimental to democracy. These relationships, however, become less pronounced with an increase in the level of GDP per capita. Overall, the findings are consistent with the historical political-economy literature which postulates that fiscal imperatives

of the state are the driving force for the development of democratic systems of government.

The second paper (Chapter 3) examines the implications of foreign trade exposure for the quality of economic institutions as represented by the extent of corruption and bureaucratic quality. The novelty of the analysis is the estimation of the impact of trade intensity (trade to GDP ratio) on institutional quality conditional on the nature of the trade policy regime. The results indicate that increased trade intensity improves institutional quality only in the context of liberalized trade policy regimes. There is also evidence that the dependence on exports of natural resources is harmful for institutional quality, but liberalization of the policy regime has the potential to mitigate this adverse impact. The findings are consistent with the predictions relating to the determinants of institutional quality in the 'rent-seeking' and 'resource-curse' literatures.

The third paper (Chapter 4) explores the implications of political openness and corruption for the size and the growth impact of public-sector infrastructure investment. Based on a public choice literature, it is hypothesized that the relationship between institutional quality and public investment differs across democratic and autocratic countries. The results suggest that corruption enhances public investment in fixed capital, only in countries with autocratic regimes. Moreover, the growth impact of public investment in fixed capital is also negative only in these countries; the negative impact, however, is mitigated as autocratic countries become more politically open. These findings point to the suboptimal nature of the use of public funds in autocratic countries.

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LIST OF ABBREVIATIONS

ACDE	Arndt-Corden Department of Economics
AR(2)	Autoregressive of order 2
FE	Fixed Effects
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
ICRG	International Country Risk Guide
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification
LSDV	Least Squares Dummy Variable
NBER	National Bureau of Economic Research
OECD	Organization of Economic Cooperation and Development
OLS	Ordinary Least Squares
PhD	Doctor of Philosophy
PRS	Political Risk Services
PWT	Penn World Tables
SITC	Standard International Trade Classification
TE	Time Effects
UN	United Nations
US	United States
WDI	World Development Indicators
WGI	Word Governance Indicators
WTO	World Trade Organization

Chapter 1: Introduction

1.1 Context

The study of the evolution and the impact of institutions has a rich tradition going back to a seminal paper by Ronald Coase (1960). Coase observed that when social and private costs diverge, markets may not facilitate all transactions. In other words, due to the presence of transaction costs, the efficient markets predicted by neoclassical theory do not exist. Therefore 'social arrangements', within the context of which individual decisions are taken, are important. Since then a great deal of scholarly work has taken note of this insight and attempted to refine the neoclassical theory which, in its original form, ignores the implications of different institutional arrangements. Douglass North brought the analysis of institutions into the mainstream through a series of famous works (1981, 1989, 1990, 1994, 2005 and others). In fact, North suggests that any fruitful approach to the study of economic development should be built around an analysis of institutional change. Recently one of the most talked about books emerging in the development literature, *Why Nations Fail* by Daron Acemolu and James Robinson (2012), reflects an ever increasing interest in this line of enquiry.

Over the last couple of decades, institutional quality has also found its way into the vast empirical growth literature which is based on both the neoclassical and endogenous theory of growth.[1] In this literature it has become a standard practice to include institutional quality as a key variable to explain differences in the level and

[1] See for example Mauro (1995), Hall and Jones (1999), Acemoglu et al (2001), Easterly and Levine(2002), Rodrik et al (2004) amongst others

growth of income per capita across countries. This has been facilitated by the widespread availability of subjective indicators measuring institutional quality. There is now a broad consensus that institutions matter in explaining differences in economic performance among countries (e.g. Temple 1999, Rodrik et al 2004, North 2005a and b, Acemoglu and Robinson 2012). Following the substantial contemporary research interest in institutional analysis, international lenders and donor agencies have also incorporated institutional development for developing countries into their agendas.[2]

There is, however, still a great deal of debate on the processes through which institutions originate and evolve. It has been recognized that Western institutions cannot be simply transplanted into developing countries (e.g. Lin 2009, Sen 2013). Furthermore there is still much scope in identifying the different ways and channels through which institutions influence economic policies and growth. This thesis tries to place itself within the rich tradition of institutional analysis, and hopes to shed light on certain aspects of firstly, institutional change and secondly, the impact of institutions.

Relating to institutional change I investigate the impact of economic policy on the quality of institutions. A substantial portion of the literature considers institutions to be determined by historical experience stretching back many decades and even centuries.[3] The inferences of these studies do not, therefore, provide much hope for institutional improvement through policy action over a shorter span of time. Economic policy is a tool in the hands of the government primarily designed to achieve economic and social objectives, often with little consideration of its consequences for

[2] See for example *World Development Report* (2002) of the World Bank.

[3] Shirley(2005) provides a brief but comprehensive survey of this literature

institutional quality. However, it is worthwhile to examine the implications of these policies for the quality of institutions, given the now widely accepted importance of institutional quality for economic development. Any evidence that is able to demonstrate a causal impact of economic policy on institutional quality potentially has profound policy implications; it would point towards practical guidance regarding the role of public policy in achieving institutional improvement.

The impact of institutions on economic performance has been more widely studied; there is a vast literature on not only the consequences of institutional quality for economic growth, but also on the link between the institutional environment and the formulation of public policy (e.g. Mulligan et al 2004). Any study about the impact of institutions could take many possible directions given their pervasive influence on every facet of economic performance. This thesis tries to contribute towards a very specific literature investigating the role of institutional quality in determining the size and growth impact of public investment. The manner in which public investment is directed in an economy is one of the most important components of public policy – it is an extremely potent tool in the hands of a government for shaping the future social and economic environment of a country. Therefore any new evidence concerning the institutional determinants of the size and productivity of public investment might hold significance for policy making, and shed light on an important channel through which institutions affect economic growth.

1.2 Organization and Methods

This thesis follows the 'three research papers' approach. The three papers follow this introductory chapter and constitute the bulk of the thesis. Each of the papers, while set in the context of institutional analysis, are self-contained and can be considered independently of each other. The endogeneity of institutional quality to economic variables is explored in the first two papers, while the impact of institutional quality is investigated in the third.

The first paper (Chapter 2) examines the implications of the nature of government revenue for political institutions, where the quality of political institutions is defined in terms of political openness (the degree of democracy). Government revenue is grouped into two types: tax revenue and non-tax revenue. It is hypothesized that a greater reliance on tax revenue increases political openness. On the other hand, a government's ability to fulfill its revenue needs through other sources of revenue, such as extraction of natural resource rents (as in the so called 'rentier states'), has negative consequences for democracy. The hypothesis is set within the context of the literature on 'fiscal sociology' (e.g. Schumpeter 1918, Herb 2003, Moore 2004, Besley and Persson 2013), which attributes democratization to the fiscal imperatives of the State.

The second paper (Chapter 3) investigates the impact of exposure to foreign trade on the quality of economic institutions. The dimensions of economic institutions considered for the purpose of the analysis are the extent of corruption and the quality of the bureaucracy. It is hypothesized that increased trade intensity (the trade to GDP

ratio) resulting from liberalization of the trade policy regime is beneficial for institutional quality; it reduces corruption and improves the quality of the bureaucracy. However, an increase in trade intensity in the context of an interventionist trade policy regime is harmful for institutional quality, because it opens avenues for rent-seeking. The hypothesis is motivated by lessons emerging from the large 'rent-seeking' literature (e.g. Tullock 1967, Krueger 1974, Buchanan 1980, Bhagwati 1980), which points out that any government-imposed restriction on economic activity has negative consequences for institutional quality.

The final paper (Chapter 4) explores the implications of corruption and political openness for the quantity and quality of public investment. Based on a literature on 'public choice' (Mohtadi and Roe 2003, Plumper and Martin 2003, Hausken et al 2004 and Deacon 2009), it is hypothesized that political economy considerations influence patterns of rent-seeking in the use of public funds. Therefore the relationship between corruption and the size as well as the growth impact of public investment depends on the degree of political openness.

The primary contribution of all three papers is empirical in nature, but the model formulation is well informed by the relevant theory. Using panel data at the cross-national level for a large number of countries at varying stages of development, the studies attempt to establish a statistical relationship between the variables of interest based on careful econometric methodologies. In each paper, the estimation sample consists of around one hundred countries; the country coverage is dictated by availability of data for all the key variables. The time coverage stretches over the past

two to three decades only, as the focus of the thesis is contemporary rather than historical.

The main estimation technique employed in each of the chapters is the fixed effects technique (FE) widely used in the empirical literature. This estimation strategy controls for country-specific fixed effects that could plausibly be correlated with both the explanatory and the dependent variables in order to capture the within-country impact of the explanatory variables. However, FE does not address potential reverse causality from the dependent to the explanatory variables; hence caution is needed in inferring causality based on the estimated coefficients (Acemoglu et al 2008). Therefore in each chapter a system Generalized Method of Moments (GMM) approach is employed to supplement FE. The technique involves joint estimation of the econometric equation in both levels and first differences of the variables (Roodman 2009a). System GMM consistently estimates a causal relation through the use of a set of internal instruments, consisting of the appropriate number of lagged levels and first differences, which identifies the exogenous variation in the explanatory variables. The use of this set of instruments also ensures consistent estimation in the presence of temporary measurement error; it is quite plausible that the institutional quality variables, which are based on subjective assessment, are measured with error.

1.3 The Literature

In each of the papers the hypotheses are motivated through a thorough and critical review of the existing literature. This helps to identify the gaps, as well as provide the theoretical basis and the analytical framework for the empirical analysis. In this sub-

section I only briefly discuss the existing literature on institutional analysis in relatively broad terms in order to clarify the definition of institutions and place the thesis in the overall context of the related literature.

1.3.1 Definition of Institutions

What exactly are institutions? How can we measure or compare their quality? According to the definition proposed by North (1990, p.3) that is now widely accepted and used, institutions are the humanly devised constraints that shape human interaction. These include formal rules, informal norms and their enforcement mechanisms. The manifestations of institutions include the political regime, the judicial system, the bureaucratic and administrative system, systems for economic regulation and even culture.

Every political or economic exchange between individuals or different segments of society involves transaction costs — the costs of defining what is being exchanged and then enforcing the agreement. The institutional structure determines these costs and thus facilitates transactions. In economic terms institutions shape the incentives of people to work, save, invest or carry out entrepreneurial activity. Economic activity would be prohibitively costly in the absence of rules such as those that ensure protection of property rights and enforce contracts between individuals. How these sets of rules are designed and enforced impact incentives and are thus a binding constraint. Institutional change transforms these constraints.

Institutions in the sense defined above are an abstract arrangement of rules, and can be easily confused with more concrete and specific structures. North (1990, 1994) introduces a distinction between institutions and organizations, which clarifies

the issue. If institutions are the 'rule of the game', then organizations are the 'players'. Organizations are defined by North (1994, p.361) as "groups of individuals bound together by some common purpose to achieve certain objectives. Organizations include political bodies (e.g., political parties, the Senate, a city council, regulatory bodies), economic bodies (e.g., firms, trade unions, family farms, cooperatives), social bodies (e.g., churches, clubs, athletic associations), and educational bodies (e.g. schools, universities, vocational training centers)."

For the purpose of measurement, it is also important to distinguish between an institutional structure that reflects rules, and the actual outcomes. As an example, a formal trichotomy of power between the executive, legislature and the judiciary, along with electoral rules is the basic institutional structure of a democracy, but how well the system actually functions in practice is the outcome. Countries with similar constitutions on paper are often perceived to have different degrees of democracy. Similarly a bureaucracy is an institutional structure meant to enforce policies and regulations, but its perceived efficiency is the outcome. The extent of corruption in a society too is an outcome of a weak institutional structure; corruption distorts incentives, reflects insecure property rights and weak contract enforceability (Aidt 2003). Ideally we want to assess the quality of institutions set up but these are impossible to quantify, and hence we have to measure outcomes, based on subjective perceptions reflected in survey data such as that collected by the *Political Risk Services* (PRS) group or the *Polity* project. While survey data has its weaknesses, for the purpose of this study it is institutional quality as it is perceived that matters. The fact

that this survey data is widely used by investors to judge the institutional environment of a country also shows a revealed preference for its use (Ades and Di Tella 1997).

1.3.2 Political and Economic Institutions

We can distinguish between two broad categories of formal institutions: political and economic. In the works of both North (1990, 1991, 1994) and Acemoglu at al (2005d, 2006b, 2012) political institutions underlie economic institutions, although the causality runs both ways. Political institutions determine the balance of power in society between the state and the citizenry, and between different interest groups. The economic institutions created by those holding political power govern economic interactions by specifying the property rights structure and contract enforcement mechanisms. Thus the economic institutions that come into being determine economic performance and the subsequent distribution of resources, which has a feedback effect on political institutions.

The interplay between economic and political institutions has been investigated by previous studies (e.g. Giavazzi and Tebellini 2005, Rock 2008, Leftwich and Sen 2011, Giullano et al 2013). In Chapters 2 and 3 of this thesis, which explore the endogeneity of institutional quality to policy, the focus is not on the relative importance of political and economic institutions or on which type of institution precedes the other. Rather, both kinds of institutions are considered as parallel and independent, and changes in either due to economic policy variables are investigated through separate analyses in different chapters. However in Chapter 4, which pertains to the impact of institutional quality, the interaction between political and economic institutions is explored.

1.3.3 Institutions and the Empirical Growth Literature

The proximate causes of variation in growth across countries and over time are differences in physical and human capital accumulation, and total factor productivity. However, the proximate determinants are themselves endogenous. Institutions are considered to be amongst the more fundamental determinants. Hall and Jones (1999) document that variation in capital accumulation and productivity can be explained by variation in, what they label as, social infrastructure (institutions and policies). They employ a Solow style level accounting framework to show that institutions and policies explain the variation in total factor productivity in a cross country empirical investigation. Hence they present a theory in which institutions play the central role in explaining economic development.

The influential paper by Acemoglu et al (2001) is the first empirical study to establish a causal link from institutions to economic performance. Rodrik et al (2004) conduct an empirical horse race between institutional quality and two other possible deep determinants of economic growth, namely trade integration and geography. They find that of the three potential deep determinants only institutions have a direct effect on growth. Once institutions are controlled for, geography and integration have no direct significant effect. These 'deeper determinants' only affect income per capita through their influence on institutions i.e. both geography and trade policy determine institutional quality which, in turn, is the primary determinant of economic performance. Easterly and Levine (2002) reach similar conclusions while comparing institutions with endowments and policies.

1.3.4 Institutional Change

The relevant question then is what determines the quality of institutions? The studies cited above, along with others, have come up with various conjectures about the determinants of institutional quality. For example, Acemoglu et al (2001) provide a historical explanation. They established the causal link between institutional quality and current income per capita by using an instrument rooted in colonial history to identify the exogenous variation in current institutional quality. They surmise that the mortality rate of early European colonialists determined their settlement patterns, which in turn influenced the institutions they set up. In regions where colonialists settled, they established inclusive institutions that have persisted to the present. In places where they faced high mortality rates, extractive institutions with no checks and balances on the power of the executive were set up, and these too have persisted.

Similarly, Hall and Jones (1999) conjecture that social infrastructure came about endogenously as a result of geography and legal origin (influence of Western systems). Using geography and legal origin as instruments they find a causal effect of social infrastructure on income per capita. Engerman and Sokoloff (2002) provide a theory of institutional evolution based on initial factor endowments. Within the New World in regions such as the Caribbean and Latin America where climate and soil encouraged the setting up of large plantations requiring slave labor, colonial elites set up extractive institutions to cement their dominance. The persistent political and economic inequality resulting from initial factor endowments led to poor institutional outcomes.

However, explanations for institutional development based on historical experience, geography or initial factor endowments suggest that institutions are destiny. If this were the case, there would be no hope for foreseeable institutional reform. Some studies, however, have provided evidence that institutional change is often driven by contemporary factors as well. For example, Jones and Olken (2009) empirically demonstrate that successful assassinations of autocrats increase the likelihood of sustained democratization. Similarly Burke and Leigh (2010) show that output contractions due to adverse weather shocks leads to pressure for democratic change in the system of government. In a related study, Burke (2012) finds a causal relationship between economic growth and the likelihood of leadership change using exogenous shocks to economic growth as instruments.

Contemporary institutional changes could be driven not only by exogenous shocks, but also by government policy. The literature on rent-seeking (discussed more thoroughly in Chapter 3 of this thesis) points out that any government-imposed restriction on economic activity leads to institutional decay (e.g. Krueger 1974) – suggesting a link between policy and institutional quality The impact of trade policy on institutional quality is examined by a vast theoretical and empirical literature as described in that Chapter. Similarly, Ades and Tella (1997) empirically show that active industrial policy is significantly associated with higher levels of corruption. Lin (2009) considers the link between a country's broader development strategy and institutional quality. He argues that a country's development strategy should be based on its endowment structure at every stage. The strategy should be dynamic in the sense that it is constantly updated as changes in the endowment structure occur with economic

progress. If a country chooses to develop industries and technologies which are incompatible with its endowments (*Comparative Advantage Defying* strategy or CAD), the government has to resort to administrative measures to channel resources to sustain these enterprises and implement various distortionary policies. CAD leads to institutional deterioration by distorting incentives and through rampant rent-seeking activities. On the other hand, in order to implement a development strategy that is consistent with a country's endowment structure (*Comparative Advantage Following* strategy), a government is forced to improve the market institutions so that relative factor prices reflect the endowment structure, and also has to improve the bureaucratic efficiency.

In this thesis, institutional change is viewed as an outcome of the relative strength or the bargaining power of different segments of society.[4] According to North (1990, 1994), institutional change occurs incrementally due to the maximizing behavior of organizations whose incentives are in turn shaped by the existing institutional structure. Any change in the distribution of resources as a result of government policy (or an exogenous shock) leads organizations to re-optimize, and leads to a change in the institutional structure. When a state needs to fulfill its revenue needs through taxation, shifting the balance of power towards the citizenry, a change in political institutions takes place. Similarly increased trade exposure may strengthen either the constituency for reform or those with a vested interest in poor institutional quality, depending on the nature of the trade policy regime. Even though the investigation of

[4] This follows the theory of institutional change proposed by North (1990 etc), Acemgolu (2005c, 2005d, 2012 etc), Grief (2008 etc) and others.

institutional change in the next two chapters is motivated by separate bodies of literature[5], there is a similar mechanism at work, which is consistent with the idea of institutional change as a bargain.

[5] The 'Fiscal Sociology' literature motivates Chapter 2, and the 'Rent Seeking' literature underpins Chapter 3

Chapter2: From Revenues to Democracy?

Abstract

This chapter contributes to a historical political economy literature, which considers the *fiscal imperatives* of the state to be amongst the driving forces behind the emergence of representative systems of government, by examining the impact on democracy of a government's reliance on alternative sources of revenue. 'Taxation' and 'natural resource rent extraction' are considered as alternative sources of revenue for the state within a unified framework. A game-theoretic model postulates that an increase in tax revenues, or a decrease in natural resource rents, enhances democracy. The predictions of the model are empirically tested using a cross-national panel dataset, covering 132 countries over the time period 1990-2009. The evidence is in line with the theoretical model. The results are broadly robust to estimation through different techniques, the inclusion of additional control variables in the econometric specification and also the use of alternative measures for democracy. The findings also suggest that the association of these variables with democracy within any given country becomes weaker as its real income per capita rises.

2.1 Introduction

Understanding the sources and process of democratization is an active area of research in political economy. Why have some cultures arrived at mature and well-functioning democratic systems of government while others have not? How can democracy be nurtured in countries where it is absent or not well established? Even outside of academic research, this question is of considerable importance to policymakers, developmental agencies and donors, civil society and the masses at large. The nature of a political regime is not only a matter of fundamental human rights, but also potentially important in understanding economic outcomes (e.g. Barro 1996, Temple 1999, Rigobon and Rodrik 2005, Acemoglu and Robinson 2006a). Even a cursory look at countries around the world reveals that the richer countries are generally more democratic.

In order to identify factors that could foster better political institutions in countries currently lacking them, it is useful to study the historical evolution of successful democracies. One theory of democratization, based on the ideas of Joseph Schumpeter, postulates fiscal imperatives as the driving force behind the modern nation state and the emergence of representative political institutions in the Western World (Schumpeter 1918, Herb 2003, Moore 2004, Besley and Persson 2013). This school of thought, labeled *fiscal sociology,* points to the historical fact that for the purpose of successfully generating revenues from their people, West European monarchs in the eighteenth and nineteenth centuries had to provide representation in return. Attempts at increasing taxation to meet growing military expenditure led to demands for representation which had to be incrementally fulfilled. Coercive power of

the state has its limits, and efficient tax collection relies on a degree of voluntary compliance, especially in the context of weak administrative structures and little documentation of the economy.

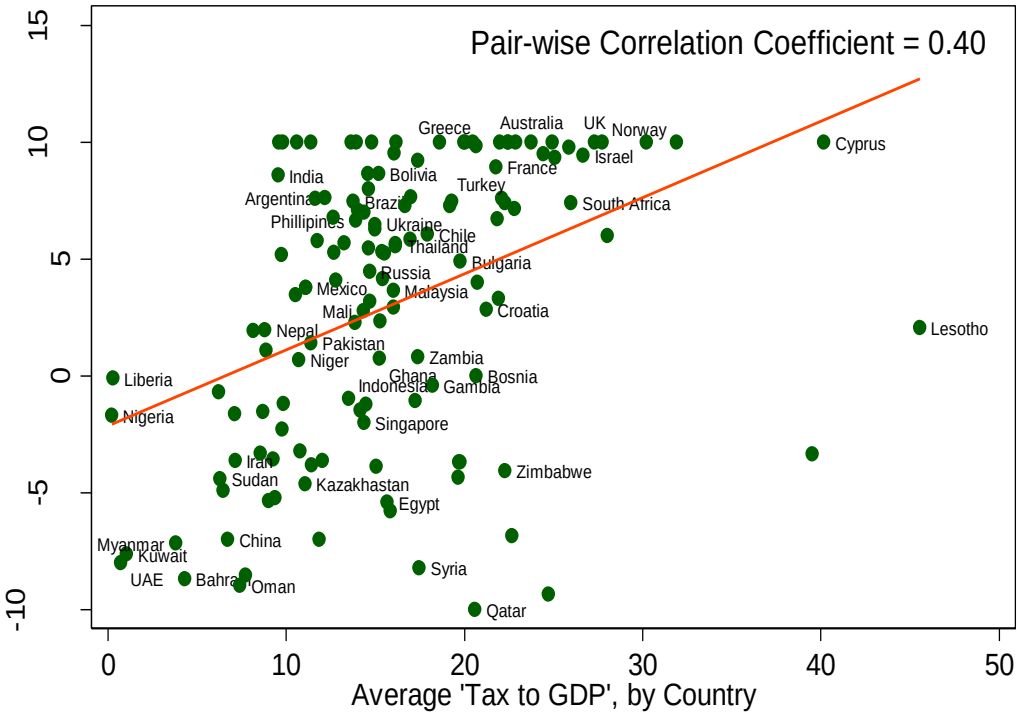
Can such a process be replicated in the modern world? Does the necessity to effectively raise revenues force governments to democratize? There are many anecdotal examples which suggest that it does. To quote one such example, the former military dictator of Pakistan, General Musharraf, had to promise parliamentary elections within three years of usurping power through a coup, arguably due to fiscal constraints. These constraints resulted from international sanctions coupled with an inability to implement a tax documentation drive in the face of popular resistance. Even in the repressive political regime of China increases in taxation have caused unrest in the rural areas over the last three decades. The protests have not constituted a challenge to the political regime, but often led to changes in the way local government operates (Bernstein and Lu 2000). Figure 2.1 demonstrates that the bi-variate relationship between total tax collected by the government as a proportion of GDP and a subjective indicator of democracy is on average positive for a large number of countries over the period 1990-2009[6].

Conversely it is argued that availability of opportunities for extracting natural resource rents in the so-called 'rentier states' has provided authoritarian regimes the fiscal space to persist over a long period of time (Collier 2007, Ross 1999 and 2001, Besley and Perrson 2010). Figure 2.2 depicts a negative relationship between total natural resource rents as a proportion of GDP and the subjective indicator of

[6] The variables and the data sources are described in detail later in this chapter.

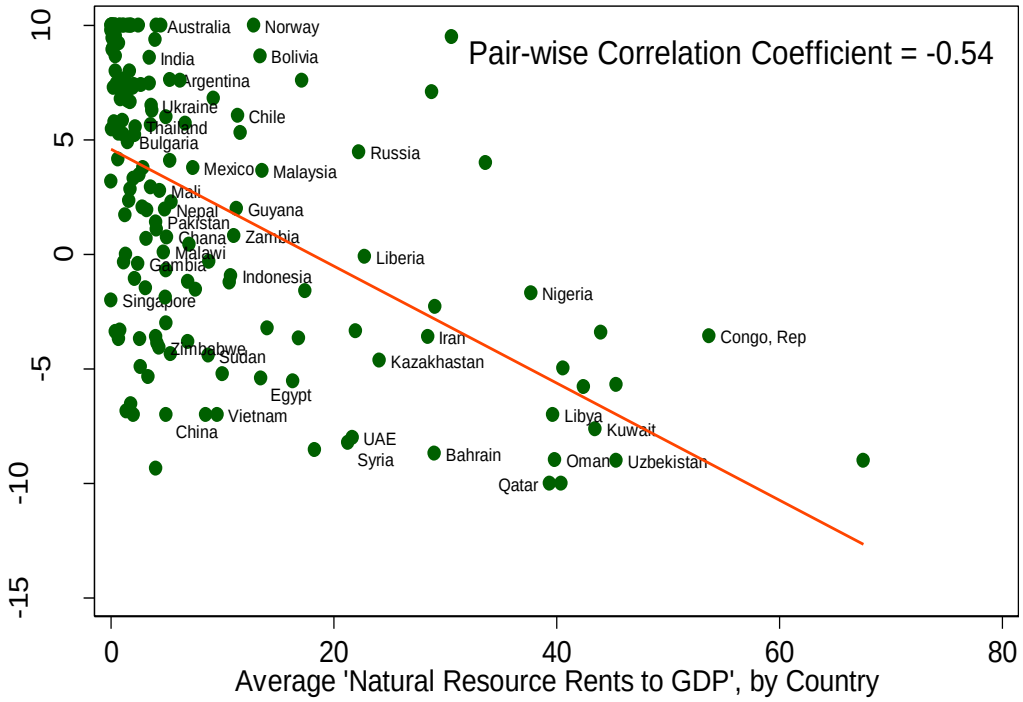
democracy. To the extent that these rents have weakened the dependence of the state on its people for taxation, there is little incentive for the population to organize for collective action to demand representation and accountability, and for the state to accede to the demands of its citizens. If these governments were fiscally constrained and forced to collect more taxes, would there be pressure for democratic change? Examples from the recent *Arab Spring* point in this direction, as discussed later in this chapter.

Figure 2.1. 'Democracy Score' versus 'Tax to GDP', 1990-2009



Source: Democracy score is measured by the Polity2 Variable provided by PolityIV project.
The measure of Tax to GDP is from World Bank's World Development Indicators.

Figure 2.2. 'Democracy Score' versus 'Natural Resource Rents to GDP', 1990-2009



Source: Democracy score is measured by the Polity2 Variable provided by PolityIV project.
The measure of Natural Resource Rents to GDP is from World Bank's World Development Indicators.

There is a rich literature on the impact of tax collection on democracy that has drawn upon both historical and contemporary examples. However this issue has not been widely examined in a cross-national context, despite the availability of data for the relevant variables. A number of studies theoretically and empirically examine the effect of political regime on tax collection capacity (Cheibub 1998; Fauvelle-Aymar 1999; Kenny and Winer 2006; Bird et al 2008; Mahdavi 2008; Besley and Persson 2009, 2010, 2013). To my knowledge, the only cross-country study that investigates the converse question (Ross 2004) finds no impact of taxation on democracy. That study, however, does not control for fixed country characteristics, which is essential to test for the association of taxation with democracy within a given country (Acemoglu 2008 et al, Burke and Leigh 2010). Neither does it establish a causal relation by addressing

the potential endogeneity of tax collection to democracy. Finally, there could be many factors correlated with both democracy and taxation that the study does not control for. Compared to Ross (2004), this chapter suggests methodological improvements for estimating the impact of taxation on democracy by addressing the issues indicated above.

Moreover, this chapter empirically examines the impact of taxation and natural resource rents on democracy within a unified framework. The negative effect of natural resource rents on democracy has been empirically documented (e.g. Barro 1999, Ross 2001, Collier and Hoeffler 2009). However these studies only look at oil wealth, and furthermore do not consider natural resource rents more broadly as a possible substitute for taxation (Devarajan et al 2010). As a possible alternative to taxation, natural resource rents can be viewed as a non-tax source of revenue. Therefore, I believe it is informative to systematically compare the relative impacts of both kinds of revenue on the nature of the political regime.

This chapter is arranged in nine sections. The next section discusses the analytical framework, based on the review of existing literature, to provide the setting for the ensuing analysis. Section 2.3 presents the theoretical framework and lists the testable propositions that follow from the model. Section 2.4 presents the econometric model to be estimated. Section 2.5 describes the variable construction and the data sources, and Section 2.6 details the estimation strategy. The descriptive statistics are presented in Section 2.7 and the estimation results are discussed in Section 2.8. Section 2.9 documents trends in both kinds of revenues leading up to selected episodes of democratization in the last twenty years. The final section

summarizes the key finding and provides the policy implications that follow from the study.

2.2 Literature Survey

The neoclassical theory of the state advanced by Douglass North (1990, 1991 etc) and others (Roberts Bates 1985, 1991; Avner Grief 2004, 2005 etc) implies a *fiscal contract* between the state and the people. *Fiscal contract* is a natural extension of the concept of a *social contract* espoused by seventeenth century philosophers such as John Locke. Locke in his monumental *Two Treatises of the Government* (1689) describes the emergence of a formal state from a state of nature for the purpose of protecting property rights and reducing disorder. The state acquires a monopoly over coercive power, but in exchange guarantees the *natural rights* of every individual. The state also acquires a monopoly on taxing its people, in exchange providing representation (North 1990) and an alignment of its policies with the preferences of the people (Bates and Lien 1985).

However, it is not apparent why rulers have to cede any absolute authority because of their need to collect taxes. A state strong enough to prevent disorder can also become a dictatorship (Djankov et al 2003). It should therefore be able to rely on coercion to extract revenues. The answer lies in the fact that collecting taxes is not costless. It requires monitoring, documentation and sanctioning, all of which cannot be carried out without complex administrative structures, thus making coercion costly (e.g. Timmons 2005; Besley and Perrson 2009, 2013a). Moreover, with the rise of capitalism assets acquired greater mobility, making tax collection even harder (Bates and Lien 1985). Capital rather than land possesses a greater taxable capacity, but it is

also easier to hide or transfer. In this context, in order to extract taxes and maximize revenues, the state has to bargain with the people rather than use coercive power alone.

The 'tax bargain' between the state and its people is made possible by the emergence of representative assemblies such as the *parliament*. These institutions facilitate both the state and tax-payers in conducting the bargain (Bates and Lien 1985). The state prefers to bargain with representatives of the people in order to negotiate a collectively binding agreement, rather than having to do so with multiple agents. The tax payers on the other hand also negotiate more effectively, and stand a greater chance to restrict the state's power and get their preferences represented, through collective action. The origin and historical evolution of representative assemblies is consistent with the above narrative (North and Weingast 1989, Ross 2004, Moore 2004). The rising cost of warfare, and the emergence of capitalism which shifted resources away from land, made monarchs in Europe more dependent on taxation. The traditional source of revenue from agriculture was not sufficient to pay for the increased military expenditure. This gave birth to the *Parliament*, the *Estates General*, the *Cortes* etc – in the beginning these were primarily assemblies where the monarchs and their people haggled over taxes.

The 'tax bargain' essentially implies that the state accepts rules limiting its exercise of arbitrary power, and gives importance to the policy preferences of the people. Thus institutions designed to constrain the coercive power of the state, such as representative assemblies, arise endogenously when the economic power – as a source of revenue – rests with the people (Grief 2005, 2008). On the other hand, when

the state has access to adequate sources of other revenues, such as natural resource rents and unconditional foreign aid, it does not need to engage in any bargain (Brautigam and Knack 2004, Collier and Hoeffler 2009, Besley and Perrson 2013). With lesser scrutiny and pressure from the taxpayers, the restraint on the coercive power of the state is weaker. These natural resource rents, which can be quite large, also enable the state to develop strong repressive mechanisms. It can employ the 'politics of patronage' to weaken political competition through bribery and repression (Ross 2001, Collier 2007). Even historically in the context of Western Europe where large natural resources were found, such as Spanish discovery of silver in Latin America in the sixteenth century, the representative assemblies did not acquire much significance (Drelichman and Voth 2008).

Therefore an empirical investigation of the impact of taxation or natural resource rents on the nature of the political regime should be viewed in terms of the revenue imperative of the state. The state could fulfill its revenue needs through either taxation or other non-tax sources of revenue that it might have access to, such as natural resource rents. This suggests considering both taxation and resource rents, which have opposing impacts on the arbitrary power of the state, in a combined framework. Such a framework would allow us to compare the relative significance of both kinds of revenue on the nature of the political regime. The empirical question would then be that, for a given level of natural resource rents, is increased reliance on taxation associated with democratization? Next, a model of the 'tax bargain' is presented for formally predicting the effect of changes in taxation and natural resource rents on democracy.

2.3 Theoretical Model

The simple game theoretic model presented here is adapted from Bates and Lien (1985). Their paper only considers taxation as a source of revenue. I introduce the counter-balancing effect of non-tax sources of revenues, and an associated resource constraint into the framework. I assume that non-tax revenues comprise entirely of natural resource rents. Also, unlike the original much more sophisticated model which made a distinction between mobile and immobile factors of production, my analysis does not require two factors of production. Hence I consider only one factor of production in order to simplify the constrained optimization problem.

There are two rational agents, the government and the citizenry, who seek to simultaneously maximize utility. The government maximizes utility by choosing the tax rate, the amount of non-tax revenues to extract and a policy position. Its utility is increasing in the tax rate and non-tax revenues but decreasing the farther its chosen policy position is from its most preferred. The chosen tax rate and the policy position affect the utility of the citizens. On the other side, the citizenry, who own the factor of production, optimize by making a production decision. Their utility is increasing in output (net of taxes and production costs). Their production determines the total taxes collected by the government and so affects its utility as well. The utility maximization problem can be represented as follows,

Government: $\underset{(t, N, V)}{\text{Max}}\ U^G [t\, f(x), N, -(V - V^+)^2]$

s.t $t\, f(x) + N \leq K$

$U^C \geq \underline{U}^C$

Citizenry: $\underset{(x)}{\text{Max}}\ U^C\ [(1-t)\ f(x) - w.x, -(V - V^-)^2]$

Where,

V lies in $[V^-, V^+]$

t lies in [0,1]

U^G: Utility of Government

U^C: Utility of Citizenry

$\underline{U}^C$: Lower bound of Utility of Citizenry. It represents the minimum tolerable utility of the population, below which there would be a revolution or upheaval

V: Government's chosen policy position

V^+: Government's preferred policy position

V^-: Citizenry's preferred policy position

$V - V^-$: The level of democracy. The closer the government's chosen policy position is to the preferred policy position of the citizenry (a smaller $V - V^-$), the greater the extent of democracy.

t: Tax rate

N: Non-tax revenues, which in this model are assumed to comprise entirely of natural resource rents.

K: Upper bound of possible revenue.[7] It can be interpreted as the maximum amount of revenues that the state can (and aims to) collect, through a mixture of taxation and natural resource rent extraction.

[7] It represents an exogenous resource constraint, and implies that revenues cannot exceed a certain finite limit. A similar resource constraint is used in the theoretical model of patronage in Collier and Hoeffler (2009).

f(x): output

x: factor of production

w: average cost of factor of production.

The solution to the problem is a Nash equilibrium in which the decision of both the government and citizenry is the best response of one to the other. The solution is derived in Appendix 2A, and it is shown that in equilibrium the inequality constraints are binding, i.e.

$U^C = \underline{U}^C$, and

$t\, f(x) + N = K$

In other words, the government chooses t, N and V such that the utility of the citizens is at the minimum tolerable level below which a revolution or upheaval would occur (implied by the first constraint), and collects as much revenue as it possibly can (implied by the second constraint). Moreover the second constraint also implies that tax and natural resource rents are alternative sources of revenue – higher natural resource rents reduce the taxation required to reach revenue K. It is then argued in Appendix 2A that democracy $(V-V^-)$ can be expressed as an explicit function of t and N. Subsequently, through an exercise in comparative statics, I show that:

$$d(V - V^-)/f(x^*)dt = - (U^C)_1 / 2 (U^C)_2 (V - V^-) < 0, \text{ and} \quad (2.1)$$

$$d(V - V^-)/dN = (U^C)_1 / 2 (U^C)_2 (V - V^-) > 0 \quad (2.2)$$

Additionally, by assuming a specific functional form for the utility of the government and citizens, I derive the optimum t, V, x and N. This confirms that these choice variables lie in the expected range (i.e. $0<t<1$, $V^- < V < V^+$, $x > 0$, $N < K$).

Therefore, the model postulates that democracy can be expressed as a function of taxes and non-tax revenues. The comparative statics results (Equations 2.1 and 2.2) are the testable propositions that follow from the model. Equation (2.1) predicts that an increase in tax revenue will lead to the alignment of the government's chosen policy position with the preferred policy position of the citizenry (i.e. a smaller $V - V^{-}$), or in other words towards more democratization. Equation (2.2) predicts that a reduction in non-tax revenues (natural resource rents) also enhances democracy. Moreover, the change in the level of democracy resulting from an increase in tax revenues will be equal in magnitude to the change due to a similar reduction in natural resource rents. The estimation equation is presented in the next section.[8]

2.4 Estimation Model

Based on the theoretical formulation, the estimation equation is specified as follows:

$$\text{Democracy}_{i,t} = \alpha_1 + \alpha_2(\text{Tax})_{i,t} + \alpha_3(\text{NRRents})_{i,t} + \alpha_4 \log(\text{YPC})_{i,t} + \alpha_5(\text{Trade})_{i,t} + \alpha_6 (\text{Urbpop})_{i,t} + \alpha_7(\text{Aid})_{i,t} + \beta_t(\text{Debt})_{i,t} + \mu_i + \varepsilon_{i,t} \quad (2.3)$$

Where,

Subscript 'i,t': country 'i' at time 't'

Democracy: The degree/strength of democracy.

[8] Before moving on to the next section, it has to be acknowledged that the theoretical model is essentially static. In reality, the choice of both taxation and natural resource rents are likely to be persistent, in the sense of being a function of previous taxation and levels of natural resource rents. Modelling these dynamic processes in a game-theoretic context goes beyond the scope of this chapter.

Tax: The percentage of total tax to GDP.

NRRents: The percentage of total natural resource rents to GDP.

YPC: GDP per capita expressed in Purchasing Power Parity terms in constant year 2005 international dollars.

Trade: The percentage of the sum of exports and imports to GDP.

Urbpop: The percentage of total population living in urban areas as defined by national statistical offices.

Aid: The percentage of official aid and development assistance to GDP.

Debt: The percentage of external public (and publically guaranteed) debt to GDP.

μ_i: Country-specific and time-invariant factors that might be correlated with both democracy and the explanatory set. These factors include geography, historical experience, legal origin, ethno-linguistic fragmentation and culture

β_t: A set of dummies for each year except for the first (1991-2009) to control for time varying common shocks to democracy across all countries in the sample. These reflect global trends.

ε: the idiosyncratic error term, capturing all other determinants of democracy.

Tax and *NRRents* are the main explanatory variables based on the theoretical model, and the expected sign of the estimated coefficients are positive and negative respectively, as predicted by the comparative static results (Equations 2.1 and 2.2). Furthermore the theoretical model predicts that the magnitudes of the two coefficients will be equal. However, empirically we should expect the estimated coefficient of *Natural Resource Rents* to be smaller, because in reality not all the natural resource rents available in an economy necessarily accrue to the government.

Then the ratio of the coefficient of *Natural Resource Rents* to the coefficient of *Tax* gives an estimate for the proportion of rents going to the government if the theoretical model is assumed to be correct. If the coefficient of *Natural Resource Rents* is a fraction r of *Tax*, this implies that 100*r percent of the rents are appropriated by the government.

The other variables included in Equation (2.3) are control variables to address possible omitted variable bias. *Aid* and *Debt* represent two other sources of non-tax revenue which reduce the dependence of governments on taxation. Aid and development assistance from donor agencies and advanced countries (*Aid*) is especially relevant for third world countries. The other source of non-tax revenue is external public debt (*Debt*). Even though this cannot be considered a source of rent as it has to be repaid eventually, it could possibly provide governments the fiscal space needed to reduce their dependence on taxes. *Aid* and *Debt* are only included as control variables, rather than as main explanatory variables in the model[9], because these are available only for a significantly reduced number of countries.[10]

YPC, *trade* and *urbpop* are also covariates that could plausibly be correlated with tax-revenue while also being possible determinants of democracy. A vast literature that seeks to explain tax performance across countries identifies the so

[9] As sources of non-tax revenue similar to natural resource rents.

[10] Furthermore strictly speaking, *Debt* is a stock unlike the other sources of revenue which are a flow, and this might create an inconsistency in the model specification. However as noted above *Debt* is only included as a control variable, and the empirical specification including *Debt* is only meant as a robustness check. Therefore I do not investigate this issue more thoroughly in this chapter.

called ‘tax handles’ (Tanzi 1989 & 1992, Leuthold 1992, Teera and Hudson 2004, Auriol and Warlters 2005, Mahdevi 2008, etc). ‘Tax handles’ are the factors that determine the tax base of a country from which revenue can be generated. In this literature a large variety of factors are investigated in order to assess their impact on tax performance, but all studies consider per capita income, the level of international trade and the degree of urbanization amongst the primary tax handles. At the same time these variables are also likely to be associated with democracy. Income per capita influences democracy – based on the ‘modernization hypothesis’ which conjectures that political development accompanies economic development (Acemoglu et al 2008, Moral-Benito and Bartolucci 2013, Benhabin et al 2013). Similarly, international trade has been investigated as an influence on democracy (Rigobon and Rodrik 2005). Lastly a higher level of urbanization is associated with economic and political development as well.

2.5 Variables Description and Data Sources

The empirical investigation is carried out using a panel dataset covering 132 countries over the period 1990-2009. It is an unbalanced panel with data for several variables missing for some years. Data for the main explanatory variable, tax revenue, are not available before 1990 for most countries. The relatively short time coverage fits in well with the purpose of this chapter, which is to investigate whether the historical process generating democracy in the Western world could be replicated in the contemporary period.

The dependent variable in Equation (2.3) is measured by an indicator called *Polity2* developed by Marshall et al (2010) who run the *Polity IV* project. This indicator

measures the degree to which democracy is present in a country. It is based on a conceptual scheme which measures the characteristics of different regimes. The data release used for this chapter contains data from 1800 to 2009.

The construction of *Polity2* is based on two different variables, *democracy* and *autocracy.* These variables measure the degree of democracy and autocracy in a country on separate eleven point scales of 0 to 10 and 0 to -10 respectively. As the authors caution, both these variables are constructed independently for each country and cannot be considered simply as opposites. This means that a country with a d*emocracy* score of 5 for example, does not necessarily has an *autocracy* score of -5. The variables *democracy* and *authority* can be combined into a composite *polity* variable which ranges from -10 (absolute autocracy) to +10 (perfect democracy). A modified variable *Polity2* provides a score on the same scale for periods where there was transition, interruption or anarchy. This is the dependent variable that is used in my regressions.

The conceptual scheme underlying these variables assigns a score based on distinct elements or characteristics of the regime, which are then combined. These broadly translate into the presence of institutions that allow citizens to express preferences about leaders and policies, the existence of institutionalized constraints on the power of executive, and the degree of opportunity provided to every citizen to participate in the political process. The score based on these elements can be interpreted as essentially measuring the existence of truly representative institutions (representative in the sense that they are accessible to the entire citizenry) that can check the power of the executive and influence its policy preferences.

As a robustness check, I also use a measure for the dependent variable from a different source. This variable is *Voice and Accountability* from the *World Governance Indicators* released by the World Bank. The data release I use contains data running from 1996 to 2009 with a few missing years in between. This variable is one of the six dimensions of institutional quality defined by the authors of these indicators (Kaufmann, Kraay and Mastruzzi 2010). *Voice and Accountability* measures not just "the extent to which a country's citizens are able to participate in selecting their government", but also civil liberties such as media freedom. In this sense it is broader than *Polity2*.

The methodology for the construction of *Voice* is also different from *Polity2*. It involves aggregation and standardization of data from 31 different sources. The distribution of the resulting variable is standard normal with a range from -2.5 to 2.5. I rescale the variable so that it ranges from 0 to 100. The sources include "surveys of individuals and domestic firms, perceptions of country analysts at multilateral development, nongovernmental organizations and commercial business information providers". Crucially the *Polity IV Project* is not one of the underlying sources. This means that *Polity2* and *Voice and Accountability* are independent, and thus using both allows a suitable check on the robustness of results.

In addition, one of the potential drawbacks of the *Polity2* variable is that it is censored at 10 for most democratic and -10 for most autocratic countries. Moreover the variable follows a discrete scale.[11] On the other hand, whereas *Voice and*

[11] For this reason, the use of Least Square Dummy Variable (LSDV) estimation used in this chapter might be problematic.

Accountability is constructed as a standard normal variable, none of the observations are bounded at the top or the bottom of the scale (Table 2B.1). Moreover, this variables is continuous rather than discrete. The use of Voice and Accountability as an alternate dependent variable allows me to check whether the results are sensitive to the bounded and discrete nature of the *Polity2* variables.

The first main explanatory variable (*Tax*) measures the central governments' tax collection. I use *Total Tax to GDP percentage* from *World Development Indicators* (WDI) provided by the World Bank. This data is based on the IMF's *Government Finance Statistics*. Total tax includes taxes on income, profits and capital gains; taxes on goods and services; taxes on international trade[12]; and a residual called 'other taxes' which comprises of taxes not allocable to the previous three categories such as property taxes, employer payroll taxes, penalties for non-payment of taxes etc. Total tax does not include most social security contributions and other sources of government revenues such as fines, fees, rents, profits of public enterprises etc. It also does not include grants. I am interested in total tax rather than total revenue, because it is generated solely from the economic activity of the citizens.

[12] It could be argued that taxes on international trade should be removed as these are administratively less costly to collect compared to other kinds of taxes. However, disaggregated tax data is available only for a reduced number of countries. Moreover, the theoretical model on which Equation (2.3) is based only makes a distinction between revenue collected from the economic activity of citizens and those from other sources. In this context taxes on international trade are also collected from the economic activity of citizens, even if these are easier to collect.

The other main explanatory variable is a measure of rents from natural resources. World Bank's *WDI* provides a relevant variable called exactly that. *Total natural resource rents* are the sum of rents from oil, natural gas, coal, mineral deposits and forests. Rents are defined as the difference between the world market value of these resources and their total cost of production. The calculation of this data is done by the World Bank staff using the *Comtrade* database maintained by the United Nations Statistics Division. It should be noted that this variable is a measure of the total rents available in a country, not all of which go to the government.

The data source for all the other variables included as covariates in Equation 2.3 (*YPC*, *Trade*, *Urbpop*, *Aid* and *Debt*) is also the World Bank's *WDI*.

2.6 Estimation Methodology

The equation is estimated using three different regression techniques – pooled OLS, fixed effects and system Generalized Method of Moments (system GMM). Fixed effects is superior to pooled OLS, while system GMM addresses additional endogeniety issues compared to fixed effects. A comparison of the estimation results reveals different perspectives into the relationship of democracy with Tax and NRRents, based on the differing assumptions underlying each technique.

The equation is first estimated through pooled OLS — this technique estimates Equation (2.3) excluding the country-specific fixed effects (μ_i). However, ignoring country-specific fixed effects could cause omitted variable bias, because the μ_i are country-specific and time-invariant factors that might be correlated with both

democracy and the explanatory set. These factors include geography, historical experience, legal origin, ethno-linguistic fragmentation and culture, which the literature considers to be important determinants of economic and political development. Thus the estimated coefficients from Pooled OLS regressions merely represent the statistical association between the explanatory variables and the dependent variable across countries (over the time period under study), indicating for example whether countries with higher taxation are also more democratic. The estimated coefficients from pooled OLS do not capture the within-country relationship, for example whether a given country on average becomes more democratic as it collects more taxes (Acemoglu et al 2008). Thus the μ_i are subsequently included in the equation, which is then re-estimated using the fixed effects regression technique. This technique involves estimating the equation after demeaning it to purge the μ_i.

While the fixed effects estimation technique mitigates omitted variable bias by removing the influence of long run determinants of both revenues and democracy, it does not address another source of endogeneity — potential reverse causality from the dependent variable to the explanatory variables. Therefore we still need to be cautious about inferring causality based on the estimated coefficients from fixed effects regressions (Acemoglu et al 2008). Strictly speaking, in order to establish a causal impact the explanatory variables need to be statistically shown as exogenous (uncorrelated with the error term).

Moreover, there is also reason to believe that democracy is a persistent variable, with the present nature of the political regime dictating its future quality (Acemoglu et al 2005b, 2006a, 2006c, 2008). Hence there is a rationale for including

lagged democracy as an explanatory variable in the econometric equation. Then the fixed effects regression technique also does not consistently estimate an equation containing the lagged dependent variable, because the lagged dependent variable is correlated with the error term after the equation is demeaned to purge the country-specific fixed effects.

Because of the concerns discussed above I subsequently re-estimate the equation after also including lagged democracy in the specification through the system Generalized Method of Moments (GMM) regression technique developed by Arellano and Bover (1995) and Blundell and Bond (1998).[13] The modified equation to be estimated is as follows,

$$\text{Democracy}_{i,t} = \alpha_1 + \alpha_2 \text{Democracy}_{i,t-1} + \alpha_3 (\text{Tax})_{i,t-1} + \alpha_4 (\text{NRRents})_{i,t-1} + \alpha_5 \log(\text{YPC})_{i,t-1} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (2.4)$$

The explanatory variables now enter the equation with a lag, so that I am in effect estimating the impact of *Tax* and *NRRents* on the change in democracy from the current to the next period. Neither does the equation include the complete set of control variables, the reason for which will be explained shortly.

The system GMM estimation procedure involves differencing the equation through either subtracting the previous observations of the variables, or alternatively subtracting from it the average of all future available observations of the variables. The second method of differencing, known as 'forward orthogonal deviations', is

[13] System GMM augments the difference GMM technique suggested by Arellano and Bond (1991)

preferable when dealing with an unbalanced panel (Roodman 2009a). Then the differenced $Democracy_{i,t-1,}$ can be instrumented by $Democracy_{i,t-2}$ (and previous lags) as these are uncorrelated with the differenced error term. The difference GMM technique uses this set of instruments only. However, lagged levels of the variables are weak instruments for the first differences if the variable is persistent (Bond et al 2001). The system GMM technique derives additional moment conditions by instrumenting $Democracy_{i,t-1}$ in the original levels equation by its contemporaneous and lagged first differences, as these are uncorrelated with the level of the error term.

System GMM estimation has an important advantage in addition to allowing consistent estimation of an equation that controls for the lagged dependent variable[14]. It allows the explanatory variables to be either endogenous or weakly exogenous (predetermined), and thus deals with the problem of likely reverse causality from taxation to democracy establishing a causal impact. In order to estimate the model, I impose the restriction that the explanatory variables *Tax, NRRents* and per capita income are predetermined. This means that they can be correlated with the past error terms as long as they are not correlated with the current error term. In other words the exclusion restriction is that for a given predetermined variable (x), $E(x_{i,t}, \varepsilon_{i,s}) = 0$ for $s \geq t$, but $E(x_{i,t}, \varepsilon_{i,s}) \neq 0$ for $s < t$. Because our explanatory variables are specified in the equation with a lag, this effectively means that they are endogenous. So for example $Tax_{i,t-1}$ can be correlated with $\varepsilon_{i,t-1}$. The predetermined variables are then instrumented in the same way as the lagged dependent variable. The System GMM estimation

[14] System GMM is primarily employed in the literature to consistently estimate an equation containing the lagged dependent variable (Bond et al 2001).

technique provides us with a set of internal instruments, rather than having to look for external instruments which are highly correlated with tax collection, but do not impact democracy through any other channel — this would be a really difficult task, and the validity of such an instrument can always be argued against.

For estimation of (2.4) through system GMM I take observations occurring every second year from 1991-2009 as this technique works best for small T (time interval) and large N (countries) (Roodman 2009a, Jayasuriya and Burke 2013). I also restrict the number of lags used for instrumenting the right-hand side variables to one. This is because a large instrument set relative to the number of observations causes an over-fitting bias for the estimates (Roodman 2009b). Increasing the number of lags used to instrument the right-hand side variables beyond one does not substantially change the estimated coefficients while improving the efficiency in terms of standard errors and diagnostics.[15]

It is for the same reason (to avoid instrument proliferation), that the complete set of control variables is not included in the specification. In any case, because system GMM provides consistent estimates for the coefficients even when the explanatory variables are correlated with the error term, we do not need to worry about omitted variables. A standard Sargan or Hansen test of over-identifying restrictions allows us to check for the validity of the instrument set; the instrument set is exogenous if it is not correlated with the error term. Thus an inappropriate exclusion of the control variables

[15] Moreover, using the minimum possible lag length allows the least reduction in the number of observations available for estimation given the availability of tax data over relatively short time duration.

would lead to the rejection of the null hypothesis (under the test of over-identifying restrictions) that the instrument set is valid.

Finally it is also worthwhile to examine if the relation between the main explanatory variables and democracy varies with the level of income per capita — for example does the impact of *Tax* (or *NRRents*) on democracy change as a country becomes richer. In order to investigate this I modify Equations (2.3) and (2.4) by including an interaction term between income per capita (in thousands of dollars) and *Tax*, as well as income per capita and *NRRents*. The estimated coefficients of these interaction terms tell us how the impact of *Tax* and *NRRents* on democracy varies as income per capita changes by a thousand dollars.

2.7 Descriptive Statistics

Before presenting the regression results I report (in Table 2B.1 of Appendix 2B) the descriptive statistics, including the means, standard deviations, minimums, maximums, as well as the number of observations and countries, for all the variables in the econometric model. As expected with a large sample of countries at varying stages of development, all the variables show substantial variation. Income per capita varies from 250 to 77,000 real international dollars. The first measure for democracy, *Polity2*, varies across the entire range of the indicator. The second measure, *Voice*, ranges from 12 to 87. Tax as a proportion GDP ranges from close to 0 to as much as 61 percentage points. Similarly, natural resource rents as a proportion of GDP varies from 0 to as high as 75 percentage points. The other sources of non-tax revenue also vary substantially. The variable 'aid as a proportion of GDP' is only relevant for developing countries: some of these countries receive no aid while others get more than the value of their

GDP. Similarly the external public (and publically guaranteed) debt as a percentage of GDP for some countries is in single digits while at the other extreme the percentage is higher than 800.

More interesting are the statistics in Tables (2.1) and (2.2). These tables show the mean of Democracy, *Tax* and *NRRents* for countries grouped by the *Polity2* quartiles (Table 2.1) and the *Voice* quartiles (Table 2.2). The mean of the proportion of tax to GDP progressively rises from around twelve to over twenty from the bottom to the top quartile of both *Polity2* and *Voice*. On the other hand, the mean of the proportion of natural resource rents to GDP falls from around fourteen for the bottom quartile to two for the top quartile. The means of *Tax and NRRents* for each *Polity2* quartile are roughly similar to the corresponding *Voice* quartile. These tables present initial yet clear-cut evidence in favor of the hypothesis of a positive linear relation between democracy and *Tax*, and an inverse linear relation between democracy and *NRRents*.

Table 2.1. Means by Polity2 Quartiles

Variable	**1st Quartile** (Polity2 < -1)	**2nd Quartile** (-1<Polity2<7)	**3rd Quartile** (7<Polity2<10)	**4th Quartile** (Polity2=10)
Polity2	-5.83	3.70	8.06	10
	(2.36)	(2.37)	(0.72)	(0.00)
Tax	12.24	14.02	16.45	20.81
	(7.11)	(7.17)	(7.05)	(7.12)
NRRents	14.75	9.62	4.01	2.93
	(16.52)	(11.70)	(6.07)	(8.15)
YPC (1000)	10.79	3.67	7.39	25.40
	(16.78)	(3.71)	(6.70)	(9.42)
Countries	46	49	56	34

Note: Standard deviation are reported in parenthesis

Table 2.2. Means by Voice Quartiles

Variable	1st Quartile (Voice < 39.39)	2nd Quartile (39.39<Voice<52.42)	3rd Quartile (52.42<Voice<70.71)	4th Quartile (Voice> 70.71)
Voice	28.92	45.80	62.44	76.88
	(7.53)	(3.80)	(5.67)	(3.92)
Tax	12.39	15.28	18.73	21.48
	(6.54)	(7.45)	(6.95)	(6.44)
NRRents	13.90	6.65	3.85	1.57
	(15.86)	(11.58)	(9.19)	(3.51)
YPC(1000)	6.21	7.81	13.50	29.89
	(10.94)	(11.98)	(9.80)	(10.74)
Countries	58	57	60	37

Note: Standard deviation are reported in parenthesis

As a sidenote, these tables also show the mean of real income per capita (in thousands) for each of the *Polity2* and *Voice* quartiles. There appears to be a non-linear relationship between income per capita and democracy, when democracy is measured by *Polity2*. Average real income per capita for the lowest quartile (the group of most autocratic countries) is higher than what it is for the second and the third quartiles. From the second to the highest quartile, the mean of real income per capita rises progressively, and the group of countries that are the most democratic are on average the richest. If democracy is measured by *Voice*, then there is a clear linear relationship between income per capita and democracy.

Finally, the pair-wise partial correlation reported in Appendix Table 2.B2 lend further credence to my hypothesis. Even though from different sources, both measures of democracy (*Polity2* and *Voice*) are highly correlated with each other (the correlation coefficient is 0.8). Moreover, both the measures display a clear positive correlation with *Tax* and an equally clear negative correlation with natural resource rents. Both are also negatively correlated with the other sources of non-tax revenue

(*Aid* and *Debt*), although the magnitude of the correlation coefficient is not as high as for *Tax* and *NRRents*. This justifies including *Aid* and *Debt* as control variables in our model rather than the main sources of revenue. The correlations of both measures of democracy are clearly positive with income per capita and urbanization. The correlation of trade with *Polity2* and *Voice* is of the opposite sign, but the magnitudes are negligible.

The pair-wise correlation of *Tax* with the three non-tax sources of revenue is also instructive. The negative correlation of *Tax* is the highest in magnitude with natural resource rents (0.26), followed by *Aid* (0.10) and then *Debt* (0.06). Furthermore, *Tax* is clearly positively correlated with all the tax handles (income per capita, trade as a proportion of GDP and urban population as a proportion of the total) included as control variables. Natural resource rents are positively correlated with external debt as a proportion of GDP; this is not surprising given the donor optimism that normally accompanies discovery of natural resources. Finally *Aid* and *Debt* also exhibit a high degree of positive pair-wise correlation with each other.

2.8 Estimation Results

2.8.1 Regression Results for *Polity2*

Table 2.3 reports the pooled OLS and Table 2.4 reports the fixed effects regression results. In both these tables the first two columns show results from a regression of the dependent variable on each of the main explanatory variables separately. In Column (3), both the explanatory variables are included together. In Column (4), the

first set of control variables — *L(YPC)*, *Trade* and *Urbpop* — are then added. Finally Column (5) also includes *Aid* and *Debt* — this is done last because the sample of countries is highly reduced, which is why this is my least preferred specification. It is only reported as a comparison to check for the robustness of estimated coefficients. Columns (3) and (4) are the preferred specifications.

In the regressions reported in Table 2.3 both *Tax* and *NRRents* are highly significant (at the one percent level) in explaining the *Polity2* score across countries over this time period — countries that tax more, and sustain themselves on smaller natural resource rents as a percentage of GDP, are more democratic. The estimated coefficients of both the variables in Column (3) confirm the prediction of the model — these are statistically significant (at the one percent level) with opposite signs. The null hypothesis that the magnitudes of the coefficients are exactly the same (as predicted by the theoretical model) cannot be rejected at any reasonable level of significance based on the F-test for equality of the coefficients. The coefficient of *Tax* indicates that a percentage point increase in *Tax* is on average associated with a 1.1 percentage point (=0.21/20*100) higher *Polity2* score[16]. To put it differently, a one standard deviation increase in *Tax* is associated with a 0.25 of a standard deviation improvement in the *Polity2* score.[17] By contrast a percentage point rise in *NRRents* is on average associated with 0.9 of a percentage point lower *Polity2* score. In terms of

[16] Here and henceforth a percentage point is meant to indicate the change as a proportion of the total range of the variable.

[17] This calculation (and all other similar calculations henceforth) is based on the estimated coefficient, and the standard deviations reported as descriptive statistics (i.e. Table 2B.1).

standard deviations: a one standard deviation increase in *NRRents* is associated with a 0.33 of a standard deviation lower *Polity2* score. Adding the control variables in Column (4) does not change the estimated coefficients substantially[18].

An interesting finding is that higher *Trade* is associated with a lower democracy score, confirming a similar result reported by Rigobon and Rodrik (2005). The magnitude of this partial correlation is not very high — only 0.15 of a percentage point lower *Polity2* score. Finally for the reduced sample of countries that results from adding *Aid* and *Debt* in Column (5), only the coefficient of *NRRents* is estimated precisely at a high level of statistical significance.

The fixed effects estimation results reported in Table 2.4 indicate that the within-country association of tax and natural resource rents with democracy remains statistically significant at the ten percent level.[19] The overall explanatory power of these regressions (indicated by the R^2 from regression of the equivalent LSDV Model) is much higher than the corresponding pooled OLS regressions, suggesting that fixed country characteristics explain most of the variation in the extent of democracy. This is exactly as expected because institutional quality, such as the nature of political regimes, is determined to a great extent by historical experience, geography, culture

[18] Note than the coefficient of *Tax* (as well as *NRRents*) in columns 3 and 4 overlap within one standard error band.

[19] The reduction in statistical significance and magnitude of the estimated coefficients is expected due to the inclusion of fixed country characteristics that are correlated with democracy as well as *Tax* and *NRRents*.

and other long-run determinants (Acemoglu et al 2001, Rodrik et al 2004, Shirley 2005 etc).

Table 2.3. Determinants of Polity2$_t$: Pooled OLS Estimation Results

Variable	(1)	(2)	(3)	(4)	(5)
Tax_t	0.285***		0.214***	0.170***	0.099
	(0.072)		(0.066)	(0.053)	(0.066)
$NRRents_t$		-0.214***	-0.177***	-0.177***	-0.120***
		(0.045)	(0.042)	(0.045)	(0.042)
$L(YPC)_t$				1.188*	-0.478
				(0.613)	(1.172)
$Trade_t$				-0.025***	-0.007
				(0.008)	(0.014)
$UrbPop_t$				0.025	0.096
				(0.036)	(0.052)
Aid_t					0.016
					(0.048)
$Debt_t$					-0.001
					(0.008)
Observations	1540	1540	1540	1516	963
Countries	130	130	130	129	91
TE included	Yes	Yes	Yes	Yes	Yes
Tax=- NRRents			0.685	0.924	0.811
R^2	0.189	0.230	0.294	0.373	0.198
Adjusted R^2	0.178	0.220	0.284	0.363	0.176

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1990-2009. Robust standard errors clustered by countries reported in parentheses. TE refers to the set of time dummies. The statistic reported for '*Tax* - *NRRents* = 0' is the p-value of the F-statistic testing for equality of the magnitudes of the coefficients.
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Table 2.4. Determinants of $Polity2_t$: Fixed Effects Estimations Results

Variable	(1)	(2)	(3)	(4)	(5)
Tax_t	0.115*		0.120*	0.121**	0.167**
	(0.063)		(0.062)	(0.061)	(0.074)
$NRRents_t$		-0.052	-0.056*	-0.061*	-0.118***
		(0.036)	(0.032)	(0.034)	(0.044)
$L(YPC)_t$				-2.486*	-4.872***
				(1.394)	(1.420)
$Trade_t$				0.010	0.025*
				(0.010)	(0.016)
$UrbPop_t$				0.198	0.228
				(0.156)	(0.183)
Aid_t					-0.007
					(0.023)
$Debt_t$					-0.002
					(0.003)
Observations	1540	1540	1540	1516	963
Countries	130	130	130	129	91
TE included	Yes	Yes	Yes	Yes	Yes
Tax= - NRRents			0.329	0.308	0.484
R^2	0.868	0.868	0.869	0.870	0.813
Adjusted R^2	0.854	0.853	0.855	0.855	0.787
R^2(within)	0.090	0.085	0.096	0.126	0.184
R^2(between)	0.94	0.263	0.326	0.105	0.114

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1990-2009. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. The statistic reported for '*Tax* = - *NRRents*' is the p-value of the F-statistic testing for equality of the magnitudes of the coefficients. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Comparing the impact of the two types of revenue in Table 2.4, the coefficient for *Tax* is more significant and higher in magnitude than *NRRents*. Columns (3) and (4) indicate that a one percentage point rise in *Tax* is associated with 0.6 of a percentage

point better *Polity2* score[20]. In other words, a one standard deviation increase in *Tax* is associated with a 0.15 of a standard deviation reduction in the *Polity2* score. For *NRRents* the negative association is 0.3 of a percentage point. In terms of standard deviation this partial correlation is -0.11. The point estimates imply that within any given country, higher taxation is more strongly associated with democracy compared to the adverse association of higher natural resource rents with democracy. However in line with the theoretical model, the null hypothesis that the coefficients are equal in magnitude cannot be rejected at the ten percent level of significance.

The negative association between *Trade* and democracy witnessed in the pooled OLS regression results also disappears within countries. An interesting result is the sign of the coefficient of *L(YPC)*. One percent higher real per capita income within a given country is associated with a *Polity2* score that is lower by 0.12 of a percentage point. This surprising result could be due to a potentially non-linear relation between income per capita and democracy (shown in Table 2.1) that I have ignored. As income per capita is not the main explanatory variable, I do not explore this issue in detail.

Unlike the pooled OLS results, the within-country association of *Tax* and *NRRents* with *Polity2* for the reduced sample of countries (following the addition of *Aid* and *Debt* in Column (5) of Table 2.4) is even stronger. The coefficients are higher in magnitude and more statistically significant. The coefficients for *L(YPC)* and *Trade* are

[20] The coefficients of *Tax* and *NRRents* in column (4) after the addition of the control variables are practically unchanged compared to column (3).

also estimated more precisely in this specification. The coefficient of *Aid* and *Debt* are not statistically significant at a reasonable level, but have the expected negative sign.

The system GMM regression results are presented in Table 2.5. The first three columns are specifications similar to Tables 2.3 and 2.4. However Column (4) only includes log of income per capita as the control variable because of reasons discussed in Section 2.6. The diagnostics indicate that the model has been adequately estimated. The p-value of the Hansen test for over-identifying restrictions shows that we cannot reject the null hypothesis that the instrument set is valid. At the same time the estimation does not likely suffer from an over-fitting bias caused by over instrumentation, as the Hansen p-value is not unrealistically high (Roodman 2009b, Jayasuriya and Burke 2013). Also, the p-value of the AR(2) test indicates that we cannot reject the null of no second order serial correlation at the ten percent level of significance, which is a necessary assumption for consistent estimation using system GMM.

The system GMM results provide the strongest evidence for my hypothesis. The positive impact of higher taxation and the adverse effect of higher natural resource rents on democracy within countries are quite substantial. Moreover, the coefficients for *Tax* and *NRRents* are statistically significant (at the five percent level). Although the point estimate of the impact of taxation is higher as expected, we still cannot reject the null hypothesis that the magnitudes of the coefficients are equal. Column (3), for example, tells us that a percentage point higher tax to GDP ratio

cumulatively increases the *Polity2* score to rise by 0.44 points[21]. This is an increase of more than 2 percentage points. On the other hand a percentage point lower natural resource rents to GDP ratio, cumulatively decreases the democracy score to fall by 0.21 points (or 1 percentage point). As suspected, democracy is a highly persistent variable as indicated by the magnitude and statistical significance of the coefficient for lagged *Polity2*. Addition of the control variable in Column (4) does not change the results to any noticeable degree, although the coefficient for *Tax* becomes slightly less statistically significant[22].

The relative magnitudes of the impact of *Tax* and *NRRents* on democracy, as indicated by the point estimates are similar in both the fixed effects and the system GMM regressions. The coefficient of *Tax* is approximately twice as large as the coefficient of *NRRents*. According to the prediction of the theoretical model the coefficients should have been of the same magnitude. This was based on the assumption that the entire natural resource rents available in an economy go to the government. In terms of the interval estimates, we cannot reject that the coefficients are equal in magnitude at the ten percent level of significance. However if we consider the point estimates, the relative magnitudes of the coefficients give an approximation of the total resource rents accruing to the government. If the theoretical model is correct, then based on the point estimates, on average around half of the rents in a country belong to the government.

[21] The cumulative impact equals 0.027/(1-0.938)

[22] The coefficients of *Tax* (and *NRRents*) in columns (3) and (4) overlap within one standard error band.

Table 2.5. Determinants of Polity2$_t$: System GMM Estimations Results

Variable	(1)	(2)	(3)	(4)
Polity2$_{t-1}$	0.944***	0.959***	0.938***	0.926***
	(0.027)	(0.017)	(0.022)	(0.023)
Tax$_{t-1}$	0.026*		0.027**	0.028*
	(0.015)		(0.013)	(0.015)
NRRents$_{t-1}$		-0.010**	-0.013**	-0.015**
		(0.004	(0.006)	(0.006)
L(YPC)$_{t-1}$				0.043
				(0.068
Observations	771	1480	761	754
Countries	131	156	130	129
TE included	Yes	Yes	Yes	Yes
Tax= -NRRents			0.337	0.429
Instruments	64	66	92	111
Hansen J test p-value	0.395	0.444	0.169	0.105
AR(2) test p-value	0.340	0.938	0.359	0.371
Wald chi-sq statistic	5135.97	7185.90	16170.03	13480.71
Wald chi-sq p-value	0.00	0.00	0.00	0.00

Notes: A constant is included in all regressions but not reported. Observations of the dependent variable at 2 year intervals are used from 1993-2009. Windmeijer-Corrected Robust standard errors from the two-step GMM estimation are reported in parenthesis. TE refers to the set of time dummies. The statistic reported for 'Tax = - NRRents' is the p-value of the chi-squared statistic testing for equality of the magnitudes of the coefficients. Orthogonal forward deviations used to purge fixed effects. All explanatory variables are treated as endogenous and instrumented by 1 lag.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

2.8.2 Regression Results for *Polity2* Including the Interaction Terms

Table 2.6. Determinants of Polity2$_t$ (including interactions)

Variable	Pooled OLS (1)	Fixed Effects (2)	System GMM (3)
Tax	0.110*	0.157**	0.024*
	(0.066)	(0.079)	(0.014)
NRRents	-0.094**	-0.083*	-0.011*
	(0.044)	(0.046)	90.006)
YPC(1000)	0.068	-0.088	0.000
	(0.072)	(0.109)	(0.000)
Tax * YPC(1000)	0.004*	-0.005**	0.000
	(0.003)	(0.002)	(0.000)
NRRents$_t$ *	-0.005***	0.002*	-0.000
YPC(1000)	(0.002)	(0.001)	(0.000)
Polity2$_{t-1}$			0.936***
			(0.023)
Observation	1540	1540	754
Countries	130	130	129
TE included	Yes	Yes	Yes
R^2	0.360	0.872	
Adjusted R^2	0.350	0.857	
R^2 (within)		0.112	
R^2 (between)		0.007	
R^2 (overall)		0.004	
Instruments			148
Hansen J test p-value			0.689
AR(2) test p-value			0.363
Wald chi-sq statistic			17786.55
Wald chi-sq p-value			0.00

Note: A constant is included in all regressions but not reported.
For pooled OLS and fixed effects regressions annual observations of the dependent variable are used from 1990-2009. Robust standard errors clustered by countries are reported. Explanatory variables are contemporaneous. TE refers to the set of time dummies. The R^2 in column (2) refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
For System GMM observations of the dependent variable at 2 year intervals are used from 1993-2009. Windmeijer-Corrected Robust standard errors from the two-step GMM estimation are shown in parentheses. Explanatory variables are lagged. Orthogonal forward deviations used to purge fixed effects. All explanatory variables are treated as endogenous and instrumented by 1 lags.
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

The results for the variation in the impact of *Tax* and *NRRents* on *Polity2* as income per capita changes are reported in Table 2.6. These results are meant as a supplementary analysis and only for the purpose of exploring whether the hypothesized impact of tax or natural resource rents on democracy depends on the level of development. Table 2.6 demonstrates an interesting contrast between the three regression techniques, emphasizing the importance of recognizing the different assumptions underlying each technique and interpreting the results accordingly.

The pooled OLS results suggest that the positive association of *Tax* and negative association of *NRRents* with democracy are stronger for richer countries. The coefficient for the first interaction term [*Tax* * *YPC*(1000)] indicates that the association between *Tax* and democracy is almost four percent (=0.004/0.11*100) higher for countries whose real per capita income is a thousand dollars greater. The coefficient of the second interaction term [*NRRents* * *YPC*(1000)] suggests that the negative association between *NRRents* and democracy is approximately five percent lower as the real income per capita increases by a thousand dollars.

However the fixed effects results in Column (2) of Table 2.6 indicate that once fixed country characteristics are controlled for the opposite relationship emerges. Thus, ignoring the long term factors correlated with both revenues and democracy leads to extremely misleading conclusions. Within countries, on average the statistical association gets weaker as a country becomes richer. The corresponding coefficient shows that as a country's real per capita income increases by a thousand dollars the positive association between *Tax* and democracy becomes three percent lower.

Similarly the negative association between *NRRents* and democracy is almost 2.5 percent lower as real income per capita increases by a thousand dollars. This is an important finding. It implies that the connection between the nature of revenues and the political regime within a given country is most pronounced when its real income per capita is low.

Finally the system GMM results in Column (3) indicate that we cannot reject the null hypothesis of no difference in the impact of *Tax* or *NRRents* on democracy as the level of income per capita changes. The coefficients of the interaction terms are not statistically significant at even the 10 percent level. Therefore, we need to be careful in inferring a causal relationship based on the fixed effects results. In other words, the causal mechanism that makes taxation and natural resource rents affect democracy does not likely change as a country becomes richer.

2.8.3 Regression Results for *Voice* as an alternative measure of democracy

For the alternative measure of democracy (*Voice*), I only report the pooled OLS and the fixed effects regression results in Tables 2.B3 and 2.B4 respectively. Due to the shorter time period over which this data is available with various missing years in between, the system GMM regression results are not estimated consistently (as indicated by the diagnostics) nor with precision. The pooled OLS and the fixed effects regression results for *Voice* are qualitatively similar to the results for *Polity2*, but quantitatively different.

The explanatory power of the pooled OLS regressions in explaining *Voice* is very similar to that for *Polity2* in the specifications that do not include the control variables. However, for the specifications with the control variables included (Columns 4 and 5) the R^2 for the regression of *Voice* is substantially higher. Column (4) of Table 2.B3 indicates that a percentage point higher *Tax* is associated with a *Voice* score that is higher by 0.44 percentage points. Whereas an additional percentage point of natural resource rents is associated with a 0.47 percentage point decrease in the score. This association is lower than the corresponding one for *Polity2*. The estimated coefficients of both *L(YPC)* and *Trade* are highly significant (at the one percent level) as well. Similar to the pooled OLS regression results for *Polity2*, the association of real income per capita with *Voice* remains positive, while for *Trade* it is negative. The estimated coefficients retain their statistical significance even for the reduced sample of countries (Column 5). More interestingly the coefficient for *Aid* is also estimated with a high level of precision (one percent level of statistical significance). However, it has the unexpected sign. Countries that receive more aid are more democratic over the time period 1996-2009. As discussed previously, this is yet another illustration of the shortcoming of the pooled OLS regression technique. It is plausible that fixed-country characteristics simultaneously affected both the nature of the political regime and the amount of aid it receive over this time period; or it could be that countries which are more democratic receive more aid rather than the other way round.

The fixed effects regressions explain the within-country variation in *Voice* to a lesser degree than *Polity2* (as indicated by the within R^2). This is expected given the shorter time period being investigated. Also, the coefficients are estimated with less

precision, and magnitudes of the association of the explanatory variables with *Voice* are smaller than with *Polity2*. Compared to *Tax*, the coefficient for *NRRents* is more statistically significant. Moreover the point estimate for the coefficient for *NRRents* is much closer in magnitude to the coefficient for *Tax*, indicating that from 1996 onwards the proportion of natural resource rents accruing to the government is smaller. Column (3) for example indicates that a percentage point increase in *Tax* is associated with a 0.13 percentage point higher *Voice* score within countries, whereas a similar increase in *NRRents* is associated with a 0.09 percentage point lower score. For the reduced sample of countries in Column (5), the only control variable that is associated at a reasonable level of statistical significance with *Voice* is *Debt*. An increase of one percentage point in the external debt to GDP ratio within a given country is associated with a 0.35 percentage point reduction in the *Voice* score.

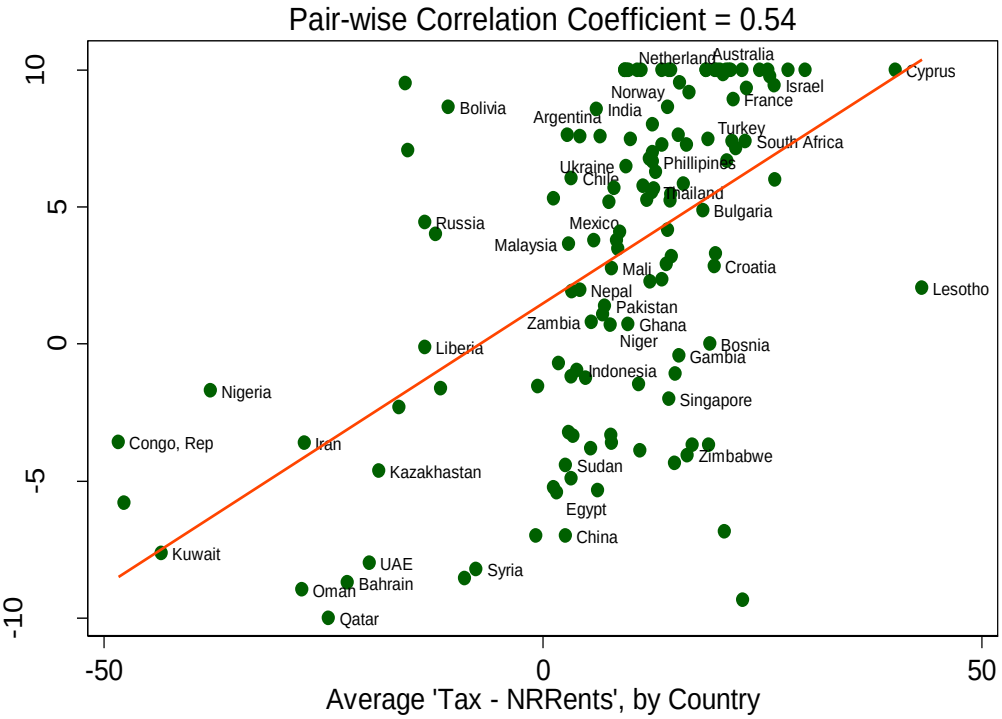
In summary, the regression results for *Voice* are broadly similar to *Polity2* — the signs of estimated coefficients for the main explanatory variables remain the same. It can be concluded that the positive association of taxation with democracy and the negative association of natural resource rents is not a peculiarity of the *Polity2* variable.

2.9 Country Examples

The cross-country evidence presented in the previous section demonstrates that in a large sample of countries over the period 1990-2009, greater taxation, on average makes the political regime more democratic, while natural resource rents have an unfavorable impact. I now look at a few selected episodes of democratization within the same time period (1990-2009), and document trends in tax revenues and natural

resource rents leading up to those. Democratization is reflected by changes in the *Polity2* or *Voice* score. It is expected that the total tax to GDP ratio would be rising relative to *NRRents* in the years prior to democratization. Thus the relevant variable to consider is the difference between *Tax* and *NRRents*, which ranges from -100 to 100. Figure 2.3 shows a strong positive bivariate relation between the mean of this variable for each country with the mean *Polity2* score for each country.

Figure 2.3 '*Polity2* Score' versus '*Tax* - *NRRents*', 1990-2009



Source: Democracy score is measured by the Polity2 Variable provided by PolityIV project.
The measures of Tax to GDP and Natural Resource Rents to GDP are from World Bank's World Development Indicators.

It has to be acknowledged that the following country examples are not a rigorous illustration of the link between revenues and democratization. I do not provide any explanation or analysis for the underlying cause of changes in these sources of revenue in the instances described. Therefore the changes in taxation or

natural resource rents cannot be interpreted as the cause of these particular episodes of democratization — these examples are presented only to supplement the cross-country evidence.

Egypt

The most important example from the *Arab Spring* is perhaps that of Egypt. President Hosni Mubarak ruled the country as a dictator for almost three decades. The *Polity2* score for Egypt for most of the decade prior to 2011 was -3, which is in the lowest quartile. The *Voice* score was around 30, which is also well into the lowest quartile. In early 2011, Mubarak was forced to step down due to a popular uprising.[23] Figure 2.C1 in Appendix 2C shows the time plot of the difference between the ratios of total taxes to GDP and natural resource rents to GDP from 2005 onwards. Between 2005 and 2010 '*Tax* - *NRRents*' increased from -10 to 4, a rise of seven percentage points. This was almost exclusively due to a fall in *NRRents*.

Syria

Syria is an example from the Middle East where a movement for democracy has been ongoing since 2011 against the longstanding dictatorial rule of Basher Al Assad. It is not yet clear how successful this struggle will be, but the pressure for democratic change has certainly begun. The *Polity2* score for Syria was -7, amongst the lowest in the world, for the entire previous decade. This will undoubtedly rise if the present democratic movement is successful. Unfortunately, I do not have *Tax* data for Syria.

[23] I do not have data for the democracy scores in 2011, but the events of the year would undoubtedly be reflected in significantly higher scores.

However, it is still informative to note that the natural resource rents to GDP ratio has fallen by more than thirteen percentage points from 2005 to 2010, as shown in Figure 2.C2.

Libya

Libya is another example where the entrenched dictatorial rule of Muammar Gaddafi that had lasted for over three decades was overturned in 2011 as a result of a popular uprising. Qaddafi's regime was one of the most autocratic in the world - the *Polity2* score was -7 throughout his rule, and the *Voice* score was also the lowest in our sample. The *Tax* data for Libya is also not available, but *NRRents* fell almost twenty five percentage points (from 70 to 45) in the five years leading up to the uprising, as is illustrated in Figure 2.C3.

Ukraine

Ukraine experienced an episode of democratization in 2005 and 2006, reflected by a rise in the *Polity2* score from 6 to 7, and the *Voice* score increase of ten percentage points from 2004 to 2006. In the five years prior to this episode, the difference between *Tax* and *NRRents* had steadily risen by 6 points, or three percentage points, as is shown in Figure 2.C4. This was mostly due a rise in total taxes as a percentage of GDP from around 12 in 2001 to over 17 in 2005.

Zimbabwe

Zimbabwe experienced pressure for democratization in 1998-1999, when the *Polity2* score jumped from -6 to -3. For the entire previous decade the democracy score had been stagnant. *Tax* data are not available after 1997, but the trend is instructive to

note. From 1992 to 1997, '*Tax-NRRents*' rose by over four percentage points, from 12 to over 21. This occurred due to a combination of a rise in *Tax* and a fall in *NRRents*. *Tax* increased by six percentage points over these five years. Natural resource rents as a percentage of GDP fell from 8 in 1992 to around 5 in 1997, and below 2 in 1998-1999. This is shown in Figure 2.C5. Subsequently *NRRents* started gradually rising again until 2008, which might explain why the democratisation that occurred in 1998-1999 was only temporary. However, in 2008 natural resource rents as a percentage of GDP again fell by four percentage points over the next two years, and this was accompanied by a rise in the *Polity2* score from -4 (which it had been for most of the decade) to 1 in 2009.

Indonesia

The long standing dictatorial rule of President Suharto was overturned in 1998 following widespread street protests. The *Polity2* score jumped from -7 in 1997 to 6 in 1999. This episode has been widely investigated, and one of the reasons attributed to the change in regime is the output contraction that immediately preceded it (Burke and Leigh 2010). However it is also instructive to note the trend in *Tax* and *NRRents* in the previous years. In the six years leading to the overthrow of Suharto, the difference between tax and natural resource rents as a percentage of GDP had risen by 4 points (close to two percentage points) as shown in Figure 2.C6.

Zambia

Zambia is a country that has experienced at least two episodes of democratization in the last two decades. In 1990-91 the twenty year long, dictatorial one party rule

headed by Kenneth Kaunda (reflected by a *Polity2* score of minus -9) came to an end following mass protests. The Polity2 score jumped to 6. I do not have tax data for the country but in the four years prior to this episode natural resource rents as a percentage of GDP had almost halved from 20 to under 10. However, democratization was slightly reversed in 1996 when the *Polity2* score fell to 1. In the three years prior, natural resource rents as a percentage of GDP had again increased by seven percentage points. Finally the *Polity2* score reverted back to 5 in 2001 – in the preceding five year *NRRents* had again fallen by over five percentage points. This is illustrated in Figure 2.C7.

2.10 Conclusion

The possible impact of a government's effort to collect more taxes from its population on the characteristics of the political regime has a basis in history, as well as episodes in the modern world. When a government is forced to collect more taxes because of fiscal imperatives, it may have to accede to the policy preferences of the people. Higher taxation often leads to pressure for changes in the political regime. Despite the existence of a rich literature to provide a historical and theoretical basis, this link has not been systematically investigated in a cross-national context. Most studies focus on the causality from political regime to tax collection. This chapter investigates the other direction, while also incorporating natural resource rents as a source of non-tax revenues into the framework. In this sense the study attempts to also add to the resource rent literature, by framing the question of its effect on the political regime within the broader issue of a State's revenue needs, following a direction pointed out by Devarajan et al (2010). This chapter is also related to literature on the income-

democracy nexus — in particular the investigation by Burke and Leigh (2010) that commodity price shocks that cause output contractions could increase the likelihood of democratic change.

The empirical evidence presented in this chapter using a sample of 132 countries for the time period 1990-2009 is consistent with the hypothesis that higher taxation leads to better democracy, even when the state has access to natural resource rents. On the other hand, natural resource rents are detrimental for democracy even in the presence of taxation. This relationship of taxation and natural resource rents with democracy is established using two different and unrelated measures of democracy. The statistical relationship is also robust to the addition of control variables in the econometric specification as well as estimation through different regression techniques. The potential endogeneity of tax revenues and natural resource rents to democracy is addressed through estimation by the system GMM, a regression technique which employs a set of exogenous internal instruments in order to establish a causal impact. It is found that the impact of a percentage point increase in the ratio of tax to GDP is equivalent to more than a two percentage point improvement in the democracy score. On the other hand, a similar increase in the ratio of natural resource rents to GDP reduces the democracy score by one percentage point.

I then document the trend in taxes and natural resource rents for a few selected countries which underwent some sort of democratization within the last twenty years. For example Egypt, Syria and Libya experienced significant falls in natural resource rents which culminated in the events labeled as the *Arab Spring*. Ukraine

presents the opposite scenario, where increased taxation was associated with pressure for better democracy in 2005-2006.

The findings of this chapter have especially critical policy implications for countries that possess well developed and functional systems for tax collection, but have recently also discovered natural resources. These new resource producers, especially certain African countries such as as Ghana, Tanzania, Mozambique and Kenya, now face the choice of continuing to rely on taxation as their main source of revenue, or shifting to natural resource rents to fulfill their fiscal needs. While exploitation of natural resources will undoubtedly be carried out, these countries would be well advised to invest these rents into trust funds, or perhaps distribute these to the citizens followed by subsequent taxation along the lines of a proposal by Devarajan et al (2010). Given the nascent state of democracy in many of these countries, the decision to use natural resource rents to as a direct source of government revenue could hamper prospects for democratic progress.

The fixed effects estimation results also suggest that the significance of the revenue imperative is greater for poorer countries. As countries become richer, the favorable link between taxation and democracy, and the adverse association of natural resource rents, becomes less pronounced. This has an important policy implication for donors and the prosperous countries with an interest in promoting democracy. These actors are likely to have more leverage over poorer countries, where the potential gains for democracy from encouragement of higher taxation are the greatest. This leverage may be especially strong because of the influence that the powerful countries have on markets for natural resources and the ability to give development assistance.

Institutional transplantation inspired by the Washington Consensus has by and large failed (Rodrik 2004, Lin 2009). However the fiscal policies of poorer countries can perhaps be more easily influenced than their political institutions.

The estimates presented here are very aggregate in nature. Further research could perhaps identify with more clarity the exact channels through which tax collection impacts political institutions. For this purpose it could be informative to identify a variable that is highly correlated with taxation, but not with democracy. Such an external instrument, if more malleable than fiscal policy, could guide us towards a more practical theory of how to promote democracy.

Appendix 2A

Before solving the problem of the government and citizenry described in Section 2.3 of the chapter, I impose the assumptions below.[24]

(1) U^G and U^C are continuously differentiable. Furthermore, $(U^G)_1$, $(U^G)_2$, $(U^G)_3$, $(U^C)_1$, $(U^C)_2$ are all > 0. Here subscripts 1, 2 and 3 refer to the partial derivative of the function with respect to the first, second and third argument of the function respectively.

(2) U^G and U^C are both quasiconcave functions, while f(x) is a concave function. This ensures that the first order conditions are sufficient conditions as well.

(3) Max U^C $[(1-t)\, f(x) - w.x, -(V^+ - V^-)^2] < \underline{U}^C$, for all t between 0 and 1. This states that Government will never be able to choose its exact preferred policy position i.e. $V \neq V^+$. If $V = V^+$, the utility of the citizens would fall below the minimum tolerable level.

The solution to the problem of both agents is a simultaneous move Nash Equilibrium. The citizenry, given *t* and *V*, chooses how much factor of production to hire, which is a best response to what the government does. The first order condition is: $(1-t)\, f'(x) = w$, and the solution is given by $x^*(t, V)$. The government, knowing $x^*(t, V)$, optimizes subject to constraints, which is a best response to the production decision of the citizenry. Therefore the government's maximisation problem can be written as,

$$\text{Max } U^G [t\, f(x), N, -(V-V^+)^2] + \lambda_1 [\, (1-t)\, f'(x) - w\,] + \lambda_2 (U^C - \underline{U}^C) + \lambda_3 (K - t\, f(x) - N)$$

[24] I follow the set of assumptions listed by Bates and Lien (1985).

(t, N, V, x)

The first order conditions are listed below:

w.r.t 't': $(U^G)_1 f(x) - \lambda_1 f'(x) - \lambda_2 (U^C)_1 f(x) - \lambda_3 f(x) = 0$ (2.A1)

w.r.t 'N': $(U^G)_2 - \lambda_3 = 0$ (2.A2)

w.r.t 'V': $-2 (U^G)_3 (V-V^+) - 2 \lambda_2 (U^C)_2 (V-V^-) = 0$ (2.A3)

w.r.t 'x': $(U^G)_1 t f'(x) + \lambda_1 (1-t) f''(x) + \lambda_2 (U^C)_1 [(1-t) f'(x) - w] - \lambda_3 t f'(x) = 0$ (2.A4)

w.r.t 'λ_1': $(1-t) f'(x) = w$ (2.A5)

w.r.t 'λ_2': $\lambda_2 (U^C - \underline{U}^C) = 0, \quad U^C - \underline{U}^C \geq 0, \quad \lambda_2 \geq 0$ (2.A6)

w.r.t 'λ_3' : $\lambda_3(K - t f(x) - N) = 0, \quad K - t f(x) - N \geq 0, \quad \lambda_3 \geq 0$ (2.A7)

where (2.A6) and (2.A7) follow from Kuhn-Tucker condition for inequality constraints

From (2.A2),

$\lambda_3 = (U^G)_2 > 0$ (2.A8)

From (2.A3),

$\lambda_2 = - [(U^G)_3 (V - V^+)] / [(U^C)_2 (V-V^-)] > 0,$ (2.A9)

as $(V - V^+) < 0$ by Assumption (3).

Then (2.A8) and (2.A9) imply that in equilibrium the inequality constraints are binding by (2.A6) and (2.A7) i.e.

$U^C = \underline{U}^C$, and (2.A10)

$t\, f(x) + N = K$ (2.A11)

Equations (2.A10) and (2.A11), which characterize the equilibrium, allow V to be written as an explicit general function of t and N. As U^C is continuously differentiable by Assumption (1) and the partial derivative of U^C with respect to $V\text{-}V^-$ is not zero for all $V \neq V^-$, by the implicit function theorem,

$V\text{-}V^- = g(t)$ such that $U^C [(1-t^*)f(x^*) - w.\, x^*, (V^*\text{-}V^-)^2] = \underline{U}^C$, and $V \neq V^-$ (2.A12)

$V\text{-}V^- = h(N)$ such that $U^C [f(x^*) + N^* - K - w.\, x^*, (V^*\text{-}V^-)^2] = \underline{U}^C$, and $V \neq V^-$ (2.A13)

Therefore taking any linear combination of (2.A12) and (2.A13),

$V\text{-}V^- = F(t, N)$ such that $U^C = \underline{U}^C$, $t\, f(x) + N = K$ and $V \neq V^-$. (2.A14)

We can then derive the comparative static results for the change in democracy resulting from changes in tax and non-tax revenues along the optimal solution path. Taking the total derivative of (2.A10) and setting $dx = 0$,

$$-\ (U^C)_1\, f(x^*)\, dt\ - 2\, (U^C)_2\, (V - V^-)\, d(V - V^-) = 0$$

$$\Rightarrow d(V - V^-)/dt = -\ (U^C)_1\, f(x^*)/\ 2\, (U^C)_2\, (V - V^-)\ <\ 0$$

$$\Rightarrow \mathbf{d(V - V^-)/f(x^*)dt = -\ (U^C)_1 / 2\, (U^C)_2\, (V - V^-)\ <\ 0} \quad (2.A15)$$

Similarly, substituting (2.A11) into (2.A10) and then taking the total derivative, and setting dx = 0,

$(U^C)_1\, dN - 2\,(U^C)_2\,(V - V^-)\, d(V - V^-) = 0$

$$\Rightarrow \mathbf{d(V - V^-)/dN = (U^C)_1 / 2\,(U^C)_2\,(V - V^-) > 0} \qquad \text{(2.A16)}$$

Finally, consider the following specific functional form for the utility of the government and citizens, this allows us to verify whether the choice variables of the optimization problem lie in the expected range.

$U^G = t\,x^{\alpha} + N - \log (V - V^+)^2$

$U^C = (1-t)\,x^{\alpha} - wx - \log (V - V^-)^2$

where $\alpha < 1$.

Then, by FOC (2.A4),

$t^* = [\lambda_2 \alpha\, x^{(\alpha-1)} - \lambda_1 \alpha\,(1-\alpha) x^{(\alpha-2)} - \lambda_2 w] / [\,(\lambda_2 + \lambda_3)\alpha\, x^{(\alpha-1)} - \lambda_1 (1-\alpha) x^{(\alpha-2)} - \alpha\, x^{(\alpha-1)}]$,

where the numerator is positive as $\lambda_1 < 0$ by definition, and $\alpha\, x^{(\alpha-1)} > w$ by (2.A5). The denominator is also positive as $\lambda_2 + \lambda_3 > 1$ by (2.A2), (2.A8) and (2.A9). Also the denominator is greater than the numerator as $\lambda_2 + \lambda_3 > \lambda_2$. Therefore, $0 < t^* < 1$ as we expect.

By FOC (2.A3),

$V^* = (\lambda_2 V^+ + V^-)/(\lambda_2 + 1)$. Thus, $V^- < V^* < V^+$ as we expect.

By FOC (2.A1),

$x^* = - \alpha \lambda_1 / \lambda_2 > 0$ as we expect.

Finally by (2.A10),

$N^* = K - t^* f(x^*)$

Appendix 2B

Table 2B.1. Descriptive Statistics (Entire Sample)

Variable	Mean	Minimum	Maximum	Observations	Countries
Polity2	4.45	-10	10	1540	130
	(6.22)				
Voice	53.71	11.93	86.53	1117	143
	(18.51)				
Tax	16.63	0.12	61.02	1802	149
	(7.53)				
NRRents	6.52	0	74.67	1802	149
	(11.27)				
L(YPC)	8.82	5.51	11.25	1802	149
	(1.28)				
YPC (1000)	13.16	0.25	77.11	1802	149
	(13.85)				
Trade	91.52	10.83	445.91	1775	148
	(55.98)				
UrbPop	57.15	5.4	100	1802	149
	(23.48)				
Aid	5.19	-0.66	148.50	1365	126
	(8.98)				
Debt	46.69	1.44	824.09	1157	102
	(52.80)				

Note: Standard deviations are reported in parentheses

Table 2.B2. Pair-wise Correlation Matrix

	1	2	3	4	5	6	7	8	9
1	1.00								
2	0.80	1.00							
3	0.38	0.44	1.00						
4	-0.41	-0.37	-0.26	1.00					
5	0.21	0.61	0.18	0.01	1.00				
6	-0.06	0.02	0.20	-0.02	0.24	1.00			
7	0.26	0.48	0.13	-0.03	0.65	0.24	1.00		
8	-0.07	-0.17	-0.11	0.03	-0.34	-0.01	-0.34	1.00	
9	-0.11	-0.22	-0.04	0.14	-0.31	-0.01	-0.14	0.46	1.00

Note:
1.Polity2
2.Voice
3.Tax
4.NRRents
5.YPC
6.Trade
7.UrbPop
8.Aid
9.Debt

Table 2.B3. Determinants of $Voice_t$: Pooled OLS Estimation Results

Variable	(1)	(2)	(3)	(4)	(5)
Tax_t	1.127***		0.960***	0.438***	0.519***
	(0.258)		(0.253)	(0.120)	(0.165)
$NRRents_t$		-0.595**	-0.445***	-0.468***	-0.331***
		(0.114)	(0.104)	(0.088)	(0.101)
$L(YPC)_t$				9.911***	5.611***
				(1.281)	(2.473)
$Trade_t$				-0.052***	-0.063**
				(0.014)	(0.029)
$UrbPop_t$				-0.028	0.064
				(0.069)	(0.097)
Aid_t					0.265***
					(0.090)
$Debt_t$					-0.013
					(0.041)
Observations	1117	1117	1117	1101	657
Countries	143	143	143	142	97
TE included	Yes	Yes	Yes	Yes	Yes
Tax = - NRRents			0.094	0.856	0.379
R^2	0.214	0.144	0.288	0.633	0.312
Adj R^2	0.206	0.136	0.281	0.626	0.294

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1996-2009. Robust standard errors clustered by countries are reported in parenthesis. TE refers to the set of time dummies. The statistic reported for 'Tax = - NRRents' is the p-value of the F-statistic testing for equality of the magnitudes of the coefficients.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Table 2.B4. Determinants of $Voice_t$: Fixed Effects Estimation Results

Variable	(1)	(2)	(3)	(4)	(5)
Tax_t	0.122		0.132*	0.120	0.217***
	(0.084)		(0.812)	(0.079)	(0.072)
$NRRents_t$		-0.088*	-0.094**	-0.096*	-0.206***
		(0.047)	(0.047)	(0.049)	(0.060)
$L(YPC)_t$				1.584	0.383
				(2.760)	(3.969)
$Trade_t$				0.014	0.019
				(0.016)	(0.021)
$UrbPop_t$				0.278	0.466
				(0.248)	(0.297)
Aid_t					0.031
					(0.039)
$Debt_t$					-0.050**
					(0.022)
Observations	1117	1117	1117	1101	657
Countries	143	143	143	142	97
TE included	Yes	Yes	Yes	Yes	Yes
Tax - NRRents = 0			0.670	0.787	0.908
R^2	0.971	0.971	0.972	0.972	0.940
Adj R^2	0.967	0.967	0.967	0.967	0.927
R^2 (within)	0.024	0.026	0.033	0.045	0.109
R^2 (between)	0.219	0.163	0.304	0.394	0.239
R^2 (overall)	0.180	0.125	0.265	0.385	0.175

Notes: A constant is included in all regression but not reported. Annual observations of the dependent variable are used from 1990-2009. Robust standard errors clustered by countries reported in parentheses. TE refers to the set of time dummies. The statistic reported for 'Tax - NRRents = 0' is the p-value of the F-statistic testing for equality of the magnitudes of the coefficients. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Appendix 2C

Figure 2.C1. '*Tax - NRRents*', *Tax*, and *NRRents*, for Egypt, 2005-2010.

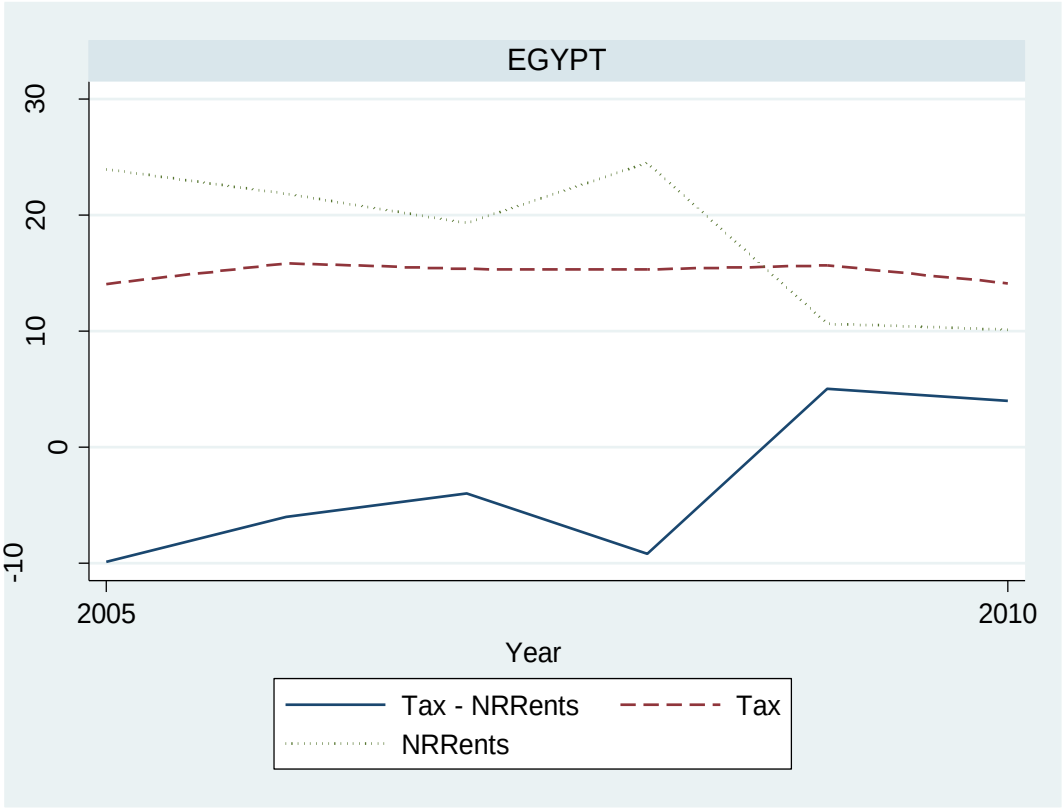


Figure 2.C2. *NRRents* for Syria, 2005-2010.

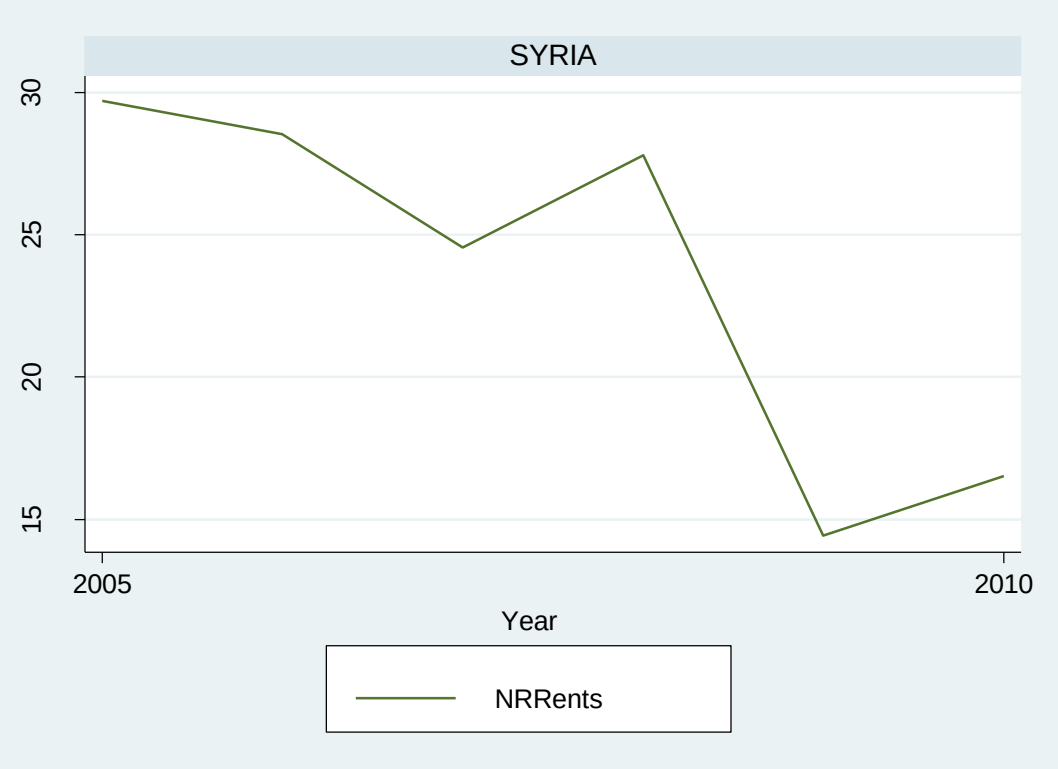


Figure 2.C3. *NRRents* for Libya, 2005 to 2009.

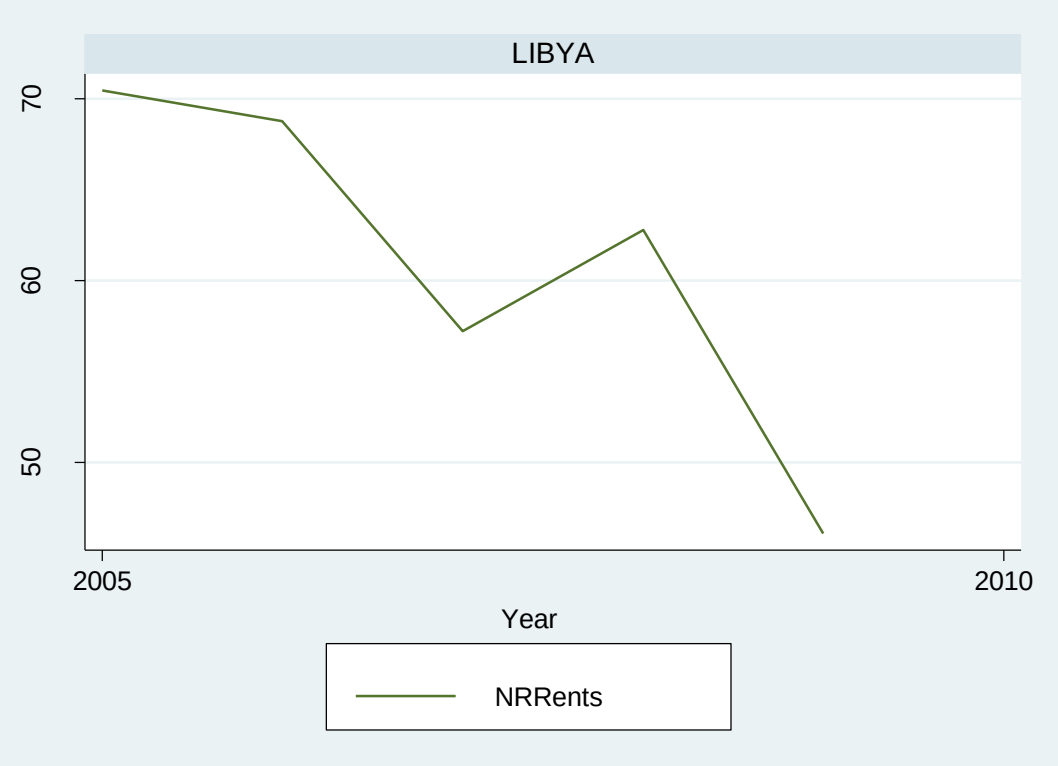


Figure 2.C4. '*Tax - NRRents*', *Tax*, and *NRRents*, for Ukraine, 2000-2006.

Figure 2.C5. '*Tax - NRRents*', *Tax*, and *NRRents*, for Zimbabwe, 1991-1997.

Figure 2.C6. '*Tax - NRRents*', *Tax*,and *NRRents*, for Indonesia, 1991-1997.

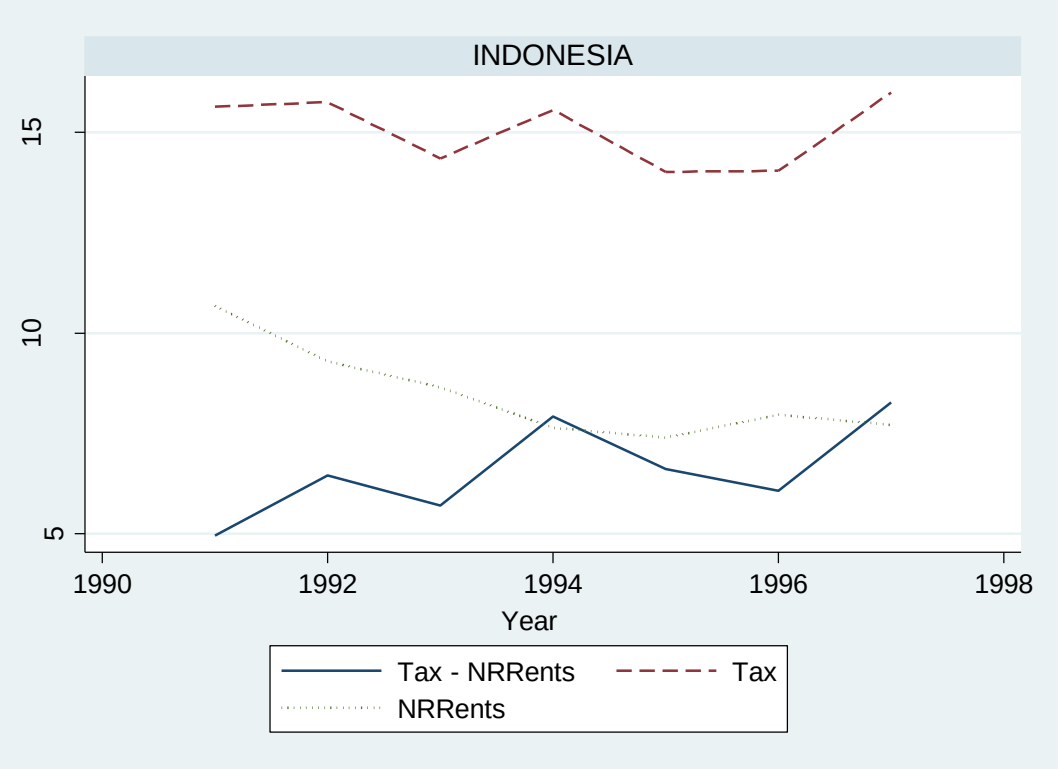
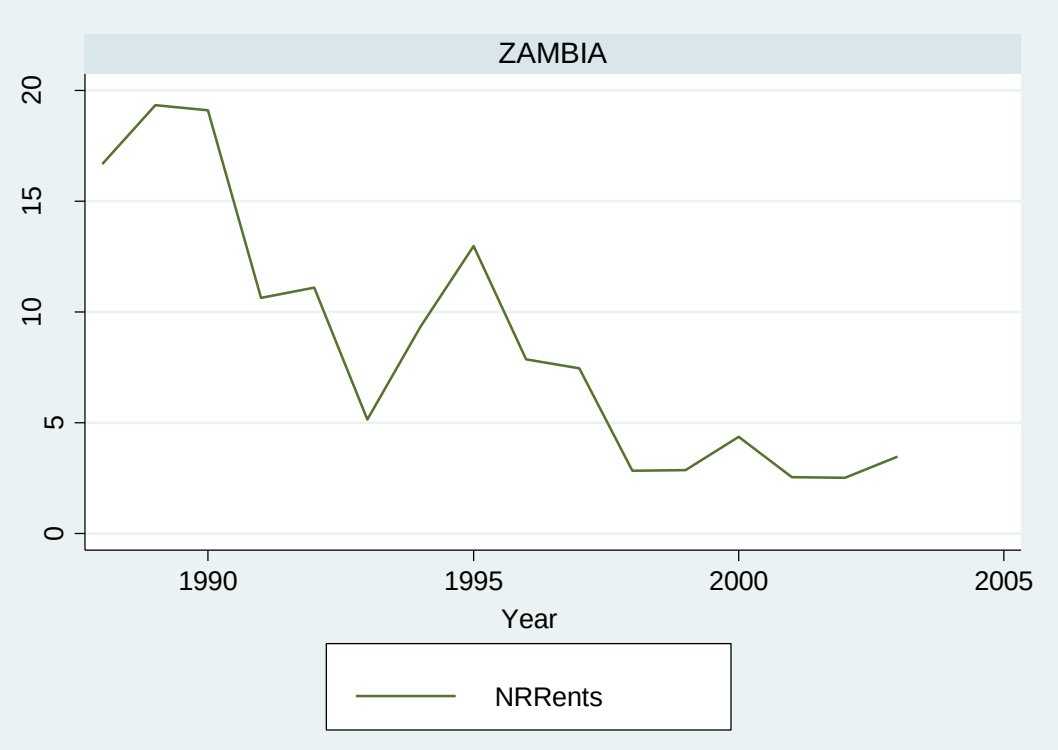


Figure 2.C7. *NRRents* for Zambia, 1988-2004.



Chapter 3: Trade and Institutional Quality

Abstract

This chapter investigates the implications of trade exposure for institutional quality while distinguishing between trade intensity and the openness of trade policy, which are often erroneously treated as synonymous in the previous literature. Based on the 'rent-seeking' literature, it is hypothesized that increased trade improves institutional quality only in the context of a liberalized trade policy regime. In the presence of a closed trade policy regime, increased trade deteriorates institutional quality by opening up new avenues for 'rent-seeking'. Furthermore, it is also hypothesized that the negative impact of natural resource exports on institutional quality, as pointed out by the 'natural resource curse' literature, is mitigated if the trade policy regime is open. The modeling strategy involves estimating the impact of trade intensity (the trade to GDP ratio) on institutional quality conditional on the nature of the trade policy regime. The empirical analysis is based on panel data covering 114 countries over the time period 1987-2008. The findings are generally consistent with the hypotheses.

3.1 Introduction

The enabling role of institutional quality in the development process is well established and generally agreed upon in the growth literature (e.g. Knack and Keefer 1997, Temple 1999, Acemoglu at al 2001, Dollar and Kray 2003, Rodrik et al 2004). However, the literature on the causes of variation in the quality of institutions among countries still remains lopsided in that it has focused predominantly on geography, initial factor endowments and historical experience (Hall and Jones 1998, Acemoglu et al 2001 & 2002, Engerman and Sokoloff 2002, Easterly and Levine 2002, Shirley 2005). These explanations overlook the potential role of contemporary factors in institutional quality improvement and suggest that 'institutions are destiny'. Therefore it is important to investigate those factors that are amenable to policy.

One such factor is trade exposure. It has been shown both theoretically and empirically that trade exposure (greater openness to trade) can improve institutions by fostering foreign competition, strengthening those groups that favor reforms and reducing the amount of artificial rents generated by trade restrictions (Krueger 1990, Ades and Di Tella 1999, Treisman 2000, Weil 2000, Sandholtz and Koetzle 2000, Gatti 2004, Levchencko and Do 2009, Bhattacharya 2012). However, there is ambiguity about how to define trade exposure in empirical analysis. Is trade exposure synonymous with trade intensity (the trade to GDP ratio) or does it describe the openness of the trade policy regime?

Trade intensity is often used as a measure of trade exposure in the empirical literature. However, an increase in trade intensity does not always occur as a result of

liberalization of trade policy (e.g. Sachs and Warner 1995, Frankel and Romer 1999, Rodriquez and Rodrik 2000, Weil 2000, Gatti 2004, Athukorala 2011, Henry et al 2012, and Milner 2013). For instance, discovery of natural resources, entry into preferential trade agreements, increase in world demand, reduction in transport costs or any other exogenous influence on trade performance could increase the volume of trade even without liberalization. The degree of trade intensity is also negatively correlated with the country size.

On the other hand, the nature of the trade policy regime as an indicator of trade exposure is not entirely satisfactory either. This is because some channels postulated in the literature through which trade exposure improves institutional quality operate only through trade intensity[25]. It is quite conceivable that liberalization of the trade policy regime may not result in the anticipated increase in the volume of trade if, for instance, a country faces high natural barriers to trade (Frankel and Romer 1999, Rodriguez and Rodrik 2000). Furthermore liberalization is an episodic event; it is not clear over what time-frame it affects trade intensity. Wacziarg and Welch (2008) do not find evidence in a large sample of countries that episodes of liberalization in the period 1990-98 increased the trade to GDP ratio within the same time period.

Consider two contrasting examples which illustrate the need to jointly consider both trade intensity and the nature of trade policy, in order to examine the impact of trade exposure on institutional quality. From 1970 to 1990 Nigeria's trade to GDP ratio grew almost four fold from around 20 percent to over 70 percent according to

[25] For example, the models formulated by Ades and Di Tella (1999), Weil (2000), and Levchenko and Do (2009) which are described in more detail in the next section.

statistics from the World Bank's *World Development Indicators*. However, the increased trade exposure occurred due to the discovery of oil, and was not a consequence of any policy reforms. Nigeria remains one of the most corrupt countries in the world (*Transparency International*, Sala-i-Martin and Subramanian 2003). On the other hand, another African country Ghana also increased its international trade starting from 1985. The trade to GDP ratio almost tripled within a decade from under 20 percent to over 60 percent. Unlike Nigeria, Ghana's higher trade exposure was driven by a series of policy reforms which involved the removal of government-imposed trade restrictions (Wacziarg and Welch 2008). The increased trade intensity resulting from liberalization was accompanied by an improvement of institutional quality as measured by the subjective indicators of corruption and bureaucratic quality provided by the *International Country Risk Guide* (ICRG).[26]

Therefore, this study uses trade intensity and the nature of the trade policy jointly in examining the impact of trade exposure on institutional quality. It is hypothesized that the impact of trade intensity on institutional quality depends on the nature of the trade policy regime. Only increased trade intensity driven by policy reform could potentially improve institutional quality. I call this 'liberalized trade'. Greater trade intensity in the absence of policy reform (un-liberalized trade) deteriorates the quality of institutions by opening up new avenues for 'rent-seeking'; this hypothesis is set in the context of the rich 'rent-seeking' literature (Tullock 1967,

[26] In 1984 Ghana ranked in the lowest decile for both the indicators, while a decade later it had close to the median score amongst all the countries for which ICRG provides governance ratings.

Krueger 1974, Bhagwati 1980, Bhagwati and Srinivasan 1980). While previous works have distinguished between trade intensity and trade policy, to my knowledge no empirical study has combined the two concepts to differentiate between liberalized and un-liberalized trade.

In this chapter institutional quality is defined as the level of corruption and the quality of the bureaucracy.[27] Both of these measures, which reflect the quality of economic institutions, are a representation of the rent-seeking efforts. The empirical analysis is carried out using a dataset covering 114 countries over the period from 1987 to 2008. Unlike previous empirical studies, I also separately analyze the impact on institutional quality of exports and imports in addition to overall trade. As a corollary this study also hypothesizes that the deleterious impact of natural resource trade on institutions, which has been suggested by the vast resource curse literature (Sachs and Warner 1995, 1999, 2001; Tornell and Lane 1996, 1998, 1999; Leite and Weidmann 1999; Sala-i-Martin and Subramanian 2003; Isham et al 2005; Robinson et al 2006), could be mitigated by liberalization of trade policy.

The chapter is arranged in eight sections. In the next section I critically survey the related literature to formulate a context for the model formulation which is then discussed in Section 3.3. This is followed by a discussion on variable construction and data sources in Section 3.4. Section 3.5 describes the estimation strategy. The descriptive statistics are presented in Section 3.6 in order to set the stage for a

[27] The reason for this selection is explained in detail in the next section.

discussion of the estimation results in Section 3.7. Section 3.8 concludes with a discussion of the results and policy implications of the study.

3.2 Literature Survey

3.2.1 The Impact of Trade Intensity on Institutions

The first channel through which greater trade intensity can lead to better institutional quality is the foreign competition effect. Due to increased foreign competition faced by domestic producers a disciplining effect is induced, which leads to a preference for better institutions (Ades and Di Tella 1999, Wei 2000, Gatti 2004, Levchenko and Do 2009). Levchenko and Do (2009) develop a general equilibrium model in which the production side consists of heterogeneous firms and monopolistic competition. Institutional quality is interpreted as the fixed cost of entry into production. Facing foreign competition, all firms prefer better institutions i.e. lower fixed cost of entry into production. [28]

Wei (2000) demonstrates using a simple two country and two period model that countries with a higher natural propensity to trade, based on their geographical characteristics, invest more in building good public institutions. Investing in a good bureaucracy is costly. At the same time, foreign producers are deterred more by weak institutions. Therefore countries which are naturally more open have a greater

[28] In the Levchenko and Do (2009) model, greater trade could also have a negative impact on institutional quality due to a political economy impact as explained shortly.

incentive to provide better public institutions to check corruption and build an efficient bureaucracy. The prediction of the model is backed by cross-national empirical evidence.

In the principal-agent model formulated by Ades and Di Tella (1999) better institutions are represented by the proportion of bureaucrats (agents) truthfully reporting profits accruing from the regulation of firms to the public representative (principal). Greater international trade increases competition, reduces the level of profits at the discretion of the bureaucrat, and lowers the probability of a bureaucrat being corrupt. [29]

However, the foreign competition effect is not the only one that operates due to increased trade intensity. Trade also has political economy effects and its impact on institutions depends on who it benefits. On one hand trade can empower the constituency for reform, but on the other it can also strengthen those interests that thrive due to poor institutions. The formal model developed by Levchenko and Do (2009) also accounts for political economy considerations in addition to the foreign competition effect. Because firms are heterogeneous and only the most efficient firms can export, foreign trade results in the elite group of exporters growing larger, and acquiring more political power relative to less productive firms. These firms prefer worse institutional quality — higher fixed costs of entry — to deter the competition from smaller firms (i.e. the political power effect). As a result of foreign trade if these

[29] Using a model of bureaucratic compensation, they show that the efficiency wage required to induce honesty falls with increased competition.

larger firms grow large enough the political power effect dominates the foreign competition effect, consequently worsening institutional quality.

History provides examples of both kinds: instances where the constituency for reform was strengthened or weakened due to increased trade. Acemoglu et al (2005a) argue that one of the contributing factors in the improvement of institutional quality in Western Europe post 1500 was trans-Atlantic trade with the new colonies. Trade strengthened the merchant groups relative to the monarchies, especially in countries with a non-absolutist system of government at the starting point such as England and the Netherlands. Institutional change is the result of a bargain between different groups with vested interests, and the change is resisted by those who stand to lose rents. Conversely where trade empowered the elites even further, institutions deteriorated (Engerman and Sokoloff 2002). Within those regions where soil and climate conditions encouraged the setting up of large plantations requiring a substantial amount of slave labor (such as the Caribbean and Latin America in the New World), colonial elites established institutions to cement their dominance. Trade with Europe in the 1700s exacerbated the inequality and led to a further deterioration of institutional quality.

3.2.2 The Impact of Trade Policy on Institutions

The political economy effect of increased trade intensity can be better understood in the context of the nature of the trade policy regime. Government-imposed restrictions on international trade such as tariffs, quotas, exchange rate controls, and other such measures create the possibility for certain sectors to earn supranormal profits or rents (Tullock 1967, Krueger 1974, Bhagwati 1980 & 1982, Buchanan 1980, Bhagwati and

Srinivasan 1980, Tollison 1982). This confers upon the government's bureaucracy a discretionary power to allocate the rents arising from these restrictions. For instance, if a quota is imposed, the bureaucracy allocates the right to import through the granting of licenses and can demand illegal monetary gains in the process. In the case of tariffs, customs officials acquire the ability to collude with importers to enable tariff evasion in exchange for bribes.

One of the central lessons of the rent-seeking literature is that any government-imposed distortion in the economy creates artificial rents. The existence of rents in an economy is not unusual, and can arise naturally from the price system. Seeking natural rents (profit seeking) involves creation of value through production of goods, and the rent eventually dissipates with increasing resources devoted to that activity (Buchanan 1980, Tollison 1982). However, as a result of a government-imposed restriction or distortion that controls entry into productive activity, resources will be devoted towards seeking artificially contrived rents through non-market mechanisms (artificial rent-seeking). Efforts towards this end range from wasteful expenditure to lobbying, bribery, and coercion.

Artificial rent-seeking, unlike natural rent-seeking, does not lead to the production of value; rather it diverts resources away from productive activity. In a seminal paper which set the foundation for the rent-seeking literature, Tullock (1967) argued that the cost of government-imposed distortions is not just the traditional deadweight loss triangle. In fact resources up to or even exceeding the total amount of the available rent might be expended in pursuit of those rents. Krueger (1974) showed that quantitative import restrictions (quotas) lead to competition amongst private

agents for acquiring import licenses, which leads to a welfare loss. This competition has no value in terms of production but does have significant social costs. Bhagwati and Srinivisan (1980) show that imposition of tariffs leads to similar consequences.

Once set in, the artificial rent-seeking process exhibits increasing returns (Tullock 1967, Murphy et al 1993). This means that it is self-enforcing and ever-increasing. Once an artificial rent-seeking opportunity has been created, vested interest groups devote even more resources for maintaining the status quo. Those adversely affected similarly expend resources to change the status quo. In order to curtail this rent-seeking the government might devise further distortionary policies or regulations, thus leading to a vicious cycle. Therefore artificial rent-seeking is even more socially costly in a dynamic setting than in a static one.

The rent-seeking literature was originally concerned with the welfare impact of artificial rent-seeking. However, implicit in the welfare analysis was the argument that once an opportunity for seeking artificially contrived rents has been established as a result of a government-imposed restriction, competition for these rents will lead to adverse consequences for institutional quality. Artificial rent-seeking takes many forms, not all of which are illegal. Lobbying, for example, is perfectly legal in many countries even though it has negative welfare consequences (Bhagwati 1980). However, artificial rent-seeking also manifests in activities which are classified as corruption (Buchanan 1980, Paul and Wilhite 1994, Lambsdorff 2002). Even though Krueger (1974) does not model institutional quality in her theoretical analysis, she does speculate that competition for rents translates into corruption in reality, and

causes deterioration in institutional quality. It leads to the perception of the market mechanism as a means for rewarding the well connected.

In order to better understand the link between artificial rent-seeking and institutional quality, it is important to clarify the meaning of institutional quality and be more precise about how it is manifested. While a detailed discussion is beyond the scope of this chapter, the widely accepted definition proposed by North (1990) is that institutions are the rules established by society to govern behavior and interaction amongst agents. In this sense, institutions are of higher quality if the rules are fair, transparent, easy to implement and difficult to contravene. Thus corruption — defined as the use of public office for private gain in disregard of the prevalent morality and laws (Shleifer and Vishny 1993, Sandholtz 2000, Lambsdorff 2002, Aidt 2003) — is a symptom of poor institutional quality. To be even more specific, Lambsdorff (2002) considers corruption as a subset of artificial rent-seeking. Whereas lobbying for example is open to anyone, entry into corruption is more restricted. In this framework, the availability of artificial rents leads to corruption amongst other legal rent-seeking activities as well.

The established rules are enforced by the bureaucracy as the agent of the government (Rauch and Evans 2000, Aidt 2003). Thus an inefficient and corrupt bureaucracy is another reflection of poor institutional quality considered in this chapter. Then clearly, if the bureaucracy has discretion over the distribution of rents that are created as a result of government-imposed restrictions, it acquires the opportunity to extract part of the rents for private gain, leading to an erosion of its

quality. Ades and Di Tella (1997, 1999) show (using the popular principal-agent framework) that availability of rents lead to corruption by the agent (bureaucracy).

3.2.3 Trade in Natural Resources and Institutional Quality

The rent-seeking literature is also related to the natural resource curse literature. This literature points out that natural resource abundance or windfall gains lead to poor economic performance (Sach and Warner 1995, 1999, 2001; Tornell and Lane 1996, 1998, 1999). Other than the more conventional arguments, one of the links identified between natural resource abundance and growth is institutional quality (Leitte and Weidmann 1999, Sala-i-Martin and Subramanian 2003, Papyrakis and Gerlagh 2004, Isham et al 2005, Robinson et al 2006). The impact of these resources on political institutions in the context of the so called 'rentier states' is examined in the previous chapter, but here I am concerned with examining the impact of the consequent export structure on corruption and bureaucratic quality.

Natural resource exploitation and exports are commonly controlled by the government, and this confers discretion over who can access the rents.[30] The competition for natural resource rents will engender corruption and an erosion of bureaucratic quality just as the competition for other policy induced artificially contrived rents does. Moreover other than the consequent artificial rent-seeking, exports of these resources also create powerful natural monopolies due to the economies of scale inherent in natural resource exploitation. In the Levchencko and Do (2009) model when certain firms grow disproportionately large, these firms prefer

[30] Similar to the discretion that arises from other government-imposed restrictions.

higher fixed costs of entry (worse institutional quality) to discourage competition. Sala-i-Martin and Subramanian (2003) and Isham et al (2005) empirically demonstrate that exports of natural resources are associated with worse economic institutions in a cross section of countries.

3.2.4 Analytical Framework

This chapter embeds the direct link between trade and institutions — the effect of trade intensity — within a framework that also accounts for the nature of the trade policy regime. Theoretically, trade intensity (the volume of trade as given by the trade to GDP ratio) impacts institutional quality through the foreign competition effect and the political economy effect as pointed out by the literature discussed earlier. The nature of a country's trade policy influences institutional quality through the rent-seeking channel. I integrate the two strands of the literature, and hypothesize that trade intensity potentially improves institutional quality only if possibilities for artificial rent-seeking do not exist. I term trade in the absence of policy restrictions as liberalized trade. In the presence of trade restrictions that open up avenues for seeking artificial rent, increased trade intensity has a negative impact on institutional quality.

As an extension, trade in natural resources (especially exports) similarly harms institutional quality because of the artificial rents involved. I hypothesize that an open trade policy reduces the amount of artificial rents associated with natural resources; therefore liberalized trade in natural resources is not quite as harmful to institutional quality. While for natural resources it is exports in particular which are likely to be linked with institutional quality, for other kinds of trade both exports and imports can be expected to have an effect. Both export and import intensity could have a bearing

on the quality of institutions through the foreign competition and the political economy effects. Similarly government policies that foster rent-seeking can be relevant for both exporters and importers. The difference in the impact of (liberalized and un-liberalized) exports versus imports is an open question and therefore worthwhile comparing through an empirical analysis.

As a final point, I consider trade policy to be exogenously determined in this chapter, and investigate the impact of the subsequent liberalized and un-liberalized trade on institutional quality. The seminal papers on rent-seeking (Tullock 1967; Krueger 1974; Bhagwati 1980, 1982) considered the welfare impact of exogenously set distortionary policies which lead to artificial rent-seeking and institutional deterioration. However, since then a great deal of work within both the rent-seeking and international trade literature has endogenized trade policy (Brock and Magee 1978, 1984; Findlay and Wellisz 1982, 1983, 1984; Krueger 1992; Alt et al 1996). It has been shown that the institutional environment, as well as the already existing rent-seeking efforts, influences the formulation of policy; the domestic political economy considerations play a major role in determining the level of tariffs, quotas, and other kinds of trade protection. While recognizing the potential reverse causality between institutions and trade policy, I am primarily interested only in exploring how institutional quality responds to trade. However, for the purpose of an empirical investigation, endogeneity of trade policy is an important issue which is addressed through the use of a system GMM estimation strategy.

3.2 Empirical Model

Motivated by the discussion in the preceding section, the econometric specifications to be estimated in turn are:

$$Inst_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-3} + \alpha_2\, open_{i,t-3} + \alpha_3\, trade_{i,t-3} + \alpha_4 (open * trade)_{i,t-3} + \alpha_5\, X_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (3.1)$$

$$Inst_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-3} + \alpha_2\, open_{i,t-3} + \alpha_3\, export_{i,t-3} + \alpha_4 (open * export)_{i,t-3} + \alpha_5\, X_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (3.2)$$

$$Inst_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-3} + \alpha_2\, open_{i,t-3} + \alpha_3\, import_{i,t-3} + \alpha_4 (open * import)_{i,t-3} + \alpha_5\, X_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (3.3)$$

where,

Subscripts i,t : country 'i' in year 't'.

Inst: Measures institutional quality. Three different indicators are separately used in each of the three equations namely corruption (*corr*), bureaucratic quality (*bq*), and an additive combination of the previous two (*comp*). The rationale for using *comp* is explained in the next section.

log(ypc): The log of real per capita GDP in purchasing power parity terms

open: The Sachs and Warner binary openness index. It takes a value of 1 for countries with an open (liberalized) policy regime, and 0 for countries with closed (un-liberalized) policy regime.

trade: The ratio of total trade to gross domestic product. It represents un-liberalized trade in this model.

export: The ratio of exports to gross domestic product. It represents un-liberalized exports in this model.

imports: The ratio of imports to gross domestic product. It represents un-liberalized imports in this model.

open * trade: A multiplicative interaction variable which represents the difference between the impact of liberalized and un-liberalized trade in this model.

open * exports: A multiplicative interaction variable which represents the difference between the impact of liberalized and un-liberalized exports in this model.

open * imports: A multiplicative interaction variable which represents the difference between the impact of liberalized and un-liberalized imports in this model.

X: A vector of additional control variables. The variables included are the log of population (*lpop*), a measure for the degree of political openness (*pol*), and a measure for the amount of natural resource rents available in a country (*nrrents*).

β: A set of dummy variables for each year except for the first (1987) to capture time varying shocks that are common to all countries. These reflect global trends in institutional quality.

μ: Country-specific and time-invariant fixed factors. Capture the invariant country characteristics correlated with both the dependent variable and the explanatory

variables. These include geography, historical experience, legal origin, ethno-linguistic fragmentation and culture

ε: the idiosyncratic error term, capturing all other determinants of institutional quality.

The Sachs and Warner binary index for the openness of the trade policy regime separates the sample into two groups of countries — those with a liberalized trade policy regime, classified as 1, and those with an un-liberalized regime, classified as 0. The model thus allows differentiation between the impacts of trade intensity on institutional quality for the two groups.[31] While the coefficient α_3 is the estimated impact of trade intensity on institutional quality for countries which are closed, α_4 is the difference in the impact of trade intensity on institutional quality between countries with open and closed trade policy regimes. Thus $\alpha_3 + \alpha_4$ is the estimated impact of trade intensity on institutional quality for countries with a liberalized policy regime. Based on the hypothesis that un-liberalized trade is harmful for institutional quality and liberalized trade improves it, the expected sign of α_3 is negative and the expected sign of $\alpha_3 + \alpha_4$ is positive.

The relation of both exports and imports with institutional quality is estimated through Equations (3.2) and (3.3) in addition to the relation between total trade (sum of exports and imports) and institutional quality through Equation (3.1). Having otherwise identical equations with only trade being replaced by exports and imports allows me to investigate whether the liberalized (and un-liberalized) impact of each of

[31] The model estimates separate intercepts and slopes (the partial impact of trade on institutional quality) for the two groups.

these with institutional quality differs quantitatively and qualitatively. All explanatory variables enter the econometric specification with a lag because any impact of trade on institutional quality is unlikely to be immediate. The choice of the third lag is discussed further in Section 3.5.

The other variables are included in the specification in order to address potential omitted variable bias. The log of income per capita is a measure for the level of development — economic development is plausibly correlated with both institutional quality and trade patterns (Rodrik et al 2004). The vector of additional control variables consists of the log of total population (*lpop*), a measure for political openness or the extent of democracy (*pol*), and also a measure for the total amount of natural resource rents available in a country (*nrrents*). Each of these variables is a possible determinant of institutional quality, while at the same time being plausibly correlated with trade intensity and policy. There is a relationship between population and indicators of institutional quality because the multi-national organizations which construct these indicators tend to focus on countries which are large, and for smaller countries those which are well governed (Knack and Azfar 2003). At the same time, according to a substantial literature in international trade theory, population is also a determinant of trade flows (e.g. Frankel and Romer 1999). Similarly, there are also reasons to believe that the nature of the political regime prevalent in a country influences other dimensions of institutional quality such as corruption and bureaucratic quality (Mohatdi and Roe 2003, Rock 2009), while also impacting both trade intensity and trade policy (Rodrik 1998, Rodrik and Rigobon 2005). Finally, as already discussed, the natural resource curse literature suggests a link between natural

resource rents and institutional quality. At the same time, it is also obvious that the presence of natural resources is an important influence on the pattern of trade that a country engages in.

As discussed in the previous Section, I am also interested in investigating the impact of trade in natural resources on institutional quality. Natural resources are of specific interest because of the artificial rents involved in the exploitation and trade of these commodities. Therefore three further equations which are similar to the previous econometric specifications are estimated in turn:

$$Inst_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-3} + \alpha_2 open_{i,t-3} + \alpha_3 natrestrade_{i,t-3} + \alpha_4 (open * natrestrade)_{i,t-3} + \alpha_5 X_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (3.4)$$

$$Inst_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-3} + \alpha_2 open_{i,t-3} + \alpha_3 natresexport_{i,t-3} + \alpha_4 (open * natresexport)_{i,t-3} + \alpha_5 X_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (3.5)$$

$$Inst_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-3} + \alpha_2 open_{i,t-3} + \alpha_3 natresimport_{i,t-3} + \alpha_4 (open*natresimport)_{i,t-3} + \alpha_5 X_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (3.6)$$

where in addition to the variables already discussed,

natrestrade: The ratio of total trade in natural resources to GDP. This represents un-liberalized trade in natural resources in this model. The expected sign of the coefficient is negative.

natresexports: The ratio of exports of natural resources to GDP. This represents un-liberalized exports of natural resources in this model. The expected sign of the coefficient is negative.

natresimports: The ratio of imports of natural resources to GDP. This represents un-liberalized imports of natural resources in this model. The expected sign of the coefficient is negative.

open * natrestrade: An interaction variable representing the difference between the impact of liberalized and un-liberalized trade in natural resources. The expected sign of the coefficient is positive.

open * natresexport: An interaction variable representing the difference between the impact of liberalized and un-liberalized exports in natural resources. The expected sign of the coefficient is positive.

open * natresimport: An interaction variable representing the difference between the impact of liberalized and un-liberalized imports in natural resources. The expected sign of the coefficient is positive.

3.3 Variable Construction and Data Sources

The empirical investigation is carried out using a panel data set covering 114 countries over the time period 1984-2008. The country coverage is dictated primarily by the availability of data for the Sachs and Warner binary openness indicator and the time coverage is limited by the data measuring institutional quality

Three different measures for the dependent variable (institutional quality) are considered. One reflection of poor institutional quality is corruption by government officials — the use of public office for private gain. A corrupt and inefficient

bureaucracy is another manifestation. The source of the indicators measuring the level of corruption (*corr*) and the quality of the bureaucracy (*bq*) is the *International Country Risk Guide* (ICRG) provided by the PRS group (2008). These indicators, as well as those measuring various other aspects of institutional quality provided by the same source, are constructed on the basis of subjective assessment by experts. The data are primarily meant as a guide for foreign investors, but have been widely used in the empirical literature as well. The third measure is a composite indicator (*comp*) constructed as the additive sum of *corr* and *bq* to be a more complete measure of institutional quality, as explained shortly. The dataset available for this Chapter runs from 1984 to 2008.

The corruption index (*corr*) is an assessment of not only direct financial corruption encountered by businesses in dealing with the government, but also political corruption such as "excessive patronage, nepotism, job reservations, favour-for-favours, secret party funding, and suspiciously close ties between politics and business"(ICRG 2008, page 31). Thus it is a broad measure that represents the type of artificial rent-seeking activities that translates into poor institutional quality. The indicator runs on a discrete scale from 0 to 6, with higher values indicating less corruption. The bureaucratic quality index is an assessment of the ability of the bureaucracy to implement policy and carry out administrative functions in an effective manner based on transparent procedures. Efficient bureaucracies tend to be autonomous from political pressures and have established rule-based mechanisms for recruitment, promotions, and postings. A bureaucracy that does not have these

attributes will operate in a discretionary and erratic manner. The indicator runs on a discrete scale from 0 to 4, with higher values representing a better bureaucracy.

Both corruption and bureaucratic quality are closely related, but still capture distinct aspects of institutional quality. Even though both the indicators are constructed by the same organization, these are positively but not perfectly correlated. In fact, the pair-wise correlation coefficient is only 0.67. The composite institutional quality indicator captures both aspects to an almost equal degree (its correlation with both *corr* and *bq* is almost 0.9). In terms of the theory discussed in Section 3.2, it is difficult to disentangle the relative importance of corruption and bureaucratic quality, thus providing a rationale for the use of the composite indicator which is a more complete measure. Also, it conveniently runs from 0-10, thus potentially providing more variation in data than either *corr* or *bq*.[32]

The main explanatory variables of interest are *trade* (and similarly *export* and *import* in Equations (3.2) and (3.3) respectively) and its interaction with the binary variable *open*. Trade (similarly export and import) intensity is the ratio of total trade to GDP and is obtained from the *World Development Indicators* (WDI). The variable *open* is the Sachs and Warner (1995) liberalization index, which has been updated by Wacziarg and Welch (2003 and 2008). This index classifies a country as having a closed trade policy for a given year if it fulfils any of five different criteria. These five criteria

[32] I alternatively constructed *comp* by converting both *corr* and *bq* to a common scale (0-5), and then added them. It makes practically no difference to the results reported in Section 3.7.

are average tariff rates of more than 40 percent, non-tariff barriers covering more than 40 percent of trade, a black market exchange rate premium of more than 20 percent, a state monopoly on major exports, and a socialist economic system. Each of the five criteria underlying the liberalization index represents a restriction on trade. It is obvious that the first two directly limit trade. The other three capture indirect barriers. All of these are government induced policy distortions which give rise to rent-seeking. In our framework trade in the presence of any of these restrictions should be associated with poorer institutional quality.

Sachs and Warner (1995) originally constructed the index for 111 countries for the time period 1950-1994. The index has been criticized as being an imperfect indicator of trade openness (e.g. Rodriguez and Rodrik 2000). In particular, the decisive criteria in classifying a country as open or closed appear to be the black market exchange rate and state monopoly on major exports rather than price or quantity restrictions. Wacziarg and Welch (2003, 2008) agree that using the index in cross-sectional studies is problematic. However they suggest that using dates of liberalization — the year following which a country remains open with respect to each of five criteria — is more sensible. This is because liberalization dates are not driven merely by changes in the black market premium or abolition of state monopolies on exports, but reflect broader liberalization. They also update the index until 2001, and expand it to include a further 22 countries. For this study I extrapolate the time period until 2005, based on the uninterrupted date of liberalization provided by Wacziarg and Welch.

The variable GDP per capita (*ypc*) is measured in year 2000 US dollars and in purchasing power parity terms, and obtained from the *Penn World Tables* (PWT) of Heston et al (2011). The data for population (*pop*) and natural resource rents (*nrrents*) are obtained from the WDI. The data for population provided by WDI is based on national censuses, with extrapolations for the intervening years based on demographic models. Natural resource rents are defined as the difference in the world price and the cost of production, and are the sum of rents from oil, natural gas, coal, minerals, and forests. The indicator for political openness (*pol*) is from the *Polity IV* project run by Marshall et al (2010), and ranges from -10 for absolutely autocratic to 10 for perfectly democratic countries.

In Equations (3.4)-(3.6) the main explanatory variables are trade, exports and imports of natural resources respectively, along with their interactions with the Sachs and Warner openness indicator. Based on the definition of natural resources provided by the WTO (*World Trade Report* 2010), natural resources trade (and similarly export and imports) is defined as the sum of trade in raw materials, fuel, and metal and ores. I obtain these data from WDI, which itself derives these from the *Comtrade* database maintained by the *United Nations Statistics Division*. The classification of commodity groups is based on S*tandard International Trade Classification* (SITC) Revision 3. Raw materials consist of SITC Section 2 (crude materials except fuels), excluding Divisions 22, 27, and 28. Fuel comprises SITC Section 3, whereas metals and ores are made up of Divisions 27, 28 and 68. WDI provides data for the trade flows of specific commodity groups as a ratio of merchandise trade, while also providing merchandize trade as a

proportion of GDP. Therefore the conversion of the specific commodity group trade as a proportion of GDP is straightforward.

Finally, I also provide descriptive statistics for trade flows (and similarly exports and imports flows) of some other commodity groups across the countries that are classified as open and closed according to the Sachs and Warner criteria. This includes manufacturing, food and commercial services, all as a proportion of GDP and obtained also from *WDI*. While these are not incorporated separately into the econometric model and thus no conclusions can be drawn about the statistical association of trade in these commodities with institutional quality, they do provide some insight and the basis for useful discussion on how trading patterns differ across open and closed countries. Also presented are descriptive statistics for education as a measure of prosperity in addition to real income per capita. The variable used is gross secondary school enrolment obtained from WDI. It is not incorporated as a control variable because there is no pressing reason to believe that secondary school enrolment is correlated with trade policy or intensity. Moreover, this variable is only available for a greatly limited group of countries.

3.4 Estimation Methodology

The Equations (3.1)-(3.6) are initially estimated by the fixed effects regression technique widely used in the cross-country empirical literature. The inclusion of a separate intercept in the model for each country controls for time-invariant and country-specific factors such as geography, culture, historical experience and ethno-linguistic fractionalization. These factors are thought to be potentially important

determinants of institutional quality (Acemoglu et al 2001, 2005b, 2008), besides being plausibly correlated with the explanatory variables. The regression technique involves estimation after demeaning the equation to purge the fixed effects. The inclusion of country-specific fixed effects in the model mitigates possible omitted variable bias. Moreover, unlike the pooled OLS technique the estimated coefficients from the fixed effects regression isolate the within-country relationship between the explanatory variables and institutional quality. For example, the estimated coefficient for liberalized trade tells us how on average institutional quality responds to changes in liberalized trade within a given country (Acemoglu 2008). For the purpose of comparison, however, I also report results from pooled OLS regressions of Equations (3.1)-(3.6).

The explanatory variables enter the econometric specification with a lag because I am interested in investigating how institutional quality responds to changes in liberalized or un-liberalized trade — the impact of increases in trade on future institutional quality. Data for institutional quality are available for the time period 1984-2008, whereas data for trade policy only run until 2005. Thus I choose the lag length to be three in order to utilize the latest available data. However, a different lag length for the explanatory variables does not make a substantial difference to the estimation results.

The combination of the fixed effects regression technique along with the use of lagged explanatory variables partially addresses the endogeneity concern that I discussed at the end of Section 3.2. However, there are also reasons to include the lagged institutional quality on the right-hand side of Equations (3.1)-(3.6). Institutional

quality is thought to be persistent with the present quality dictating the future (Acemoglu et al 2006c). Yet with the inclusion of the lagged dependent variable on the right-hand side, fixed effects regression does not estimate consistently. This is because the lagged dependent variable is correlated with the error term, which violates the condition for consistent estimation.

Thus I re-estimate Equations (3.1)-(3.6) after incorporating lagged institutional quality using the system Generalized Method of Moments technique developed by Arellano and Bover (1995) and Blundell and Bond (1998), which augments the difference GMM technique suggested by Arellano and Bond (1991). System GMM estimates the impact of the explanatory variables on changes in institutional quality. This procedure involves differencing the equations through either subtracting the previous observations of the variables, or alternatively subtracting from it the average of all future available observations of the variables. The second method of differencing, known as 'forward orthogonal deviations', is preferable when dealing with an unbalanced panel such as the one used for this study (Roodman 2009a). Then the differenced lagged institutional quality can be instrumented by all previous lags of institutional quality as these are uncorrelated with the differenced error term. Additional moment conditions can be derived by instrumenting the lagged institutional quality in the original levels equation by its contemporaneous and lagged first differences, as these are uncorrelated with the error term.

The system GMM estimation has an important advantage besides allowing consistent estimation of an equation that controls for the lagged dependent variable. It allows the explanatory variables to be either endogenous or weakly exogenous

(predetermined). In order to estimate the model, I impose the restriction that the main explanatory variables are predetermined. This means that they can be correlated with the past error terms as long as they are not correlated with the current error term. In other words the exclusion restriction is that for a given predetermined variable (y), $E(y_{i,t}, \varepsilon_{i,s}) = 0$ for $s \geq t$, but $E(y_{i,t}, \varepsilon_{i,s}) \neq 0$ for $s < t$. Because our explanatory variables are specified in the equation with a lag, this effectively means that they are endogenous. So for example $Trade_{i,t-3}$ can be correlated with $\varepsilon_{i,t-3}$. The predetermined variables are then instrumented in the same way as the lagged dependent variable.

The fact that the econometric equations can be consistently estimated even when the explanatory variables are not exogenous allows us to deal with the problem of likely reverse causality from institutional quality to trade policy and intensity, and establish a causal relation. The system GMM estimation technique provides us with a set of internal instruments, rather than having to search for external instruments which are highly correlated with trade policy or intensity, but do not impact institutions through any other channel. This would be a very difficult task, and the validity of such an instrument can always be argued against.

For the estimation of Equations (3.1)-(3.6) through system GMM, I do not include the vector of additional control variables. Including the additional variables leads to the problem of instrument proliferation — if the set of instruments is large relative to the number of observations it causes an over-fitting bias (Roodman 2009b). However because the explanatory variables can be correlated with the error term, there is no pressing reason to worry about omitted variables. If omission of the additional control variables leads to a bias, it would be reflected in the 'Hansen test of

over-identifying restrictions' which I report with the estimation results. This test checks for the validity of the instrument set under the null hypothesis that this set is exogenous. For the same reason (to avoid instrument proliferation) I only take observations occurring every third year, rather than using annual observations as is done for the pooled OLS and fixed effects regressions. It has been pointed out widely in the literature that system GMM works best for small T (time interval) and large N (countries) (e.g. Roodman 2009a, Jayasuriya and Burke 2013).

3.6 Descriptive Statistics

Table 3.A1 in the appendix of this chapter presents the descriptive statistics including the means, standard deviations, minimums, and maximums of the variables used, as well as the number of observations and countries in the estimation sample. Tables 3.A2 and 3.A3 report these statistics separately for the group of countries that are open and closed respectively according to the Sachs and Warner criteria. In addition, in each of the tables I also report the descriptive statistics for other variables — trade, exports and imports of certain other types of merchandise trade as well as secondary school enrolment — which are not employed in the econometric model but reveal on average significant differences across open and closed countries.

Table 3.A1 for the overall sample demonstrates that all variables exhibit a substantial amount of variation. This is expected in a large cross-country sample which includes countries at all stages of development. For example, the minimum real income per capita (in PPP terms) in the sample is $101 while the maximum is $68,000. As another example, trade as a proportion of GDP varies from 0.31 to 430 percent.

Tables 3.A2 and 3.A3 are more interesting as they reveal striking differences between open and closed countries. Both the corruption and bureaucratic quality indicators are on average better for countries that have an open (liberalized) trade policy regime. These countries are also substantially more democratic — one standard deviation less than the mean political openness score for open countries is still higher than the mean score for closed countries.[33] The average real GDP per capita of open countries is almost three times higher and secondary school enrolment almost twice. Better average scores for institutional quality, political openness, GDP per capita and education suggest that open countries are more prosperous. On the other hand these countries possess substantially less natural resource rents as a proportion of GDP – almost a third of the rents available in closed countries on average. Open countries are also much smaller in terms of population size, the mean being almost half of that of closed countries.

The trading patterns also reveal interesting differences, in line with the hypothesis of this study. The mean of trade as a proportion of GDP is higher by 20 percentage points for the sample of open countries. These countries export and import more in equal measure. This difference is reflected across the two sets of countries by the means of manufacturing trade, exports and imports as a proportion of GDP. On the other hand, the mean of trade in natural resources as a proportion of GDP is more than 4 percentage points lower for open countries. However, that is only true for exports, and not for imports. On average closed countries appear to be natural

[33] Open and closed henceforth refers to the nature of the trade policy regime. This terminology is used interchangeably with liberalized and un-liberalized.

resource exporters, while open countries import these resources. Closed countries also trade more in food items as a proportion of GDP; however, unlike for natural resources, closed countries both import and export more on average. Finally, closed countries on average import more, and export less, commercial services as a share of GDP.

Tables 3.A4, 3.A5, and 3.A6 report the pair-wise correlations amongst the variables. These tables demonstrate the difference in trading patterns across the two sets of countries in a different way. The Sachs and Warner openness indicator has a positive correlation with overall trade, exports, and imports. This is reflected even more starkly by manufacturing trade, exports, and imports. The correlation of the openness indicator is negative only with exports of natural resources. With food items this is true for imports as well. Finally, the correlation of the openness indicator is positive with commercial services exports and negative with imports.

These three tables also reveal the pair-wise correlations of the institutional quality indicators with the other variables. Both corruption and bureaucratic quality have a higher positive correlation with trade intensity for the sample of countries that have open trade policy regimes, as is expected. The institutional quality indicators are positively correlated with manufacturing and commercial services trade (both exports and imports). On the other hand their partial correlations with natural resources trade and in particular exports are negative. Both exports and imports of food items have a negative correlation with the indicators.

The descriptive statistics relating to the data that I use for the econometric analysis, provide broad support for the hypotheses of this study, and set the stage for a discussion of the regression analysis in the next Section.

3.7 Estimation Results

3.7.1 Regression Results for Equations (3.1)-(3.3)

Tables 3.1-3.3 present the fixed effects regression results for Equations (3.1)-(3.3) respectively.[34] Corruption (*corr*), bureaucratic quality (*bq*) and the composite indicator (*comp*) enter, in turn, as the dependent variables in each table.[35] Tables 3.A7-3.A10 contain the corresponding pooled OLS regression results presented only for comparison, and will not be the focus of the discussion. The first regression for each of the institutional quality variables (Column 1 for corruption, Column 4 for bureaucratic quality and Column 7 for the composite indicator) does not comprise of the complete model, and only includes the Sachs and Warner openness indicator (*open*) and trade intensity (*trade*) as the explanatory variables. This regression shows the association of trade intensity with institutional quality for the entire sample, ignoring the difference between un-liberalized and liberalized. The next regression for each of the dependent variables adds the interaction variable. A comparison of the two sets of regressions

[34] As a reminder trade is the explanatory variable in Equation 3.1 (Table 3.1), exports in Equation 3.2 (Table 3.2) and imports in Equation 3.3 (Table 3.3)

[35] Also as a reminder, higher values of institutional measures imply better institutional quality.

demonstrates the impact of introducing the distinction between liberalized and un-liberalized. The final regressions also include the set of control variables.

The regression results reported in Table 3.1 for Equation (3.1) partly confirm our hypotheses. While there is no evidence that un-liberalized trade is harmful for institutional quality at a reasonable level of statistical significance, liberalized trade is associated with better bureaucratic quality and a higher composite institutional score at the ten percent level of significance.[36] The coefficient of the interaction term (*open* * *trade*) indicates the difference in the impact of *trade* on institutional quality in open countries relative to its impact in closed countries; in other words, the difference between the association of liberalized and un-liberalized trade with institutional quality. The sum of coefficients for *trade* and (*open* * *trade*) is the impact of liberalized trade.

If I do not differentiate between liberalized and un-liberalized trade (Columns 1, 4 and 7), neither the coefficient of openness nor of trade intensity explain institutional quality. On the other hand when the distinction between liberalized and un-liberalized trade is introduced in Columns (2), (5), and (8) through the inclusion of the interaction term (*open* * *trade*), I find that only the coefficient of the interaction term is significant at the five percent level. Un-liberalized trade shows little statistically

[36] However, with corruption as the institutional quality variable in Columns (1)-(3), there is no evidence that liberalized trade lowers corruption (i.e. improves institutional quality) at a reasonable level of statistical significance. Nevertheless, the coefficient of the interaction variable indicates that relative to un-liberalized trade, trade after liberalization is associated with lower corruption.

significant association with institutional quality. For each of the dependent variables the coefficient of the interaction term (*open* * *trade*) is positive and larger in magnitude than the (negative) coefficient of un-liberalized trade, indicating that the partial correlation of liberalized trade with institutional quality is positive. Adding the control variables in Columns (3), (6), and (9) does not change the results to any noticeable degree.[37]

Column (9) for example shows that an increase in liberalized trade by 10 percentage points is associated with a 0.1 point (=0.13-0.03) improvement in the composite indicator. This improvement is a 1 percentage point increase.[38] The impact of liberalized trade on *comp* is significantly different from zero at the ten percent level. Looking at the underlying institutional quality measures separately, such an increase in liberalized trade would improve the corruption score by 3 percentage points (Column 3) and the bureaucratic quality score by 7 percentage points (Column 6).[39]

To put this in a different way, a one standard deviation increase in the trade to GDP ratio is associated with more than a third of a standard deviation improvement in *comp*.[40] For example, if Pakistan liberalized and then traded as much as Thailand (increased its trade to GDP ratio by almost 40 percentage points), keeping everything

[37] The coefficients overlap within one standard error band.

[38] Here and henceforth, a percentage point is defined as the change in the variable as a proportion of its total range.

[39] The impact on corruption is however not different from zero at a reasonable level of statistical significance.

[40] Here and henceforth, this calculation is based on the estimated coefficients, and the standard deviations of the variables as reported in Table 3.A1.

else constant, its composite institutional quality score is predicted to improve by more than 10 percent of its existing score.[41]

Table 3.2 reports the regression results for Equation (3.2); exports are now the main explanatory variable. Similar to the results for total trade, the first regression for each dependent variable demonstrates that without the distinction between liberalized and un-liberalized, neither the coefficient of openness nor of export intensity explains institutional quality at a statistically significant level. However, whereas liberalized (but not un-liberalized) trade explains institutional quality with precision once the interaction variable is added, now un-liberalized exports exhibit a statistically significant association at the ten percent level with corruption and the composite indicator. Un-liberalized exports increase corruption and deteriorate composite institutional quality. Relative to un-liberalized exports, the impact of liberalized exports on all three institutional quality variables is positive.[42] For instance Column (9) shows that an un-liberalized increase in the export to GDP ratio by 10 percentage points is associated with a 1.2 percentage point deterioration in the composite indicator. There is no evidence that a similar increase in liberalized exports decreases the composite indicator; in fact compared to un-liberalized a similar increase in liberalized exports improves *comp* by 2.6 percentage points.

[41] The existing *comp* score for Pakistan is 3.92.

[42] However there is no evidence that the overall impact of liberalized exports on *corr* and *comp* is positive at a reasonable level of significance. Nevertheless the impact on *bq* is positive at the ten percent level of significance.

Table 3.1. Fixed Effects Regression Results for Institutional Quality (Equation 3.1)

	Corruption			Bureaucratic Quality			Composite Inst Quality		
Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(YPC)	-0.399	-0.421	-0.337	0.560***	0.535***	0.539**	0.161	0.114	0.201
	(0.291)	(0.282)	(0.305)	(0.213)	(0.201)	(0.234)	(0.420)	(0.396)	(0.443)
Open	0.069	-0.226	-0.299	0.205	-0.146	-0.200	0.274	-0.372	-0.499
	(0.133)	(0.218)	(0.218)	(0.153)	(0.221)	(0.224)	(0.223)	(0.395)	(0.386)
Trade	0.001	-0.003	-0.003	0.004	-0.001	0.000	0.005	-0.004	-0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
Trade		0.005*	0.006**		0.006**	0.007**		0.012**	0.013**
*Open		(0.003)	(0.003)		(0.003)	(0.003)		(0.005)	(0.005)
log(pop)			0.318			0.097			0.415
			(0.539)			(0.450)			(0.805)
Polity2			0.016			0.005			0.021
			(0.011)			(0.010)			(0.018
NRRents			0.001			-0.003			-0.002
			(0.003)			(0.003)			(0.004)
Obs	2554	2554	2433	2554	2554	2433	2554	2554	2433
Countries	114	114	109	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.367	0.388		0.028	0.009		0.093	0.061
T.E incl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.810	0.812	0.805	0.848	0.852	0.848	0.865	0.867	0.863
R^2(within)	0.264	0.270	0.272	0.100	0.116	0.124	0.139	0.157	0.164

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parenthesis. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Trade + (Trade * Open)' equals zero. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Table 3.2. Fixed Effects Regression Results for Institutional Quality (Equation 3.2)

	Corruption			Bureaucratic Quality			Composite Inst Quality		
Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(YPC)	-0.392	-0.410	-0.309	0.574***	0.552***	0.561**	0.182	0.143	0.252
	(0.291)	(0.279)	(0.300)	(0.212)	(0.200)	(0.231)	(0.418)	(0.388)	(0.428)
Open	0.071	-0.204	-0.279	0.212*	-0.115	-0.166	0.283	-0.319	-0.445
	(0.134)	(0.200)	(0.201)	(0.125)	(0.195)	(0.199)	(0.227)	(0.351)	(0.345)
Export	0.001	-0.007*	-0.008*	0.004	-0.005	-0.004	0.004	-0.012*	-0.012*
	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.008)	(0.007)	(0.008)
Export *Open		0.011**	0.012**		0.013**	0.014**		0.024**	0.026***
		(0.005)	(0.005)		(0.006)	(0.006)		(0.010)	(0.010)
log(pop)			0.366			0.104			0.470
			(0.545)			(0.460)			(0.812)
Polity2			0.017			0.006			0.023
			(0.011)			(0.010)			(0.018)
NRRents			0.002			-0.002			-0.000
			(0.003)			(0.003)			(0.004)
Obs	2554	2554	2433	2554	2554	2433	2554	2554	2433
Countries	114	114	109	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.446	0.514		0.097	0.047		0.190	0.161
T.E incl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.810	0.812	0.805	0.847	0.851	0.848	0.864	0.868	0.863
R^2(within)	0.263	0.272	0.273	0.089	0.113	0.119	0.135	0.158	0.164

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parentheses. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Export + (Export * Open)' equals zero. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Table 3.3. Fixed Effects Regression Results for Institutional Quality$_t$ (Equation 3.3)

	Corruption$_t$			**Bureaucratic Quality$_t$**			**Composite Inst Quality$_t$**		
Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(YPC)	-0.396	-0.420	-0.351	0.579***	0.549***	0.556**	0.183	0.130	0.205
	(0.291)	(0.287)	(0.312)	(0.213)	(0.205)	(0.238)	(0.420)	(0.406)	(0.459)
Open	0.065	-0.182	-0.246	0.192	-0.1222	-0.178	0.257	-0.304	-0.424
	(0.132)	(0.222)	(0.221)	(0.121)	(0.223)	(0.227)	(0.220)	(0.401)	(0.393)
Import	0.003	-0.003	-0.003	0.008**	0.002	0.003	0.011*	-0.001	0.000
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.007)	(0.006)	(0.006)
Import *Open		0.008	0.009		0.010*	0.011*		0.020*	0.020**
		(0.006)	(0.006)		(0.006)	(0.006)		(0.010)	(0.010)
log(pop)			0.260			0.080			0.340
			(0.534)			(0.447)			(0.811)
Polity2			0.016			0.003			0.019
			(0.011)			(0.010)			(0.018)
NRRents			0.000			-0.003			-0.003
			(0.003)			(0.003)			(0.004)
Obs	2554	2554	2433	2554	2554	2433	2554	2554	2433
Countries	114	114	109	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.297	0.266		0.009	0.003		0.049	0.024
T.E incl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.810	0.811	0.804	0.850	0.852	0.849	0.865	0.867	0.863
R^2(within)	0.264	0.268	0.270	0.104	0.119	0.126	0.142	0.155	0.162

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parentheses. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Import + (Import * Open)' equals zero. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Table 3.3 presents the results for Equation (3.3), using imports as the main explanatory variable. Corruption is not explained with statistical precision by any of the regressors. However, even for *bq* and *comp*, the distinction between liberalized and un-liberalized imports is less clear. Even without the inclusion of the interaction term (*open* * *imports*) in the model, higher import intensity is associated at a significance level of at least ten percent with a better score for bureaucratic quality and the

composite indicator (Columns 4 and 7 respectively). A 10 percentage point increase in import intensity is associated with a 1.1 percentage point increase in *comp*. When the interaction variable is introduced, liberalized imports now positively explain institutional quality at a statistically significant level, whereas there is no evidence that un-liberalized imports hurt institutional quality. For example Column (9) shows that an increase in liberalized imports of 10 percentage points is associated with a 2 percentage point improvement in the composite indicator, at the five percent level of significance.

An interesting feature of the fixed effects results presented in Tables 3.1-3.3 is that GDP per capita is only correlated with bureaucratic quality — the coefficient is positive and statistically significant at the one percent level — and not with corruption. In fact the overall explanatory power (indicated by the R^2) of the set of regressors is slightly higher as well for bureaucratic quality.

Tables 3.A7-3.A8 report the corresponding pooled OLS regression results for Equations (3.1)-(3.3) and reveal interesting differences compared to the fixed effects results. Firstly, as expected, the overall explanatory power of the fixed effects regressions is higher (comparing the R^2); an additional 30 to 40 percentage point variation in institutional quality is explained by fixed effects compared to the corresponding pooled OLS regressions. Secondly, income per capita is now positively associated with not only bureaucratic quality, but also with corruption at a highly significant level. Similarly, the control variables now appear significant. Democracy is associated with an improvement in the corruption score, while country size is correlated positively with bureaucratic quality. Moreover the Sachs and Warner

openness indicator, which did not appear important in explaining institutional quality in the within-country context (fixed effects regressions), now exhibits a more statistically significant association. Most of the explanatory power of these variables (income per capita, democracy, country size, and the openness indicator) disappears once country-specific factors are controlled for. Thus a comparison of the pooled OLS results with the fixed effects results reinforces the importance of the country-specific factors in explaining institutional quality and mitigating omitted variable bias. In contrast, the main variables of interest (liberalized and un-liberalized trade, exports, imports) appear to be more important in explaining institutional quality in the within-country context. Compared to the pooled OLS, they are generally statistically more significant and robust to the inclusion of control variables in the fixed effects regressions.

Finally, the system GMM regressions are presented in Table 3.4. This table reports the causal impact of liberalized as well as un-liberalized trade (in Columns 1 and 2), exports (in Columns 3 and 4), and imports (in Columns 5 and 6) on the change in institutional quality over the subsequent three-year period. Here, and henceforth, I only report the regressions for the composite indicator as the institutional quality variable, and exclude corruption and bureaucratic quality in order to simplify the discussion. It has already been argued in Section 3.4 that the composite indicator is a more complete and thus suitable measure for our purpose. Neither do I report the regressions which include the control variables, as discussed in Section 3.5.

Table 3.4. System GMM Regression Results for Composite Institutional Quality (Equations 3.1-3.3)

Ind Var	(1)	(2)	(3)	(4)	(5)	(6)
Comp	0.8340***	0.8429***	0.8319***	0.8337***	0.8561***	0.8508***
	(0.0342)	(0.0298)	(0.0316)	(0.0302)	(0.0334)	(0.0283)
log(YPC)	0.2660***	0.2276***	0.3050***	0.2415***	0.2009***	0.2169***
	(0.0793)	(0.0604)	(0.0575)	(0.0562)	(0.0759)	(0.0625)
Open	-0.0548	-0.3600	-0.0426	-0.3983	-0.1171	-0.2814
	(0.1503)	(0.2614)	(0.1377)	(0.2434)	(0.1519)	(0.2701)
Trade	0.0002	-0.0050*				
	(0.0016)	(0.0026)				
Trade *Open		0.0052*				
		(0.0028)				
Exports			-0.0013	-0.0112**		
			(0.0032)	(0.0052)		
Exports *Open				0.0117**		
				(0.0058)		
Imports					0.0026	-0.0077
					(0.0030)	(0.0050)
Imports *Open						0.0081
						(0.0054)
Obs	810	810	810	810	810	810
Countries	114	114	114	114	114	114
'$\alpha_3 + \alpha_4 = 0$'		0.7918		0.7565		0.8326
T.E included	Yes	Yes	Yes	Yes	Yes	Yes
Instruments	90	112	90	112	90	112
Hansen j Test p-value	0.128	0.292	0.135	0.267	0.100	0.323
AR(2) Test p-value	0.846	0.933	0.884	0.830	0.958	0.979
Wald chi-sq statistic	2267.08	3695.15	2848.24	3660.40	2130.34	3928.18
Wald chi-sq p-value	0.00	0.00	0.00	0.00	0.00	0.00

Notes: A constant is included in all regressions but not reported. Observations of the dependent variable at 3 year intervals are used from 1987-2008.The explanatory variables are lagged by three years. Windmeijer-Corrected robust standard errors from the two-step GMM estimation shown in parentheses. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Trade + (Trade * Open) = 0' in Columns (1)-(3), 'Export + (Export * Open) = 0' in Columns (4)-(6), 'Import + (Import * Open) = 0' in Columns (7)-(9) respectively. Orthogonal forward deviations are used to purge fixed effects. All explanatory variables are treated as endogenous and instrumented by 2 lags.
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

The diagnostics for all the system GMM regressions indicate that Equations (3.1)-(3.3) have been adequately estimated. The p-value of the Hansen test for over-identifying restrictions shows that we cannot reject the null hypothesis that the instrument set is valid at the ten percent level of significance. Also, the estimation does not likely suffer from an over-fitting bias caused by over-instrumentation, as the p-value is not unrealistically high (Roodman 2009b, Jayasuriya and Burke 2013). The p-value of the AR(2) test indicates that we cannot reject the null of no second order serial correlation of significance, which is a necessary assumption for consistent estimation using system GMM.

The results for each of the three equations show that the lagged dependent variable is highly persistent, as expected. It is significant at the one percent level in each of the regressions and explains current institutional quality better than any other regressor. In addition, the estimated coefficient for income per capita is highly significant (at the one percent level) and positive as well in all the regressions.

For my main explanatory variables the results show that the distinction between liberalized and un-liberalized is important for trade (Equation 3.1) and exports (Equation 3.2), but not for imports (Equation 3.3). Neither trade nor export intensity have a causal impact on institutional quality at any reasonable level of statistical significance if the interaction variable is not included. When the distinction is introduced in Column (2), I find that un-liberalized trade has a negative impact on institutional quality. On the other hand, there is no evidence that the impact of liberalized trade is statistically different from zero at a reasonable level of significance. However, we can conclude that the impact of trade on institutional quality in open

countries relative to closed countries is positive; in other words the negative impact of un-liberalized trade is eliminated by liberalization of trade policy. Column 2 shows that an increase of 10 percentage points in the un-liberalized trade to GDP ratio reduces institutional quality by 3.2 percent points [=0.05/(1-0.84)]. Relative to un-liberalized trade a similar increase in liberalized trade improves institutional quality by 3.3 percentage points.[43]

The results for Equation (3.2) with exports as the explanatory variable are qualitatively similar, but 'stronger' in terms of both precision and magnitude. Column (4) indicates an increase of 10 percentage points in un-liberalized exports as a proportion of GDP reduces the composite institutional quality score by 6.7 percentage points. On the other hand, an equivalent increase in liberalized exports improves *comp* by 7.0 percentage points relative to un-liberalized exports.[44]

Finally, the results for Equation (3.3) with imports as the explanatory variable are the 'weakest'. Even with the distinction between liberalized and un-liberalized, we cannot reject at a reasonable level of statistical significance that imports have no causal impact on institutional quality.

[43] The overall impact however is an improvement of only 0.13 percentage points, which is not statistically different from zero.

[44] The overall impact however is an improvement of only 0.30 percentage points, which is not statistically different from zero.

3.7.2 Regression Results for Equations (3.4)-(3.6)

Table 3.5 reports the fixed effects regression results for institutional quality with liberalized and un-liberalized trade, exports and imports in natural resources as explanatory variables (Equations (3.4)-(3.6) respectively). Table 3.A10 presents the pooled OLS regression results, again only meant for a broad comparison, and these will not be discussed as they reveal similar differences with fixed effects regressions as they did for Equations (3.1)-(3.3).

The first three columns of Table 3.5 report the regressions results for Equation (3.4) and show that the distinction between liberalized and un-liberalized remains important for trade in natural resources. Without the interaction term included, intensity of trade in natural resources has no association with institutional quality. When the interaction variable is introduced, I find that un-liberalized trade in natural resources is negatively associated with institutional quality at a high level of statistical significance (one percent). On the other hand, there is no evidence that liberalized trade in natural resources is harmful for institutional quality. Column (3) for example shows that a 10 percentage point increase in un-liberalized trade as a proportion of GDP is associated with a 4.2 percentage point deterioration in the composite indicator. In other words, a one standard deviation increase in un-liberalized natural resource trade is correlated with almost a fifth of a standard deviation decrease in *comp*. For example, if Pakistan's natural resource trade as a proportion of its GDP in 2011 was to increase to the level of Nigeria (which is an increase of 38 percentage points), keeping everything else constant, its composite institutional score is predicted to fall by more than 40 percent of the existing score.

Table 3.5. Fixed Effects Regression Results for Composite Institutional Quality (Equations 3.4-3.6)

Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(YPC)	0.632	0.649	0.891	0.554	0.557	0.758	0.826	0.894	1.082*
	(0.544)	(0.539)	(0.576)	(0.521)	(0.520)	(0.541)	(0.580)	(0.578)	(0.614
Open	0.509**	0.027	-0.084	0.476**	0.341	0.250	0.53**	0.106	0.063
	(0.210)	(0.295)	(0.278)	(0.207)	(0.260)	(0.242)	(0.211)	(0.276)	(0.268)
NatResTrd	-0.005	-0.036***	-0.042***						
	(0.011)	(0.013)	(0.014)						
Open * NatResTrd		0.042***	0.046***						
		(0.014)	(0.014)						
NatResExp				-0.024*	-0.04**	-0.055***			
				(0.014)	(0.02)	(0.18)			
Open * NatResExp					0.022	0.029*			
					(0.016)	(0.016)			
NatResImp							0.027*	-0.042	-0.038
							(0.016)	(0.034)	(0.035)
Open* NatResImp								0.087**	0.075**
								(0.035)	(0.036)
Log(pop)			0.847			0.561			0.656
			(0.785)			(0.778)			(0.798)
Polity2			0.044**			0.048***			0.046**
			(0.018)			(0.017)			(0.018)
NRRents			0.010			0.023			-0.002
			(0.014)			(0.016)			(0.011)
Obs	2026	2026	1950	2050	2050	1973	2083	2083	2000
Countries	112	112	107	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.429	0.755		0.322	0.223		0.011	0.014
T.E included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.881	0.884	0.885	0.883	0.883	0.885	0.883	0.885	0.885
R^2(within)	0.147	0.164	0.188	0.156	0.159	0.187	0.151	0.166	0.190

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parentheses. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Trade + (Trade * Open) = 0' in Columns (1)-(3), 'Export + (Export * Open) = 0' in Columns (4)-(6), 'Import + (Import * Open)=0' in Columns (7)-(9) respectively. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

The results for exports in natural resources are reported in the next three Columns of Table 3.5. Exports of natural resources harm institutional quality, when the distinction between liberalized and un-liberalized is not made. Column (4), which does

not include the interaction variable, shows that the intensity of exports in natural resources has a negative association with *comp*. When the interaction variable is introduced (Columns 5 and 6), I find that liberalized trade in natural resources mitigates the negative impact. In fact, there is no evidence that the impact of liberalized trade in natural resources is statistically different from zero. Column (6) shows that a 10 percentage point increase in un-liberalized natural resource export as a proportion of GDP is associated with a 5.5 percentage point deterioration in institutional quality at a significance level of one percent.[45]

The results for imports of natural resources presented in the final three columns of the table are very different compared to exports. There is no evidence of a negative association of natural resource imports with institutional quality. This is in line with my expectation, as the rent-seeking behavior which hurts institutional quality is relevant mainly for exports of these resources which are tightly controlled by the government. In fact, the results show that liberalized imports of natural resources have a positive correlation. Column (7) shows that without the distinction between liberalized and un-liberalized, intensity of natural resource imports is positively correlated with *comp* at the ten percent level of significance. When the interaction variable is introduced (Columns 8 and 9), I find that a 10 percentage point increase in liberalized *NatResImp* is associated with a 3.7 percentage point improvement in *comp* at a significance level of five percent.

[45] A similar increase in liberalized exports has a lower negative association (26 percentage points), and this is not statistically different from zero at a reasonable level of significance.

The system GMM results for Equations (3.4)-(3.6) are presented in Table 3.6. Similar to the results for Equations (3.1)-(3.3), the diagnostics here also indicate that the equations have been estimated adequately. Moreover, the estimated coefficients for the lagged dependent variable and GDP per capita in all the regressions remain similar.

The conclusions that the system GMM estimation of Equation (3.4)-(3.6) leads to are broadly similar to those from the fixed effects results. However, introducing the distinction between liberalized and un-liberalized appears less meaningful. For Equation (3.4) with *NatResTrd* as the main explanatory variable, I find that intensity of trade in natural resources has a negative effect on institutional quality at a significance level of five percent – Column (1) shows that an increase of 10 percentage points in the proportion of trade in natural resources to GDP reduces *comp* by 4.5 percentage points. When the interaction variable is introduced (in Column 2), neither the coefficients for un-liberalized trade nor the interaction term are statistically significant.

For Equation (3.5), I find that intensity of natural resource exports deteriorates institutional quality. Column (3) shows that an increase of 10 percentage points reduces *comp* by 8.7 percentage points, and the estimated coefficient is significant at the five percent level. When the interaction variable is introduced (in Column 4), I find that an increase of 10 percentage points in un-liberalized exports of natural resources deteriorates *comp* by 6.4 percentage points at the ten percent level of significance. There is no evidence that the impact of liberalized exports of natural resources on institutional quality is statistically different from zero.

Table 3.6. System GMM Regression Results for Composite Institutional Quality (Equations 3.4-3.6)

Ind Var	(1)	(2)	(3)	(4)	(5)	(6)
Comp	0.8418***	0.8525***	0.8674***	0.8745***	0.8577***	0.8681***
	(0.0310)	(0.0289)	(0.0350)	(0.0289)	(0.0345)	(0.0280)
Log(YPC)	0.2834***	0.2442***	0.2077***	0.1771***	0.2958***	0.2303***
	(0.0723)	(0.0614)	(0.0627)	(0.0662)	(0.0777)	(0.0627)
Open	-0.1444	0.0720	-0.2446	-0.0791	-0.1785	0.0386
	(0.1227)	(0.1996)	(0.1539)	(0.1750)	(0.1564)	(0.1681)
NatResTrd	-0.0071**	-0.0033				
	(0.0032)	(0.0066)				
Open * NatResTrd		0.0060				
		(0.0088)				
NatResExp			-0.0116***	-0.0081*		
			(0.0035)	(0.0044)		
Open * NatResExp				0.0040		
				(0.0074)		
NatResImp					-0.0046	-0.0061
					(0.0094)	(0.0140)
Open* NatResImp						0.0138
						(0.156)
Obs	627	627	636	636	644	644
Countries	104	104	106	106	106	106
'$\alpha_3 + \alpha_4 = 0$'		0.856		0.711		0.490
T.E included	Yes	Yes	Yes	Yes	Yes	Yes
Instruments	90	112	90	112	90	112
Hansen j Test p-value	0.436	0.530	0.288	0.519	0.152	0.489
AR(2) Test p-value	0.437	0.368	0.352	0.268	0.301	0.282
Wald chi-sq statistic	4117.86	5302.81	4208.14	4564.67	3627.69	5771.49
Wald chi-sq p-value	0.00	0.00	0.00	0.00	0.00	0.00

Notes: A constant is included in all regressions but not reported. Observations at 3 year intervals are used from 1987-2008. Windmeijer-Corrected Robust standard errors from the two-step GMM estimation shown in parenthesis. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Trade + (Trade * Open) = 0' in columns (1)-(3), 'Export + (Export * Open) = 0' in columns (4)-(6), 'Import + (Import * Open) =0' in columns (7)-(9) respectively. Orthogonal forward deviations used to purge fixed effects. All explanatory variables are treated as endogenous and instrumented by 2 lags.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Finally, the regressions results for Equation (3.6) in Columns (5) and (6) demonstrate no statistically significant causal impact of imports of natural resources on the composite institutional quality score, in line with the fixed effects results.

3.8 Conclusion

This chapter attempts to add to the growing literature on the link between trade exposure and institutional quality. It is motivated by the observation, based on historical experience as well as formal theoretical models, that a country that engages in greater international trade does not necessarily improve its institutions. I hypothesize that institutional quality might only improve if greater trade occurs in the context of a liberalized (open) trade policy regime. In the presence of trade restrictions and policy distortions, increased trade deteriorates institutional quality. The hypothesis is set within the context of the 'rent-seeking' literature. The central lesson of this literature is that any government-imposed restriction leads to artificial rent-seeking. Artificial rent-seeking then manifests as corruption and erosion of bureaucratic quality.

For ease of exposition, I distinguish between the two different kinds of trade as liberalized and un-liberalized. Classification of trade policy as open or closed is based on the widely used Sachs and Warner binary openness indicator. While some previous works have differentiated between trade intensity (the proportion of trade to GDP) and trade policy, to my knowledge the distinction between liberalized and un-liberalized trade is unique. Moreover I look at not only the impact of overall trade, but also consider exports and imports separately in an identical framework. Within the

same setting and also based on the rent-seeking premise, I further investigate whether liberalization mitigates the deleterious impact of trade in natural resources on institutions, as pointed out by the 'natural resource curse' literature.

The contribution of this chapter is primarily the empirical cross-country evidence derived from a careful econometric strategy. The data used for the analysis comprises of 114 countries from 1987 to 2005. Based on the rent-seeking literature, the relevant institutional quality variables identified are subjective indicators (widely used by investors and the previous empirical literature) measuring the extent of corruption and bureaucratic quality — these two are combined to form a composite variable that exhibits more variation and a more complete representation of institutional quality. The hypothesis is tested by relying on an interaction variable which combines trade intensity with policy, and thus makes a distinction between liberalized and un-liberalized trade. Results without this distinction are presented alongside to judge whether the distinction was worthwhile making. Plausible control variables are included, and the within-country association of trade with institutional quality estimated through use of the fixed effects estimation technique. The system GMM estimation technique, which generates a set of internal instruments, is relied upon to address additional endogeneity concerns and make inferences about causality.

The evidence presented in this chapter supports the hypothesis to a reasonable degree. The fixed effects results suggest that liberalized trade is associated with better institutional quality within countries — the results are stronger for imports compared to exports. Moreover, whereas un-liberalized exports are found to be associated with deterioration in institutional quality, the same cannot be said for imports. With regards

to the investigation of the impact of natural resource trade on institutional quality, exports are highly associated with a deterioration of institutions, but liberalization mitigates the harmful effect.

The causal relationships estimated through system GMM portray a broadly similar story. Whereas the negative causal impact of un-liberalized exports on institutional quality is quite large, the beneficial effect of liberalized exports is relatively smaller and not estimated at a reasonable level of statistical significance. Imports demonstrate no statistically precise causal impact. Similarly, the impact of natural resource exports on institutions is substantially negative, while, like the fixed effects results, there is no evidence that liberalized exports of natural resources hurt institutional quality.

The separate analysis undertaken for exports and imports suggests that artificial rent-seeking engendered by government-imposed policy restrictions operates more vigorously on the export side, both for overall trade, and more specifically, for natural resource trade. While this was expected for natural resources, for overall trade this was an open question to be answered by the empirical analysis. Furthermore, the deterioration of institutional quality due to un-liberalized exports is quite substantial. Even if the beneficial impact of liberalized exports is relatively smaller or even zero, at least liberalization eliminates the institutional erosion that would result without it.

For countries that try to follow an export promotion strategy, this leads to an important policy recommendation. The role of institutional quality for strong economic performance is now widely accepted, as discussed in the introductory chapter of this thesis. Therefore, in order to reap the full rewards of an export-led development

strategy, countries should liberalize the trade regime first. This is especially crucial for natural resource exporters. While the natural resource curse operates through other channels as well, institutional erosion is an important one. Indeed for a country like Nigeria, which is often quoted as a classic example in this regard, the institutional channel may well be the most pressing (Sala-i-Martin and Subramanian 2003, Robinson et al. 2006).

Appendix 3

Table 3.A1. Descriptive Statistics (Entire Sample)

Variable	Mean	Minimum	Maximum	Observations	Countries
Corruption	3.21 (1.42)	0	6.17	120	2438
Bureaucratic Quality	2.16 (1.26)	0	4	120	2438
Composite Inst Quality	5.37 (2.47)	0	10.17	120	2438
Real GDP per Capita (PPP)	10437 (11127)	101	68290	115	2276
Trade to GDP	73.94 (51.30)	0.31	429.95	117	2311
Exports to GDP	35.55 (27.18)	0.18	229.68	117	2311
Imports to GDP	38.40 (25.07)	-17.13	200.27	117	2311
Population	4.67*10^7 (1.47 * 10^8)	239511	1.30 * 10^9	119	2416
Polity2	3.33 (6.74)	-9	10	115	2341
Natural Res Rents to GDP	7.32 (13.50)	0	218.89	117	2330
Sec School Enr Rate(gross)	67.60 (33.71)	3.07	162.35	116	1809
Manuf Trade to GDP	37.22 (36.16)	4.18	299.88	112	1865
Food Trade to GDP	8.55 (7.08)	1.00	60.03	112	1865
Comm Serv Trade to GDP	0.20 (0.19)	0.04	1.71	110	116
Natural Res Trade to GDP	11.69 (10.15)	1.15	88.74	111	1832
Manuf Exp to GDP	14.77 (19.55)	0.00	152.04	114	1896
Food Exp to GDP	4.94 (5.78)	0.01	48.16	114	1896
Comm Serv Exp to GDP	0.10 (0.11)	0.01	1.07	110	116
Natural Res Exp to GDP	6.67 (8.94)	0.02	77.55	113	1856
Manuf Imp to GDP	22.32 (17.70)	2.10	151.73	114	1880
Food Imp to GDP	3.63 (2.71)	0.12	22.84	114	1880

Comm Serv Imp to GDP	0.10 (0.08)	0.02	0.64	110	116
Natural Res Imp to GDP	5.07 (4.24)	0.08	47.69	114	1880

Note: Standard deviation reported in parentheses

Table 3.A2. Descriptive Statistics (Open countries)

Variable	Mean	Minimum	Maximum	Countries	Observations
Corruption	3.55	0	6	93	1567
	(1.39)				
Bureaucratic	2.55	0	4	93	1567
Quality	(1.17)				
Composite	6.10	0	10	93	1567
Inst Quality	(2.37)				
Real GDP per	13297	399	68290	92	1529
Capita (PPP)	(11990)				
Trade to GDP	79.92	13.75	429.95	92	1538
	(56.23)				
Exports to	38.50	4.90	229.68	92	1538
GDP	(29.76)				
Imports to	41.24	6.08	200.27	92	1538
GDP	(27.25)				
Population	2.90*10^7	366706	2.98*10^8	92	1545
	(4.66*10^7)				
Polity2	5.97	-9	10	91	1524
	(5.35)				
Natural Res	3.98	0	65.02	92	1545
Rents to GDP	(6.59)				
Average yrs	7.61	0.28	13.19	86	334
of Schooling	(2.86)				
Manuf Trade	41.41	4.18	299.88	92	1392
to GDP	(39.17)				
Food Trade	8.28	1.00	60.03	92	1392
to GDP	(7.20)				
Comm Serv	0.21	0.04	1.71	90	96
Trade to GDP	(0.20)				
Natural Res	10.84	1.15	88.74	91	1377
Trade to GDP	(9.26)				
Manuf Exp to	17.38	0.01	152.04	92	1401
GDP	(21.29)				
Food Exp to	4.72	0.04	48.16	92	1401
GDP	(5.67)				
Comm Serv	0.11	0.01	1.07	90	96
Exp to GDP	(0.12)				
Natural Res	5.57	0.03	45.73	91	1386
Exp to GDP	(6.91)				
Manuf Imp to	24.04	2.10	151.73	92	1402
GDP	(18.99)				
Food Imp to	3.57	0.24	22.84	92	1402
GDP	(2.70)				
Comm Serv	0.10	0.02	0.64	90	96
Imp to GDP	(0.09)				
Natural Res	5.27	0.23	47.69	92	1402
Imp to GDP	(4.41)				

Note: Standard deviation reported in parentheses

Table 3.A3. Descriptive Statistics (Closed Countries)

Variable	Mean	Minimum	Maximum	Countries	Observations
Corruption	2.62	0	6.17	77	871
	(1.27)				
Bureaucratic	1.46	0	4	77	871
Quality	(1.09)				
Composite	4.07	0	10.17	77	871
Inst Quality	(2.10)				
Real GDP per	4538	101	34889	70	747
Capita (PPP)	(5662)				
Trade to GDP	62.05	0.31	198.77	73	773
	(36.95)				
Exports to	29.68	0.18	100.70	73	773
GDP	(19.90)				
Imports to	32.37	-17.14	98.42	73	773
GDP	(18.63)				
Population	7.80 * 10^7	239511	1.30^10^9	77	871
	(2.34*10^8)				
Polity2	-1.58	-9	10	74	817
	(6.31)				
Natural Res	13.88	0	218.89	74	785
Rents to GDP	(19.76)				
Average yrs	4.84	0.53	11.90	64	170
of Schooling	(2.54)				
Manuf Trade	24.88	4.55	132.01	61	473
to GDP	(20.87)				
Food Trade	9.35	1.06	37.32	61	473
to GDP	(6.64)				
Comm Serv	0.20	0.04	0.54	20	20
Trade to GDP	(0.13)				
Natural Res	14.27	1.26	77.63	58	455
Trade to GDP	(12.11)				
Manuf Exp to	7.39	0.00	60.40	63	495
GDP	(10.39)				
Food Exp to	5.57	0.01	31.15	63	495
GDP	(6.06)				
Comm Serv	0.08	0.01	0.34	20	20
Exp to GDP	(0.08)				
Natural Res	9.90	0.02	77.55	61	470
Exp to GDP	(12.68)				
Manuf Imp to	17.30	2.24	71.61	63	478
GDP	(11.87)				
Food Imp to	3.81	0.12	17.63	63	478
GDP	(2.72)				
Comm Serv	0.12	0.04	0.26	20	20
Imp to GDP	(0.07)				
Natural Res	4.48	0.08	23.64	63	478
Imp to GDP	(3.65)				

Note: Standard deviation reported in parentheses

Table 3.A4. Pair-wise Correlation Matrix (Trade)

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	0.67	1.00									
3	0.92	0.90	1.00								
4	0.11	0.21	0.17	1.00							
5	0.31	0.42	0.39	0.20	1.00						
6	0.25	0.35	0.32	0.71	0.71	1.00					
7	-0.00	0.08	0.04	0.80	0.10	0.61	1.00				
8	0.19	0.28	0.25	0.85	0.28	0.78	0.80	1.00			
9	-0.06	-0.15	-0.11	0.38	-0.11	0.20	0.37	0.20	1.00		
10	0.25	0.26	0.28	0.65	0.03	0.61	0.32	0.33	0.24	1.00	
11	-0.23	-0.15	-0.21	0.38	-0.06	0.28	0.66	0.14	0.05	0.01	1.00

Notes:
1. Corruption
2. Bureaucratic Quality
3. Composite Institutional Quality
4. Trade to GDP
5. Sachs and Warner Openness Indicator
6. Liberalized Trade to GDP
7. Merchandise Trade to GDP
8. Manufacturing Trade to GDP
9. Food Trade to GDP
10. Commercial Services Trade to GDP
11. Natural Resource Trade to GDP

Table 3.A5. Pair-wise Correlation Matrix (Exports)

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	0.67	1.00									
3	0.92	0.90	1.00								
4	0.13	0.27	0.21	1.00							
5	0.32	0.42	0.39	0.22	1.00						
6	0.28	0.39	0.36	0.75	0.68	1.00					
7	-0.00	0.09	0.05	0.76	0.08	0.58	1.00				
8	0.24	0.35	0.32	0.73	0.33	0.78	0.67	1.00			
9	-0.01	-0.09	-0.05	0.14	-0.15	0.04	0.14	-0.08	1.00		
10	0.28	0.31	0.32	0.53	0.13	0.58	0.05	0.20	0.10	1.00	
11	-0.22	-0.16	-0.21	0.35	-0.16	0.08	0.64	-0.04	-0.13	-0.20	1.00

Notes:
1. Corruption
2. Bureaucratic Quality
3. Composite Institutional Quality
4. Exports to GDP
5. Sachs and Warner Openness Indicator
6. Liberalized Exports to GDP
7. Merchandise Exports to GDP
8. Manufacturing Exports to GDP
9. Food Exports to GDP
10. Commercial Services Exports to GDP
11. Natural Resource Exports to GDP

Table 3.A6. Pair-wise Correlation Matrix (Imports)

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	0.67	1.00									
3	0.92	0.90	1.00								
4	0.08	0.14	0.12	1.00							
5	0.32	0.42	0.39	0.17	1.00						
6	0.22	0.31	0.28	0.64	0.73	1.00					
7	-0.00	0.05	0.02	0.84	0.12	0.59	1.00				
8	0.11	0.18	0.16	0.89	0.20	0.73	0.84	1.00			
9	-0.14	-0.19	-0.17	0.63	0.03	0.38	0.62	0.50	1.00		
10	0.18	0.16	0.18	0.70	-0.12	0.53	0.47	0.44	0.35	1.00	
11	-0.09	-0.00	-0.05	0.43	0.16	0.55	0.70	0.25	0.24	0.35	1.00

Notes:
1. Corruption
2. Bureaucratic Quality
3. Composite Institutional Quality
4. Imports to GDP
5. Sachs and Warner Openness Indicator
6. Liberalized Imports to GDP
7. Merchandise Imports to GDP
8. Manufacturing Imports to GDP
9. Food Imports to GDP
10. Commercial Services Imports to GDP
11. Natural Resource Imports to GDP

Table 3.A7. Pooled OLS Results for Institutional quality (Equation 3.1)

	Corruption			Bureaucratic Quality			Composite Inst Quality		
Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(YPC)	0.65***	0.66***	0.54***	0.68***	0.69***	0.62***	1.33***	1.35***	1.16***
	(0.07)	(0.07)	(0.07)	(0.05)	(0.05)	(0.06)	(0.11)	(0.11)	(0.11)
Open	0.36**	0.12	0.07	0.34**	-0.02	0.10	0.70***	0.09	0.17
	(0.15)	(0.22)	(0.24)	(0.13)	(0.26)	(0.26)	(0.25)	(0.43)	(0.45)
Trade	-0.00	-0.00	-0.00	-0.00	-0.01	-0.00	-0.00	-0.01*	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Trade		0.00	0.00		0.01*	0.00		0.01*	0.01
*Open		(0.00)	(0.00)		(0.00)	(0.00)		(0.01)	(0.01)
log(pop)			-0.05			0.15***			0.09
			(0.06)			(0.04)			(0.09)
Polity2			0.03***			0.01			0.04**
			(0.01)			(0.01)			(0.02)
NRRents			-0.01			-0.01			-0.01
			(0.01)			(0.01)			(0.01)
Obs	2554	2554	2433	2554	2554	2433	2554	2554	2433
Country	114	114	109	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.851	0.858		0.443	0.005		0.575	0.073
T.E incl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.496	0.498	0.503	0.593	0.600	0.627	0.608	0.613	0.620

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parenthesis. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Trade + (Trade * Open)' equals zero.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Table 3.A8. Pooled OLS Results for Institutional quality(Equation 3.2)

	Corruption			Bureaucratic Quality			Composite Inst Quality		
Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(YPC)	0.66***	0.67***	0.55***	0.68***	0.70***	0.61***	1.34***	1.36***	1.16***
	(0.07)	(0.07)	(0.07)	(0.05)	(0.05)	(0.06)	(0.11)	(0.11)	(0.11)
Open	0.36**	-0.01	-0.05	0.33**	-0.05	0.05	0.69***	-0.06	-0.00
	(0.15)	(0.21)	(0.22)	(0.13)	(0.24)	(0.24)	(0.25)	(0.40)	(0.41)
Exports	-0.00	-0.01**	-0.01*	-0.00	-0.01*	-0.00	-0.00	-0.02**	-0.01
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Export		0.01**	0.01*		0.01**	0.01		0.02**	0.02*
*Open		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Log(pop)			-0.06			0.14***			0.08
			(0.06)			(0.04)			(0.08)
Polity2			0.03***			0.01			0.04**
			(0.01)			(0.01)			(0.02)
NRRents			-0.00			-0.01			-0.01
			(0.01)			(0.01)			(0.00)
Obs	2554	2554	2433	2554	2554	2433	2554	2554	2433
Countries	114	114	109	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.769	0.985		0.305	0.004		0.431	0.035
T.E incl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.496	0.502	0.506	0.593	0.602	0.629	0.608	0.617	0.624

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parenthesis. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Exports + (Export * Open)' equals zero.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Table 3.A9. Pooled OLS Results for Institutional quality (Equation 3.3)

	Corruption			Bureaucratic Quality			Composite Inst Quality		
Ind Var	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(YPC)	0.65***	0.65***	0.53***	0.68***	0.69***	0.63***	1.33***	1.33***	1.16***
	(0.07)	(0.07)	(0.07)	(0.05)	(0.05)	(0.06)	(0.11)	(0.11)	(0.11)
Open	0.36**	0.30	0.27	0.34**	0.07	0.18	0.70***	0.38	0.45
	(0.15)	(0.23)	(0.24)	(0.13)	(0.26)	(0.25)	(0.25)	(0.44)	(0.45)
Imports	-0.00	-0.00	-0.00	-0.00	-0.01	0.00	-0.00	-0.01	0.00
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Import		0.00	0.00		0.01	0.00		0.01	0.00
*Open		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Log(pop)			-0.04			0.15***			0.11
			(0.06)			(0.04)			(0.09)
Polity2			0.03***			0.01			0.04**
			(0.01)			(0.01)			(0.02)
NRRents			-0.01			-0.01			-0.02*
			(0.01)			(0.00)			(0.01)
Obs	2554	2554	2433	2554	2554	2433	2554	2554	2433
Countries	114	114	109	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.999	0.759		0.672	0.005		0.812	0.164
T.E incl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.496	0.496	0.501	0.593	0.597	0.625	0.608	0.609	0.618

Notes: A constant is included in all regressions but not included. Annual observations of the dependent variable are used from 1987-2008. The explanatory variables are lagged by three years. Robust standard errors clustered by countries reported in parenthesis. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Import + (Import * Open)' equals zero.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Table 3.A10. Pooled OLS Results for Composite Institutional Quality (Equations 3.4-3.6)

Indep Vars	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(YPC)	1.41***	1.43***	1.30***	1.40***	1.42***	1.28***	1.44***	1.44***	1.27***
	(0.12)	(0.11)	(0.12)	(0.11)	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)
Open	0.68**	0.07	0.25	0.59**	0.32	0.36	0.72**	0.64	0.43
	(0.28)	(0.41)	(0.40)	(0.28)	(0.35)	(0.35)	(0.30)	(0.40)	(0.37)
NatResTrd	-0.02*	-0.04***	-0.01						
	(0.01)	(0.02)	(0.02)						
Open *		0.04***	0.02						
NatResTrd		(0.02)	(0.02)						
NatResExp				-0.03**	-0.04***	-0.00			
				(0.01)	(0.02)	(0.02)			
Open *					0.03*	0.02			
NatResExp					(0.02)	(0.02)			
NatResImp							0.01	-0.01	-0.02
							(0.01)	(0.04)	(0.04)
Open*								0.02	0.038
NatResImp								(0.04)	(0.04)
Log(pop)			0.07			0.08			0.08
			(0.10)			(0.09)			(0.10)
Polity2			0.03*			0.04*			0.04*
			(0.02)			(0.02)			(0.02)
NRRents			-0.03***			-0.03***			-0.03**
			(0.01)			(0.01)			(0.01)
Obs	2026	2026	1950	2050	2050	1973	2083	2083	2000
Countries	112	112	107	114	114	109	114	114	109
'$\alpha_3 + \alpha_4 = 0$'		0.822	0.151		0.526	0.171		0.437	0.319
T.E included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.621	0.630	0.640	0.623	0.627	0.634	0.617	0.617	0.639

Notes: Annual observations are used from 1984-2008. Robust standard errors clustered by countries reported in parenthesis. The explanatory variables are lagged by three years. TE refers to the set of time dummies. The statistic reported for '$\alpha_3 + \alpha_4 = 0$' is the p-value of the F statistic testing that 'Trade + (Trade * Open) = 0' in columns (1)-(3), 'Export + (Export * Open) = 0' in columns (4)-(6), 'Import + (Import * Open)=0' in columns (7)-(9) respectively.

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Chapter 4: Corruption, Public Investment and Growth across Autocracies and Democracies

Abstract

This chapter examines the implications of institutional quality for public investment in fixed capital. The previous empirical literature has found mixed evidence regarding the contribution of public investment in fixed capital to economic growth. However, this literature has overlooked the possibility that institutional determinants potentially shape both the amount of public investment as well as its impact on growth. I hypothesize that the link between corruption and public investment (pointed out by anecdotal evidence and a relatively recent literature), and consequently the growth impact of public investment, fundamentally differs across autocratic and democratic regimes due to political economy considerations. The chapter presents empirical evidence based on a panel data analysis covering 87 countries, which suggests that corruption inflates public investment only in autocratic countries. It is also found that in autocratic countries public investment adversely affects the growth rate. The results point to the role of arbitrary and sub-optimal decision making regarding allocation of public funds in autocratic countries.

4.1 Introduction

The role of public investment in promoting economic growth remains a contentious issue. Investment in fixed capital by the government mainly consists of developing infrastructure and investing in state-owned enterprises. Public investment in infrastructure, in principle, helps increase overall investment while also enhancing the productivity of the private sector (Barro 1990, Chhiber et al 1992, Glomm and Revikumar 1994). Such large-scale infrastructure can often not be built by the private sector alone due to a divergence between private and social benefits. On the other hand, government spending can also crowd out the private sector by using up scarce resources and reducing the availability of credit for private firms. Also, state-owned enterprises may complement or compete with private firms, and there is evidence that private investment is more productive (Blejer and Khan 1984, Khan and Reinhart 1989, Chhiber et al 1992, Khan and Kumar 1997). Whether public investment helps or hurts economic growth is a question that, therefore, deserves further investigation.

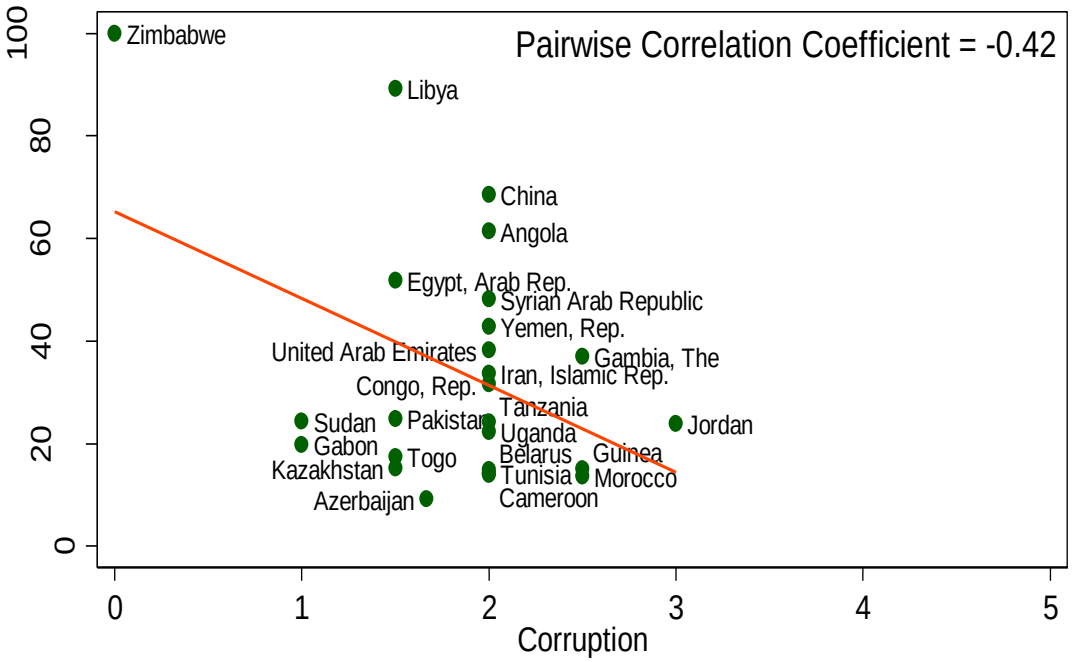
Other than the economic issue of complementing or crowding out the private sector, investment by the public sector in developing countries is especially susceptible to corruption and often dictated by political considerations. State-owned enterprises are frequently plagued by poor governance and used as a means of providing wide-scale employment or supporting selected constituencies by the government of the day (Khan and Kumar 1997, Huang and Snell 2003). Even the positive impact of public investment in infrastructure on growth is not straightforward. A number of studies, motivated by a plethora of anecdotal evidence, find that large scale investment in infrastructure is often driven by factors which are

not purely economic (Tanzi and Davoodi 1997, Pritchett 2000, Haque and Kneller 2012 etc). The proverbial bridges to nowhere and airports in the desert are conceived because of the potential for political corruption in large scale construction projects.

The existing empirical literature that tests for the impact of public investment on growth in developing countries provides mixed results (e.g. Aschauer 1989, Khan and Reinhart 1989, Barro 1991, Devarajan et al 1996, Khan and Kumar 1997, Devarajan et al 2003, Athukorala and Sen 2004, Erden and Holcombe 2005). The mixed evidence might simply be due to the varying country and time coverage employed by different studies. Or it could be that the quality and quantity of public investment interacts with the institutional environment present in a country – a possibility which has been relatively overlooked by the previous literature and merits a more detailed investigation especially in the context of developing countries. Even those empirical studies that postulate a link between corruption and public investment ignore the role of the nature of the political regime as an important determinant. Figure 4.1 shows a simple bivariate relation between public investment in fixed capital and corruption for a group of developing (non-OECD) countries with autocratic political regimes in the year 2005. Figure 4.2 presents the same relationship for a group of countries that are democratic in the same year.[46] The figures suggest that corruption affects public investment in very differing manners across autocratic and democratic countries.

[46] The year 2005 was chosen because of the availability of data for the maximum number of countries. The bivariate relationship shown in the figures remains similar in other years. The definitions of the variables and data sources, as well as the classification of countries as autocratic and democratic, are described in further detail in Section 4.4 of this chapter.

Figure 4.1 'Public Investment in Fixed Capital' against 'Corruption', in autocratic countries in the year 2005.

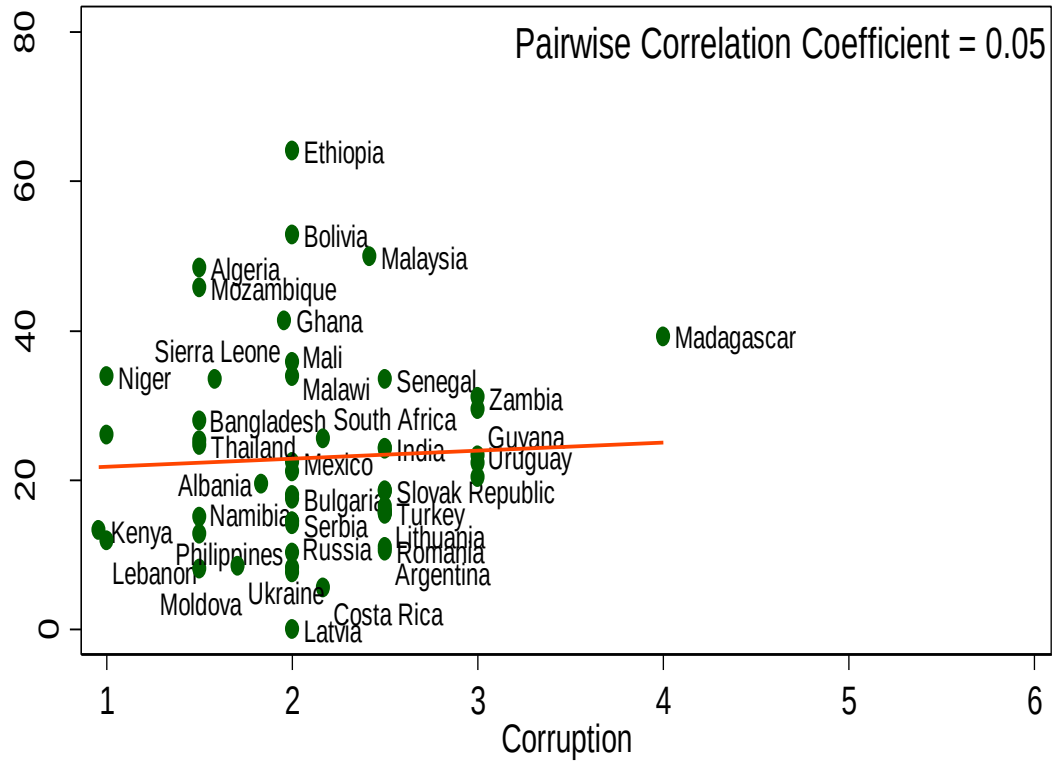


Notes:
Public investment in fixed capital is expressed as a percentage of total investment in fixed capital, and dervided from the World Development Indicators
Higher values of the corruptuion score represent lower corruption. It is devrived from the International Country Risk Guide
Classification of political regime is based on the Polity2 score provided by the PolityIV project. Autocratic countries have a Polity2 score less than zero

This chapter empirically examines the role of institutional quality in determining firstly the size and secondly the productivity (the impact on growth) of fixed capital investment by the public sector in developing (non-OECD) countries, while recognizing that the relationship between corruption and public investment might be non-linear. Specifically, based on a relatively recent strand of 'public choice' literature (Mohtadi and Roe 2003, Plumper and Martin 2003, Hausken et al 2004, Deacon 2009), it is hypothesized that the link between corruption and public investment, and subsequently public investment and growth, is dictated by political economy considerations. This hypothesis is incorporated into the modeling strategy through the

use of multiplicative interaction variables, as well as estimation of the postulated relationship separately for autocratic and democratic countries. Moreover, I use a larger sample of countries and a more recent time coverage for the cross-country econometric analysis compared to previous investigations.

Figure 4.2 'Public Investment in Fixed Capital' against 'Corruption', in democratic countries in the year 2005.



Notes:
Public investment in fixed capital is expressed as a percentage of total investment in fixed capital, and dervided from the World Development Indicators
Higher values of the corruptuion score represent lower corruption. It is devrived from the International Country Risk Guide
Classification of political regime is based on the Polity2 score provided by the PolityIV project. Democratic countries have a Polity2 score more than zero

Finally unlike previous work, this study identifies the relative size of public sector investment in fixed capital as a proportion of total investment in fixed capital,

rather than as a proportion of GDP, as the relevant measure for public investment in the model specification. This helps to abstract from the question of whether public investment crowds out or complements private investment, which is not the primary question here.[47]

The analysis draws upon various strands of the related literature which I survey in Section 4.2 in order to provide the analytical framework for the empirical analysis. Section 4.3 explains the model specification. Section 4.4 describes the variable construction and data sources. Section 4.5 discusses the estimation methodology. The descriptive statistics are presented in Section 4.6 and the estimation results discussed in Section 4.7. I conclude in Section 4.8 with a discussion and the policy implications of the study.

4.2 Literature Survey

4.2.1 Institutional Determinants of Public Investment

A great deal of anecdotal evidence, as well as earlier works investigating the growth impact of public investment hinted that corruption was a factor that inflates and misdirects investment by the government (e.g. Krueger and Orsmond 1989). Then in a seminal paper, Devarajan et al (1996) demonstrated that the capital component of

[47] Using this measure of public investment implies that I do not have to control for private investment in the model specification. In other words, I assume full crowding out. However, as a robustness check, public investment as a proportion of GDP is also used as a measure in the model specification.

public expenditure has a negative impact on per-capita growth in a sample of developing countries.[48] Their finding was in contrast to the conventional wisdom, which recommended allocating a higher share of the budget for public investment in developing countries.

Building on this important insight, Tanzi and Davoodi (1997) presented cross-country evidence that corruption inflates capital expenditure and lowers the quality of infrastructure. The authors argued that capital expenditure generates more rent-seeking opportunities for government officials compared to current expenditure. Investment in accumulating new capital or infrastructure involves larger amounts of money and more arbitrary decision-making compared to maintenance of existing capital and the operating expenses of the government. In fact, in many developing countries repair of existing infrastructure is neglected for precisely this reason. Haque and Kneller (2012) use a larger sample of countries and longer time coverage to simultaneously estimate equations for growth, corruption, and public investment. Their findings confirm that in countries with a higher incidence of corruption, the level of public investment is higher and its impact on growth is lower.

A recent strand of the 'public choice' literature incorporates political economy considerations to explain the link between corruption and public spending (Mohtadi and Roe 2003, Plumper and Martin 2003, Hausken et al 2004, Deacon 2009). Public spending is in the hands of the executive and the bureaucracy that acts as its agent. The control over the allocation of these public funds creates opportunities for rent-

[48] In contrast, the authors found that current expenditure had a positive impact on growth in the same sample of countries.

seeking. The pattern of rent-seeking in turn is a function of the nature of the political regime in terms of the power of the executive, and the relation between the executive and the bureaucracy.

There are at least two classes of theoretical models exploring the link between corruption in public spending and the nature of the political regime. The first is a framework that models the demand for rent-seeking (Mohtadi and Roe 2003). Rent seekers outside the government act as monopolistic competitors in order to appropriate a portion of funds earmarked for provision of public goods as rents, by bribing government functionaries. The mechanism through which the rent seekers are able to operate depends on the openness of the political regime.

In an autocratic regime, the number of rent seekers is restricted to the small elite who operate by bribing the executive which tightly controls the bureaucracy. As the regime becomes more democratic, the tight control of the executive over the bureaucracy weakens, allowing it to independently engage in rent-seeking, in effect decentralizing rent-seeking. Also, information about opportunities for rent-seeking becomes more readily available as does access to government functionaries. As the return to rent-seeking activity becomes higher, the number of rent seekers increases, driving up aggregate rents. As the regime evolves and becomes highly democratic, two separate mechanisms reduce aggregate rents. First, the rent-seeking becomes more and more competitive so that eventually average rents per individual (as well as aggregate rents) fall, making the activity less attractive. Also the probability of corrupt government officials being caught rises. Thus this model predicts that as an autocratic

regime becomes more politically open, corruption in public spending initially increases but then eventually falls as democracy matures.

The second class of theoretical models developed by Plumper and Martin (2003), Hausken et al (2004), and Deacon (2009) explain the supply side of rent-seeking. Both autocratic and democratic government seek to remain in power by assuring political support, and rely on public spending for this purpose. However, the manner in which public funds are employed as a means towards political survival depends on the nature of the political regime. An autocratic regime relies on the support of small elite or certain powerful groups. A democratic regime, in contrast, needs wider political support. A highly autocratic government can assure the support of its small constituency of power by doling out public funds as rents (as long as the general individual can be provided a certain minimum level of consumption which prevents a revolution). As the regime becomes democratic and political participation increases, it becomes increasingly expensive to give direct transfers. As the regime eventually transitions towards becoming highly democratic and political participation becomes widespread, popular support can only be assured through large scale provision of public services.

The first part of my empirical analysis, which examines the impact of corruption on public investment, incorporates the predictions of the two types of models that corruption in public spending is a function of a regime's political openness (authority characteristics). These models also suggest that the political economy considerations that drive rent-seeking in public funds are different in autocratic regimes compared to

those that are democratic. This insight is incorporated and tested by estimating the relationship separately for autocratic and democratic countries.

The point of departure of my analysis compared to the political economy literature discussed above (Mohtadi and Roe 2003, Plumper and Martin 2003, Hausken et al 2004, Deacon 2009) is that I focus on public investment in fixed capital, rather than public spending more broadly defined. This is because, as already discussed, funds allocated for investment or capital expenditure provide the most obvious opportunities for rent-seeking. In order to test this proposition, I also examine the association of corruption with government consumption expenditure, and compare with it with the association of corruption with public investment.

4.2.2 Growth Impact of Public Investment

Investment is the key determinant of growth in both neoclassical and endogenous models of growth (Solow 1956, Romer 1994). Whereas in the neoclassical framework investment contributes to growth simply through physical capital accumulation, in various endogenous growth models it also explains improvement in technology (Romer 1986 and 1990, Lucas 1988, Barro 1990, Grossman and Helpman 1990, and others). The essential difference in the two frameworks relates to the returns to capital. In the former the elasticity of output with respect to capital is less than one and in the latter it equals one.

In the neoclassical framework, total investment can simply be disaggregated into its private and public components (Khan and Reinhart 1989, Khan and Kumar 1997). In this context public investment neither competes with nor complements private investment and both kinds of capital exhibit diminishing returns. This leads to a

steady state growth path and sustained growth is explained by exogenous technological change. In contrast, the endogenous growth model developed by Barro (1990) incorporates government investment as provision of public services which enhance the productivity of private capital. If government spending is set at the optimum level, then private capital when combined with public services exhibits constant returns and generates sustained growth.

Therefore in both the theoretical formulations, public investment enters the production function. Therefore, regardless of whether the neoclassical or endogenous growth frameworks are assumed to be correct, the impact of public investment on growth can be analyzed using cross-country growth regressions, which are based on a log linearization around the steady state (Mankiw et al 1992, Barro and Sala-i-Martin 2004). The endogenous growth models merely predict the coefficient of initial income per capita to be zero in these regressions, as opposed to the neoclassical framework in which it is expected to be negative.

However, the large number of empirical studies investigating the link between public investment and growth using the cross-country growth regression framework provide extremely mixed results. Barro (1991) found that government consumption is negatively associated with growth in per capita income, while government investment does not have any statistical association. Devarajan et al (1996), and Ghosh and Gregoriou (2008), find that in developing countries current expenditure is positively related to growth while capital expenditure or public investment has a negative effect, which goes against conventional policy advice. In contrast, Easterly and Rebelo (1993) present cross country evidence that general government investment is robustly and

positively related with growth. In particular they demonstrate that public investment in transport and communication has an extremely significant impact on growth. Khan and Kumar (1997) also find a positive and statistically significant impact of public investment on growth, although lower than the impact of private investment, and also that it varies across regions and according to the level of development.

In all the empirical studies mentioned above, no account is taken of the fact that the growth impact of public investment potentially depends on institutional quality. Rajkumar and Swaroop (2008) show that the effectiveness of public spending in health and education depends on the quality of governance. Haque and Kneller (2012) let the growth impact of public investment depend on corruption using a simultaneous system of equations. However the growth model they specify includes public and private investment as a proportion of GDP separately, and therefore total investment is ignored, similar to the approach of Khan and Kumar (1997). I am interested in investigating the impact of public investment in fixed capital specifically, and not public investment as more broadly defined. Therefore total investment needs to be included in the empirical model if it is to be based on the theoretical models of growth. Then with investment as a proportion of GDP already included in the model, I consider public investment as a percentage of total investment in fixed capital (rather than as a proportion of GDP) as the relevant proxy for the relative size of public sector investment in infrastructure.[49]

[49] However, as a robustness check, I also report results using public investment as a proportion of GDP (*publicinv2*) in line with the previous empirical growth literature.

Moreover, corruption is not the only institutional quality variable that potentially affects the productivity of public investment. The political economy literature discussed in Section 4.2.1 suggests that the ways in which public funds are employed, and hence their impact on growth, depends on the nature of the political regime. Therefore in the growth regression framework, I consider political openness as an additional institutional determinant of the growth impact of public investment.[50]

4.3 Empirical Model

4.3.1 Institutional Determinants of Public Investment

For the first part of the analysis which investigates the institutional determinants of public investment in fixed capital, the following equations are estimated:

$$publicinv_{i,t} = \alpha_0 + \alpha_1 corr_{i,t-3} + \alpha_2 \log(ypc)_{i,t-3} + \alpha_3 inv_{i,t-3} + \alpha_4 indus_{i,t-3} + \alpha_5 urban_{i,t-3} + \alpha_6 open_{i,t} + \mu_i + \varepsilon_{i,t} \quad (4.1)$$

$$publicinv_{i,t} = \alpha_0 + \alpha_1 corr_{i,t-3} + \alpha_2 pol_{i,t-3} + \alpha_3 (corr * pol)_{i,t-3} + \alpha_4 \log(ypc)_{i,t-3} + \alpha_5 inv_{i,t-3} + \alpha_6 indus_{i,t-3} + \alpha_7 urban_{i,t-3} + \alpha_8 open_{i,t-3} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (4.2)$$

Where,

Subscripts i,t : country 'i' in year 't'.

[50] Similar to the first part of the empirical analysis, I also estimate the growth equations separately for autocratic and democratic countries, based on the insight that the political economy considerations in the use of public funds essentially differ across the two kinds of countries.

publicinv: Public sector fixed capital formation as a proportion of total fixed capital formation. It proxies for the relative size of public investment in infrastructure and state owned enterprises.

corr: Measures the level of corruption. Higher values represent lower corruption

pol: Measures openness of the political regime. Higher values represent more democracy.

corr * pol: A multiplicative interaction variable which represents the impact of corruption on public investment conditional on political openness.

log(ypc): The logarithm of real per capita GDP in purchasing power parity terms.

inv: Total investment as a proportion of GDP.

ind: Value added by the industrial sector as a proportion of GDP.

urban: The percentage of the population living in urban areas.

open: Total trade as a proportion of GDP.

β: A set of dummy variables for each year except for the first to capture time varying shocks that are common to all countries. These reflect global trends in the dependent variable.

μ: Country-specific and time-invariant fixed factors. Capture the invariant country characteristics correlated with both the dependent variable and the explanatory variables. These include geography, historical experience, legal origin, ethno-linguistic fragmentation and culture.

The right-hand side variables enter the model with a lag because fixed capital does not begin forming instantaneously (Deacon 2009).[51] The level of corruption is the main explanatory variable, and Equation (4.1) estimates its association with public investment while ignoring political economy considerations. Equation (4.2) incorporates the insight that the association of corruption with public investment depends on the openness of the political regime — '$\alpha_1 + \alpha_3 \, pol_{i,t-3}$' in Equation (4.2) is the estimated association of corruption with public investment as a function of political openness.[52]

The other variables (*ypc, inv, indus, urban* and *open*) are included in Equations (4.1)-(4.2) as control variables because these are possible determinants of public sector investment (while also plausibly being correlated with institutional quality). The size of the public sector in an economy is influenced by the level of development and the overall level of investment, and the extent of industrialization as predicted by the widely cited Wagner's Law (Sturm 2001, Hausken et al 2004). As a country develops

[51] I attempt different lag lengths, but increasing it to more than three years does not change the results to any significant degree. I use the minimum possible lag length in order to maximize the number of observations given the availability of the data over a relatively short time span — the time period of the analysis is discussed in Section 4.4.

[52] It has to be recognized that the coefficient α_3 can also be interpreted as the impact of political openness on public investment conditional on corruption, in contrast to the manner stated. This is true for any multiplicative interaction of two variables. However, the test for the statistical significance of the coefficients potentially provides guidance for interpreting the interaction variable in one way or the other. If for example α_1 and α_3 are separately as well as jointly significant while α_2 and α_3 are not, I consider it supportive of the interpretation I have used.

economically, and it becomes more industrialized, the demand for infrastructure (along with other public services) is expected to increase. The degree of urbanization can also be viewed in this light, in addition to being a control for population dependency (Sturm 2001, Haque and Kneller 2012). Countries that have a greater exposure to trade are also expected to possess larger public sectors (Rodrik 1998). At the same time all these variables have been shown to be correlated with the quality of institutions as well (e.g. Acemoglu et al 2008, Burke and Leigh 2010, Bhattacharya 2012). Thus these variables need to be controlled for in the model in order to minimize potential omitted variable bias.

The Equations (4.1) and (4.2) are also estimated separately for countries with autocratic regimes and democratic regimes, in addition to the entire sample together, based on the hypothesis that the political economy considerations which explain the relationship between corruption and public investment differ across autocratic and democratic countries. The validity of splitting the sample into the two sub-samples can be examined by relying on the Chow Test (Chow 1960, Burke 2012). This procedure tests whether the improvement in the fit of the estimated equation as a result of splitting the sample is statistically significant.

Finally, In addition to public investment in fixed capital, the Equations (4.1) and (4.2) are also estimated with the government consumption expenditure as a proportion of GDP (*govcons*) as an alternate dependent variable. This is done to make sure that the estimated coefficients are not capturing the association of the explanatory variables with overall government size, rather than public investment specifically; this allows testing for the premise that rent-seeking opportunities

primarily arise from public funds meant for infrastructure and investment in state owned enterprises.

4.3.2 Growth Impact of Public Investment

For the second part of the empirical analysis, the following cross-country growth equations are estimated:

$$gr_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-5} + \alpha_2\, inv_{i,t-5} + \alpha_3\, pop_{i,t-5} + \alpha_4\, publicinv_{i,t-5} + \beta_t + \mu_i + \varepsilon_{i,t} \quad (4.3)$$

$$gr_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-5} + \alpha_2\, inv_{i,t-5} + \alpha_3\, pop_{i,t-5} + \alpha_4\, open_{i,t-5} + \alpha_5\, publicinv_{i,t-5} + \alpha_6\, pol_{i,t-5} + \alpha_7\, (publicinv_{i,t-5} * pol_{i,t-5}) + \beta_t + \mu_i + \varepsilon_{i,t} \quad (4.4)$$

$$gr_{i,t} = \alpha_0 + \alpha_1 \log(ypc)_{i,t-5} + \alpha_2\, inv_{i,t-5} + \alpha_3\, pop_{i,t-5} + \alpha_4\, open_{i,t-5} + \alpha_5\, publicinv_{i,t-5} + \alpha_6\, corr_{i,t-5} + \alpha_7\, (publicinv_{i,t-5} * corr_{i,t-5}) + \beta_t + \mu_i + \varepsilon_{i,t} \quad (4.5)$$

where, in addition to the variables included in the previous analysis,

gr: Five year average of the growth of per capita Gross Domestic Product (GDP) from time t-4 to t.

pop: Annual population growth.

publicinv * pol: A multiplicative interaction term to test for the effect of political openness on the growth impact of the relative size of public investment in fixed capital.

publicinv * corr: A multiplicative interaction term to test for the effect of corruption on the growth impact of the relative size of public investment in fixed capital.

The dependent variable is the average growth of real GDP per capita from time t-4 to t.[53] Annual observations of this variable are used so the dependent variable is a forward moving average. Using a five year average counteracts against business cycle fluctuations, whereas a moving average substantially increases the number of observations in the sample (Devarajan et al 1996).[54] However I also re-estimate the baseline regression (Equation (4.3)) using observations of the variable occurring every five years (i.e. a five yearly panel), which is more standard in the empirical literature, and report the results as a robustness check.

The set of time dummies in the growth equation captures in particular the common productivity and technology shocks to all countries. Similarly, the country-specific effects specifically capture the differences in the initial level of technology or efficiency, in addition to the invariant country characteristics mentioned in the context of Equations (4.1)-(4.2) (Mankiw et al 1992, Bond et al 2001).

The explanatory variables enter the model with a five year lag to capture the medium term growth impact of these factors — the right-hand side variables can then be interpreted as initial values of these factors. The choice of a five year lag length is common in the empirical growth literature (Barro and Sala-i-Martin 2004).[55] Equation (4.3) is the baseline regression estimating the growth impact of *publicinv*, which is the

[53] It is calculated as the compound rate of growth over a five year period, by taking the geometric average of the annual rates of growth.

[54] As explained further in Section 4.5, the fixed effects regression technique does not estimate the growth equations consistently unless the number of time periods is large.

[55] Using a different length does not substantially change my estimation results.

main explanatory variable. The addition of the interaction variables in Equations (4.4) and (4.5) tests for the effect of institutional quality (political openness and corruption considered in turn) on the growth impact of *publicinv*. In addition to investment as a proportion of total investment in fixed capital (*publicinv*), I also estimate Equations (4.3)-(4.5) with public investment in fixed capital as a proportion of GDP (*publicinv2*) as an alternate explanatory variable. This allows verifying for the growth impact of public investment regardless of the way it is measured.

The variables 'initial per capita income' (*ypc*), 'annual population growth' (*pop*) and 'total investment' (*inv*) in Equations (4.3)-(4.5) are standard in growth regressions and derived from the neoclassical growth model (Barro and Sala-i-Martin 2004). The expected sign of the estimated coefficient of initial per capita income is negative as theory predicts the conditional convergence of per capita growth rates once other factors are kept constant. The expected sign for the coefficient of *inv* is positive and *pop* is negative.

Similar to Equations (4.1) and (4.2), Equations (4.3)-(4.5) are also estimated separately for countries with autocratic and democratic regimes, in addition to the entire sample together, again based on the premise that political economy considerations make the relationship between institutional quality, public investment and growth fundamentally different across the two types of countries.[56]

[56] Estimating the equation separately for the two groups is exactly equivalent to estimating a single equation, in which a binary variable (that separates the sample into two groups) is used to generate separate intercept and slope interaction variables – the approach employed in Chapter 3 of this thesis. Unlike in Chapter 3, I find the

4.4 Variable Construction and Data Sources

The dataset used for the first part of the empirical analysis, relating to the institutional determinants of public investment, covers a maximum of 87 countries over the time period 1988 to 2011. The time coverage is limited by the availability of data for corruption, which is only available from 1985 onwards. The second part of the empirical analysis, which investigates the growth impact of public investment, covers a maximum of 109 countries. The time coverage for estimating Equation (4.5), in which corruption is an explanatory variable, is limited to 1990-2011. However, for estimating Equations (4.3) and (4.4), which do not include corruption as a variable, the time coverage is expanded to the period 1970-2011. For both parts of the empirical analysis, the country coverage is dictated by availability of data for public investment.

The data source for all variables, except for measures of institutional quality and the real GDP per capita, is the World Bank's *World Development Indicators* (WDI) online database. Data provided by WDI is itself based on different underlying sources such as IMF's *Government Finance Statistics*, United Nation's *World Urbanization Prospects* and *World Population Prospects* and World Bank's *National Accounts Data* and *International Comparison Program*.

The measure for the main variable (public investment) is gross fixed capital formation by the public sector. WDI provides data for total fixed capital formation in

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approach of sample splitting preferable for presentation purposes here, because of the larger number of key variables (stemming from theory in the model) – a slope interaction variable would need to be generated for each of the variables in order to estimate separate coefficients for the two groups.

an economy and that by the private sector, which I use to obtain the variable *publicinv*.[57] This includes government construction of infrastructure such as roads, railways, land improvements, buildings etc and also plant, equipment and machinery purchases by the government.

The measure for corruption (*corr*) is from the *International Country Risk Guide* (ICRG) provided by the PRS group. This indicator is constructed on the basis of subjective assessment by experts. The data are primarily meant to be a guide for foreign investors but have been widely used in the empirical literature as well. The indicator is an assessment of not only direct financial corruption encountered by businesses in dealing with the government, but also political corruption such as "excessive patronage, nepotism, job reservations, favour-for-favours, secret party funding, and suspiciously close ties between politics and business" (ICRG 2008, page 31) . Thus it is a broad measure that represents the type of rent-seeking activities that influence public investment as pointed out by the political economy literature. The indicator runs on a discrete scale from 0 to 6 with higher values indicating less corruption.

The measure for political openness is an indicator provided by the *PolityIV* project run by Marshall et al (2010). The *PolityIV* project rates underlying authority characteristics of the political regime, namely 'competiveness and openness of executive recruitment, constraints on the executive, and competitiveness or regulation of political participation'. The scores assigned for these distinct elements are combined

[57] And similarly, also to obtain *publicinv2* as the alternate explanatory variable in Equations (4.3)-(4.5).

to form separate variables to measure both the degree of democracy (*democ*) and autocracy (*autoc*) of each regime. Both *democ* and *autoc* run on an 11 point scale[58], with higher absolute values representing a greater extent of democracy and autocracy respectively. For an empirical analysis these two variables can be added together to form a combined variable called *Polity2* (*pol*) that runs from -10 (most autocratic) to 10 (most democratic). I use this variable to measure the openness of political regimes. For the purpose of splitting the sample, I classify countries as democratic if the *pol* score is above 0, and as autocratic otherwise.

The institutional quality measures are subjective indicators unlike the economic variables, as there is no objective way to measure abstract characteristics such as corruption and democracy. Despite the possible bias involved in constructing subjective indicators, both the data sources have been widely used to carry out empirical analysis concerning institutions. Also, the fact that these indicators are purchased widely by investors to judge the institutional environment of a country shows a revealed preference for this data.

WDI provides data for annual percentage changes of GDP per capita based on constant price local currency units, which I use to obtain the five yearly average rate of growth (*gr*). GDP per capita (*ypc*) is measured in constant year 2000 US dollars and is in purchasing power parity terms.[59] The measure for total investment (*inv*) is gross capital formation as a proportion of GDP; it consists of not only outlays on fixed assets in an economy but also net changes in inventories. Value added by industry as a proportion

[58] *Democ* varies from 0 to 10 for and *autoc* runs from 0 to -10.

[59] This data is obtained from *Penn World Tables* (PWT 7.0) of Heston et al (2011).

of GDP (*indus*) refers to the ISIC divisions 10-45 and incorporates the subgroups mining, manufacturing, construction, electricity, water and gas. Total trade (*open*) is the sum of exports and imports of goods and services as a proportion of GDP. Annual population growth (*pop*) is based on mid-year de-facto population — it includes immigrants. The alternate dependent variable used in Equations (4.1) and (4.2) is the consumption share of government as a proportion of GDP (*govcons*), which only consists of current expenditures by the government and does not include any capital formation.

4.5 Estimation Strategy

For the purpose of estimating Equations (4.1)-(4.5), I employ the fixed effects estimation technique, which is widely used in cross-country empirical analysis. The reason for the suitability and popularity of the technique for empirical analysis of this sort is because it provides consistent estimates for the coefficients even when the country-specific and time-invariant factors are correlated with the set of explanatory variables. Fixed factors such as geography and historical experience are thought to be related with not only economic variables but also institutional quality (Acemoglu et al 2001, 2005, 2008). In contrast, the random effects estimation technique makes the unrealistic assumption that the country-specific fixed factors are not correlated with any of the right-hand side variables. I formally test for this assumption using a robust

version of the Hausman test.[60] As suspected, for each of the equations the test strongly rejected the null hypothesis that random effects provide consistent estimates of the coefficients.

While the fixed country-specific factors and the control variables mitigate the possible omitted variable bias which leads to inconsistent estimation, there is still a concern over the endogeneity bias arising from reverse causality. For example, with regard to Equations (4.1)-(4.2), a higher level of public sector investment could lead to more opportunities for corruption or influence the authority characteristics of the political regime. Or with reference to Equations (4.3)-(4.5) it is quite possible that the growth rate of per capita GDP influences the size of public sector investment. Thus, although fixed effects estimation allows us to isolate the within-country association between the explanatory variables and the dependent variable, it does not establish a causal relationship. Ideally, I need instrumental variables that are correlated with the right-hand side variables while not affecting public investment through any other channel in Equations (4.1) and (4.2) (uncorrelated with the idiosyncratic error term). This is especially difficult for institutional quality variables and thus is beyond the scope of the current study.[61] However, it can be reasonably argued that through the use of lagged explanatory variables the possibility of reverse causality is minimized. For the lagged explanatory variables to be endogenous, some factor not captured by the

[60] Unlike the standard version, the robust version of the test does not assume that the random effects estimator is efficient and instead uses cluster (country) robust standard errors to calculate the chi-squared test statistic (Cameron and Trivedi 2010).

[61] Exogenous shocks are more likely to be valid instruments for changes in output rather than for institutional quality (e.g. Burke 2012).

set of control variables or the fixed country effects would have to influence public investment three years ahead, while also being correlated with the explanatory variables in the initial period. Even though not impossible, it is not immediately obvious either.

For the second part of the empirical analysis pertaining to the examination of the growth impact of public investment, there is another source of endogeneity bias. The logarithm of initial GDP per capita on the right-hand side of a growth regression is equivalent to the lagged dependent variable (Bond et al 2001). It is well known that the fixed effects regression technique does not consistently estimate an equation that includes the lagged dependent variable as an explanatory variable.[62] The size of the bias, however, becomes smaller as the number of time periods increases (Nickell 1981, Wooldridge 2002). Thus I use observations occurring annually when using fixed effects to estimate Equations (4.3) to (4.5) in order to maximize the number of time periods.

The presence of the lagged dependent variable on the right-hand side of the growth regressions allows me to rely on the system generalized method of moments (system GMM) estimation technique to further address endogeneity concerns.[63] The system GMM technique provides consistent estimates even when the explanatory variables are endogenous or weakly exogenous (correlated with past error terms only).

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[62] This is because the lagged dependent variable on the right-hand side is correlated with the error term after the equation is demeaned to purge the fixed effects.

[63] The System GMM estimation technique developed by Arellano and Bover (1995) and Blundell and Bond (1998), is popularly used in the empirical literature to consistently estimate an equation that contains the lagged dependent variable as an explanatory variable.

When the right-hand side variables enter the econometric specification with a lag as in my model, the less restrictive restriction of weak exogeneity allows the explanatory variables to be endogenous (correlated with the contemporaneous error term). The estimation technique generates a set of internal instruments uncorrelated with the error term. This set consists of the appropriate number of lags of the right-hand side variables as instruments in the differenced version of the original equation, and the first differences (and the appropriate number of lagged first differences) as instruments in the original level equation.

The validity of the instrument set can be tested through a Hansen test of over-identifying restrictions. Under the null of this test the residuals are un-correlated with the set of instruments. Thus if the instrument set is found to be exogenous, we are able to establish a causal relationship between the explanatory variables and the dependent variable. However the Hansen test is weakened if the set of instruments is relatively large compared to the number of observations due to an over-fitting bias (Roodman 2009b). For this reason I am only able to estimate Equation (4.3) through system GMM; the additional variables in Equations (4.4) and (4.5) cause rapid instrument proliferation.

Lastly, in estimating Equation (4.3) through system GMM, I use observations occurring every five years from 1970 to 2010 (i.e. using a five yearly panel), so that the number of time periods in the panel is nine. This System GMM technique works best for small T (time interval) and large N (countries) samples (Roodman 2009a, Jayasuriya and Burke 2013).

4.6 Descriptive Statistics

Table 4.A1 in the appendix of this chapter reports the descriptive statistics including the means, standard deviations, maximums, minimums, numbers of observations and countries, for all the variables used in the empirical analysis. The sample consists of developing (non-OECD) countries at varying stages of development. Even with the OECD countries excluded, all the economic variables as well as the institutional quality measures show a substantial variation. For example, the real GDP per capita in purchasing power parity terms varies from a minimum of 250 US dollars to a maximum of 70,000 US dollars. Public investment as a proportion of GDP ranges from close to 1 percent up to 43 percent. Public investment as a proportion of total investment in fixed capital ranges from 1 to 98 percent. Similarly, the institutional quality scores for the countries in the sample vary across the entire range of these indicators.

Tables 4.A2 and 4.A3 present these statistics separately for the sample of countries with autocratic and democratic regimes. The main economic variables (real GDP per capita, growth, investment, and public investment) display a larger variation as indicated by their standard deviation for the sample of autocratic countries. Further comparison between the two sets of countries reveals some interesting insights.

Democratic countries are on average more prosperous during the time period of this study — average real GDP per capita is 800 international dollars higher. This is despite the fact that OECD countries (which are all democratic) are excluded and the maximum real GDP per capita for the democratic countries in the sample is only 18,000 international dollars compared to a maximum of 70,000 for autocratic

countries. Similarly, the mean of annual growth rate for democratic countries is 0.5 percent higher than autocratic countries.

However, the mean of total investment as a proportion of GDP is almost the same for the two types of countries. In contrast, the level of public investment in democratic countries on average is significantly lower than in autocratic countries – as a proportion of GDP it is one and a half percentage points lower and as a proportion of total investment in fixed capital it is 8 percentage points lower. The share of government consumption expenditure as a proportion of GDP on average is also slightly lower (less than one percentage point) in democratic countries

For the other variables as well, democratic countries on average 'perform better'. The mean of the corruption score for democratic countries is 0.2 points or 3.33 percentage points (=0.2/6 *100) greater.[64] The mean of population growth is 0.7 percent lower, the trade to GDP ratio is 5 percentage points greater and tax collected as a proportion of GDP is 2 percentage points higher. The proportion of population living in urban areas is on average 6 percentage points higher. Surprisingly the industrial share of GDP is on average 2 percentage points lower for democratic countries.

[64] Here and henceforth a percentage point is defined as the change as a proportion of its total range of the variable.

4.7 Estimations Results

4.7.1 Institutional Determinants of Public Investment

The fixed effects regression results for Equations (4.1) and (4.2), pertaining to the institutional determinants of public investment in fixed capital (*publicinv*), are presented in Table 4.1. The results are reported for the entire sample (in Columns 1 and 2), as well as separately for autocratic countries (in Columns 3 and 4) and democratic countries (in Columns 5 and 6). The p-value of the Chow test statistic indicates the validity of splitting the sample.

The first regression for each of the estimation samples (Columns 1, 3 and 5) corresponds to Equation (4.1), which does not include political openness (*pol*) as an explanatory variable. The main explanatory variable in these columns is corruption (*corr*)[65]. The next column for each estimation sample (Columns 2, 4 and 6) reports the regression results for Equation (4.2), which adds political openness and its interaction with corruption (i.e. *corr* * *pol*) into the model. These regressions show the association of corruption with *publicinv* as a function of political openness. Comparing the results of the two sets of regressions illustrates the importance of the nature of the political regime in determining the impact of corruption on public investment.

The results for the entire sample (reported in the first two Columns of Table 4.1) do not demonstrate any relationship of corruption with *publicinv* at a reasonable level of statistical significance — neither as the sole institutional variable (in Equation 4.1) nor as a function of political openness (in Equation 4.2). These regressions explain

[65] As a reminder, higher values of the variable represent lower corruption.

less than 10 percent of the within-country variation in *publicinv* as indicated by the R^2 (within). However, the p-value of the Chow test statistic indicates that a significant improvement in fit is achieved by estimating Equations (4.1) and (4.2) separately for autocratic and democratic countries, justifying the approach of sample splitting.

Following the splitting of the sample, interesting results emerge for the group of autocratic countries. The regressions in Columns (3) and (4) of the table reveal that corruption is positively associated with public investment in the sample of autocratic countries, but only when the impact of corruption is considered as a function of political openness. Column (3) indicates that corruption has no statistically significant relation with *publicinv* when political openness is not taken into account, similar to the results for the entire sample. However once political openness (*pol*) and its interaction with corruption (i.e. *pol *corr*) are added to the specification (in Column 4 to represent Equation 4.2), it is found that corruption explains public investment in fixed capital at the one percent level of significance. Both the variables added to the specification in Column (4) are jointly significant at the one percent level.

The estimated coefficient of corruption in Column (4) indicates that an improvement of one standard deviation in the corruption score is associated with an almost four percentage points lower *publicinv*.[66] To put this into perspective, if Pakistan reduced corruption to the level prevalent in India in the year 2008 (i.e. improved the corruption score from 2 to 2.5) keeping everything else constant, its

[66] This calculation employs the estimated coefficient of corruption in Column (4) and the standard deviation of corruption (listed in Table 4.A2) for the autocratic group of countries.

publicinv is predicted to fall by 2 percentage points.[67] Moreover, the coefficient of the interaction variable is also significant at the five percent level; it indicates that the negative association of a standard deviation improvement in the corruption score on *publicinv* is enhanced by half a percentage point, when the political openness score increases by one point (or 5 percentage points). The rationale for interpreting the interaction variable as I have done, rather than as the association of political openness with public investment (conditional on corruption), is based on the statistical significance of the coefficient of political openness – the association of political openness with public investment is estimated at a very low level of statistical significance.

For the group of democratic countries, corruption shows no statistically significant association with public investment (Columns 5 and 6). Compared to autocratic countries, for democratic countries a lesser extent of the within-country variation in *publicinv* is explained by the regressions. Even adding political openness and its interaction with corruption makes no noticeable difference to the results. In fact, the institutional quality variables are not even jointly significant at a reasonable level of statistical significance, indicating that for democratic countries institutional quality does not determine public investment.

[67] The actual difference in *publicinv* between the two countries in 2008 is 1.3 percentage points.

Table 4.1 Fixed Effects Regression Results for Public Investment in fixed capital (as a proportion of total investment in fixed capital)

	Entire Sample		Autocratic Countries		Democratic Countries	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Corr	-1.334	-1.315	-0.547	-4.184***	-0.414	0.316
	(0.936)	(0.937)	(1.587)	(1.546)	(0.958)	(1.077)
Pol		-0.027		0.632		0.670*
		(0.379)		(0.562)		(0.336)
Pol * Corr		-0.044		-0.584**		-0.226
		(0.123)		(0.222)		(0.141)
Log(ypc)	0.854	0.546	3.824	3.380	21.901***	21.214***
	(5.595)	(5.678)	(6.394)	(6.762)	(6.629)	(6.566)
Inv	-0.267**	-0.269**	0.011	0.047	-0.475***	-0.499***
	(0.132)	(0.132)	(0.159)	(0.141)	(0.137)	(0.143)
Indus	0.442**	0.433**	0.664***	0.654***	0.250	0.254
	(0.168)	(0.170)	(0.212)	(0.198)	(0.304)	(0.289)
Open	0.047	0.050	0.025	0.018	0.038	0.029
	(0.052)	(0.053)	(0.103)	(0.096)	(0.058)	(0.058)
Urban	0.067	0.061	0.731	0.879*	0.106	0.083
	(0.352)	(0.352)	(0.463)	(0.478)	(0.286)	(0.289)
Countries	88	88	51	51	72	72
Observations	1521	1521	592	592	929	929
Chow Test	0.001	0.001				
'α_1=0,α_2=0, α_3=0'		0.415		0.002		0.264
'α_1=0,α_3=0'		0.321		0.014		0.255
'α_2=0,α_3=0'		0.782		0.002		0.141
T.E. Included	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.640	0.640	0.700	0.712	0.718	0.720
R^2(within)	0.095	0.096	0.173	0.207	0.127	0.133
R^2(between)	0.008	0.027	0.000	0.000	0.083	0.083

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1988-2011. The explanatory variables are lagged by three years. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. The statistic reported for the Chow Test is the p-value of the F statistic testing the null hypothesis that the set of estimated coefficients for the sample of autocratic countries is statistically the same as that for the sample of democratic countries. α_1 is the coefficient of *corr*, α_2 is the coefficient of *pol* and α_3 is the coefficient of *corr*pol* — the statistics reported for the test of joint significance of the coefficients is the p-value of the F statistic. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Table 4.2. Fixed Effects Regression Results for Government Consumption (as a proportion of GDP)

	Entire Sample		Autocratic Countries		Democratic Countries	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Corr	0.425**	0.430**	0.171	0.876*	0.702**	0.967***
	(0.203)	(0.204)	(0.356)	(0.481)	(0.271)	(0.336)
Pol		-0.016		-0.225		0.042
		(0.078)		(0.153)		(0.084)
Pol * Corr		-0.007		0.117**		-0.058
		(0.025)		(0.057)		(0.038)
Log(ypc)	1.765*	1.678	4.248**	3.976**	1.966	1.592
	(1.080)	(1.101)	(1.607)	(1.481)	(1.949)	(1.938)
Inv	0.027	0.027	0.139***	0.132***	-0.027	-0.029
	(0.028)	(0.028)	(0.040)	(0.039)	(0.025)	(0.026)
Indus	-0.038	-0.041	-0.017	-0.015	0.000	-0.014
	(0.051)	(0.050)	(0.056)	(0.055)	(0.060)	(0.058)
Open	0.002	0.002	-0.064***	-0.062***	0.027**	0.027**
	(0.013)	(0.013)	(0.022)	(0.022)	(0.012)	(0.012)
Urban	-0.216**	-0.217**	-0.416***	-0.441***	-0.035	-0.043
	(0.102)	(0.102)	(0.154)	(0.152)	(0.086)	(0.084)
Countries	88	88	51	51	82	82
Observations	1517	1517	588	588	929	929
Chow Test	0.293	0.082				
'α_1=0,α_2=0, α_3=0'		0.143		0.175		0.027
'α_1=0,α_3=0'		0.096		0.113		0.019
'α_2=0,α_3=0'		0.674		0.090		0.089
T.E. Included	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.759	0.760	0.819	0.823	0.798	0.804
R^2(within)	0.105	0.107	0.343	0.355	0.103	0.127
R^2(between)	0.001	0.001	0.068	0.070	0.103	0.114

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1988-2011. The explanatory variables are lagged by three years. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. The statistic reported for the Chow Test is the p-value of the F statistic testing the null hypothesis that the set of estimated coefficients for the sample of autocratic countries is statistically the same as that for the sample of democratic countries. α_1 is the coefficient of *corr*, α_2 is the coefficient of *pol* and α_3 is the coefficient of *corr*pol* — the statistics reported for the test of joint significance of the coefficients is the p-value of the F statistic. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

As a side-note, the set of control variables also explain *publicinv* differently across autocratic and democratic countries. For autocratic countries, the only variable other than corruption that explains *publicinv* is the level of industrialization. It is positively associated with public investment at a high level of statistical significance (one percent level). For democratic countries the only variables to explain public investment are GDP per capita (positively associated with *publicinv*) and the level of overall investment as a proportion of GDP (negatively associated with *publicinv*).

For the purpose of comparison, I also report (in Table 4.2) the regression results for Equations (4.1) and (4.2) with government consumption expenditure as a proportion of GDP (*govcons*) replacing *publicinv* as the dependent variable.[68] This is done to check that corruption enhances only public investment in fixed capital, rather than the overall size of the government. The results are consistent with this hypothesis.

For the group of autocratic countries, in contrast to *publicinv*, improved corruption scores are positively associated with government consumption expenditure, however only when considered as a function of political openness (in Column 4). Moreover, the positive association is enhanced, as an autocratic country becomes more politically open as indicated by the estimated coefficient of the interaction variable (i.e. *pol* * *corr*). The relationship between corruption and public investment is similar for the group of democratic countries, regardless of whether the impact of corruption is considered as a function of political openness or not. In this

[68] Note that the sample of countries remains the same in both Table 4.1 and Table 4.2, in order to make a valid comparison.

case adding political openness and the interaction variable to the specification only increases the magnitude and the statistical significance of the positive coefficient for corruption slightly.

With regards to the other variables, for the sample of autocratic countries, now four other variables also explain *govcons* at a high level of statistical significance (one percent or five percent). In these countries, GDP per capita and overall investment (*inv*) are positively associated with government consumption. On the other hand the proportion of trade to GDP (*open*) and the level of urbanisation (*urban*) are negatively associated with *govcons*. For the group of democratic countries, other than corruption, the only variable associated with *govcons* at a reasonable level of significance is *open* (the association is positive).

Thus the comparison suggests that the determinants of government consumption expenditure noticeably differ from the determinants of public investment in fixed capital. The extent of within-country variation (as indicated by the within R^2) in *govcons* that is explained by the regressions is much higher compared to *publicinv* for the group of autocratic countries. For democratic countries, however, the within-country variation in *govcons* explained by the regressions remains roughly similar to the regressions for *publicinv*.

4.7.2 Growth Impact of Public Investment

The regression analysis investigating the growth impact of public investment is presented in this sub section. My preferred measure of public investment is *publicinv* (public investment in fixed capital as a proportion of total investment in fixed capital) based on the discussion in Sections 4.2 and 4.3. However as a robustness check, the

results using *publicinv2* (public investment in fixed capital as a proportion of GDP), following the previous empirical growth literature, are also reported and discussed alongside.

Table 4.3 reports the fixed effects results for the entire sample with *publicinv* as the explanatory variable.[69] The first column in this table corresponds to Equation (4.3), which is the baseline specification and does not include the institutional quality variables. The second column represents Equation (4.4), in which political openness and its interaction with public investment (i.e. *pol* * *publicinv*) are added to the specification. The third column corresponds to Equation (4.5), in which corruption (and its interaction with *publicinv*) rather than political openness is the institutional quality variable added to the baseline specification. The results in the table indicate that *publicinv* is not associated with growth at any reasonable level of statistical significance in any of the specifications, neither by itself nor as a function of institutional quality variables. However, the p-value of the Chow test statistic shows that a significant improvement in fit is achieved by estimating Equations (4.3) and (4.4) separately for the sample of autocratic and democratic countries. However, with corruption as the institutional quality variable, the Chow Test provides no reason to split the sample.

[69] As a reminder, the fixed effects analysis is carried out using annual data, with the five year (forward moving) average growth rate of GDP as the dependent variable

Table 4.3. Fixed Effects Regression Results for Annual Growth$_t$ (Entire Sample)
(using Public Investment as a proportion of Total Investment in Fixed Capital as the explanatory variable)

Independent Variables	(1)	(2)	(3)
$log(ypc)_{t-5}$	-3.493***	-3.451***	-5.718***
	(0.809)	(0.826)	(0.964)
inv_{t-5}	0.196***	0.197***	0.176***
	(0.303)	(0.031)	(0.038)
pop_{t-5}	0.015	0.040	0.012
	(0.141)	(0.130)	(0.217)
$publicinv_{t-5}$	-0.012	-0.010	-0.001
		(0.007)	(0.016)
pol_{t-5}		-0.024	
		(0.045)	
$(publicinv * pol)_{t-5}$		0.000	
		(0.001)	
cor_{t-5}			0.120
			(0.351)
$(publicinv * cor)_{t-5}$			-0.001
			(0.007)
Countries	109	107	88
Observations	2233	2214	1516
Chow Test	0.082	0.079	0.293
'α_4 =0, α_5 = 0, α_6=0'		0.454	0.966
'α_4=0, α_6= 0'		0.370	0.955
'α_5 =0, α_6 = 0'		0.868	0.896
T.E Included	Yes	Yes	Yes
R^2	0.631	0.634	0.696
R^2(within)	0.346	0.347	0.501
R^2(between)	0.019	0.018	0.001

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1970-2011 in Columns (1) and (2), and from 1990-2011 in Column (3). The dependent variable is a moving average of the growth rate from year t-4 to t. The explanatory variables are lagged by five years. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. The statistic reported for the Chow Test is the p-value of the F statistic testing the null hypothesis that the set of estimated coefficients for the sample of autocratic countries is statistically the same as that for the sample of democratic countries. α_4 is the coefficient of *publicinv*, α_5 is the coefficient of *pol* in Column (2) and *corr* in Column (3), and α_6 is the coefficient of the interaction variable — the statistics reported for the joint significance of coefficients is the p-value of the F statistic. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Table 4.4. Fixed Effects Regression Results for Annual Growth$_t$
(using Public Investment as a proportion of Total Investment in Fixed Capital as the explanatory variable)

	Autocratic Countries		Democratic Countries	
Independent Variables	(1)	(2)	(3)	(4)
log(ypc)$_{t-5}$	-2.454**	-2.315**	-6.419***	-6.500***
	(1.223)	(1.170)	(0.915)	(0.926)
inv$_{t-5}$	0.223***	0.225***	0.152***	0.149***
	(0.038	(0.038)	(0.048)	(0.048)
pop$_{t-5}$	0.034	0.067	-0.052	-0.009
	(0.149)	(0.131)	(0.239)	(0.233)
Publicinv$_{t-5}$	-0.037***	-0.019*	-0.003	0.001
	(0.011)	(0.010)	(0.012)	(0.013)
pol$_{t-5}$		-0.122		0.052
		(0.082)		(0.062)
(publicinv 2* pol)$_{t-5}$		0.003*		-0.001
		(0.002)		(0.001)
Countries	75	75	81	79
Observations	1033	1031	1200	1183
'α_4 =0, α_5 = 0, α_6=0'		0.007		0.709
'α_4=0, α_6= 0'		0.002		0.553
'α_5 =0, α_6 = 0'		0.149		0.530
T.E Included	Yes	Yes	Yes	Yes
R^2	0.689	0.696	0.697	0.697
R^2(within)	0.374	0.382	0.466	0.468
R^2(between)	0.212	0.222	0.048	0.048

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1970-2011 in columns (1) and (2), and from 1990-2011 in column (3). The dependent variable is a moving average of the growth rate from year t-4 to t. The explanatory variables are lagged by three years. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. α_4 is the coefficient of *publicinv*, α_5 is the coefficient of *pol* , and α_6 is the coefficient of the interaction variable — the statistics reported for the joint significance of the coefficients is the p-value of the F statistic. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Therefore, Table 4.4 then reports the regression results for Equations (4.3) and (4.4), separately for the sample of autocratic countries (in Columns 1 and 2 respectively) and for the democratic countries (in Columns 3 and 4 respectively). *Publicinv* is negatively associated with annual growth only for the sample of autocratic countries at a reasonable level of significance. Comparing across Columns (1) and (3) (i.e. in the baseline regressions), the estimated coefficients for *publicinv* for the sample of autocratic and democratic countries do no overlap within one standard error band; therefore the association of *publicinv* with growth is statistically different across the groups at the ten percent level of significance. Column (1) indicates that an increase of 1 percentage point in *publicinv* is associated with a reduction of 0.04 percent in average growth.

Once political openness and its interaction with *publicinv* (i.e. *publicinv* * *pol*) is added to the baseline specification, it is again found that public investment only impacts growth in autocratic countries, although the negative association is mitigated as the level of political openness increases (as indicated by the coefficient of the interaction variable).[70] The coefficient of the interaction variable indicates that as the score for political openness increases by 1 point (or 5 percentage points), the estimated negative growth impact of *publicinv* is reduced by almost 15 percent.[71] For the sample of democratic countries there is no evidence of such a relationship.

[70] Support for interpreting the coefficient of the interaction variable in the manner that I have done is provided by the statistical significance of the coefficients.

[71] This calculation is based on the estimated coefficients of *publicinv* and *publicinv* * *pol* in Column (2).

These growth regressions also demonstrate another interesting contrast between the two groups of countries. The coefficient of initial GDP per capita is estimated with a high degree of statistical precision (it is significant at the one percent level) and has a negative sign, in line with the neoclassical theories of growth, for both groups of countries. However, the magnitude of the coefficient is significantly higher for democratic countries[72], suggesting that there is greater conditional convergence amongst this group. The coefficient for investment is also estimated at a high level of significance for both groups, however it does not statistically differ across the two groups at the ten percent level.

When *publicinv2* (public investment in fixed capital as a proportion of GDP) is used as the measure of public investment, the regression results remain qualitatively the same, and in fact become slightly stronger in terms of statistical precision: compare Table 4.A4 with Table 4.3, and Table 4.A6 with Table 4.4. Columns (1) and (2) of Table 4.A4 indicate that *publicinv2* is negatively associated with growth even for the entire sample.[73] An increase of 1 percentage point in *publicinv2* is associated with a reduction of slightly less than 0.1 percent in the average rate of growth. A similar result is not portrayed in Column (3), most likely because the time coverage of the regressions that include *corr* is relatively curtailed. The p-value of the Chow test statistic supports estimating Equations (4.3) and (4.4) separately for the sample of autocratic and democratic countries. Table 4.A5 reports the results after the sample

[72] The coefficients do not overlap within one standard error band.

[73] Recall that *publicinv* was not found to be negatively associated with growth in Table 4.3

splitting. In line with the results in Table 4.4, public investment is adversely associated with growth only in autocratic countries at a high level of statistical significance (five percent level). Also similar to previously, an increase in political openness mitigates the negative impact. However, now there is a strong evidence of convergence only amongst democratic countries, and not amongst autocratic countries.[74]

Finally I report the system GMM results for the regression of Equation (4.3) using a five yearly panel (observations occurring every five years rather than annually).[75] The estimated coefficient of public investment now represents the strict causal impact of public investment on growth. Table 4.5 reports the results for the entire sample (in Column 1), as well as the sample of autocratic countries (Column 2) and democratic countries (Column 3), with *publicinv* as the measure of public investment. Table 4.A6 instead reports the regression results using *publicinv2* as the measure of public investment. The diagnostics indicate that the equation has been adequately estimated. The p-value of the Hansen test for over-identifying restrictions shows that we cannot reject the null hypothesis pertaining to the validity of the instrument set at the ten percent level of significance. Also, the estimation does not likely suffer from an over-fitting bias (caused by over-instrumentation) as the p-value associated with the test statistic is not unrealistically high (Roodman 2009b). The p-value of the AR(2) test indicates that we cannot reject the null hypothesis of no second

[74] In fact the estimated coefficients of initial GDP per capita across the two set of countries do not overlap within two standard error bands.

[75] As discussed in Section 4.5, I do not estimate Equations (4.4) and (4.5) using this technique because of the instrument proliferation and weak diagnostics that result from the additional variables in the specification.

order serial correlation, which is a necessary assumption for consistent estimation using system GMM.

Table 4.5. System GMM Results for $Growth_t$
(using Public Investment as a proportion of Total Investment in Fixed Capital as the explanatory variable)

	Entire Sample	Autocratic Countries	Democratic Countries
Independent Variables	(1)	(2)	(3)
$log(ypc)_{t-5}$	-1.088***	-1.330**	-0.223
	(0.427)	(0.531)	(0.438)
inv_{t-5}	0.206***	0.239***	0.205***
	(0.054)	(0.062)	(0.061)
pop_{t-5}	-1.772***	-1.152***	-1.017***
	(0.338)	(0.293)	(0.319)
$publicinv_{t-5}$	-0.031**	-0.048***	0.004
	(0.015)	(0.017)	(0.029)
Countries	109	63	79
Observations	464	204	260
Chow Test	0.000		
T.E Included	Yes	Yes	Yes
Instruments	77	75	72
Hansen J Test p-value	0.293	0.715	0.632
AR(2) Test p-value	0.696	0.299	0.320
Wald chi-sq statistic	91.34	81.17	171.71
Wald chi-sq p-value	0.00	0.00	0.00

Notes: A constant is included in all regressions but not reported. Observations of the dependent variable at five year intervals are used from 1970-2010, thus the number of time periods in the panel is equal to nine. The dependent variable is the average of growth rate from t-4 to t. All explanatory variables are treated as endogenous and instrumented by 1 lag. Windmeijer-Corrected robust standard errors from the two-step GMM estimation are shown in parenthesis. Orthogonal forward deviations are used to purge fixed effects. TE refers to the set of time dummies. The statistic reported for the Chow Test is the p-value of the F statistic testing the null hypothesis that the set of estimated coefficients for the sample of autocratic countries is statistically the same as that of the sample of democratic countries.
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

The results presented in Table 4.5 are consistent with the fixed effects regressions results. The estimated impact of *publicinv* on growth is negative for the entire sample at a high level of statistical significance (one percent level). However the p-value of the Chow test indicates that a significant improvement in fit is achieved through sample splitting. Once the sample is split, it is found that *publicinv* has a negative impact on growth at a level of reasonable statistical significance only for the sample of autocratic countries.[76] In autocratic countries, an increase in *publicinv* by one percentage point reduces the average rate of growth by almost 0.05 percent. Similarly when *publicinv2* is used as the measure of public investment as reported in Table 4.A6, the Chow test again supports estimating the equation separately for the two sets of countries, and the results show that public investment impacts growth negatively only in autocratic countries.[77] Column (2) of the table indicates that an increase of one percentage point in *publicinv2* curtails average growth by 0.3 percent.

In contrast to the fixed effects regression results reported previously, the estimated coefficients of initial GDP per capita in both the tables (Table 4.5 and Table 4.A6) suggest that convergence occurs in autocratic countries rather than the democraticgroup of countries [78] — the system GMM regression technique is preferable to fixed effects on the grounds discussed in Section 4.5. These results also

[76] The estimated coefficients of *publicinv* across the two samples do not overlap within one standard error band.

[77] Moreover, now the estimated coefficients of *publicinv2* across the two samples do not overlap within two standard error bands i.e. we can reject the null that the coefficients are equal to each other at the five percent level of significance.

[78] The coefficients do not overlap within one standard error band.

provide evidence that the population growth rate adversely affects growth in both samples of countries, and the magnitude of the impact is similar.[79] The fixed effects regression results only estimate the association of investment (and not population growth) with growth of GDP per capita with precision.

4.8 Conclusion

This chapter is an empirical investigation into the implications of institutional quality for both the relative size as well as the growth impact of public investment in fixed capital in developing countries. The chapter examines the proposition that corruption influences public sector investment, for which there already exists anecdotal and empirical evidence. The innovation of the empirical analysis is that it incorporates political economy considerations based on theoretical works from a 'public choice' literature (Mohtadi and Roe 2003, Plumper and Martin 2003, Hausken et al 2004, Deacon 2009). Based on these works it is hypothesized that the impact of corruption on the relative size of public investment depends on the openness of the political regime. Furthermore, the relationship between corruption and public investment, and subsequently the growth impact of public investment, is fundamentally different across autocratic and democratic regimes.

The empirical analysis, which is based on a panel dataset of developing countries, yields some interesting results. The first main finding is that a lowering of corruption is associated with a reduction in public investment only in autocratic

[79] The coefficients overlap within one standard error band.

countries. Moreover, corruption affects public investment within autocratic countries only when it is considered as a function of political openness. The evidence does not suggest any link between corruption and public investment in democratic countries.

The results are not driven by the overall size of the public sector, but pertain specifically to investment in fixed capital. With government consumption expenditure as the dependent variable, there is no evidence of such relationships. This supports the proposition that it is public funds meant for infrastructure development and state owned enterprises which are most vulnerable to rent-seeking activities, rather than the operating and maintenance expenditure of a government.

The second main finding, which is consistent with the first set of results, is that the relative size of public investment in fixed capital is negatively associated with the growth of GDP per capita only in autocratic countries. Moreover, within autocratic countries the negative impact of public investment on growth is mitigated by increasing political openness. The evidence presented has important implications. The results suggest that in autocratic countries, enlarging the share of public sector investment in fixed capital is not good for growth prospects. The lack of political openness leads to corruption and rent-seeking in public spending, and hence sub-optimal public investment. The findings should not be interpreted to mean that corruption does not exist in democratic countries, but only that rent seeking does not affect the size and productivity of public investment. This is consistent with the theoretical models of public choice which predict that democratic regimes are only able to secure popular support and ensure political survival through provision of public

goods, and not direct transfers (Plumper and Martin 2003, Hausken et al 2004 and Deacon (2009).

While this chapter focused specifically on public investment, the study is a subset of a vast empirical literature on the growth impact of overall public spending and also its composition,[80] the growth impact of institutions,[81] and finally also the institutional determinants of patterns of public spending[82]. Further empirical research could perhaps investigate the role of political economy considerations in directing public investment at a more disaggregated level of classification (by functionality). Are certain types of public investment more susceptible to corruption and political considerations? The data required for such an analysis was not available for this study, but nevertheless it is a potentially fruitful future endeavor. In particular, it would be worthwhile identifying a better measure than public sector gross fixed capital formation to proxy for investment in physical infrastructure in a large enough cross-section of countries.

[80] For example, Krueger and Orsmond (1990), Barro (1989, 1991), Hansson and Henrekson (1994),

[81] For example, Mauro (1995), Barro (1996), Acemoglu et al (2001), Rodrik et al (2004)

[82] For example, Mauro (1998), Gupta et al (2001), Mulligan et al (2004)

Appendix 4

Table 4.A1. Descriptive Statistics (Entire Sample)

Variable	Mean	Minimum	Maximum	Countries	Observations
Growth (Annual)	1.88 (6.06)	-47.29	65.69	113	2626
Publicinv	35.59 (19.32	0.84	98.59	113	2637
Publicinv2	7.19 (4.66)	0.10	42.98	113	2637
Govcons	14.78 (6.50)	2.05	69.54	112	2618
Corr	2.53 (0.96)	0	6	89	1677
Pol	0.43 (6.69)	-10	10	113	2637
Ypc	3867 (4854)	180	65879	111	2618
Inv	22.25 (8.98)	1.76	91.59	113	2635
Pop	2.04 (1.36)	-7.53	14.78	113	2637
Ind	29.69 (12.68)	4.22	95.70	113	2462
Open	72.55 (39.06)	6.09	280.36	113	2633
Urban	41.44 (19.76)	3.11	93.03	112	2635

Note: Standard Deviations are reported in parentheses.

Table 4.A2. Descriptive Statistics (Autocratic Countries)

Variable	Mean	Minimum	Maximum	Countries	Observations
Growth (Annual)	1.60 (7.10)	-47.29	65.69	83	1329
Publicinv	39.54 (20.90)	0.84	98.59	83	1337
Publicinv2	8.02 (5.47)	0.10	42.98	83	1337
Govcons	15.15 (6.92)	2.05	69.54	82	1323
Corr	2.39 (0.99)	0	4	56	716
Pol	-5.67 (2.71)	-10	0	83	1337
Ypc	3478 (5913)	180	65879	82	1326
Inv	22.23 (10.21)	1.76	91.59	83	1335
Pop	2.41 (1.42)	-7.53	14.78	83	1337
Ind	30.77 (15.00)	4.25	95.70	79	1251
Open	69.54 (37.85)	6.09	275.23	83	1337
Urban	38.15 (18.86)	3.11	93.03	83	1337

Note: Standard Deviations are reported in parentheses.

4.A3.Descriptive Statistics (Democratic Countries)

Variable	Mean	Minimum	Maximum	Countries	Observations
Growth (Annual)	2.17 (4.75)	-33.75	21.76	84	1297
Publicinv	31.53 (16.60)	3.53	96.19	84	1300
Publicinv2	6.34 (3.45)	0.70	23.22	84	1300
Govcons	14.39 (6.03)	3.46	54.52	84	1295
Corr	2.62 (0.92)	0	6	67	961
Pol	6.71 (2.33)	0	10	84	1300
Ypc	4266 (3400)	182	19908	83	1292
Inv	22.28 (7.52)	2.17	76.70	84	1300
Pop	1.66 (1.17)	-2.85	5.08	84	1300
Ind	28.63 (9.82)	4.22	65.53	83	1211
Open	75.65 (40.04)	7.53	280.36	84	1296
Urban	44.82 (20.11)	8.53	92.75	83	1298

Note: Standard Deviations are reported in parentheses.

Table 4.A4. Fixed Effects Regression Results for Annual Growth$_t$ (Entire Sample)
(using Public Investment as a proportion of GDP as the explanatory variable)

Independent Variables	(1)	(2)	(3)
log(ypc)$_{t-5}$	-3.450***	-3.249***	-6.033***
	(0.873)	(0.890)	(1.098)
inv$_{t-5}$	0.213***	0.211***	0.191***
	(0.033)	(0.033)	(0.043)
pop$_{t-5}$	0.033	0.056	0.067
	(0.134)	(0.125)	(0.242)
Publicinv2$_{t-5}$	-0.082*	-0.071*	-0.037
	(0.044)	(0.041)	(0.067)
pol$_{t-5}$		-0.016	
		(0.042)	
(publicinv2 * pol)$_{t-5}$		0.000	
		(0.001)	
corr$_{t-5}$			0.090
			(0.305)
(publicinv2 * cor)$_{t-5}$			-0.000
			(0.005)
Countries	109	107	85
Observations	2233	2214	1323
Chow Test	0.055	0.094	0.143
'α_4 =0, α_5 = 0, α_6=0'		0.247	0.909
'α_4=0, α_6= 0'		0.218	0.765
'α_5 =0, α_6 = 0'		0.932	0.942
T.E Included	Yes	Yes	Yes
R^2	0.634	0.636	0.697
R^2(within)	0.350	0.350	0.403
R^2(between)	0.029	0.025	0.008

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1970-2011 in Columns (1) and (2), and from 1990-2011 in Column (3). The dependent variable is a moving average of the growth rate from year t-4 to t. The explanatory variables are lagged by five years. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. The statistic reported for the Chow Test is the p-value of the F statistic testing the null hypothesis that the set of estimated coefficients for the sample of autocratic countries is statistically the same as that for the sample of democratic countries. α_4 is the coefficient of *publicinv*, α_5 is the coefficient of *pol* in Column (2) and *corr* in Column (3), and α_6 is the coefficient of the interaction variable — the statistics reported for the joint significance of coefficients is the p-value of the F statistic. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Table 4.A5. Fixed Effects Regression Results for Annual Growth$_t$
(using Public Investment as a proportion of GDP as the explanatory variable)

	Autocratic Countries		Democratic Countries	
Independent Variables	(1)	(2)	(3)	(4)
$log(ypc)_{t-5}$	-1.847	-1.902	-6.372***	-6.479***
	(1.316)	(1.267)	(0.943)	(0.971)
inv_{t-5}	0.264***	0.252***	0.155***	0.150***
	(0.042)	(0.043)	(0.045)	(0.046)
pop_{t-5}	0.068	0.088	-0.048	-0.011
	(0.131)	(0.123)	(0.237)	(0.227)
$publicinv2_{t-5}$	-0.189***	-0.136**	-0.018	-0.006
	(0.059)	(0.063)	(0.057)	(0.060)
pol_{t-5}		-0.102		0.049
		(0.063)		(0.062)
(publicinv2 * $pol)_{t-5}$		0.003**		-0.001
		(0.001)		(0.001)
Countries	75	75	81	79
Observations	1033	1031	1200	1183
'α_4 =0, α_5 = 0, α_6=0'		0.008		0.639
'α_4=0, α_6= 0'		0.003		0.484
'α_5 =0, α_6 = 0'		0.132		0.591
T.E Included	Yes	Yes	Yes	Yes
R^2	0.695	0.701	0.697	0.697
R^2(within)	0.387	0.392	0.466	0.468
R^2(between)	0.325	0.295	0.047	0.047

Notes: A constant is included in all regressions but not reported. Annual observations of the dependent variable are used from 1970-2011 in Columns (1) and (2), and from 1990-2011 in Column (3). The dependent variable is a moving average of the growth rate from year t-4 to t. The explanatory variables are lagged by three years. Robust standard errors clustered by countries are reported in parentheses. TE refers to the set of time dummies. α_4 is the coefficient of *publicinv*, α_5 is the coefficient of *pol* , and α_6 is the coefficient of the interaction variable — the statistics reported for the test of joint significance of coefficients is the p-value of the F statistic. The R^2 refers to the coefficient of determination from estimation of the equivalent Least Squares Dummy Variable Model (LSDV).
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Table 4.A6. System GMM Results for Growth$_t$
(using Public Investment as a proportion of GDP as the explanatory variable)

	Entire Sample	Autocratic Countries	Democratic Countries
Independent Variables	(1)	(2)	(3)
log(ypc)$_{t-5}$	-0.929**	-1.262***	-0.440
	(0.438)	(0.438)	(0.334)
inv$_{t-5}$	0.233***	0.317***	0.202***
	(0.061)	(0.071)	(0.049)
pop$_{t-5}$	-1.734***	-1.084***	-1.178***
	(0.345)	(0.294)	(0.291)
Publicinv2$_{t-5}$	-0.160***	-0.266***	-0.044
	(0.061)	(0.072)	(0.085)
Countries	109	63	79
Observations	464	204	260
Chow Test	0.003		
T.E Included	Yes	Yes	Yes
Instruments	77	75	72
Hansen J Test p-value	0.351	0.167	0.423
AR(2) Test p-value	0.799	0.754	0.841
Wald chi-sq statistic	80.09	111.61	145.30
Wald chi-sq p-value	0.00	0.00	0.00

Notes: A constant is included in all regressions but not reported. Observations of the dependent variable at five year intervals are used from 1970-2010, thus the number of time periods in the panel is equal to nine. The dependent variable is the average of growth rate from t-4 to t. All explanatory variables are treated as endogenous and instrumented by 1 lag. Windmeijer-Corrected Robust standard errors from the two-step GMM estimation are shown in parenthesis. Orthogonal forward deviations are used to purge fixed effects. TE refers to the set of time dummies. The statistic reported for the Chow Test is the p-value of the F statistic testing the null hypothesis that the set of estimated coefficients for the sample of autocratic countries is statistically the same as that for the sample of democratic countries.
*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

Chapter 5: Conclusion

This thesis contributes to the literature on institutions and economic performance. Following a stage-setting introductory chapter, which places the thesis within the context of the related literature, Chapters 2 and 3 explored the endogeneity of institutional quality to economic policy variables. Chapter 4 then examined the implications of institutional quality for public investment in fixed capital, which is an important tool of public policy.

The importance of institutional quality for economic growth is now well established. However, a large part of the literature attributes the development of political and economic institutions to long-run factors such as historical experience, geography, culture and so on. In fact the central thesis of one of the most talked about books to emerge from the development literature in recent times, *Why Nations Fail* (Acemoglu et al 2012), is that institutions are a product of the long run historical experience of societies. At certain 'critical junctures' the development of institutions diverged across nations, as a result of unique circumstances. The Western world and its offshoots were fortunate enough to develop inclusive institutions which facilitated extensive investment and entrepreneurship resulting in prosperity. The rest of the world was unable to develop in the same way because it was held back by extractive institutions, which concentrated power in the hands of narrow groups and discouraged widespread participation in economic activity. Once a certain path of institutional development was set in motion, societies embarked on very different paths of

development because of institutional persistence. This view predicts a bleak picture for the prospects of poor countries to develop, and suggests that institutions are destiny.

Even though long run historical experience may be extremely significant, this thesis took the view that institutional quality can improve through policy action even over relatively shorter periods of time. It agrees with the insight that institutions cannot simply be transplanted into the developing world, and institutional change has to come from within countries (e.g. Lin 2009, Leftwich and Sen 2011). North (1990) describes institutional change as incremental, and a consequence of the maximizing activity of various players in society. If government policy can shift the distribution of resources in such a way as to strengthen the constituency for reform, and those with an interest in wealth creation, sustainable institutional improvement may be possible in the poor countries of the world.

The empirical evidence presented in Chapters 2 and 3 is consistent with the optimistic view. The long run historical experience that led to the development of inclusive political and economic institutions in the Western world could be replicated in the contemporary world if the appropriate policy action is taken. A contemporary rather than historical focus is achieved in this thesis through the use of recent and relatively short time coverage for the empirical analysis, and through the consideration of explanatory variables that are immediately in the hands of political makers.

The empirical investigation carried out in Chapter 2 suggests that if a government relies on taxation in order to fulfill its fiscal needs, then democratization may be possible. This link is more pronounced for poorer countries. On the other hand, revenue from natural resources is harmful for political openness. This finding has an

important policy implication for the new African resource producers such as Ghana, Kenya, Mozambique and Tanzania. These countries have well-developed systems for tax collection, but now have a choice of fulfilling their fiscal needs through natural resource rents. The findings of this chapter suggest that these countries could hamper the progress of their nascent democracies by replacing taxation with natural resource rents as the main source of revenue. The findings also have policy implications for international lenders and donor agencies, and the richer countries of the world. These actors should incorporate an encouragement of domestic taxation into their agendas for assistance of developing countries. These actors might also have an influence over the international markets for natural resources, and should press poorer countries, especially the new resource producers, to rely less on natural resource rents to directly fulfill their fiscal needs. They should advocate creative proposals such as those that suggest redistribution of resource rents to citizens, and then subsequent taxation of the citizens by the government (Devarajan et al 2010).

The findings from Chapter 3 suggest that increased trade intensity (i.e. trade to GDP ratio) following the liberalization of trade policy regime is beneficial for economic institutions; it leads to a decrease in corruption and an improvement in the quality of the bureaucracy. Un-liberalized trade on the other hand is detrimental for institutional quality. This link is stronger for exports compared to imports. For exporters of natural resources in particular, the evidence suggests that a liberalization of trade policy is critical. In the presence of an interventionist trade regime, exporting natural resources has an extremely harmful impact on institutional quality; this negative impact, however, is mitigated by liberalization. The investigation was premised on an essential

insight of the 'rent-seeking' literature which points out that any government-imposed restriction on economic activity has adverse consequences for institutional quality.

The findings of Chapter 3 present important policy recommendations as well. It has already been recognized by the mainstream trade and development literature that import substitution policies are counterproductive (Krueger 1980, 1990a, 1997 and various other studies). However, even for countries that aim to follow an export promoting development strategy it is important that government-imposed distortions be removed. While export growth is inherently considered 'better' than import growth due to balance of payment and employment generation considerations, the evidence in Chapter 3 suggests that rent-seeking activities which negatively impact institutional quality operate much more vigorously on the export side.

Chapter 4 investigated the reverse question, the impact of political openness and corruption (a symptom of poor economic institutions) on the size and productivity of public investment in fixed capital, which proxies for infrastructure. Thus, whereas the first two core chapters explored the effect of economic policy variables on institutional quality, the final core chapter examined how the interaction of political and economic institutions influences an important tool of economic policy. The evidence from this chapter suggests that the political economy considerations that drive public investment operate differently across autocratic and democratic regimes. It is found that public investment in fixed capital is positively associated with corruption, only in countries with autocratic regimes. Furthermore, results also indicate that the growth impact of public investment in fixed capital is negative in autocratic countries; the negative impact, however, is mitigated by increased political

openness. The findings point to the relevance of sub-optimal decision making in autocratic countries.

The empirical strategy in all the papers involved addressing establishing a causal relationship between the explanatory and the dependent variables by addressing endogeneity issues, through estimation by the system Generalized Method of Moments technique (SGMM). This technique is an important convenience as it generates a set of internal instruments consisting of the appropriate number of lagged level and first differences of the explanatory variables. However, SGMM technique is often criticized for its sensitivity to the choice of lags (e.g. Acemoglu et al 2013). But the empirical analysis of the thesis does not solely rely on the SGMM estimator; it is used to supplement the fixed effects regression technique. In all three core chapters the SGMM results are broadly similar to the fixed effects results, indicating that the estimated relationships are not driven by the choice of a particular estimation technique.

The alternative strategy of identifying an exogenous external instrument is very difficult in practice, even harder is to argue convincingly for its validity. However, a convincing external instrument potentially provides a greater insight into the mechanism at work. It helps develop the broad contours of a theory. For example the theory of institutional change proposed by Acemoglu et al (2005d, 2012) is based on the instrument for institutional quality they identified in an earlier paper (2001). They argued that the mortality rate of colonial European settlers is highly correlated with the quality of current institutions, but do not affect contemporary economic performance through any other channel. This provided an explanation for the origins

and development of institutions based on historical experience. For example with reference to Chapter 2 in this thesis, if an external instrument can be identified and this variable is more easily influenced than the fiscal policy of countries, this could help develop a more practical theory of how to promote democracy. The lack of any external identification strategy is perhaps a shortcoming of the empirical approach employed in this thesis, but does suggest directions for future research.

Another potential limitation of the thesis is the sole reliance on cross-national investigations. Such studies provide evidence for the average statistical relationship between variables of interest across and within countries. However, it is a worthwhile as a future research agenda to carry out more nuanced comparative studies of countries following the direction suggested by the cross-national evidence. This could help identify with more clarity and in more detail the mechanisms at work.

Finally, there is room for improvement relating to the measures of institutional quality used. This thesis has made a broad distinction between political and economic institutions. However, there are possibly even more nuanced classifications of institutions. For instance, this thesis did not consider the role of informal institutions, which are based on cultural norms and traditions and are distinct from formal institutions (North 1990, Roland 2004). Informal institutions likely play a critical role in early stages of development, and specifically in enabling initial growth accelerations (Sen 2013). Moreover, even the measures for the quality of formal political and economic institutions considered in this thesis are highly aggregate. Some previous studies have attempted to 'unbundle' institutional quality through classifications based on functionality (Rodrik 2005, Acemoglu et al 2005c, Sen 2013). Given the focus of this

thesis, it was not necessary to distinguish further between different facets of institutional quality. However, as a future direction of research it could perhaps be useful, in terms of understanding the link between economic policy and institutional quality, to take a more nuanced view of institutions. Since this is initially difficult in the context of cross-national investigations, there is a need for detailed comparative country studies.

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