

# **Essays in Political and Development Economics**

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## **Dedication**

*To Carlos, Maria de Lourdes, Carlos Andrés and Juan Francisco.*

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## List of Abbreviations

AMEs	average marginal effects
CIA	Central Intelligence Agency
GDP	gross domestic product
GTOPO30	Global 30 arc-second elevation data
IV	instrumental variable
OECD	Organisation for Economic Cooperation and Development
OLS	ordinary least squares
US	United States
UCDP/PRIO	Upssala Conflict Data Program and International Peace Research Institute, Oslo
WWII	Second World War

## List of Variables

EF	ethnic fractionalisation
FD	fiscal decentralisation
PA	political autonomy
RD	road density
SFI	state fragility index
SWWW	Sachs-Warner-Wacziarg-Welch indicator
TRI	terrain ruggedness index

# **Abstract**

This thesis consists of three essays on political economy and development economics.

The first essay, entitled ‘What Underlies Weak States? The Role of Terrain Ruggedness’, examines the effect of rugged topography on state capacity, namely, the ability of the state to commit to policies, collect taxes, and provide public goods and security over its territory. Specifically, the essay considers state capacity as an outcome of collective action and terrain ruggedness as a factor impeding cooperation among the state’s constituents. As state capacity is best observed by means of its outcomes, four latent variables are used as proxies for its measurement—inflation, rule of law, taxation performance, and presence of civil war. Using a dataset of 190 independent countries over the period 1960–2010 and an index of terrain ruggedness quantifying accurately topographic irregularities, the results demonstrate that an increase in terrain ruggedness significantly hinders state capacity. Moreover, it is found that more rugged countries have experienced delays in urbanisation and it is through this channel that some functions of the state may have been reduced over time. The study undertakes many robustness checks to substantiate its main finding, such as accounting for spillover effects due to shared topographical characteristics across bordering countries. Overall, the evidence suggests that irregularities in the terrain are important hurdles for state development, even after considering other determinants of state formation and progression such as elite domination, artificial states and regime type.

The second essay, entitled ‘State Capacity: How to Mitigate the Adverse Consequences of Terrain Ruggedness?’, builds on the first essay and proposes some solutions to the negative consequences of terrain ruggedness on state capacity. Specifically, the essay explores whether or not the negative effects of topography can be alleviated through a denser road network, fiscal decentralisation and political autonomy. State capacity is again proxied by the aforementioned four latent variables. The results suggest that higher road

density increases the probability of collecting more taxes in rugged countries but also reduces the ability of the state to control inflation and to enforce rule of law. Fiscal decentralisation reduces the likelihood of high inflation and civil war in more rugged countries. Conversely, while political autonomy is associated with lower inflation, it leads to a higher probability of eruption of civil wars in more rugged countries. The policy implication of this research is to adopt fiscal decentralisation to alleviate the adverse effects of rugged topography, but it is emphasised that questions like the initial conditions that a country should attain before embarking on such reform need to be investigated prior to making a concrete policy prescription.

The third essay, entitled ‘Empirically Testing the Persistence of Power, Elites and Institutions: Evidence from Land Reforms around the World, 1900–2010’ has a different focus. It empirically tests Acemoglu and Robinson’s (2008) predictions on the interactions of elites, political power and the adoption of pro-citizen economic policies in their paper, ‘Persistence of power, elites, and institutions’, in the *American Economic Review* (vol. 98, no. 1, pp. 267–93). By exploiting a novel dataset containing information about the number of enacted and implemented land reforms around the world over the twentieth century, the essay examines whether the elites maintain *de facto* political power over the citizens and whether *de facto* and *de jure* political powers have effects on economic policies that are supposedly beneficial for citizens. Specifically, the essay empirically tests whether (i) pro-citizen economic institutions are adopted when there is a broad political representation of the masses and elites are constrained (full democracy); (ii) pro-elite economic institutions are adopted when the political regime represents the interest of the elites (non-democracy); and (iii) pro-elite economic institutions are adopted when elites are able to exert power on the political system (*de facto* political power) even if the *de jure* political power represents the masses (captured democracy). The empirical part uses a panel dataset of 150 countries spanning from 1900 to 2010. The results indicate that trade openness, a proxy for pro-citizen economic policy, is more likely to arise in countries with more democratic political regimes and where major land reforms have been enacted

or implemented. Additionally, trade openness is less likely to arise in countries with less democratic political regimes and where the elites are able to block the implementation of land reforms. The study further distinguishes among land reforms with different motives, and finds that it is more *redistributive* land reforms that lead to a higher likelihood for more pro-citizen economic policies. In order to mitigate the endogeneity problem arising from reverse causality, enacted and implemented land reforms are instrumented using the influence of the United States (US) on the country during the Cold War. Estimates using an instrumental variable (IV) strengthen the previous results. The essay concludes that Acemoglu and Robinson's (2008) conjectures are consistent with data on land reform enactment and implementation and the associated implications for elite power.

# Chapter 1: Introduction

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## 1.1. Overview

This thesis consists of three essays in the fields of political economy and development economics. Specifically, it aims to analyse two distinct but nevertheless connected phenomena: the role of physio-geography in state development, and the link between elite domination and the choice of pro-citizen economic policies. The overarching theme across the two topics is the dynamics of inter-group cooperation and associated impediments for a higher collective welfare.

The new political economy literature studies the problems arising in the political sphere through the lenses of traditional tools widespread in the economics literature. Currently, the field relies on analytical devices derived from rational choice, public choice, public finance and economic growth, as well as some of the newest developments in econometric techniques.<sup>1</sup> In mainstream economics, variables such as technology, institutional framework and societal structure are usually taken as exogenous. While this abstraction sometimes is a useful shortcut to demonstrate the impact of one variable or policy on a certain economic outcome (e.g. the effects of interest rates on consumer spending or the link between fiscal and monetary policy and long-term inflation), it does not shed light on the reasons why a certain policy or technology is chosen over others. Precisely, the new political economy endogenises key variables such as institutions<sup>2</sup>, political framework and societal structure to study what determines these variables in first place. Indeed, this literature suggests that decision-makers or politicians are not benevolent and their decisions are balance out by their private incentives (e.g., holding office in the next term, seeking rents and getting personal favours) and public incentives (e.g., the electorate's preferences, demographics and

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<sup>1</sup> Persson and Tabellini (2002) and Besley (2007) offer a summary of how the field has been progressing since its beginnings.

<sup>2</sup> Broadly, institutions can be defined as the human-made constraints that outline the interaction between the members of a society (North 1991).

country's history. In a nutshell, political economy adds 'political constraints' to the economic problem.

A relatively recent phenomenon within the field of political economy has been the growing interest in understanding the political economy side of the economic development process. Broadly, the idea is to comprehend the importance and role of political and economic institutions, and their determinants (e.g. initial income distribution, colonisation, geography, ethnicity, state structure, patrimonial rule, culture, social norms, cooperation and group heterogeneity) in shaping long-term economic and political outcomes.

The idea that institutions are relevant for economic welfare is an important advance in the economics literature. North (1991, p. 97), who pioneered the study of institutions, posits, 'institutions are the humanly devised constraints that structure political, economic and social interaction'. An initial body of research aimed to determine which type of institutions matter and in which context.<sup>3</sup> Protection of property rights and rule of law were found to be examples of good economic institutions driving long-term investment and therefore economic growth (see Acemoglu & Johnson 2005; Knack & Keefer 1995).

In this vein, an area of growing interest is that of *what drives* the development of such institutions. The current scholarship offers many possibilities. Followers of the Coase theorem contend that collective choices can always bring about the most efficient outcome; the institution or decision that arises in a collective choice situation will be one that reflects the best outcome for the group and no other decision can better achieve this outcome. That is, any modification of the outcome decision will make at least one person worse off, relative to the benchmark outcome.<sup>4</sup> Otherwise, there would be room for bargaining such that the winners arising from the adoption of the efficient

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<sup>3</sup> Acemoglu, Johnson and Robinson (2005) describe a list of institutions that are important for long-term welfare.

<sup>4</sup> 'Most efficient' means the best outcome that a society can attain. Some societies may be aware of better institutions but may not be able to afford or implement them given prohibitive transaction costs.

institution will compensate the losers.<sup>5</sup> However, this approach does not take into account the fact that the economic institutions are chosen by those holding political power—that there is a power imbalance embedded in the negotiating procedures in the first place—and therefore the decisions taken might favour those in power, making it possible for inefficient institutions to arise (Acemoglu 2003). This assertion is based on political scientists' views about the persistent conflicts of interest between groups in a society.<sup>6</sup> Effectively, societal conflict is at the core of current research in the political economy of development and as such, the topic opens up many research questions. For instance, what are the consequences of a fierce competition between different groups? What type of heterogeneity in groups matter for economic and political development? What are the origins of group heterogeneity? What are the strategies chosen by different groups to impose their views? What is the best way to encourage cooperation between heterogeneous groups?

All these suggest that the role of history and path dependence is crucial in political economy. The framework is dynamic rather than static. History and, more specifically, historical accidents, are also used to explain the rise of different institutions and their impact on current outcomes.<sup>7</sup> For instance, the length of the colonisation process, the identity of the coloniser, the waves of the colonisation process and the origins of the legal framework are major determinants of the institutional setting (Feyrer & Sacedorte 2009; La Porta et al. 1999; Olsson 2009). However, the question that remains is: why do initial institutions differ from one place to another even in cases where the coloniser was the same (or why were there similar institutions with different colonisers)? To answer that, it is necessary to introduce the specific context of where and when a certain institution arises. For instance, Sokoloff and Engerman (2000) posit that differences in factor endowments in the Americas arising from geographical characteristics explain the observed variability of the institutional design. Acemoglu, Johnson and Robinson (2001) find that geography, through

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<sup>5</sup> See Coase (1960) and Stigler (1966).

<sup>6</sup> See Alesina and Drazen (1991), Persson and Tabellini (1994) and Grossman and Helpman (1994) for early contributions.

<sup>7</sup> Nunn (2009) offers a review of the scholarship about history and economic development.



its impact on settler mortality, explains the variability in past institutions.<sup>8</sup> Nunn and Puga (2012) find that topography is the core variable to explain why some African countries suffered less from slavery.

With this background in mind, the next subsection discusses the importance of geography in the making of current political and economic outcomes.

## 1.2. Geography as a Driver of Long-term Economic and Political Development

One recent area of research gaining momentum is the role of geography and its interaction with history within the political economy context and how this interaction can underlie the development and the nature of institutions that, in turn, shape and influence economic and welfare outcomes. Stasavage (2010) demonstrates that small European polities were more likely to have more representative institutions than larger countries in medieval times, given that travel costs were significantly lower in small countries allowing assemblies to meet more frequently. Thus, assemblies could monitor public finances more closely and the public were keener to pay taxes, augmenting the state capacity to obtain revenue. Similarly, Berkowitz and Clay (2011) find that rainfall and distance to rivers and lakes explain past levels of political competition within the states in the United States (US). Following a sequential approach, these authors determine that past levels of political competition explain current levels of political competition, which in turn, explain the degree of independence of the state courts. The final outcome is that the more independent the judiciary from political parties, the higher income per capita.

In political economy terms, the link between history and current outcomes is known as *persistence*. Within a dynamic game setting, Lagunoff (2009) demonstrates that the set of institutions available at time  $t$  are a function of the institution chosen at time  $t-1$ . In other words, once an institution is chosen, it creates path dependence. Dell (2010) offers empirical evidence showing that

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<sup>8</sup> Hall and Jones (1999) find that the economic institutions and government regulations, summarised as an index of social index, is partially explained by distance from the equator.

there is a relationship between Peru's topography, adoption of past inefficient economic institutions during the Spanish colonisation and its current development outcomes. She shows that regions where Spanish colonisers imposed a coercive labour system called *mita*<sup>9</sup> present lower levels of development today relative to boundary regions that were not affected by this system. Yet, institutions are not the only mechanisms through which history and geography could have long-lasting effects. Nunn and Wantchekon (2011) show that countries whose ethnic groups were more affected by the slave trade present higher contemporaneous levels of mistrust.<sup>10</sup> Alesina, Giuliano and Nunn (2013) present evidence relating the type of terrain suitable for different types of crops, the corresponding adoption of traditional agriculture methods in the pre-industrial era (plough cultivation vs. shifting cultivation) and current beliefs about gender roles. Thus, places where the plough was the most suitable form of agricultural production for the terrain show greater gender inequality beliefs and less female participation in the labour market and in politics today. Hence, persistence could also be the product of culture, norms and beliefs, which were, in turn, driven by geographically influenced historical paths.

Although geography is currently studied together with history and as a determinant of initial institutions, it is important to note that it also plays a role by itself as a determinant of economic and political outcomes. Gallup, Sachs and Mellinger (1999) provide evidence that geographical distance from core markets and being a landlocked country are important determinants of transportation costs and hence income levels. Additionally, they find that countries with tropical climates suffer a higher disease burden than countries with temperate climates, which reduces labour productivity.<sup>11</sup> Finally, they posit that the market value of agricultural production correlates negatively with every increase in average temperature recorded (see Sachs & Warner 1997, Landes 1999 and Mellinger, Sachs & Gallup 2000). In the same line of

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<sup>9</sup> The highly rugged topography of these regions made it impossible for the natives to escape from the brutal Spanish colonisers.

<sup>10</sup> Interestingly, Nunn and Puga (2012) uncover that the number of slaves caught were linked directly to the level of terrain ruggedness observed in a specific geographic area.

<sup>11</sup> A higher disease burden could also affect economic outcomes through fertility. In fact, high child mortality makes parents keener to have more children as an insurance factor in case one child dies, thereby keeping the country in a Malthusian poverty trap (Strulik 2008).

argument, Diamond (1997) explains the role of physical geography and ecology for the early rise of agricultural production that facilitated the transition from hunting and gathering societies to sedentary societies, opening the door for technological progress. Olsson and Hibs (2005) provide empirical support for Diamond's view and conclude that current variations in economic income are also strongly determined by measures of physio-geography and biogeography.

The political science literature also makes use of geographic features to explain some political outcomes. Fearon and Laitin (2003) find that a higher presence of mountains is associated with the presence of civil conflicts. This does not mean that countries with more mountains are more prone to civil conflict. On the contrary, their study shows that geography sometimes makes it more difficult for the state to control its territory effectively and a mountainous terrain can pose many challenges to conflict resolution in cases of civil tensions.<sup>12</sup> Moreover, Herbst (2000) elucidates qualitatively that African topography and ecology are not conducive to consolidation of power, and therefore earlier African rulers or colonisers were not able to implement a hierarchical state that could control their territory and enforce rules. This failure translates into current weak states plagued with civil violence, low provision of public goods and lack of revenue from taxation.

### **1.2.1. Geography and the State**

A new, but still infant, body of research in political science and political development aims to understand the causes and consequences of weak states (see Acemoglu 2005, Acemoglu et al. 2011 and Besley & Persson 2010). Besley and Persson (2009) find that political stability and cohesive political institutions are important determinants of state capacity, measured as the fiscal capability to raise tax and the legal endowment to enforce property rights. Moreover, Dincecco and Prado (2012) show that pre-modern wars greatly explain current fiscal state capacity.

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<sup>12</sup> Buhaug, Gates and Lujala (2009) find that topography and distance are directly linked to the duration of civil conflicts.

An important gap in this research is that these studies do not explain the role of topographic characteristics in determining the current behaviour of the state. Following Herbst's (2000) reasoning, one might expect that topography plays a role for the projection of power, and therefore, for developing an efficient central authority, the modern state. Therefore, the first essay in this thesis attempts to answer empirically whether terrain ruggedness, an exogenous factor, is a root determinant for state capacity outcomes today.

The results robustly show that terrain ruggedness plays a negative role for current state capacity. They also identify early urbanisation as a mechanism through which this exogenous effect works. Thus, it is shown that terrain ruggedness affects the outcomes of state capacity not only directly, but also indirectly through certain channels. The essay does not answer, however, if topography matters for any specific political or economic institution.

Given the findings in the first essay, the second essay focuses on whether or not devices or arrangements that optimally reduce transaction costs and foster inter-group cooperation can be used to overcome the topographical challenges generated by rugged terrain. Within the context of a literature that has often raised concerns with respect to the use of pure geographic arguments for explaining political and economic outcomes (labelled 'geographical determinism'), this essay explores if man-made factors that interact with geographic features can explain their importance in influencing political outcomes. Specifically, Acemoglu, Johnson and Robinson (2002), Easterly and Levine (2003), and Rodrik, Subramanian and Trebbi (2004) assert that geography has an impact on economic welfare when it interacts with institutions. While this observation is important, the inclusion of variables capturing the interaction of institutions with geography does not entirely wipe out the statistical significance of the direct effect of geographic variables from the econometric analysis. For instance, distance to the equator or latitude is still found to be a significant determinant in almost all cross-country analyses trying to explain differences in development outcomes, regardless of whether institutional variables are included in the explanatory variables.

Sachs (2001) argues that there is no need to fight for or against any of these views and that it is more important to find solutions to specific problems arising from having certain geographic characteristics; solutions such as discovering an effective vaccine against malaria or better ways to connect the hinterland to coastal areas. Even if researchers find a vaccine or if roads are built, the geographic burden will still be present and with it an ongoing cost.

Nevertheless, it is not only technology that could help to overcome negative effects of geography. If rugged terrain increases transaction costs and reduces inter-group cooperation, then the answer to surmount this problem might lie in finding the right institutions or devices to increase the yields of inter-group cooperation.

In essence, the second essay of this thesis tries to provide an answer to the question of whether there are specific economic or political arrangements that could help mitigate the negative effect of topography for building a capable modern state, and if there are, what would they be? One of the main challenges caused by terrain ruggedness is that it prevents authorities from projecting power from the centre to the periphery and increases the transaction costs of cooperation. From history, monarchs, kings, dictators and democratically elected presidents have built roads aiming to broadcast power to the hinterland and thus to gain control over that territory. Thus, if there would be a device that can serve as a mechanism to reduce transaction costs and promote cooperation between citizens, building roads is an option to consider (Agenor 2010).

A challenging topography can also physically isolate different groups and create disengagement between the citizens and the state authorities, which could create tension and lead to a weak state apparatus. As a way to diminish this divergence and to avoid secession, Alesina (2003) emphasises that sharing power between groups located in different areas could overcome otherwise negative potential outcomes such as civil wars. Traditionally, there are two ways of embarking on such a situation (i.e. sharing fiscal responsibilities between different levels of government and sharing political power between regions). Thus this essay asks, if in addition to a denser road network, fiscal

decentralisation and political autonomy might mitigate the negative effect of terrain ruggedness on state capacity.

While the results for political autonomy and higher road density are mixed, the results for fiscal decentralisation are more concrete. The findings suggest that fiscal decentralisation reduces the negative effect of terrain ruggedness for some state capabilities in more rugged countries.

Although some of these findings are appealing from a policy perspective, the essay does not provide insights into how to implement reforms or whether to adopt certain economic policies over others. On the contrary, its objective is far from providing a one-size-fits-all solution to rugged countries with weak state apparatus. One caveat of the essay is that it treats fiscal and political decentralisation as exogenous variables as it does not attempt to determine the drivers of these policies. Thus, any suggestion or advocacy for policy reform should first try to understand what brings about fiscal or political decentralisation in the first place as well as what the consequences of adopting such policies are.

### **1.3. Societal Conflict and the Political Economy of Development**

If the solutions to problems of state capacity lie in the structure of the political system, it is important to understand how political systems develop and evolve, whom they serve and how they can be influenced and leveraged for economic development policy. Indeed, Acemoglu and Robinson (2013) point to the necessity of a broader understanding of the distributional effects of adopting certain economic policies in order to avoid strengthening the position of already powerful groups, which usually results in poorer development outcomes. Thus, an emerging body of research attempts to understand the role of elites in the development process.

The study of elites takes as its foundations the premise that different groups have different preferences about certain economic policies. This societal

conflict point of view is central in the fields of political science and political economy. Many studies have shown the strong explanatory power of societal heterogeneity for certain outcomes. Alesina, Baqir and Easterly (1999) demonstrate that the degree of ethnic heterogeneity within a geographic location matters for the level and nature of provision of public goods. Alesina et al. (2003) develop different measures of heterogeneity such as fractionalisation based on language, religion and ethnicity, and conclude that these variables are important explanatory variables for economic, social and political development.<sup>13</sup>

Theoretical models of power relations in the political economy literature are based on the premise that there are two types of groups in a society: elites and citizens. In these models, typically the elites hold office and maximise the returns from adopting certain policies at the expense of the citizens. For instance, powerful elites might choose to develop a weak state to escape present and future taxation in case they lose power and the citizens demand higher levels of tax collection and enforcement from the wealthy in society (Acemoglu, Ticchi & Vindigni 2011). They might also invest in militias to influence elections (Acemoglu, Ticchi & Vindigni 2010) or simply support dictatorial regimes that make decisions in their favour.<sup>14</sup>

If the distribution of political power is important for the determination of economic policies, how is the political power attributed? Acemoglu and Robinson (2008) hypothesise that it can be designated in two ways. The first is referred to as *de jure* political power, which is linked to the power granted by formal political institutions (i.e. constitution, laws, political regime) and the second is called *de facto* political power, which stems from informal institutions and truly reflects the power that is held in practice by groups that

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<sup>13</sup> See also Alesina and La Ferrara (2005), Desmet, Ortuño-Ortín and Wacziarg (2012), Desmet, Weber and Ortuño-Ortín (2009), Fearon (2003) and Montalvo and Reynal-Querol (2005).

<sup>14</sup> These theoretical models simplify the complex phenomenon of societal conflict. For instance, a new emerging elite might try to destroy the old elite and gain power by forming a coalition with the citizens, and new political and economic policies could be the result of the bargaining process. In this chapter, we abstract from these complexities and treat societal conflict as the permanent struggle between elites and citizens in line with Acemoglu and Robinson's (2008) views.

are not always those that are in office (e.g. militia, businessmen clubs, landlords and warlords). These two types of political power and their interaction are the main determinants, according to Acemoglu and Robinson (2008), of economic policies. Despite this important claim, this hypothesis has not been tested using data. Therefore, the third essay of this thesis aims to investigate the link between these measures and economic choices.

The main contribution of this essay resides, specifically, in exploiting a variable that captures the power of the elites. It is proposed that the holding and maintenance of productive assets in the economy—land in most cases, particularly throughout history—is an important indicator of whether or not the asset-owning elites hold power and maintain it over time. The important test of whether or not changes in *de jure* power are echoed by changes in *de facto* power when political reform is said to take place is whether or not the concentrated ownership of productive assets that reflects the concentration of political and economic power has also transferred to a broader population base.

To undertake this investigation, a unique dataset containing the enactment and implementation of land reforms over the last century is refined and employed. The idea is that, as land represents the economic power, powerful elites will resist the enactment of land reforms. Where this resistance is ineffectual (or deemed to be politically destabilising, which in itself poses a risk to economic power holdings), elites may choose to agree to the *enactment* of the land reforms while covertly planning to suppress their implementation in actuality. Thus, land reforms may be initiated on paper but never realised due to the mitigation of the movement by the elites in the long term. The advantage for the elites in agreeing to the *enactment* of land reform is that they can give the impression of being pro-reform and thus quell any groundswell of political instability that may result from full resistance to redistributive reform. They can also dissipate the critical political impetus generated by the pro-citizen reformers and may thus have a better chance at blocking the implementation.

Thus the hypothesis is that where the elites maintain control over land resources, they also maintain control over the political system, even if the



system itself is, at least on paper, reformed to accommodate a more pro-citizen approach. Accordingly, the essay tests whether or not countries that are supposedly democratic (i.e. support a democratic election process) are effectively democratic in the sense that they are representative of the broad electorate, in reality. Specifically, countries that are deemed to be *de jure* democratic, which have enacted and implemented land reforms that are pro-citizen since their democratisation, are also determined to be *de facto* democratic. Conversely, those who have made the move to democracy on paper but have maintained the more feudal composition of productive asset holdings are deemed by this study to be only *de jure*, but not *de facto*, democratic. The results of the essay show that once the elites have been defeated, the economic choice is in line with citizens' preferences and the political system is both *de jure* and *de facto* democratic. In this sense, countries that have achieved full democratisation have managed to constrain the otherwise disproportionate power of the elite and, as a result, are able to undertake economic policies that are more in line with long-term development objectives.

To conclude, the thesis analyses the role of two main factors that thwart inter-group cooperation and reduces the collective output of societies with consequences for long-run development, namely physio-geography and elite domination of political systems. The results show that terrain ruggedness hinders the development of state capacity through an increase in transaction costs, and that pro-citizen economic policies are more likely to arise in countries where the masses have been able to constrain the power of the elites.

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## Chapter 2: What Underlies Weak States? The Role of Terrain Ruggedness

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### 2.1. Introduction

There is a resurgent and growing debate in the literature on the role of the state machinery in promoting economic development (Besley & Persson 2011a). In contrast to earlier debates that focus on the appropriate level of government intervention, current discussions centre on the questions of what constitutes an effective state apparatus and why inefficient states emerge and persist (Acemoglu, Ticchi & Vindigni 2011). This essay concentrates on the underlying foundations for effective states, and asks: what are the impediments to the development and sustainability of state capacity? The essay argues that obstacles for collective action are important hurdles to state formation and progression. In particular, rough topography, as a barrier to cooperation, is a fundamental factor in the early development of effective states and is, in turn, an important predictor of state capacity today.

One strand of research addressing state formation recognises that a state is formed by a group of citizens sharing common interests aiming to satisfy their particular needs. In particular, agents form coalitions to overcome a common enemy or a problem when the benefits of creating such a group are greater than the benefits of acting alone. Cooperation among the state's constituents is needed, not only for forming the state, but also to increase its capacity over time. In this sense, state formation and development is an outcome of collective action (Blanton & Fargher 2008; Levi 1989; Olson 1971).<sup>1</sup>

The recent economics literature defines state capacity as the ability to tax effectively and provide growth-enhancing public goods. These functions and

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<sup>1</sup> Collective action is not the only factor underlying state formation. Other theories emphasise, for instance, the role of war in making modern states (Tilly 1992), elite domination (Acemoglu and Robinson 2008) or colonisation (Olson 2009). However, even under those circumstances, rugged terrain might affect the collective behaviour needed for state capacity to improve over time through greater transaction costs. These theories are revisited in Sections 2.2 and 2.5.2.



competencies of the state promote economic development and welfare distribution (Acemoglu 2005; Besley 2011; Besley & Persson 2009; 2010; 2011a; 2011b). The political science literature places more emphasis on the state being the provider of the rule of law and the host of political institutions. Importantly, both fields hold the common view that all the state's economic and political functions are tightly connected and society's inability to invest in them will result in lost tax revenue, reduced provision of public goods, diminished rule of law, and feeble political institutions.

If state capacity is vital for increasing welfare, then what determines its initiation, evolution and persistence? Instead of focusing on the achievement of a capable state apparatus in its completeness, this essay re-focuses on the underlying factors behind the collective action problem in the first place. The core argument here is that impediments to collective action, and the extent to which they can be addressed, will determine where a state falls in the state capacity 'spectrum' and can explain the efficacy of the state machinery today.<sup>2</sup>

Accordingly, the essay empirically investigates the role of terrain ruggedness, a core factor that features as a major obstacle for collective action. The argument is that because the ruggedness of the terrain increases the costs of cooperation—by raising transaction costs—and reduces the benefits of collective action, the more prevalent this characteristic is within a country, the weaker the state apparatus is likely to be. Terrain ruggedness presents considerable challenges for the provision of public goods, not only by constituting a physical obstacle to infrastructure development, but also by restricting congregation, communication and interaction. The latter are keys to collective action agreement and critically shaped the capacity and effectiveness of early institutions. Nunn and Puga (2012), Berkowitz and Clay (2011), Dell (2010), Stasavage (2010), Sokoloff and Engerman (2000), and Easterly and Levine (2003) illustrate that geographical conditions crucially affect the quality

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<sup>2</sup> Indeed, Acemoglu, Ticchi and Vindigni (2010) posit that the degree of cooperation between citizens might be an outcome of institutions rather than the other way around. To avoid the reverse causality problem, the main independent variable in this study is terrain ruggedness index which captures the difficulties of cooperation and is totally exogenous to political institutions.

of initial institutions and the availability of future policy options. For instance, Stasavage (2010), focusing on European state formation for the period 1250 to 1750, shows that smaller and compact polities were able to develop political institutions with broad representation because nominated authorities were able to meet more frequently to invigilate state finances.

The terrain ruggedness measure—originally constructed by Riley, DeGloria and Elliot (1999) and later updated and improved by Nunn and Puga (2012)—precisely quantifies topographic irregularities in a country's land area. Based on digital elevation data taken from the Global 30-arc second elevation data (GTOPO30), a global dataset developed through international collaboration led by the US Geological Survey Center, it accurately measures topographic characteristics of a certain geographical area by using satellite images. Elevation observations in GTOPO30 are regularly spaced at 30 arc-seconds (926 meters) across the entire surface of the Earth, thus facilitating a fine measure of terrain characteristics (Nunn & Puga 2012). This degree of precision for the terrain structure captures the proximate conditions that affect collective behaviour among different human groups and the costs of cooperation arising from geographic constraints. That is, only fine grid measurements of the Earth's surface can allow quantification of the collusion costs of topographic disturbances. For instance, settlements that lie on different sides of hills or in different altitudes within a short span are likely to face non-negligible costs of communication and cooperation. Simple distance variables like 'as-the-crow-flies' measures, or indicators reflecting larger scale irregularities such as the percentage of mountains in a country's surface area, are too crude to capture this type of settlement dispersion and the associated costs of inter-group cooperation.<sup>3</sup>

The focus on terrain ruggedness also parallels Nunn and Puga (2012), who show, somewhat surprisingly, that rugged topography reduced the severe effects of the slave trade in Africa, given the difficulties associated with 'recruiting' slaves in such terrain. The argument in this essay is predicated on a

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<sup>3</sup> Topographic heterogeneity may significantly underlie the spatial choice of early settlements, but this does not change the thrust of the main argument.

similar, but contrasting (from the outcome's point of view), logic—rugged terrain makes it more difficult for different groups to cooperate. An implied competing hypothesis, nonetheless, is that terrain ruggedness can result in highly densely populated areas, and that people in these locations can congregate and cooperate more easily. The net effect of terrain ruggedness under these circumstances is an empirical question.

Another distinctive contribution of this essay is methodological: the treatment of state capacity as a latent variable. Despite the broad agreement on the state as a crucial platform upon which to build and implement welfare-enhancing policies, there is little consensus as to how to measure its effectiveness and compare its performance across countries. Besley and Persson (2009) argue that the empirics of state capacity are complex, as states perform a myriad of functions. The main estimation problem is that the level of state capacity is not observable; researchers observe only its outcomes. Therefore, we utilise the latent variable model, which, from a statistical point of view, captures perfectly the state capacity concept described above. Specifically, the index function underlying the latent variable model moderates the probability of a state being weak or strong in the 'spectrum' of states, given the explanatory variables, where the relevant outcome is observed once a threshold is exceeded.

The outcome variables to measure state capacity here are inflation, rule of law, share of tax revenue in gross domestic product (GDP), and presence of civil war. It must be stressed that these outcomes are not some simple measures of economic or political performance; rather, they closely represent the symptoms of strong versus weak states. They are also tightly linked to cooperation in collective action and thus clearly indicate a state's ability to perform its functions over time.

Given this background, we exploit a sizeable variation in topographic features and state performance exhibited by countries around the globe, which permits a useful empirical leverage to assess the hypothesised relationship. After demonstrating the direct predictive power of terrain ruggedness on state capacity, we explore one specific channel through which the related force

variable may matter: early urbanisation. The central reasoning here is that urbanised societies are more likely to have solved their tax collection problem earlier and have better infrastructure and connectivity. This reasoning implies that terrain ruggedness may delay urbanisation and subsequently reduce state capacity.

The findings of this study show that terrain ruggedness robustly predicts state capacity today, both directly and through the hypothesised channel, with meaningful and consistent marginal effects across an array of models. Further, we also find that its effect on state capacity is non-linear, suggesting that countries may try to overcome its negative effects, but after a certain point, ruggedness becomes inhibiting and starts exerting its negative influence. Our results are robust to account for alternative mechanisms that might explain state formation (e.g. elite presence, artificial states) and to control for possible spatial spillovers of state fragility among neighbouring countries.

## 2.2. The State and the Collective Action Problem

In his seminal book, Olson (1971) theorises that the state is formed by a group of citizens sharing common interests aiming to satisfy their particular needs. Hence, the origin of the state is explained by cooperation in collective action. Levi (1989) posits that agents form groups or coalitions to overcome a common enemy or problem when the benefits of creating such a group are greater than the benefits of acting alone.<sup>4</sup> Maintenance of the state also requires that the benefits of and incentives for cooperation are preserved over time. Accordingly, an organisational structure that deters the formation of internal factions (e.g. through a ‘Weberian monopoly of violence’) and distributes the benefits of collective action is integral to the sustenance of the state. The size of the coalition can also affect state capacity because incentives to cooperate are reduced as the coalition increases in size due to the free-rider problem

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<sup>4</sup> Using archaeological data, Blanton and Fargher (2008) find evidence that even rulers of pre-modern states provided public goods in exchange for different types of income from taxpayers in complex societies such as Egypt, the Aztecs, China and Ancient Greece.

(Olson 1971). Collective action theory thus highlights common interests and incentives for cooperation as keys to state formation and persistence.

Another theory explaining state formation is based on external wars (Tilly 1992). The core argument is that modern states emerge as a consequence of military competition. Since fighting wars need vast resources, state bureaucratisation was seen as a more efficient and sophisticated way of organising resource extraction than relying on local elites. Under this theory, collective action is not seen as a main determinant of state formation. However, the military approach does not rule out that cooperation improves state progression, in which case collective action, though not explaining why a state is formed, might explain the development of state capacity. Similarly, even if a society begins with elite domination of the political scene in which citizens are only inactive players (see Acemoglu & Robinson 2008), or even if the colonial powers left a state structure behind to start off with, collective action is needed to improve state capacity over time and ensure its survival.

### **2.2.1. What is State Capacity?**

State capacity is perhaps best defined by its antithesis. The political science literature refers to ‘fragile states’ or ‘weak states’ as those that are unable to provide basic public goods, effectively exert control over their territory, commit to a policy or enforce the rule of law (Fukuyama 2011). In economics, the concept is more commonly related to the capacity to raise taxes and provide public goods. Acemoglu (2005) defines weak states as those that cannot tax and regulate the economy or deal efficiently with non-state actors. Regardless of whether the perspective is from political science or economics, weak states do not produce outputs in line with their citizens’ long-term welfare.

It is also important to differentiate state capacity from political regime. A state with a democratic regime might be weak, while a more dictatorial regime may have a stronger state. Moreover, the lack of state capacity is not unique to poor or developing countries. For instance, the recent explosion of social violence in Bahrain, which has one of the highest incomes per capita in the Gulf, is an

example of a country where high income and social unrest can co-exist. Further, the extent to which differences in political systems explain different levels of state capacity is not clear. Both consolidated democracies and nondemocratic states face problems related to legitimisation of the state. For instance, fierce political confrontation between fractionalised elites is at the heart of the Belgian disintegration debate. In summary, despite being related, political regimes and state capacity are distinct phenomena.<sup>5</sup>

### **2.2.2. Terrain Ruggedness as an Impediment to Cooperation in Collective Action**

The simplest framework to illustrate a collective action problem is a static game, where the predicted Nash equilibrium generates a socially inefficient outcome if players do not cooperate.<sup>6</sup> Theoretical models mostly rely on social norms, reciprocity and trust to explain how the socially efficient equilibrium can emerge.

In this strand of research, an important predictor of cooperation within a group is transaction costs. North (1991) emphasises that higher transaction costs can offset the gains from cooperation, even in settings where all individuals want to cooperate. North describes situations where societies facing higher transaction costs are more likely to remain idle or even decline, while those facing lower transaction costs will progress over time. Olson (1971, pp. 46–7) argues that:

Any group that must organize to obtain a collective good will find that it has a certain minimum organization cost that must be met ... The organizational costs include the costs of communication among group members, the costs of any bargaining among them, and the costs of creating, staffing, and maintaining any formal group organization.

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<sup>5</sup> Fragile states also differ from failed states such as Somalia or Sudan, where neither security nor justice is delivered by the state. A fragile state could become a failed state (Collier 2009).

<sup>6</sup> Examples of such games are Tragedy of the Commons and Stag Hunt (Binmore 2007).

Then the question is: what determines transaction costs? Physio-geography is clearly a non-trivial source of transaction costs. Early societies, in particular, confronted substantial constraints and prohibitive costs due to geographical features.<sup>7</sup> Nunn and Puga (2012) explain that terrain ruggedness makes transportation and construction costly, reduces profits for agriculture, and is negatively related to income per capita. The provision of rule of law also requires not only enacting laws and codes, but also monitoring and enforcing them and, for that, the state needs to establish courts and maintain their operation. Organisational costs of such operations are higher in settings characterised by difficult topography.

Along these lines, several World Bank reports for Latin America argue that rugged terrain imposes serious constraints on the region due to difficulties associated with the delivery of infrastructure and basic services (World Bank 2009).<sup>8</sup> In addition, Dell (2010) documents the persistent negative effects of past institutions, designed on the basis of terrain ruggedness, on current levels of consumption in Peru. The *mita*, an institution characterised by a forced labour system in silver mines, was imposed by the Spanish colonisers only in places surrounded by mountains, so that the native population could not escape. Dell demonstrates that current consumption is 25 per cent lower in areas where *mita* was in place. She illustrates how physio-geography can have persistent effects on current levels of development. Extending this reasoning to state capacity, rugged terrain can increase transaction costs, deterring cooperation for the provision of public goods.<sup>9</sup>

Another strand in the literature highlights the role of terrain ruggedness in civil conflicts. It is well known that mountainous topography increases the likelihood or duration of civil war by providing rebels with advantage and

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<sup>7</sup> Stasavage (2010, p. 628) cites several sources on how tough geography led to absenteeism in assembly meetings or complaints by assembly members about prohibitive travel costs in early European polities.

<sup>8</sup> Ulubasoglu and Cardak (2007) find that landlocked countries, which are generally mountainous, exhibit higher inequality between rural and urban educational attainment due to difficulties associated with public service delivery to rural areas.

<sup>9</sup> Topography can also impede private sector development, which can in turn affect the demand for infrastructure or the 'supply of tax revenues'. In our analysis this issue is addressed by controlling for the size of government ('1 - private sector size') where appropriate.

negatively affecting military operations (Buhaug, Gates & Lujala 2009; Fearon & Laitin 2003). Examples relating to Colombia, Algeria, Peru, Cuba and Afghanistan are well documented (Acemoglu, Ticchi & Vindigni 2010; Arreguín-Toft 2001).<sup>10</sup>

A final aspect of rugged topography is that its negative consequences can be alleviated, if not reversed, through engineering. A case in point is Switzerland. Though not all rugged countries are as successful as this country, it is reasonable to expect that an average country would try to overcome certain forms of ruggedness. Further, some levels of ruggedness may provide certain advantages over a smoother terrain (e.g. productivity of certain crops), or spatial segregation may motivate cooperation among settlements up to some level of topographic difficulty (e.g. sharing a river or building a road for common use). All of these imply that adverse consequences of ruggedness may start being observed after a point, in which case ruggedness may exert a non-linear influence on state capacity.

### **2.2.3. Inability to Commit**

Another dimension of a state's strength is its ability to commit. This commitment is often required for implementing policies that concern a broad cross-section of the public. This requires first a broad agreement on the part of the constituents about the policy, and second, cooperation for the implementation and maintenance of the policy. Inability to commit is a particularly observable, but not directly measurable, symptom of a weak state.

North, Wallis and Weingast (2009, p. 46) argue that fragile states, or, in their definition, the natural state, 'has a limited ability to make commitments about the future'. By contrast, modern states have a complete set of rules and constraints that allow them to make credible long-term commitments. In the theory of conflicts, credibility is embedded in pacts. Usually, pacts in modern states are enduring, because associated laws, institutions, separation of powers,

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<sup>10</sup> Similarly, Herbst (2000) argues that colonisers conquered territories to the extent that benefits from expansion did not offset the costs.



and checks and balances make the pacts credible. For example, Uganda has experienced more than six civil internal wars in the last 40 years. After each dispute is settled, a new one emerges because parties involved in the conflict cannot make credible commitments, and break the ‘pacts’.<sup>11</sup>

An obvious sphere in which to observe the inability to commit is unstable monetary and fiscal policies that lead to inflationary pressures. It is generally agreed that rulers have strong incentives to increase short-term employment by fuelling the economy with money. This, in turn, influences future expectations about inflation, creating a dynamic inconsistency problem. To avoid such a dilemma, the institutional framework must generate correct incentives to governments and central bankers to adopt credible policies (Blinder et al. 2008). Thus, a state that is able to commit to a sustained monetary policy would produce a low inflation rate over time. Inability to commit to policies expands also into areas such as fiscal policy, debt management, and even deterrence.

### **2.3. Data and Methodology**

As noted earlier, the concept of state capacity transcends income, political systems, colonialism and geographic location. Given the multidimensionality and complexity of the topic, it is difficult to separate the causes and consequences of state fragility. Besley and Persson (2010) state that some indexes used to measure state fragility mix causes and symptoms and, therefore, using such indexes to derive statistical inferences attracts strong reservations. Since state capacity cannot be observed directly, it is not advisable to use traditional statistical tools to make inferences. However, researchers can observe its outcomes, such as civil conflict, inflation and the size of the underground economy. Thus, state capacity fits the definition of a latent variable and, so, can be analysed using a latent variable model. One can analyse whether a state possesses a weak or strong capability through an index

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<sup>11</sup> Acemoglu (2005) states that, in consensually strong states, it is the credibility of the state’s commitment to redistribution policy that allows for higher taxation.

function with appropriate manifest variables, where, with suitable indicators of state fragility, the index function would be  $\beta_0 + \beta_1 TRI$ , moderating the probability of a weak state occurring if the threshold 0.5 is exceeded. Therefore, the index function captures, usefully, the underlying mechanism that leads to the observed outcome, either high-type or low-type (i.e. strong or weak state capacity). A clear alternative is the continuous treatment of state capacity indicators and, hence, a linear estimation. The implications of this choice are checked in Appendix A1.<sup>12</sup> An additional econometric difficulty is the inability to observe collective action itself. While its determinants and outcomes are known, it is difficult to summarise collective action in a variable. Consequently, our latent variable model takes a reduced form.

Formally,

$$Y_i^* = \alpha + \beta X_i + \varepsilon_i \quad (1)$$

Where  $Y_i^*$  is the latent variable representing state capacity,  $X_i$  are the manifest variables, and  $\varepsilon_i$  is the error term.  $Y_i^*$  is defined as follows:

$$Y_i = \begin{cases} 1, & \text{if } Y_i^* > \bar{Y}^* \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

where  $Y$  has the following probability:

$$\Pr(Y_i = 1 | X_i) = \Phi(\beta X_i) \quad (3)$$

which we estimate with a logit model.<sup>13</sup>

To test our principal hypothesis that terrain ruggedness impedes cooperation in collective action and reduces state capacity, we estimate the following index function:

$$Y_i^* = f(\text{terrain ruggedness}_i (TRI), Z_i) \quad (4)$$

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<sup>12</sup> For instance, an extra mountain contributing to state capacity by X per cent is a difficult inference to make.

<sup>13</sup> Only the average marginal effects are presented here. Logit estimates are available upon request.

where  $Y_i^*$  captures state capacity for country  $i$ , and  $Z$  is a vector of controls as discussed below. This essay utilises four indicators to measure  $Y_i^*$ : (i) the average inflation rate over the period 1960 to 2009, (ii) the rule of law averaged over the period 1996 to 2010, (iii) tax revenue/GDP averaged over the period 1990 to 2009, and (iv) the presence of civil war over the period 1975 to 2010.

Specifically, if average inflation over the 50-year period exceeds a certain threshold, this signals the state's inability to commit to policies. The benefit of using inflation as a proxy for state capacity is three-fold. First, it is a good proxy for the commitment to stable monetary and fiscal policy. North, Wallis and Weingast (2009) argue that many weak states have experienced periods of high inflation due to self-imbalances that have not been addressed properly. Second, weak states frequently resort to inflation tax (Besley & Persson 2009; 2010; Levi 1989; Tilly 1992). Third, inflation is a public good. When inflation is low, relative prices are more stable and hence individuals and firms face less uncertainty.

We use a 10 per cent inflation rate as the threshold to construct the latent variable indicator. While sensitivity to this threshold is tested to check for robustness, 10 per cent appears to represent a well-accepted figure.<sup>14</sup> Essentially, while moderate inflation may be acceptable over growth periods, no country with stable monetary and fiscal policy would score an average inflation rate higher than 10 per cent over a 50-year period.

The second state capacity indicator is the rule of law and is obtained from Kaufmann, Kraay and Mastruzzi (2010). North, Wallis and Weingast (2009) posit that the rule of law is characterised by credible commitments between all members of a society, including rulers and citizens. The concept has two main components: (i) the state provides protection to its citizens from the abuse of other citizens, and (ii) the state prevents itself from behaving in a predatory manner towards its constituents. Thus, the rule of law is a public good. Given

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<sup>14</sup> Fischer (1996) emphasises that double-digit figures of inflation are unfavourable for growth. Khan and Senhadji (2001) find that an inflation rate above 11 per cent is harmful to growth in developing countries.

the way this index is constructed, the mean value, 0, is adopted as the threshold for the latent variable.

The third indicator is tax revenue as proportion of GDP, following the reasoning of Levi (1989) and Tilly (1992). Tax collection is a broader measure of state capacity, indicating the extent to which the state can extract revenue from its constituents and enforce tax legislation and tax compliance. This indicator also signals the scope of the state; minimalistic states would prefer to have lower taxes than interventionist states. Note, however, that minimalistic states should not be confused with weak states.<sup>15</sup> We use a threshold level of 15 per cent, a figure close to the mean observed in the sample. A threshold level of 17 per cent is also used to check robustness.

The last indicator is the presence of civil war, taken from the Upssala Conflict Data Program and International Peace Research Institute UCDP/PRIO Armed Conflict Dataset. This variable captures the inability to peacefully resolve disputes among a state's constituents. A civil war reflects a lack of social contract, a characteristic of weak states.<sup>16</sup> Our latent variable equals 1 if there have been one or more incidents of civil war in that country between 1975 and 2010, and 0 otherwise.

On a comparative note regarding the outcome variables, a distinct feature of inflation is that, while other state capacity outcomes are all affected by both the 'lack of cooperation' and 'physical obstacle' consequences of rugged terrain (e.g. the use of the terrain by civil insurgencies), the inability to commit is abstracted from the latter dimension and reflects only the lack of cooperation and collaboration among the constituent groups of the state.

The main control variable included in *Z* is the ethnic fractionalisation index (EF) developed by Alesina et al. (2003). The role of ethnic fractionalisation in state capacity is well-established (Alesina, Baqir & Easterly 1999; Besley &

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<sup>15</sup> Our measure does not include contributions to social security as part of the tax revenue, so it more accurately reflects the real strength capacity of states to collect taxes.

<sup>16</sup> On wealth inequalities between politically relevant ethnic groups and ethnic conflict, see Cederman, Weidmann and Gleditsch (2011).

Persson 2009). Consequently, we include this index in all models.<sup>17</sup> Other control variables are described in the results discussion below. The main sample consists of 190 independent countries around the world. Definitions and sources of the data are provided in Appendix A2.

## 2.4. Empirical Results

This section discusses the relationship between the latent indicators and the main independent variables; summary statistics are presented in Table 1. Figures 1a to 1d display the nonparametric relationships between the latent and independent variables. Some observations appear to be influential. Since logit regression uses numerical methods to approximate the solution, influential observations could seriously distort the behaviour of the maximum likelihood estimator (Bondell 2005). Accordingly, influential observations are trimmed.<sup>18</sup> Visual inspection of Figures 1a to 1d shows a potentially non-linear relationship between the latent variables and the terrain ruggedness index (TRI). We investigate whether these visual checks hold in the next subsections.

### 2.4.1. Inflation

Estimation results of Equation 3, using inflation as the latent variable, are presented in Table 2. The linear effect of TRI is investigated first. Column 1 suggests that this choice performs poorly for the entire sample. In Column 2, a non-linear specification improves the fit, and the effect of TRI is estimated to be statistically significant. Coupled with the information in Figure 1a, this non-linear effect implies that countries attempt to take advantage of ruggedness up to a point, but after that point, the geographical characteristic becomes

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<sup>17</sup> As an alternative fractionalisation phenomenon, we have considered linguistic fragmentation because language differences may pose a challenge to cooperation in collective action, but this variable has been estimated to be largely insignificant. This finding is consistent with the literature on ethnic fractionalisation above, suggesting that ethnicity matters more as a barrier to cooperation and that language differences can be overcome, at least for basic communication.

<sup>18</sup> Outliers are identified using influential analysis for binary models. Specifically, we make use of the Pregibon delta beta influence statistic to determine influential observations. This statistic is the counterpart for binary models of the traditional Cook's distance used in least square models.

inhibiting. The mean of the individual marginal effects in Column 2 is positive, indicating, on average, a detrimental effect on state capacity. Column 3 presents the results without Tajikistan, an outlier observation, where all estimated coefficients are statistically significant as before. Effectively, one standard deviation increase in TRI increases the likelihood of a high-inflation regime by 13 per cent. To investigate whether these results are driven by a specific region, countries in Africa, Asia, Europe and Latin America are eliminated one at a time. Columns 4 to 7 report that the results hold for all regions but Asia.<sup>19</sup> This is not surprising given that many countries located in this part of the world are weak and rugged. In Column 10, our core factor is tested for its ability to predict state capacity within developing countries and former colonies, or when excluding small countries. Our predictor remains highly robust after these exercises.

Another concern is the potential concentration of weak states in some regions, such as Africa, resulting in standard errors being artificially lowered. Statistically speaking, this problem could result in spatial correlation of the residuals. Clustering standard errors by regions, Column 11 shows that the estimates remain significant (this issue is revisited in Section 2.5.1). Columns 12 to 14 add additional controls such as colonial origins,<sup>20</sup> legal origins and latitude<sup>21</sup> to control for particular institutions arising historically that affect a state's strength. Our main variable remains robust.

Overall, the findings highlight clearly that TRI is a significant predictor of inflation performance, suggesting that rugged topography deters coordination, resulting in an inability to commit and thus giving rise to a weak state.

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<sup>19</sup> For a within-Africa or -Asia regression, a higher sample size is needed given the estimation methodology.

<sup>20</sup> The year of independence is also included to control for different waves of decolonisation. Acemoglu et al. (2008) use this variable to distinguish extractive from settlement colonies and Olsson (2009) uses it to differentiate the two main waves of colonisation.

<sup>21</sup> Although latitude is different from climate variables (e.g. rainfall, extreme weather, number of seasons), several well-known studies have made use of latitude or distance to the equator as a proxy to summarise the average climate experienced in a country (see mainly Frankel & Romer 1999).

### 2.4.2. Rule of Law

Table 3 presents a diverse set of results using rule of law as the outcome variable. Column 1 shows a regression with a linear predictor; estimates are not significant. The next specification, Column 2, adds a quadratic term for TRI. The main predictor is statistically significant, and the sign anticipated. Influential analysis was performed to verify whether some observations were driving the results. A visual inspection of Figure 2b suggests that Andorra, Lesotho, and Monaco might potentially affect the estimation. Column 3 finds that removing these observations improves the results. The estimates in Table 3 suggest that a one standard deviation increase in TRI increases the likelihood of a low-rule of law regime by 11 per cent. Since rule of law is also a public good that needs to be constantly funded, its provision is highly affected by ongoing transaction costs. Thus, the results show that more rugged countries are less prone to sustaining law and order, all else constant.

As in Section 2.4.1, countries in Africa, Asia, Europe and Latin America are eliminated one at a time to check whether the results are driven by specific geographic characteristics. The estimates, reported in Columns 4 to 7, are highly significant. Columns 8 to 10 utilise only developing countries, only former colonies, and exclude small countries, respectively, and the results remain robust. Column 11 presents the estimates with clustered standard errors by regions. Columns 12 to 15 add additional controls to the baseline regression and all results indicate the strong and robust predictive power of rugged physio-geography for state capacity as proxied by the rule of law.

Olsson and Hansson (2011) argue that the maintenance of the rule of law depends on the size of the country since it is more difficult to broadcast power from the capital to other regions. Therefore, the size of the country was added as an additional control in the baseline regression. Results show that TRI remains statistically significant.<sup>22</sup>

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<sup>22</sup> No interaction effects between country size and TRI were found, meaning that the effect of ruggedness is invariant to country size. Results are not presented here but are available upon request.

### 2.4.3. Tax Revenue/GDP

Table 4 displays the results using tax revenue/GDP as the outcome variable proxying the capability of the state to collect taxes. Column 1 reports a regression with linear predictors; estimates are significant, although TRI is significant only at 10 per cent. The next specification adds a quadratic term for TRI to check whether there is a non-linear relationship. As the results are not statistically significant, the linear specification is preferred. Beginning with Column 3, initial government expenses<sup>23</sup> are controlled for, since the scope of tax collection ultimately depends on government size. Controlling for this variable, the results are statistically significant. The test of influential observations reveals no country that may be of concern. Results eliminating Africa, Asia, Europe and Latin America one at a time are displayed in Columns 4 to 7, all of which are statistically significant, except, as above, when Asia is removed. Columns 8 to 10 utilise only developing countries, only former colonies, and exclude small countries, respectively. The results remain robust, except for only former colonies.<sup>24</sup> Column 11 presents the estimates when using clustered standard errors by regions. Columns 12 to 15 add additional controls to the baseline regression. All results remain robust after these exercises. Marginal effects are highly consistent across the columns, suggesting that a one standard deviation rise in TRI increases the likelihood of poor-tax collection regime (i.e. being a weak state, by 6%). In posterior robustness checks, the cut-off point that defines a state as weak was increased to 17 per cent; however, TRI is not significant.<sup>25</sup> The differing strength of TRI in this circumstance may indicate that tax collection performance in a country is driven by other factors in addition to TRI.

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<sup>23</sup> Initial government size corresponds to the average of government expenditure/GDP between 1985 and 1989. Incorporating further years into the regression can lead to reverse causality.

<sup>24</sup> Again, the loss in significance could be caused by a reduction in sample size.

<sup>25</sup> Results are available upon request.



#### 2.4.4. Presence of Civil War

Results using the presence of civil war as the latent indicator of state fragility are displayed in Table 5. Column 1 shows marginal effects using a linear model in predictors. A quadratic term for TRI is added in Column 2, providing even more significant estimates. Figure 2b suggests that Tajikistan might be an influential observation. Removing this observation in Column 3 does not drastically change the estimates. Results eliminating Africa, Asia, Europe and Latin America one at a time are displayed in Columns 4 to 7, respectively, all of which are statistically significant. Columns 8 to 10 show that relationships are significant within developing countries, former colonies and when excluding small countries. Column 11 presents the estimates when using clustered standard errors by regions. Columns 12 to 15 add additional controls to the baseline regression. All results remain robustly significant after these exercises. Marginal effects are highly consistent across the columns, suggesting that a one standard deviation rise in TRI increases the likelihood of a high civil conflict regime by 20 per cent.

#### 2.4.5. Early Urbanisation as a Transmission Mechanism

So far we have focused on the direct predictive power of TRI on state capacity in a reduced form framework. However, we cannot say anything about the mechanisms through which this relationship establishes itself. It is likely that physio-geography affects the very devices or platforms that facilitate the building of state capacity and the maintenance of its operations. While there might be several such channels, we focus on early urbanisation (i.e. in 1900). The central reasoning here is that rugged terrain may delay the urbanisation process, with the latter forming the ‘bridge’ for TRI to affect state capacity.

The effect of the initial pattern of urbanisation on state formation in Europe has been subject to numerous scholarly works (Stasavage 2010). The novelty in our approach is to generalise this argument to a large group of countries and test it empirically as an explicit mechanism between TRI and several state capacity measures. There are two possible dimensions of early urbanisation

that may facilitate stronger states today. First, building up cities (i.e. urbanisation) *per se* requires that citizens choose to stay in a specific urban area and not to exit. Urbanised societies are more likely to have solved their tax collection problem, and have better infrastructure and connectivity. This is because minimal organisational costs, for which the cost of the first unit of collective good will be exceedingly high in relation to the cost of the subsequent units, are more likely to be borne in an urban setting (Olson 1971). It is also well documented that urban centres typically do not exhibit self-sufficient production patterns and, therefore, need to exchange and cooperate with other polities in order to endure. Economic gains from trade, specialisation and agglomeration determine this ability for urban centres. In addition, in various parts of the world, urban settlements were granted some degree of autonomy to self-manage their laws, rules and even taxes. Thus, cities (i.e. those with a ‘sizeable’ population) are considered a cooperation success (Glaeser 2011). Urbanisation is also likely to yield stronger political organisation through labour unions, churches, universities and professional associations. In general, organisational capital, which is needed to build and sustain a state, is likely to emerge in an urbanised society.

The second effect is related to the ‘earliness’ of this phenomenon. That is, for early urbanised societies, the timeframe considered becomes larger such that there is a longer period over which organisational capital can emerge, and in stronger terms. Therefore, our hypothesis from this discussion is that all else being equal, rugged terrain delays the urbanisation process and such societies are less likely to have strong states today.

In light of this, we first test whether TRI can explain early urbanisation, and whether early urbanisation can, in turn, predict the measures capturing state capacity.<sup>26</sup> Results are displayed in Table 6. Columns 1 and 2, using least squares estimation, document strongly that TRI is negatively related to

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<sup>26</sup> Data for urbanisation in 107 countries in 1900 were obtained from Chandler (1987). The data are for settlements with populations above 40,000. If a country has no such settlement, then the urbanisation rate of that country was assumed to be 0. This assumption is addressed in the regressions by controlling for those observations with a dummy. Data for countries’ total population to calculate the urbanisation rate were obtained from McEvedy and Jones (1978).

urbanisation in 1900, even after several controls. That is, the more rugged the country, the less urbanised it was in 1900. This is a critical finding, since early urbanisation may also be related to initial institutions. Therefore, this result can shed some light on the importance of physio-geography for initial institutions that matter for current outcomes (Stasavage 2010). The next question is whether the extent of early urbanisation represents a country's ability to act collectively today. Columns 3 to 5 show that such a channel effect does not exist when inflation is regarded as the state capacity outcome. Given the insignificance of TRI and early urbanisation, it is possible to suggest that TRI has a unique direct effect on state capacity.

However, Columns 6 to 8, presenting the predicted probabilities for the rule of law, show that early urbanisation and TRI remain good predictors of the latent variable, as before. This means that TRI has two effects in place: a direct effect on the rule of law and an indirect effect working through early urbanisation. Columns 9 to 11 document only a direct effect of TRI on outcomes of state capacity. Last, controlling for several variables, early urbanisation has the predicted negative effect on the presence of civil war, with a z-statistic of -1.85. When TRI is included in the model, this effect is almost completely washed out, meaning that there is at least some effect working through our suggested channel.

## **2.5. Robustness Checks**

### **2.5.1. Statistical Independence and Spatial Spillovers in State Capacity**

If bordering countries share similar terrain characteristics, then each country may not necessarily constitute a statistically independent observation. For instance, the whole of Africa may very well be regarded as a few independent data points based on physio-geography (e.g. many countries share the Sahara

desert). This suggests that spatial spillovers may exist in state capacity between neighbouring countries based on geographical characteristics.<sup>27</sup>

To test for a global spatial autocorrelation of state capacity, Moran's I test for TRI was performed using a contiguity matrix—entries are 1 for countries sharing a common land border, and 0 otherwise.<sup>28</sup> The Moran's I statistic for the sample is equal to 0.274, with a z-score of 5.019 and a p-value of 0.01, suggesting global spatial autocorrelation. We address this problem by incorporating the spatial dimension of TRI in the estimation.<sup>29</sup> Thus, Equation 1 becomes:

$$Y_i^* = f(TRI_i, EF_i, WQ_j, Z_i) \quad (5)$$

where  $W$  is a spatial weight matrix. To obtain  $W$ , we use a contiguity matrix weighted by neighbour's surface area.  $Q_j$  are neighbours' terrain. A significant estimate for  $\phi$  would indicate possible spatial spillovers across bordering countries. The average marginal effects of Equation 5 using neighbours' ruggedness are shown in Table 7. In general, no evidence is found for neighbours' ruggedness affecting country outcomes directly. Even with the inclusion of neighbours' ruggedness, the main predictors maintain their explanatory power. Thus, our confidence in the statistically significant estimates in Tables 1 to 4 is increased.

### 2.5.2. Other Possible Mechanisms

The main idea behind this essay is to use the collective action theory to explain the formation of a state. However, a state may be formed in other ways too. For instance, a society may start out with an elite dominance of the political scene and citizens may simply be inactive players (Acemoglu & Robinson 2008). To isolate the collective action channel as much as possible, we include in the regressions land gini at independence. Despite being an imperfect measure of

<sup>27</sup> See also Ades and Chua (1997) and Murdoch and Sandler (2004) for negative consequences of social unrest and civil wars that spread spatially across countries.

<sup>28</sup> Data are obtained from Mayer and Zignago (2005).

<sup>29</sup> This subsection does not try to answer if there are spillover effects of state capacity among countries but whether or not there are spill-over effects of terrain ruggedness.

the power of elites,<sup>30</sup> this variable's inclusion in Equation 1 does not greatly alter the standard errors of TRI (Panel A in Table 8).

Another possible mechanism is related to artificial states. Although we have controlled for colonial legacy as the main factor behind this phenomenon, artificial political boundaries that do not coincide with 'natural' ethnic divisions on the field may blur our collective action story; see Alesina, Easterly and Matuszeski (2011) for a systematic, innovative treatment of these states. We incorporate their fractal measure of artificial states into our main equation, but this does not change the thrust of our results (Panel B in Table 8).<sup>31</sup>

Regime type might also blur the 'mapping' from collective action to state capacity. For instance, lack of collective action might lead to an autocrat taking over the reign of the country, who might, in turn, establish a strong state. We test whether TRI explains constraints on the executive at independence, with the latter being a measure of the regime type, but find no significant link to initiate the concerned mechanism (Panel C in Table 8).<sup>32</sup>

## 2.6. Conclusions

Traditionally, the state has been conceived as an organisation that is able to implement any type of policy. However, constraints related to its own capacity have generally been disregarded. Accordingly, a recent research agenda has begun investigating the main determinants of state capacity (Acemoglu 2005; Besley & Persson 2009; 2010; 2011a; 2011b). Considering that the success of

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<sup>30</sup> Admittedly, the empirics of such a channel can be more complex given interaction effects that may exist. For instance, initial political inequality could shape the initial set of institutions, coalitions, bureaucracy and military. A more elaborate analysis needs to consider the interactions between political regime, elite strength, mass formation, and the like.

<sup>31</sup> The fractal measure is estimated to be insignificant in three cases, thus, it is justifiable to remove it from those equations. The reduction in the standard error of TRI when the fractal measure is included in the rule of law equation is contributed by the reduced sample size.

<sup>32</sup> The validity of our core argument from an historical point of view primarily relies on the evidence provided by Stasavage (2010) for Europe during 1250–1750. Still, it would be desirable to investigate TRI's explanatory power on historical state capacity. Historical series on state capacity measures are, unfortunately, not available for many countries. Although it would not replace this shortcoming, repeating the analysis above for only contemporary *developed* countries, yields, as anticipated, much less significant evidence, reflecting a weaker link between state capacity and 'initial conditions' in that set of countries.

the state depends on cooperation, ability to commit, and provision of public goods, this essay indicates an exogenous feature that can affect cooperation in collective action: physio-geography. This study's analysis provides robust and clear evidence that terrain ruggedness, representing physio-geography, plays critical role in a state's capacity. Exploiting sizeable variations in the topography of countries around the world, we document, using a latent variable model, that this factor strongly predicts state capacity outcomes today, such as inflation, rule of law, tax collection, and presence of civil war. This evidence is robust across other estimation approaches and consistent with the collective action theory, whereby transaction costs generated by terrain ruggedness constitute major setbacks to act collectively.

The essay next demonstrated that early urbanisation, an intermediate outcome of collective action, forms a significant mechanism for the observed relationship between terrain ruggedness and state capacity. More specifically, countries that urbanised in the relatively distant past to develop the necessary infrastructures and organisations to live together in large settlements can maintain a stronger state apparatus that can provide improved public goods provision. While there may be other possible mechanisms involved, such as social trust and land distribution, their effects are likely to be more nuanced in that they may interact with other variables, such as the power of the elites, history, and other initial conditions. These mechanisms, together with other underlying factors, can be a fruitful research avenue for the empirics of state capacity.

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## Tables and Figures

Table 1. *Descriptive Statistics for Latent Variables*

	(1)	(2)	(3)	(4)
Variables	Inflation	Rule of law	Tax revenue/GDP	Years in civil war
Mean	44.19	-0.07	16.47	0.26
Standard deviation	107.61	0.97	7.5	0.79
Percentiles %				
0	3.72	-1.27	8.14	0
25	5.22	-0.85	11.4	0
50	8.49	-0.24	15.23	0
75	18.57	0.61	21.03	0
90	124.11	1.38	25.35	1.01
Obs.	186	191	148	160

Table 2. *Average Marginal Effects; Dependent Variable:  $Y = 1$  if Inflation > 10%; 0 Otherwise*

Variables	(1) Linear	(2) Baseline	(3) Baseline	(4) Baseline	(5) Baseline	(6) Baseline	(7) Baseline	(8) Baseline	(9) Baseline	(10) Baseline	(11) Baseline with clustered std. errors	(12) Baseline controlling for colonial origins	(13) Baseline controlling for legal origins	(14) Baseline controlling for latitude	(15) Baseline with all controls
TRI	0.00555 (0.210)	0.0951** (2.358)	0.0983** (2.372)	0.0806* (1.878)	0.0729 (1.372)	0.122** (2.536)	0.111** (2.491)	0.0832* (1.680)	0.144** (2.435)	0.101** (1.984)	0.0983** (2.433)	0.0748* (1.764)	0.0862** (1.982)	0.0989** (2.379)	0.0540 (1.333)
EF	0.262** (1.974)	0.352*** (2.634)	0.346*** (2.594)	0.267 (1.432)	0.395*** (2.885)	0.385** (2.418)	0.363** (2.565)	0.307* (1.937)	0.530*** (3.050)	0.254 (1.618)	0.346*** (3.680)	0.384*** (2.847)	0.489*** (3.464)	0.359** (2.549)	0.434*** (3.139)
Ind. Year												0.00140** (2.425)			0.000875 (1.462)
Colony: SPA												0.130			0.0642
Colony: GBR												(1.019)			(0.433)
												-0.313***			-0.162
Colony: FRA												(-4.353)			(-1.536)
												-0.339***			-0.321***
Legal: GBR												(-2.836)			(-2.747)
													-0.404***		-0.468***
Legal: FRA													(-5.222)		(-3.724)
													-0.287***		-0.330***
Latitude													(-3.424)		(-3.113)
														0.000523	-0.0047***
Observations	182	182	181	129	139	141	148	147	116	152	181	181	180	181	180
Sample	All	All	All excluding influent obs.	All excluding obs. & Africa	All excluding influent obs. & Asia	All excluding influent obs. & Europe	All excluding influent obs. & Latin America/ Caribbean	Developing countries	Former colonies	All excluding small countries	All excluding influent obs.	All excluding influent obs.	All excluding influent obs.	All excluding influent obs.	All excluding influent obs.

Notes. Robust z-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

(a) Column 1 presents the linear prediction of TRI and EF on the dependent variable. Column 2 introduces the square of TRI as a predictor. Column 3 is the baseline specification. Column 4 eliminates African countries from the sample. Column 5 eliminates Asian countries from the sample. Column 6 eliminates European countries from the sample. Column 7 eliminates Latin America and Caribbean countries from the sample. Column 8 uses a sample consisting of developing countries—those countries that are not part of the Organisation for Economic Cooperation and Development (OECD). Column 9 uses a sample consisting of former colonies categorised as such by Olsson (2009). Column 10 shows estimates for the baseline specification using standard errors corrected by clusters. Clusters correspond to the following regions: Asia, Europe, North America, South America and Oceania. Column 12 controls for colonial origins and independence year using Olsson (2009) and Acemoglu et al. (2008). Column 13 controls for legal origins using La Porta, Lopez-de-Silanes and Shleifer (2008). East Timor legal origin is coded as French. Legal origin for Palau is not specified. Column 14 controls for latitude. Column 15 uses all controls.

(b) Columns 3–16 eliminate Tajikistan since it is an influential observation.

Table 3. *Average Marginal Effects; Dependent Variable:  $Y = 1$  if Rule of Law  $> 0$ ; 0 Otherwise*

Variables	(1) Linear	(2) Baseline	(3) Baseline	(4) Baseline	(5) Baseline	(6) Baseline	(7) Baseline	(8) Baseline	(9) Baseline	(10) Baseline	(11) Baseline with clustered std. errors	(12) Baseline controlling for colonial origins	(13) Baseline controlling for legal origins	(14) Baseline controlling for latitude	(15) Baseline with all controls
TRI	-0.00354 (-0.115)	-0.0835** (-2.243)	-0.0921** (-2.395)	-0.124*** (-3.063)	-0.0743* (-1.683)	-0.0844* (-1.864)	-0.0905** (-2.083)	-0.118*** (-2.620)	-0.0997* (-1.779)	-0.0950** (-2.256)	-0.0921** (-1.977)	-0.0789** (-2.186)	-0.0660 (-1.617)	-0.0906** (-2.433)	-0.0634* (-1.818)
EF	-0.710*** (-7.464)	-0.790*** (-8.390)	-0.820*** (-9.005)	-0.688*** (-4.258)	-0.879*** (-12.50)	-0.663*** (-5.519)	-0.784*** (-7.851)	-0.601*** (-4.805)	-0.643*** (-4.947)	-0.798*** (-8.286)	-0.820*** (-5.676)	-0.683*** (-6.665)	-0.823*** (-8.139)	-0.783*** (-7.908)	-0.686*** (-6.150)
Ind. Year												-0.0015*** (-3.354)			-0.00103** (-2.042)
Colony: SPA												-0.363*** (-3.474)			-0.280*** (-2.736)
Colony: GBR												0.190*** (3.008)			0.159 (1.288)
Colony: FRA												-0.421*** (-2.794)			-0.445*** (-3.149)
Legal: GBR													0.264*** (3.373)		0.220 (1.586)
Legal: FRA													0.0174 (0.225)		0.206** (2.171)
Latitude														0.00183 (1.248)	0.00353** (2.079)
Observations	187	187	184	133	140	144	151	150	117	155	184	184	183	184	183
Sample	All	All	All excluding influential obs.	All excluding influential obs. & Africa	All excluding influential obs. & Asia	All excluding influential obs. & Europe	All excluding influential obs. & Latin America/ Caribbean	Developing countries	Former colonies	All small countries	All excluding influential obs.	All excluding influential obs.	All excluding influential obs.	All excluding influential obs.	All excluding influential obs.

Notes. Robust z-statistics in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

(a) Same as Note (a) in Table 2.

(b) Columns 3–16 eliminate Andorra, Lesotho and Monaco since they are influential observations.

Table 4. *Average Marginal Effects; Dependent Variable:  $Y = 1$  if  $Tax/GDP > 15\%$ ; 0 Otherwise*

Variables	(1) Linear	(2) Baseline	(3) Baseline	(4) Baseline	(5) Baseline	(6) Baseline	(7) Baseline	(8) Baseline	(9) Baseline	(10) Baseline	(11) Baseline with clustered std. errors	(12) Baseline controlling for colonial origins	(13) Baseline controlling for legal origins	(14) Baseline controlling for latitude	(15) Baseline with all controls
TRI	-0.0523* (-1.731)	-0.0537 (-1.102)	-0.0499** (-2.051)	-0.0665** (-2.102)	-0.0159 (-0.462)	-0.0488* (-1.719)	-0.0508** (-2.009)	-0.0524* (-1.862)	-0.0218 (-0.598)	-0.0603** (-2.335)	-0.0499** (-2.514)	-0.0452* (-1.823)	-0.0450* (-1.681)	-0.0504* (-1.845)	-0.0486* (-1.722)
EF	-0.66*** (-4.905)	-0.66*** (-4.616)	-0.538*** (-4.221)	-0.544*** (-2.823)	-0.531*** (-3.740)	-0.484*** (-3.102)	-0.574*** (-4.376)	-0.472*** (-2.986)	-0.626*** (-3.983)	-0.524*** (-3.980)	-0.538*** (-7.174)	-0.587*** (-4.194)	-0.683*** (-5.401)	-0.638*** (-5.341)	-0.737*** (-5.236)
Init. gov. size			0.0277*** (4.623)	0.0232*** (3.237)	0.0358*** (6.147)	0.0284*** (4.250)	0.0234*** (3.340)	0.0295*** (4.253)	0.0360*** (4.949)	0.0276*** (4.642)	0.0277*** (3.936)	0.0224*** (3.114)	0.0250*** (3.749)	0.0311*** (4.601)	0.0267*** (3.676)
Ind. Year												7.68e-05 (0.0895)			0.000292 (0.365)
Colony: SPA												0.00474 (0.0367)			-0.180 (-1.237)
Colony: GBR												0.199* (1.783)			-0.131 (-0.698)
Colony: FRA												0.0266 (0.195)			-0.103 (-0.702)
Legal: GBR													0.399*** (3.768)		0.405*** (2.059)
Legal: FRA													0.232** (2.214)		0.238* (1.884)
Latitude														-0.0041*** (-2.840)	-0.00289 (-1.549)
Observations	127	127	127	90	97	100	101	96	82	113	127	127	127	127	127
Sample	All	All	All	All	All	All	All	Developing countries	Former colonies	All	All	All	All	All	All
			excluding influential obs.	excluding influential obs. & Africa	excluding influential obs. & Asia	excluding influential obs. & Europe	excluding influential obs. & LAC	excluding influential obs.	excluding small countries	excluding influential obs.	excluding influential obs.	excluding influential obs.	excluding influential obs.	excluding influential obs.	excluding influential obs.

Notes: Robust z-statistics in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ 

(a) Same as Note (a) in Table 2.

(b) Columns 3–15 control for initial government size.

Table 5. *Average Marginal Effects; Dependent Variable:  $Y = 1$  if Presence of Civil War; 0 Otherwise*

Variables	(1) Linear	(2) Baseline	(3) Baseline	(4) Baseline	(5) Baseline	(6) Baseline	(7) Baseline	(8) Baseline	(9) Baseline	(10) Baseline	(11) Baseline with clustered std. errors	(12) Baseline controlling for colonial origins	(13) Baseline controlling for legal origins	(14) Baseline controlling for latitude	(15) Baseline with all controls
TRI	0.0649** (2.134)	0.149*** (4.293)	0.152*** (4.329)	0.128*** (4.180)	0.159*** (3.373)	0.166*** (3.588)	0.155*** (4.103)	0.179*** (4.079)	0.191*** (3.280)	0.156*** (4.222)	0.152*** (7.685)	0.142*** (3.961)	0.152*** (4.292)	0.150*** (4.288)	0.145*** (3.960)
EF	0.476*** (3.747)	0.585*** (4.351)	0.578*** (4.303)	0.489*** (3.234)	0.583*** (3.609)	0.509*** (2.864)	0.614*** (4.467)	0.507*** (2.850)	0.335 (1.538)	0.573*** (4.075)	0.578*** (7.501)	0.605*** (4.333)	0.527*** (3.806)	0.551*** (3.897)	0.532*** (3.855)
Ind. Year												-0.000320 (-0.590)			-7.16e-05 (-0.112)
Colony: SPA												0.0222 (0.202)			-0.00986 (-0.0840)
Colony: GBR												-0.0416 (-0.510)			-0.140 (-1.121)
Colony: FRA												-0.0198 (-0.169)			-0.0587 (-0.469)
Legal: GBR													0.0917 (0.924)		0.180 (1.130)
Legal: FRA													0.118 (1.242)		0.121 (0.926)
Latitude														-0.0009 (-0.640)	-0.0003 (-0.180)
Observations	161	161	160	110	118	126	133	128	100	148	160	160	160	160	160
Sample	All	All	All	All	All	All	All	Developing countries	Former colonies	All	All	All	All	All	All
			excluding influential obs.	excluding influential obs. & Africa	excluding influential obs. & Asia	excluding influential obs. & Europe	excluding influential obs. & Latin America/ Caribbean	excluding influential obs.	excluding colonies	excluding small countries	excluding influential obs.	excluding influential obs.	excluding influential obs.	excluding influential obs.	excluding influential obs.

Notes. Robust z-statistics in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

(a) Same as Note (a) in Table 2.

(b) Columns 3–16 eliminate Tajikistan since it is an influential observation.



Table 6. *Early Urbanisation as a Transmission Mechanism*

OLS: Urbanisation in 1900		AME: Inflation			AME: Rule of law			AME: Tax			AME: Civil war			
Variables	(1) Baseline	(2) Baseline and controls	(3) Baseline	(4) Direct effect	(5) Direct + Indirect effect	(6) Baseline	(7) Direct effect	(8) Direct + Indirect effect	(9) Baseline	(10) Direct effect	(11) Direct + Indirect effect	(12) Baseline	(13) Direct effect	(14) Direct + Indirect effect
Urban_1900			-0.827 (-0.824)		-0.408 (-0.401)	2.168*** (4.415)		1.614*** (4.463)	1.082 (1.496)		0.686 (1.134)	-1.073* (-1.857)		-0.347 (-0.765)
TRI	-0.0108** (-2.310)	-0.0154*** (-2.980)		0.0924* (1.712)	0.0791 (1.381)		-0.115*** (-3.454)	-0.0682* (-1.903)		-0.0728** (-2.315)	-0.0672** (-2.146)		0.174*** (5.200)	0.162*** (4.442)
EF	-0.107*** (-3.995)	-0.0807*** (-2.798)		0.278 (1.289)	0.254 (1.239)		-0.551*** (-5.735)	-0.437*** (-4.741)		-0.671*** (-3.775)	-0.614*** (-2.977)		0.383*** (2.908)	0.356*** (4.148)
Ind. year		-0.00051*** (-4.163)	0.0024*** (4.105)	0.0024*** (6.607)	0.0024*** (4.317)	-0.0019*** (-7.254)	-0.0022*** (-9.880)	-0.0016*** (-4.077)	-0.00023 (-0.212)	-0.00028 (-0.298)	0.00010 (0.0939)	0.00080** (2.053)	0.0010*** (2.711)	0.0011*** (1.998)
Colony SPA		-0.0428* (-1.713)	0.189 (1.199)	0.196 (1.238)	0.198 (1.210)	-0.358*** (-3.606)	-0.371*** (-3.123)	-0.356*** (-4.393)	0.00264 (0.0140)	-0.0327 (-0.152)	-0.0204 (-0.0985)	-0.0108 (-0.0715)	0.0278 (0.218)	0.0326 (0.240)
Colony GBR		-0.00425 (-0.171)	-0.173** (-2.028)	-0.181*** (-2.655)	-0.169** (-2.268)	0.131* (1.759)	0.109 (1.344)	0.0792 (1.075)	-0.0288 (-0.0846)	-0.0987 (-0.294)	-0.122 (-0.368)	-0.149 (-0.686)	-0.154 (-0.715)	-0.142 (-0.618)
Colony FRA		-0.0239 (-1.284)	-0.380* (-1.958)	-0.386** (-2.152)	-0.366** (-1.969)	-0.302 (-1.187)	-0.348 (-1.466)	-0.316 (-1.373)	-0.00554 (-0.0403)	0.0463 (0.255)	0.0189 (0.0876)	-0.142 (-0.536)	-0.108 (-0.510)	-0.0910 (-0.386)
Legal: GBR		-0.0171 (-0.548)	-0.164 (-0.746)	-0.204 (-1.194)	-0.186 (-0.985)	-0.0205 (-0.205)	0.0311 (0.373)	0.0814 (1.159)	0.336 (1.156)	0.492* (1.956)	0.512** (2.105)	0.274 (1.287)	0.234 (1.381)	0.252 (1.369)
Legal: FRA		-0.0214 (-1.026)	-0.0528 (-0.549)	-0.112 (-1.008)	-0.0906 (-0.772)	-0.0711 (-0.759)	-0.00329 (-0.0301)	0.0185 (0.190)	0.142 (1.356)	0.186 (1.325)	0.209 (1.411)	0.271** (2.257)	0.203** (2.313)	0.225** (2.294)
Log. Area		0.00323 (1.053)	0.0412* (1.658)	0.0505** (2.248)	0.0418* (1.879)	-0.0531*** (-2.730)	-0.0491 (-1.583)	-0.0450** (-1.964)	-0.0530 (-1.529)	-0.0405 (-1.152)	-0.0394 (-1.088)	0.0440** (2.008)	0.0664*** (3.325)	0.0578** (2.565)
Initial govt. size									0.0265*** (3.217)	0.0244*** (5.937)	0.0236*** (5.231)			
Constant	0.128*** (6.378)	1.107*** (4.514)												
Observations	187	186	153	153	153	156	156	156	113	113	113	149	149	149
R-squared	0.091	0.241												

Notes. z-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Columns 1–2 estimate urbanisation using OLS. Columns 3–10 present average marginal effects using clustered standard errors. Regressions in Columns 3–10 include a dummy variable to control for the assumption that countries with no settlements greater than 40,000 in 1900 had a 0 urbanisation rate.

Table 7. *Ruggedness and Spatial Correlation; Dependent Variable: State Capacity*

Variables	Latent inflation			Latent rule of law			Latent tax/GDP			Latent presence of civil war		
	(1) Baseline	(2) Baseline controlling for colonial origins	(3) Baseline controlling for legal origins	(4) Baseline	(5) Baseline controlling for colonial origins	(6) Baseline controlling for legal origins	(7) Baseline	(8) Baseline controlling for colonial origins	(9) Baseline controlling for legal origins	(10) Baseline	(11) Baseline controlling for colonial origins	(12) Baseline controlling for legal origins
TRI	0.0855* (1.805)	0.0833* (1.865)	0.0975* (1.852)	-0.104** (-2.359)	-0.0812** (-2.114)	-0.0901* (-1.891)	-0.0495* (-1.773)	-0.0450 (-1.632)	-0.0488* (-1.670)	0.138*** (3.095)	0.133*** (2.903)	0.135*** (3.038)
Neighbours'	0.0372	0.00709	-0.0104	0.0813	0.0151	0.0820	0.0117	0.00374	0.0242	0.0407	0.0404	0.0595
TRI	(0.509)	(0.101)	(-0.136)	(1.299)	(0.267)	(1.326)	(0.153)	(0.0495)	(0.319)	(0.533)	(0.506)	(0.809)
EF	0.214 (1.399)	0.198 (1.281)	0.378** (2.382)	-0.625*** (-5.736)	-0.489*** (-3.807)	-0.680*** (-5.846)	-0.441*** (-3.286)	-0.488*** (-3.388)	-0.586*** (-4.410)	0.563*** (4.120)	0.578*** (4.039)	0.511*** (3.637)
Islands	-0.420*** (-2.708)	-0.439*** (-2.780)	-0.368** (-2.280)	0.381*** (3.783)	0.272*** (2.603)	0.286** (2.526)	0.290** (2.237)	0.225 (1.566)	0.218 (1.608)	-0.161 (-0.944)	-0.148 (-0.867)	-0.155 (-0.916)
Initial gov. size							0.0267*** (4.573)	0.0232*** (3.495)	0.0252*** (3.865)			
Ind. Year		0.00204*** (3.888)			-0.00177*** (-4.380)			-0.000203 (-0.241)			-0.00005 (-0.1000)	
Colony SPA		0.184 (1.619)			-0.377*** (-3.998)			-0.00268 (-0.0208)			0.0534 (0.466)	
Colony GBR		-0.237*** (-3.207)			0.107 (1.547)			0.155 (1.417)			-0.0233 (-0.282)	
Colony FRA		-0.321*** (-2.979)			-0.388*** (-2.624)			0.0387 (0.301)			-0.00772 (-0.0642)	
Legal: GBR			-0.319*** (-3.559)			0.195** (2.170)			0.345*** (3.110)			0.115 (1.185)
Legal: FRA			-0.273*** (-3.233)			0.0364 (0.457)			0.221** (2.089)			0.129 (1.385)
Observations	180	180	179	185	185	184	127	127	127	161	161	161

Notes. Z-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Columns 1–3 use Y\*=1 if inflation >10%, 0 otherwise.

Islands are controlled for in all specifications as entries for those countries in the contiguity matrix W are 0.

Table 8. *Robustness Checks*

Panel A – Results controlling for initial land inequality.							
Average Marginal Effects							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inflation	Inflation with controls(‡)	Rule of law	Rule of law with controls (‡)	Tax/GDP	Tax/GDP with controls (‡)	Civil war	Civil war with controls (‡)
Initial Land Gini(°)	0.00334 (1.265)		-0.00209 (-0.661)		0.00337** (2.417)		-0.00171 (-0.800)
TRI	0.0869 (1.612)	-0.0805 (-1.225)	-0.0867 (-1.356)	-0.0669 (-0.790)	-0.0609 (-0.907)	0.189*** (2.867)	0.185*** (2.683)
EF	0.318* (1.954)	0.336* (1.872)	-0.864*** (-3.899)	-0.683*** (-2.751)	-0.697*** (-3.027)	0.367*** (2.505)	0.341** (2.507)
Initial Gov. Size				0.0305*** (3.073)	0.0286*** (3.689)		
Area	0.0675*** (3.810)	0.0657*** (3.986)	-0.0301** (-2.131)	-0.0267 (-1.354)	-0.0434 (-1.260)	0.0421* (1.682)	0.0432* (1.930)
Observations	81	82	82	72	72	76	76

Panel B – Results controlling for Artificial States				Panel C – Regime Type	
Average Marginal Effects				OLS	
(1)	(2)	(3)	(4)	(1)	(2)
Inflation (‡)	Rule of Law (‡)	Tax/GDP (‡)	Civil War (‡)	Constraints on Executive at Independence	Constraints on Executive at Independence (‡)
Artificial State	-0.00245** (-2.145)	0.00269 (1.230)	3.08e-05 (0.0271)	TRI	0.172 (0.342)
TRI	0.0636 (0.836)	-0.0749 (-0.977)	0.198*** (4.136)	TRI sq.	-0.0602 (-0.581)
EF	0.429*** (3.164)	-0.806*** (-9.322)	0.470*** (4.394)	EF	-0.349 (-0.923)
Initial Gov. Size		0.0238*** (3.194)		Constant	-11.95 (-1.522)
Observations	128	91	123	Observations	157
				R-squared	0.004
					0.319

Notes. Robust t-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(‡) Controls used in the regressions are legal origins, colonial origins and independence year.

(°) Initial land gini is the gini coefficient of land tenure closest to independence year.

Figure 1a. Non Parametric Regression  
Inflation

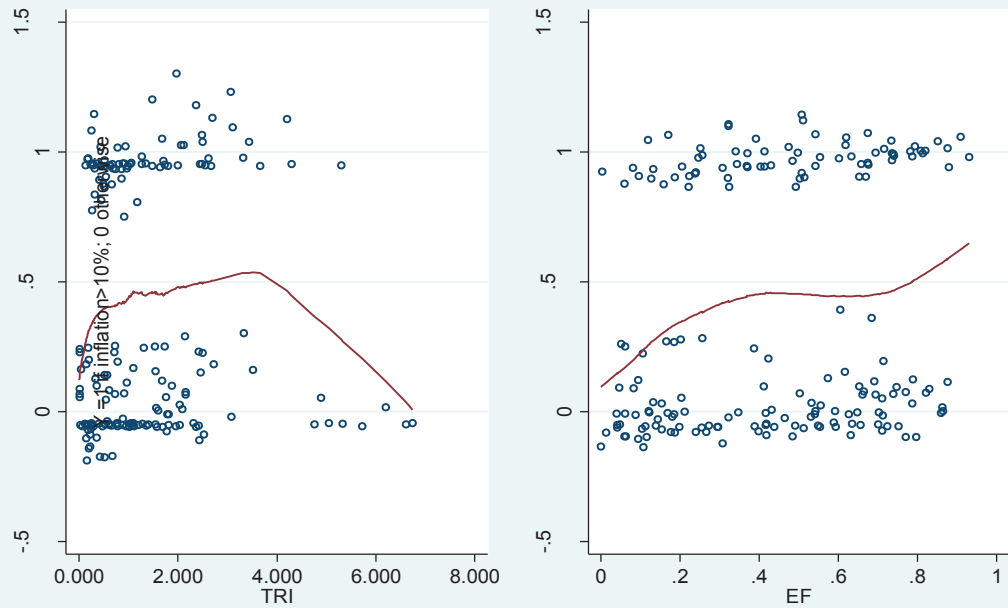


Figure 1b. Non Parametric Regression  
Rule of Law

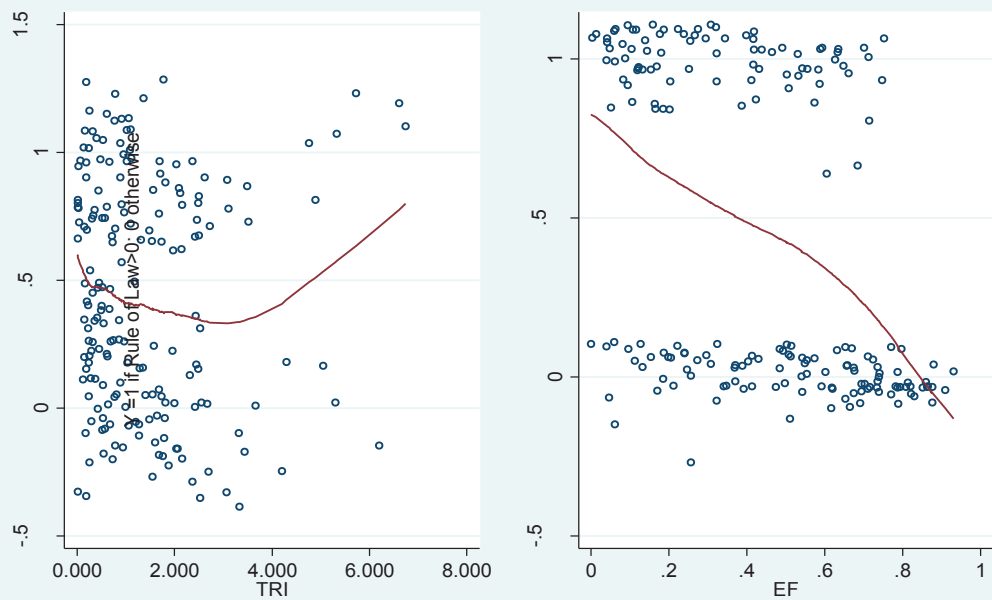


Figure 1c. Non Parametric Regression  
Tax Revenue

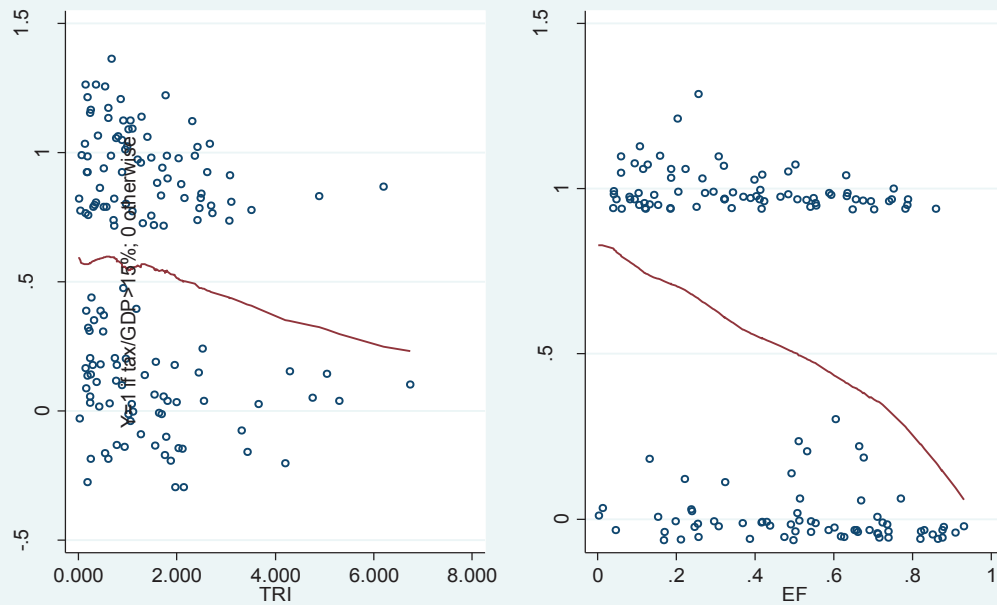


Figure 1d. Non Parametric Regression  
Presence of civil war

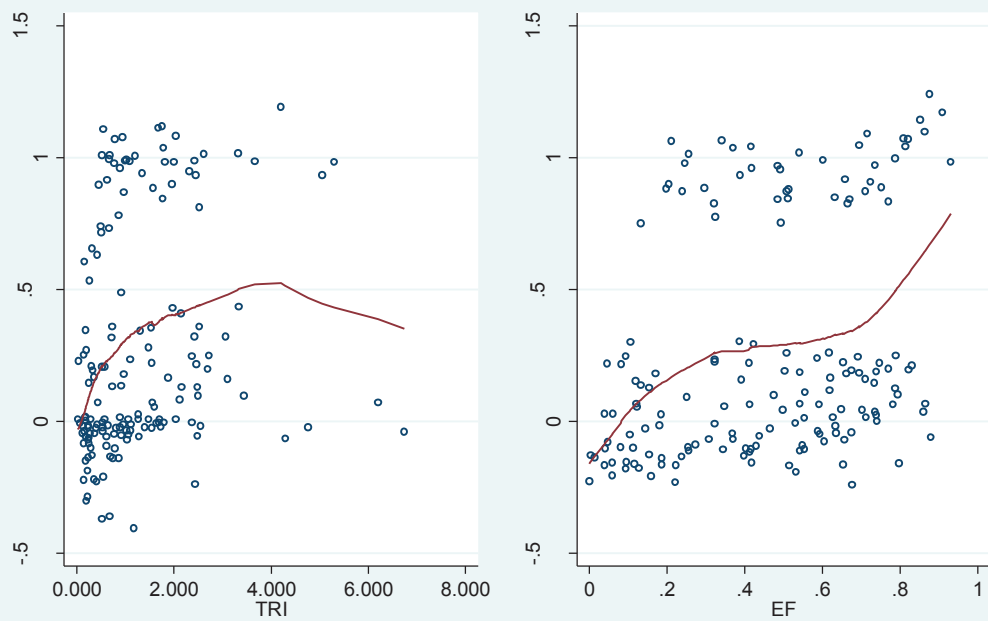


Figure 2a. Influential Observations

Y = 1 if inflation &gt; 10%; 0 otherwise

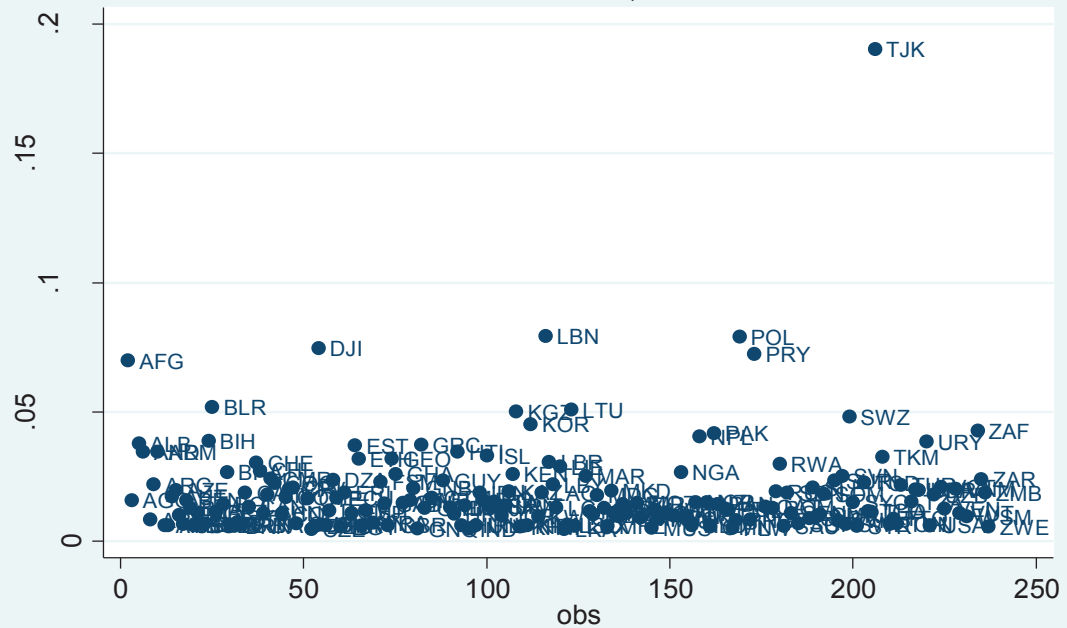


Figure 2b. Influential Observations

Y = 1 if Rule of Law &gt; 0; 0 otherwise

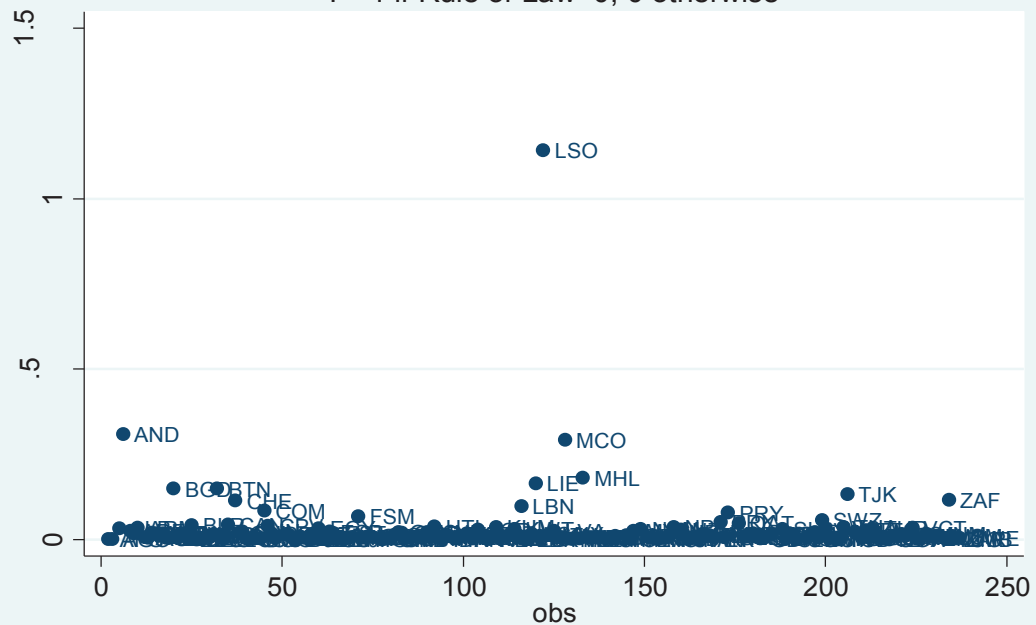


Figure 2c. Influential Observations

Y = 1 if Tax/GDP &gt; 15%; 0 otherwise

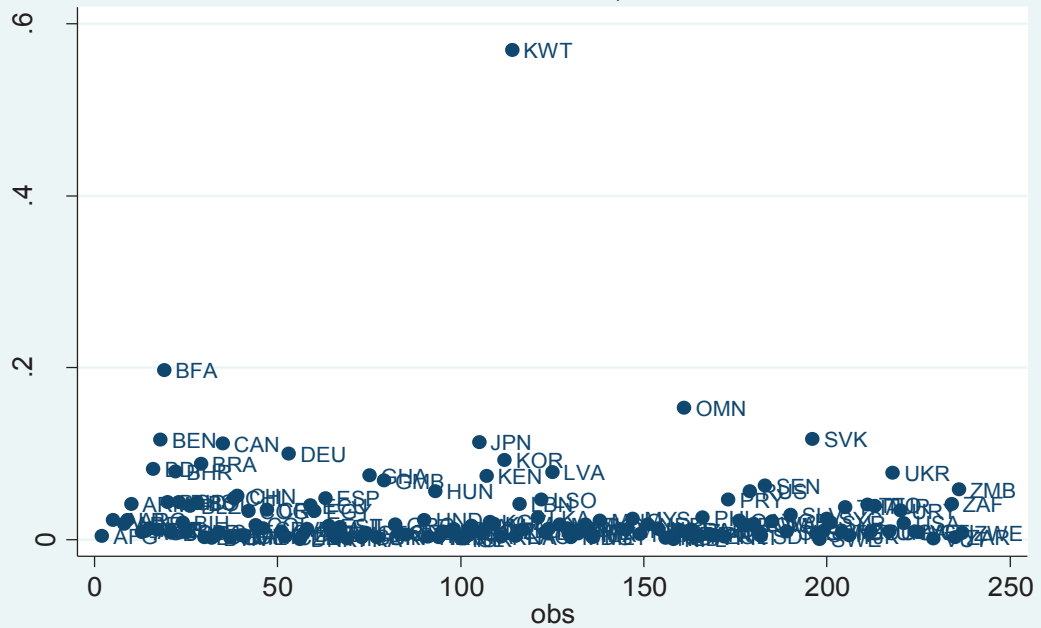
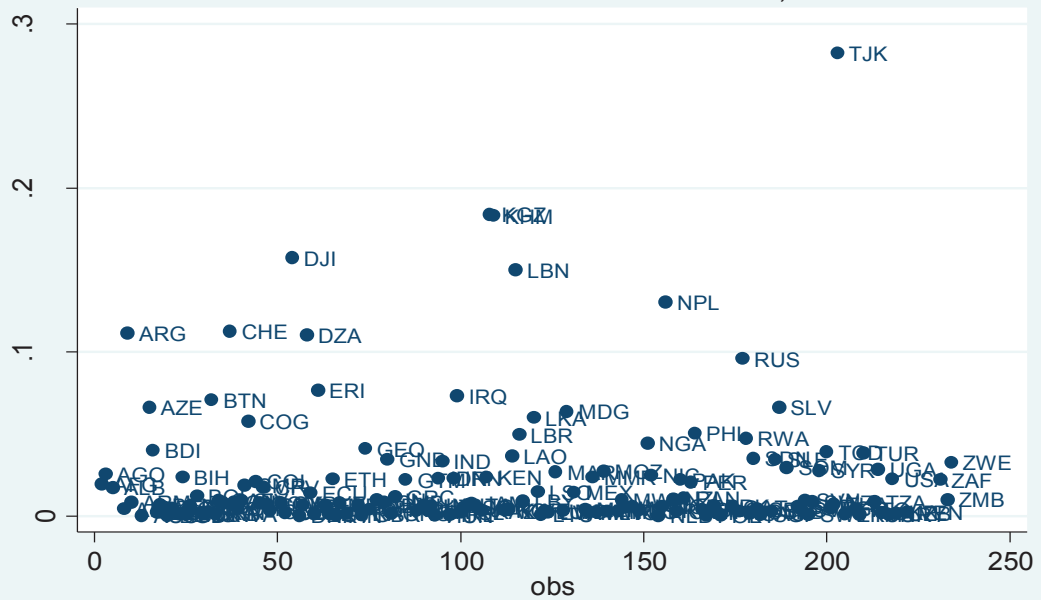


Figure 2d. Influential Observations

Y = 1 if Presence of civil war from 1975 onwards; 0 otherwise



## **Appendix**

### **A1. The Relationship between Terrain Ruggedness and Ethnic Fractionalisation**

In our study, we have controlled our latent models using ethnic fractionalisation as a main control, following the literature. However, Michalopoulos (2012) establishes that variations in soil quality and elevation can explain ethnic diversity today, except for its component that was determined after 1500 AD. We investigate the implications of this intuitive finding on our results in a few ways. First, we test whether EF is explained by TRI in our sample. Table A1 shows that the answer is in the affirmative when TRI enters the equation non-linearly with our usual controls. Accordingly, we remove TRI appropriately from our main equations, and find that the average marginal effects (AMEs) of EF are reduced by an average of six per cent across all four dependent variables (compared to AMEs reported in Column 15 of Tables 2–5). This drop, however, does not seem to be huge. Second, checking the simple correlation between TRI and EF, we find it to be -0.14 and statistically insignificant. Third, in unreported regressions, we interact TRI and EF in our main equations and find these terms to be statistically insignificant. Thus, it appears that the component of ethnic fragmentation that was shaped post-1500 AD is an important predictor for today's state capacity and therefore it cannot be ignored from the main analysis. Given these results, it seems more appropriated to use EF rather than soil quality as a more immediate platform for collective action without disregarding considerable information.

### **A2. Estimation Method**

One concern with a latent variable model is that relevant information may be left out when constructing the latent indicators. Also, the choice of threshold for the outcome indicator may be arbitrary, especially in the case of rare events. To see whether a continuous treatment of the state capacity would make a difference, a least squares estimation was adopted. Results, shown in



Table A2 below, indicate that TRI is statistically significant in explaining rule of law and persistence of civil war, but not for inflation and taxation. It is conceivable that an extra unit of terrain ruggedness may not be able to explain an extra unit of inflation or an extra percentage of tax proceeds; rather, it could explain the probability of high inflation or better tax collection performance, as moderated by the collective action channel. We also use the State Fragility Index (SFI) 2009 of Marshall and Cole (2011) as the dependent variable, despite the reservations about such indices (Besley & Persson 2011). Results indicate that TRI strongly predicts this continuous variable in the anticipated direction.

### **A3. Other Possible Concerns**

#### *Trust and Social Capital*

The reduced form model may also not capture all processes leading a society to cooperate. For instance, trust and social capital have largely been seen as key ingredients for cooperation in role model states. Accordingly, correlations between trust-related cross-country measures and TRI (unreported) have been checked for, but no significant relationships were observed, nor any change in TRI coefficients when the former were included in Equation 1. Instead of ruling out this mechanism completely, it is our conjecture that trust may affect a state's foundations through their associations with other interactive factors, such as history, wars and climate. For instance, in a recent study, Nunn and Wantchekon (2011) show that the transatlantic and Indian Ocean slave trade to which Africa was subjected more than 400 years ago strongly explains the mistrust within African society today. One would probably need to model some interactions to capture such linkages.

#### *Population Density*

If there are no people living around mountains, why should we care about terrain ruggedness? Using population-weighted ruggedness, which factors in the population share of each 30-by-30 arc-second cell into the calculation of the ruggedness index (as provided by Nunn & Puga 2012), finds statistically

significant effects on rule of law and civil conflict, a nearly significant effect on inflation, and an effect with z-statistic equal to 1 on taxation performance, with all coefficient signs prevailing as before. Although the population data belong to 2000 in the calculation and population movements over time are unaccounted for, these results seem to support our main argument (results available upon request).

### *Informal Economy*

An important limitation in testing our main hypothesis is the lack of a direct measure for ability to tax. Thus, as an additional proxy, we use the share of shadow economy in GDP (Schneider, Buehn & Montenegro 2010), a reverse measure of the ‘ability to tax’ and provision of public good availability, in our analysis. Both ordinary least squares (OLS) and logit results strongly support the positive (and non-linear) role of terrain ruggedness in the likelihood of observing a larger informal economy in the countries (results available upon request).

### *Country Size (Log Area)*

As noted in the text, Stasavage (2010) find that more compact states are more governable. Thus, a valid concern in our case is whether the TRI somehow penalises large states or has a correlation with state size. When controlling for log surface area throughout the models, the estimates for TRI remains robust and significant in all of the regressions.

Table A1. *The Relationship between Ethnic Fractionalization and Terrain Ruggedness*

OLS				Average Marginal Effects			
Dependent Variable: Ethnic Fractionalisation				Dependent Variables: Latent Variables			
Variables	(1) EF (#)	(2) EF	(3) EF (#)	(4) Inflation (#)	(5) Rule of Law (#)	(6) Tax/GDP (#)	(7) Civil war (#)
EF				0.415** (2.027)	-0.654*** (-5.752)	-0.665*** (-7.341)	0.410*** (3.554)
TRI	0.00657 (0.426)	-0.148*** (-4.189)	-0.114*** (-3.207)				
TRI sq.		0.0265*** (4.118)	0.0240*** (3.278)				
Initial Gov. Size						0.0251*** (6.960)	
Log. Area	0.0303*** (3.646)	0.0260*** (4.059)	0.0345*** (4.601)				
Constant	-2.075*** (-3.318)	0.311*** (4.651)	-2.092*** (-3.663)				
Observations	186	187	186	180	183	127	160
R-squared	0.224	0.141	0.284				

Notes. z-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

(‡) Controls used in the regressions are legal origins, colonial origins and independence year.

Table A2. *Robustness Checks: Estimation Method; Continuous Dependent Variables*

Variables	Panel A – Results using continuous variables. OLS									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Inflation	Inflation with controls (‡)	Rule of law	Rule of law with controls (‡)	Tax/GDP	Tax/GDP with controls (‡)	Years in civil war	Years in civil war with controls (‡)	State Fragility Index (SFI)	SFI with controls (‡)
TRI	5.185 (0.569)	-8.234 (-1.250)	-0.336*** (-2.631)	-0.328** (-3.625)	0.165* (0.27)	0.277 (0.406)	0.146*** (3.742)	0.130** (3.556)	0.468*** (4.700)	0.621*** (6.433)
TRI sq.	-1.626* (-2.046)	0.756 (1.653)	0.0614** (2.404)	0.0528** (3.113)			-0.0242*** (-3.809)	-0.0212** (-3.928)		
EF	53.68*** (4.122)	72.14*** (4.217)	-1.881*** (-7.418)	-1.511*** (-5.668)	-11.46*** (-4.91)	-14.39*** (-7.643)	0.279*** (3.432)	0.273** (3.907)	14.55*** (4.325)	10.59*** (6.673)
Initial Gov. size					0.384*** (3.54)	0.349** (3.721)				
Constant	19.54 (1.893)	-693.5* (-2.369)	0.992*** (5.195)	11.80*** (7.379)	15.26*** (5.95)	-11.60 (-0.512)	-0.105** (-2.005)	0.0597 (0.213)	1.515 (0.644)	-41.04** (-3.137)
Observations	181	180	184	183	127	127	160	160	157	157
R-squared	0.018	0.201	0.228	0.408	0.286	0.347	0.095	0.116	0.323	0.435

Notes. Robust t-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(‡) Controls used in the regressions are legal origins, colonial origins and independence year.

(?) Initial land gini is the gini coefficient of land tenure closest to independence year.

## A4. Data Sources and Descriptions

Variable	Source	Description	Link
Inflation	World Bank (2013), World Development Indicators database.	GDP deflator (annual %)	<a href="http://databank.worldbank.org">http://databank.worldbank.org</a>
Rule of law	Kaufmann, Kraay, and Mastruzzi (2010)		<a href="http://info.worldbank.org/governance/wgi/index.asp">http://info.worldbank.org/governance/wgi/index.asp</a>
Tax revenue/ GDP	World Bank (2013), World Development Indicators database.	Tax revenue (% of GDP)	<a href="http://databank.worldbank.org">http://databank.worldbank.org</a>
Civil conflict	Uppsala University Conflict Program and International Peace Research Institute (2013), UCDP/PRIO Armed Conflict Dataset	Presence of civil war	<a href="http://www.pcr.uu.se/research/ucdp/datasets/ucdp_prio_armed_conflict_dataset/">http://www.pcr.uu.se/research/ucdp/datasets/ucdp_prio_armed_conflict_dataset/</a>
Terrain ruggedness index	Nunn and Puga (2012)		<a href="http://diegopuga.org/data/rugged/">http://diegopuga.org/data/rugged/</a>
Ethnic fractionalization	Alesina et al. (2003)		<a href="http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls">http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls</a>
Government size	World Bank (2013), World Development Indicators database.	Expense (% of GDP)	<a href="http://databank.worldbank.org">http://databank.worldbank.org</a>
Colonial origins and independence years	Acemoglu et al. (2008) and Olsson (2009)		<a href="http://economics.mit.edu/faculty/acemoglu/data/ajry2008">http://economics.mit.edu/faculty/acemoglu/data/ajry2008</a>
Legal origins	La Porta, Lopez-de-Silanes and Shleifer (2008)		<a href="http://www.economics.harvard.edu/faculty/shleifer/files/JEL_%20web.xls">http://www.economics.harvard.edu/faculty/shleifer/files/JEL_%20web.xls</a>
Latitude, area	Nunn and Puga (2012)		<a href="http://diegopuga.org/data/rugged/">http://diegopuga.org/data/rugged/</a>
Security legitimacy index	Marshall and Cole (2011)	Secleg	<a href="http://www.systemicpeace.org/inscr/SFIv2010a.xls">http://www.systemicpeace.org/inscr/SFIv2010a.xls</a>
Contiguity matrix	Mayer and Zignago (2005)		<a href="http://www.cepii.fr/anglaisgraph/bdd/distances.htm">http://www.cepii.fr/anglaisgraph/bdd/distances.htm</a>

## Chapter 3: State Capacity: How to Mitigate the Adverse Consequences of Terrain Ruggedness?

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### 3.1. Introduction

The importance of rugged terrain for economic development and performance is vividly debated among political scientists, economists, policymakers and practitioners alike. While some studies show that rugged terrain increases communication costs, hinders agricultural production and provides natural advantages for warfare (Fearon & Laitin 2003; Gibson & Rozelle 2003), other studies document that rugged topography may provide some benefits for contemporaneous development outcomes through their impact on institutions (Nunn & Puga 2012).

In order to better understand the net effect of terrain ruggedness, academic research currently focuses on elucidating the channels through which different geographic characteristics may have an effect on long-run economic development. A recent influential paper by Nunn and Puga (2012) suggests that more rugged countries in Africa were less exposed to slave trafficking since this geographic characteristic provided natural barriers to natives looking for safer places to hide in order to avoid being captured. As a result, citizens of those countries have more trust in their counterparts than in less rugged countries in Africa. This social capital has resulted in better institutional quality and development in general, relative to those converse cases. Conversely, Dell (2010) finds that places where early Spanish settlers in Peru had imposed a coercive labour system called *mita* have currently lower levels of consumption and public goods than places where they had not. Interestingly, this labour institution needed rugged places to work to prevent workers/slaves from escaping.<sup>1</sup> The first essay in this thesis finds that terrain ruggedness is

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<sup>1</sup> Stasavage (2010) analyses the impact of other geographic dimensions on past institutions, observing that small European countries were more likely to have more representative institutions than larger countries in medieval times. This was because assemblies in small countries could meet more frequently due to significantly lower travel costs, which meant that

negatively correlated to state capacity on average, and proposes that bad topography delayed the modern urbanisation process, which in turn is negatively correlated to the current levels of state capacity.

While there is a renewed interest in geographic determinants of economic outcomes, little attention has been paid to interactions between geographical characteristics and a state's behaviour. Recent research, nevertheless, suggests that certain influential characteristics can emerge in such geographically challenged states that produce highly favourable development outcomes despite this initial handicap. In fact, there are some 'unlucky' countries, from a topography point of view, that have been able to develop a strong state apparatus. Vibrant examples of these countries are Austria, Switzerland and Norway.<sup>2</sup> A question that naturally arises is: what did these countries do to mitigate the negative effect of terrain ruggedness such that they were able to develop strong state capacity? Although there is an array of possible answers to this question, the aim of this essay is to narrow down these possibilities.

Thus, this essay analyses if there are human-made factors that alleviate the negative effects of rough topography on state capacity. One clear negative effect of unfavourable geography is increased transaction costs when citizens of the state are geographically dispersed. Thus, any device or mechanism reducing those transaction costs, particularly for law and order enforcement and state functions such as tax collection, service provision and domestic market development, must have a positive effect on state capacity. Ageron (2010) demonstrates that, initially, road infrastructure can be a key factor in reducing transaction costs and therefore regarded as a basic ground layer for development. Given its positive externalities to the private sector (i.e. reducing time to travel and transport goods, providing quicker access to education and health services and, even more importantly, freeing time for more productive tasks), road density is crucial to developing living standards in rugged geographical areas, and the key for citizens' incorporation into the state's

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they could monitor public finances more closely and the public were keener to pay taxes, augmenting the state capacity to obtain revenue.

<sup>2</sup> The fact that there are some rugged countries with a good status apparatus does not change the nature of the negative correlation between rugged terrain and state capacity.

system. Roads open up important channels of connection on a political and social level as well, decreasing the autonomous nature of population enclaves in a geographically dispersed population within a rugged terrain. Following this reasoning, and the reverse causation problem notwithstanding, this essay asks if building roads produces positive outcomes for the development of state capacity, particularly in countries with difficult terrains.

Institutional design is another candidate for alleviating the adverse effects of rugged terrain on state capacity. Accordingly, the essay asks if fiscal and political design helps to overcome the negativity of rough topography. Specifically, can fiscal and political decentralisation reduce transactions costs? Initially, one could surmise that decentralisation could increase coordination costs, making its adoption less favourable. For instance, Gerring, Thacker and Moreno (2005) assert that good governance is achieved in countries with inclusive institutions that are able to centralise political power and implement pacts and agreements, rather than in those countries that decentralise power. However, this argument does not take into account other benefits of decentralisation such as those from better handling the diversity of preferences within a political circumscription or more efficiently managing large political entities, avoiding internal tension. As many arguments regarding the benefits and costs of decentralisation can be cast, the empirical analysis in this essay aims to clarify the situation with respect to rugged countries, and to answer whether fiscal and political decentralisation have a different impact on them.

In sum, the key contribution of this essay is to fill the gap in the literature regarding the link between geography and state capacity by empirically investigating to what extent road infrastructure and political and fiscal decentralisation reduce the negative impact of rugged terrain on state capacity, using a sample of independent countries over the period 1960–2010.

The essay is organised as follows: Section 3.2 briefly discusses the links between state capacity and the proposed mitigating factors. Section 3.3 describes the data used in the analysis and outlines the empirical strategy. Section 3.4 presents the empirical results and Section 3.5 concludes.



### 3.2. Conceptual Overview

It is generally agreed in the political science field that societies are organised around states, which are self-governing political entities with a centralised source of authority that can enforce rules and use legitimate means of coercion to control the territory inside its boundaries. However, there is an array of states where this definition holds only partially. In the international relations literature, they are called fragile or weak states, meaning that they have limited capabilities to fulfil their basic obligations.<sup>3</sup> Although this might seem an issue of more interest to other fields rather than economics, recent research shows that having a weak state apparatus also has negative consequences on economic outcomes. Acemoglu (2005) and Besley and Persson (2009; 2011) demonstrate that weak states are unable to tax, redistribute welfare and provide public goods, including protection of property rights, which has long-term and persistent negative consequences for economic development. Hence state capacity is also of strong concern to the policy or development economist.

Theoretical research on state capacity lists the sources of state fragility—the inability of the state to fulfil its obligations—as heterogeneity of preferences between the constituents and high transactions costs due to geographical constraints (Besley & Persson 2011; Olsson & Hansson 2011). For instance, Fearon and Laitin (2003) find that lengthy civil wars are more prone to onset in mountainous regions since this topographic feature provides rebels with natural advantages to fight against the central power (e.g. as in Colombia or Afghanistan). Also, Scott (2009) claims that mountains in South-East Asia have been used as sacred havens for people not wanting to become part of the modern state. In other words, Scott acknowledges that rugged terrain obstructs the expansion of the state machinery into the hinterland. Moreover, Herbst (2000) pioneers the idea that rugged terrain in Africa hinders the projection of power from the centre of territories to their periphery due to highly prohibitive costs of expansion. Therefore, states in such areas are destined to face

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<sup>3</sup> State capacity can be interpreted as the ability/capacity of a country to govern its territory in an efficient manner. Thus, countries lacking state capacity are seen as weak or fragile states.

difficulties with respect to unification and border control. Although this strand of research seems to provide a geographic deterministic explanation of why some countries might find it difficult to control their territory efficiently, the underlying implication from a state capacity reading of the literature is that rugged terrain is a key obstacle to the state's ability to project power within its territorial boundaries.

Historically, amplifying the road network has been viewed as a key method of broadcasting power to the hinterland.<sup>4</sup> There are numerous historical examples of how emperors and rulers built roads to incorporate territories into their empires and states.<sup>5</sup> The economics literature on the benefits of building road infrastructure is vast. It is widely known that roads induce total factor productivity gains by reducing transaction costs and thus facilitating trade, market integration, factor mobility<sup>6</sup> and the spread of ideas (World Bank 2009).<sup>7</sup> In addition, building roads increases capital stock with positive impacts on income per capita (Banerjee, Duflo & Qian 2012; Canning 1999; Esfahani & Ramirez 2003). Further, expanding the road network can serve as a bridge to approximate public services (e.g. health, education, law and order) to the hinterland (Agenor 2010); creating room to legitimise the action of state.

Based on this reasoning, our argument is that an increase in the road network diminishes transaction costs between individuals, facilitating political and economic engagement. Importantly, expanding the radius of state activity to the hinterland delivers more public services, 'buying' the ability to extract resources and bolster territories in the hinterland. Thus, road infrastructure has a positive effect on state capacity where rugged terrain would otherwise thwart the projection of state power.

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<sup>4</sup> Scott (2009) predicts that stateless people in South-East Asia people would disappear as states build and expand their transportation network to reach 'hilly' areas.

<sup>5</sup> Setting aside the conceptual differences between empires and modern states, one example of road construction and broadcasting of power is the Roman Empire. Sais (2006) finds that military governments often choose to maintain a good road system to expedite the movement of troops.

<sup>6</sup> Factor mobility is seen as a key determinant in achieving income convergence in areas where the population is culturally and linguistically homogeneous.

<sup>7</sup> Yet the presence of more roads could lead to congestion and other environmental problems. For an updated synthesis of the literature, refer to World Bank (2009).

Another approach to mitigate the obstruction of state capacity when the state governing body is separated from its citizens is to physically extend an arm of the state into the areas of concern. A country that has challenges projecting power because of its size might decide to transfer some power to local governments to keep those territories unified under it and avoid secession (Alesina 2003). In reality, sharing power implies transfer of legal decision making, roles and responsibilities to lower tiers of government. The literature defines political decentralisation as the process of granting subnational bodies the right to legislate in some areas without the right of veto from the central authority (Treisman 2002). Conversely, fiscal decentralisation is more related to the delegation of administrative tasks and spending under the broad agenda of the centralised government. The extent of fiscal decentralisation is usually reflected in the percentage of revenues or expenses out of the corresponding total, which is the responsibility of subnational governments.<sup>8</sup>

We observe two strands of literature regarding geographically induced detachment of government from its constituents, which are essentially two sides of the same coin. In particular, the analysis of combatting state capacity constraints in a geographically challenged environment is well placed within the classic public finance theoretical framework. Classical public finance theory predicts that fiscal decentralisation reduces asymmetries between citizens and the central authority, making the provision of public goods more tailored to each region (Oates 1972),<sup>9</sup> Theoretically, fiscal decentralisation is optimal when the marginal cost of providing ‘governance’ for a centralised polity is higher than the benefits. Generally, in the literature, these costs are directly related to the size of the territory, ethnic composition of the population and income inequality (heterogeneous demand). For instance, the size of a territory increases the costs of centralised provision of public goods because the distance of the central government to the location where the goods are provided will render it detached and disconnected from the needs of the people

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<sup>8</sup> Dreher and Fisher (2010, p. 986) call political autonomy the ‘right to decide’ and fiscal decentralisation ‘the right to act’.

<sup>9</sup> Classical notes on fiscal federalism are Tiebout (1956) and Musgrave (1959). Oates (1999) provides a synthesis of these arguments.

there. That is, where the centralised authority cannot perceive, share and monitor people's needs because it is too far removed from them, they are unlikely to be able to gauge the extent and nature of their needs correctly. This suggests that a decentralised representative of the government providing the services according to the needs of the population may be able to counter the obvious costs that centralised provision would entail.

However, territorial size, ethnic composition and other population heterogeneities are not the only factors that can detach a centralised government from its populace. As previously discussed, were the distance to be short but the topography between the central government and the governed extremely rugged, the exact same costs should also apply to the central government's provision of public goods under these circumstances. In essence, any barrier to communication and cooperation will increase the costs of centralised government provision of public goods.

So, the question that this essay asks is: When might we expect political decentralisation to be effective? The decision to fiscally decentralise a country should logically depend on the perceived net benefits of this path. Theoretically, the benefits of maintaining a central fiscal government are economies of scale in the provision of public goods and management of the tax base and better coordination in the implementation of broad public policies, especially those regarding monetary and fiscal policy. Empirical evidence regarding the net costs or benefits of fiscal decentralisation yield mixed results. While Akai and Sakata (2002), Fisman and Gatti (2003), Iimi (2005) and Falch and Fischer (2012) find positive outcomes related to decentralisation; other studies show that decentralisation brings net costs (see Prud'Homme 1995; Rodriguez-Pose & Ezcurra 2011; Zhang & Zou 1998).<sup>10</sup>

Although earlier results are mixed, previous analyses do not differentiate between the benefits of decentralisation for rugged as opposed to non-rugged countries. Our conjecture is that fiscal decentralisation could yield particular

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<sup>10</sup> Weingast (2014) has an extensive discussion on the current stance of fiscal decentralisation on economic development.

benefits to topographically challenged states. Decentralisation reduces the negative impact of rugged terrain by fiscally breaking down territories into smaller ones, forcing policymakers to consider the cost structure of each particular region when providing public goods. Thus, we expect that decentralisation could enhance state capacity where the terrain is more rugged than in states where topographical changes are smoother, holding other variables constant.

### 3.3. Data and Methodology

To test our predicted relationships, we first need to measure state capacity. Different measures have been developed lately, mainly in the international aid context, to assess the level of state capacity. However, Besley and Persson (2011) assert that measuring state capacity is problematic given the nature and multidimensionality of the concept and because most of the current indicators measuring it cannot differentiate causes from consequences.<sup>11</sup> Thus, statistical inference using such indicators directly could not be robust. Yet the main problem with the term state capacity is the lack of a widely accepted definition, so finding indicators of it could be cumbersome. What is agreed in the literature, however, is that the state is responsible for providing some basic functions, such as enforcing stability and maintaining peace and order. In order to perform these functions, the state needs to have different capabilities, and arguably, those cannot be directly observed. In an attempt to overcome this caveat, the first essay in this thesis operationalizes the term state capacity through a latent variable approach that models the outcomes of state capacity via suitable indicators. Specifically, if a continuous variable  $x$ , representing one outcome, is equal or higher than a certain threshold level, then the transformed indicator  $\bar{x}$  equals 1, and 0 otherwise. Briefly, this transformed variable indicates whether or not a state has a weak status apparatus, and it can be estimated using a suitable estimator for binary response.<sup>12</sup> The main idea of

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<sup>11</sup> Examples of such measures are the Index of State Weakness compiled by the Brookings Institution and the State Fragility Index calculated by the Polity IV project.

<sup>12</sup> State capacity is an unobservable 'skill/capability' for researchers in the same way that students' skills are unobservable for teachers. Teachers assess students' skills by looking at

this approach is to reveal whether or not a country is weak by looking at the consequences of state capacity rather than trying to find a measure of a concept that itself is difficult to assess. Outcomes of state capacity considered in this essay are inflation, lack of rule of law, low levels of taxation, and presence of civil war.<sup>13</sup> All sources and definitions of variables are in the Appendix.

Data for terrain ruggedness are taken from Nunn and Puga's (2012) index, which quantifies the degree of topographic irregularity in a given surface based on elevation models relying on satellite images.<sup>14</sup> The terrain ruggedness index (TRI) takes higher values as the level of irregularity increases. The novelty of this measure is that it is able to capture fine changes in the terrain, which gives a better idea of how rugged a country is. Very rugged countries in Nunn and Puga's sample are, for instance, Nepal, Bhutan, Switzerland and Tajikistan.

The road density indicator (RD) for each country is constructed by weighting road network by country surface. Data measuring a country's land size and the length of its road network are taken from the World Development Indicators dataset averaged over the period 1991–2010 (World Bank 2013). The road network indicator measures all roads built in a country in kilometres, regardless of their quality. Among our sample, the countries with the highest road density are Malta, Bahrain and Belgium.

Fiscal decentralisation (FD) is proxied by the subnational revenue share; specifically, the revenue collected by local and municipal tiers divided by the national total revenue. Data are obtained from the Fiscal Decentralization Indicators, a dataset containing standardised information across countries until 2000. This dataset is gathered by the World Bank (World Bank 2013), and obtained through the International Monetary Fund's Government Finance Statistics (International Monetary Fund 2013). We average this indicator for the period 1990–2000. The most fiscally decentralised countries in our dataset

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outcomes (e.g. exam marks), as it is impossible to observe natural abilities of performing certain cognitive tasks. Only students who achieve a score equal or higher than the pass mark are thought to have the minimum ability required and pass the exam/grade. Our approach for rating state capacity follows a similar logic.

<sup>13</sup> For a better understanding of the methodology regarding latent variables, see Chapter 2.

<sup>14</sup> For technical details about the index, see Riley, DeGloria and Elliot (1999).

are Serbia and Montenegro, Canada and China, while the most fiscally centralised countries are Cyprus, Swaziland and Ethiopia.

Political autonomy (PA) comes from a dataset compiled by Treisman (2008). Specifically, we use a dichotomous indicator that equals 1 if local governments are allowed by the constitutions to legislate in their respective areas such that the federal government cannot have any say on such laws. In other words, this variable indicates if there are autonomous local political legislative bodies below the national legislative branch whereby the latter could not overrule any decision made by the former. There are 18 countries in our dataset with a constitutional decentralised decision-making process following Treisman's definition. Some examples, among others, are Austria, India and Switzerland.

### 3.3.1. Important Covariates

Besley and Person (2009; 2011) assert that state capacity is negatively related to heterogeneity of ethnic preferences and we account for this observation by controlling for the degree of ethnic fractionalisation in all of our models. Data for this indicator are taken from Alesina et al. (2003). Additionally, initial income per capita is incorporated into the estimating equation to mitigate the possible endogeneity issue arising from the fact that richer countries could afford better road infrastructures or better institutional frameworks. Other initial conditions affecting outcomes of state capacity such as legal origins, colonial origins, year of independence and geographical position have been widely documented in the macro development literature and have therefore been included as control variables in our empirical specification.

### 3.3.2. Methodology

Our baseline regression model is:

$$Y_i^* = \alpha + \beta_1 TRI_i + \beta_2 M_i + \beta_3 (TRI_i * M_i) + Z\beta$$

where  $Y_i^*$  is one the outcomes of state capacity; (i) the average inflation rate over the period 1960 to 2009, (ii) the rule of law averaged over the period 1996

to 2010, (iii) tax revenue/GDP averaged over the period 1990 to 2009, and (iv) the presence of civil war over the period 1975 to 2010.

Each of these indicators is binary by construction so a logit model is used to estimate the main relationships. TRI represents terrain ruggedness index, the main independent variable, M is one of our mitigating factors, and the interaction term between TRI and M accounts for a differential effect of the mitigating factor in more rugged countries. Z denotes the vector of controls.

### 3.4. Empirical Results

In this section we describe our main findings in relation to each of the three hypothesised mitigating factors. Table 1a shows summary statistics for our variables of interest and dependent variables.<sup>15</sup>

#### 3.4.1. Road Density

Panel A in Table 2 shows the results using inflation as the latent variable for state capacity and road density as the mitigating factor.<sup>16</sup> Column 1 indicates that TRI exerts a negative non-linear effect on state capacity; confirming prior results. RD is statistically significant with a negative sign, indicating that in fact it is associated with less inflation in the long run on average for all the countries in the sample. This is in line with one of our main hypotheses, that more roads might facilitate cooperation between citizens and therefore increase state capacity. We include the initial level of income as a control to account for the fact that richer countries might have started with higher road density. With the aim of identifying the basic relationship between RD, state capacity and TRI, Column 2 introduces the interaction term of RD and TRI in a model with linear TRI to avoid masking some effects that the interaction term might cause on the non-linear term of TRI given our logit estimation methodology. We find

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<sup>15</sup> Table 1b shows the correlation matrix between the independent variables used as mitigating factors.

<sup>16</sup> We present logit estimates because we are interested in observing interaction effects of TRI and other variables. Presenting AMEs would hide the statistical significance of the interaction term. AMEs are available upon request.



that the interaction term is statistically significant with a positive sign. This means that a denser road network indeed reduces this state capability, which differs from the initial hypothesis. This could mean that ruggedness is not overcome by increasing the road network in more rugged countries; on the contrary, it weakens state ability to control inflation. Although this could be the result of roads easing the transmission mechanism of factor costs' changes into final prices,<sup>17</sup> the statistical interpretation is that roads do not reduce the negative effect of TRI on our inflation-transformed variable in rugged countries.<sup>18</sup> This implies that there might be some other mechanisms through which monetary policy is transmitted with regard to rugged countries and they need to be accounted for.<sup>19</sup>

Column 3 introduces some controls to the previous specification and the results do not change. Columns 4 to 6 add different specifications for TRI and the interaction effect between TRI and RD. The results suggest that higher road density is associated with higher state capacity on average but a denser road network makes the negative effect of bad topography in rugged countries worse.

Panel B in Table 2 presents the results using rule of law as the indicator for state capacity. Basically, our estimates show that RD is positively associated with our transformed variable rule of law. This means that more roads are associated with better law and order enforcement over the period analysed for the average country. It could be that the construction of roads facilitates the coordination of authorities to provide law and order or even heightens the presence of the state's representatives throughout the country.<sup>20</sup> Despite these

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<sup>17</sup> For instance, an increase in the cost of inputs (e.g. petrol) could lead to deeper inflationary pressures in rugged countries as they might have a different cost structure (reflecting higher transportation costs) than less rugged countries.

<sup>18</sup> Another interpretation is that the marginal cost of road usage in more rugged countries is higher and this cost cannot be offset even by the physical presence of a road, resulting in higher prices.

<sup>19</sup> Another avenue of research is to analyse how state's authorities are able to broadcast monetary policy to the hinterland in the presence of roads compared to cases where roads are non-existent. A more precise statistical investigation is needed to find the correct transmission mechanism of monetary policy in rugged countries.

<sup>20</sup> Another mechanism through which enforcement of rule of law could work is that the construction of roads improves the spatial distribution of courts, number of judges, and so on, enhancing the state capacity to provide law and order.

findings, the interaction term between RD and TRI displays a sign contrary to the previous expectation (Columns 8–12), meaning that a denser road network makes the enforcement of rule of law worse in more rugged countries. This highlights the need to understand how financial and legal institutions spread into the hinterland in more rugged countries with better road connections.

Panel A in Table 3 displays the estimates using taxation as a proxy for state capacity. Following the findings of Chapter 2 that TRI exerts a linear effect on the state's extractive capacity, we present results using a linear specification. Column 1 shows that RD is not statistically significant for tax collection on average. Column 2 introduces the interaction term between RD and TRI. Although the result is not statistically significant, the sign is as expected. Column 3 adds some controls to the specification and remarkably, the interaction term becomes statistically significant at 10 per cent level, showing that road density could improve the capacity to collect taxes over time in more rugged countries.<sup>21</sup> This finding is more in line with the original hypothesis emphasising the possible role of road infrastructure as a means for the central government to extract resources from the hinterland, either by imposition or by increasing the people's willingness to pay taxes in rugged areas.

Panel B in Table 3 displays the results employing the presence of civil war as an indicator of state capacity. RD estimates are not statistically significant in different model specifications (Columns 4–9). The presence of RD in the estimating equation does not alter the coefficient nor the statistical significance of TRI on the final outcome. In general, RD is not statistically related to this outcome of state capacity, and the interaction effect between TRI and RD, although showing the expected coefficient, does not reduce the negative impact of rugged topography on a state's outcomes.

In summary, we find that RD increases inflation, worsens the enforcement of the rule of law and improves tax collection performance in more rugged

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<sup>21</sup> The correlation between initial income per capita and government expenditure is 0.25, reducing the likelihood of observing multicollinearity. However, unreported estimations show that results do not differ when initial income per capita is removed from the specification.

countries. Conversely, it is associated with lower inflation and better rule of law in non-rugged countries.

### 3.4.2. Fiscal Decentralisation

Another important characteristic of a country is whether the task of collecting public revenue is mainly performed by a central authority or shared between different levels of government. In this subsection we investigate whether fiscal decentralisation could be a factor to mitigate the negative effects of terrain ruggedness on outcomes of state's behaviour. Panel A in Table 4 displays the results using inflation as an indicator of state capacity. Column 1 shows that FD has no significant effect on inflation for all countries in the sample. However, Columns 2 and 4 show that FD has a statistically significant impact on more rugged countries. While FD has a negative effect on inflation on average, it has better results for inflation in more rugged countries.

Panel B in Table 4 displays the results using rule of law as a proxy capturing the state capacity to enforce law and order. Estimates in Columns 6 to 10 suggest that there is no statistically significant effect of FD on this state capacity outcome.

Panel A in Table 5 shows the impact of fiscal decentralisation on the state's extractive capacity. Estimates in Columns 1 to 3 show that FD reduces the state capacity to collect taxes on average. The interaction term between FD and TRI is not statistically significant; although the sign is as expected.

Panel B in Table 5 presents the estimates using the presence of civil war to infer state capacity. Results in Columns 4 to 8 suggest that FD reduces the state capacity to avoid the onset of civil conflict. Additionally, the negative effect of TRI on state capacity could not be reversed by FD on average. However, the estimate of the interaction term between FD and TRI in Column 7 suggests that FD reduces the presence of civil wars in more rugged countries.

In general, we find evidence suggesting that FD reduces the likelihood of long-term inflation and civil war in more rugged countries. Additionally, we find, as

a by-product of our estimates, that FD reduces the ability of the states to collect taxes in general.

### 3.4.3. Political Decentralisation

Next, we analyse whether centralised or shared political decision making has consequences for state capacity and more importantly if there is a role for political constitutions to reduce the negative impact of terrain ruggedness in countries where this physical characteristic is more predominant.

Panel A in Table 6 presents the results when using inflation to proxy state capacity. The estimates in Columns 1 to 6 show that PA increases the likelihood of higher inflation over time. However, this effect is reversed for rugged countries since the interaction between TRI and PA is statistically significant in all specifications and with the predicted sign. Thus, rugged countries with a decentralised political making system are more likely to have a better state apparatus.

Panel B in Table 6 displays the relationship between PA and rule of law. The estimates in Columns 7 to 12 suggest that there is no significant effect of this constitutional feature on the capacity to enforce law and order. Also, the interaction effect is not statistically significant, meaning that there is no statistical difference between politically autonomous rugged countries and more politically centralised rugged countries.

Panel A in Table 7 presents the results when using tax extraction as an indicator of state capacity. The estimates are not statistically significant. Thus, PA has no statistical influence as a source undermining or enhancing this state capacity.

Panel B in Table 7 shows the estimates using the presence of civil war as a proxy for state capacity. Column 4 suggests that PA increases the likelihood of civil war, though this result is not robust as shown by insignificant estimates in other specifications. The interaction term between TRI and PA in Columns 7

and 8 show that more rugged countries with a politically autonomous system are more likely to be classified as weak states.

Overall, we find that PA is associated with less inflation and an increased likelihood of facing civil conflict in more rugged countries. Additionally, we observe that the direct effect of this constitutional outcome is higher inflation over time for the average country.

### 3.5. Conclusions

Are there factors that mitigate the adverse consequences of terrain ruggedness on state capacity? Chapters 2's main findings show that rugged terrain hinders different capabilities of the state. However, this conclusion does not mean that countries that are challenged from a topographic point of view have to remain weak since human-made factors could reduce the negative effect of difficult terrain. Our findings suggest that an increase in road density is associated with more tax collection in more rugged countries. However, we find that a denser road network could cause a reduction in the state capability with respect to controlling inflation and enforcing the rule of law.

Moreover, our research shows that fiscal decentralisation reduces the likelihood of long-term inflation and the presence of civil war in more rugged countries. Finally, we find that political autonomy produces different outcomes. While this constitutional characteristic is associated with lower inflation in more rugged countries, it also increases the probability of facing civil conflict in such countries.

Even though the policy implication of this research is that adopting fiscal decentralisation could help rugged countries to reduce transaction costs and foster state capacity, one might need to understand what triggers reforms in first place. The approach taken here (and also a caveat of this study) is to treat denser road networks, fiscal decentralisation and political autonomy as exogenous variables. Further understanding of the political economy of road

construction, fiscal decentralisation and political autonomy could help to provide better responses as to when it is advisable to embark on such reforms.

Although, the main aim of this research was to explain differences in the infrastructure and institutional design of rugged countries, we find that higher road density is associated with less inflation and greater enforcement of rule of law in non-rugged countries. This opens the door for future research exploring the mechanisms through which road density could increase some state capacity outcomes in non-rugged countries.

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## Tables

Table 1a. *Descriptive Statistics*

	(1)	(2)	(3)	(4)
Variables	TRI	RD (km of roads/ sq. km of land)	FD (revenue collected by local governments/ total revenue in %)	PA (1 if politically autonomous; 0 otherwise)
Mean	1.372	0.801	22.901	
Standard deviation	1.336	2.508	15.610	
Median	0.944	0.250	22.764	
Max	6.740	31.75	80.531	
Min	0.002	0.004	2.020	
Frequency:				
0				112
1				18
Observations	192	182	69	130

Table 1b. *Correlation Matrix*

	(1)	(2)	(3)
Variables	RD	FD	PA
RD	1.000		
FD	-0.1678	1.000	
PA	0.1107	0.1847	1.000

Table 2. *Road Density and State Capacity*

Variables	Panel A					Panel B						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable: Y = 1 if Inflation > 10%; 0 Otherwise												
RD	-0.855** (-2.495)	-1.140*** (-2.648)	-1.471** (-2.334)	-1.112** (-2.499)	-1.402* (-1.739)	-2.241** (-2.552)	2.197** (2.059)	4.326*** (2.905)	4.246** (2.394)	4.135*** (2.929)	4.729*** (3.234)	4.690*** (3.219)
TRI	0.858** (2.213)	-0.0113 (-0.0734)	-0.0808 (-0.487)	0.770* (1.947)	0.632 (1.336)	0.0939 (0.174)	-0.903* (-1.750)	0.652* (1.776)	0.815*** (2.402)	-0.187 (-0.325)	0.0399 (0.0565)	0.505 (0.540)
TRI sq.	-0.167** (-2.408)			-0.164** (-2.302)	-0.139* (-1.700)	-0.0467 (-0.539)	0.200** (2.088)			0.149* (1.681)	0.105 (0.875)	0.0485 (0.357)
TRI * RD		0.155** (2.401)	0.209** (2.209)	0.159** (2.334)	0.517 (0.659)	1.270 (1.410)		-1.350*** (-2.980)	-1.450*** (-3.667)	-1.240*** (-3.179)	-2.010 (-1.474)	-2.352 (-1.483)
TRI sq. * RD					-0.0691 (-0.451)	-0.205 (-1.122)					0.167 (0.554)	0.211 (0.577)
EF	0.0778 (0.0962)	-0.332 (-0.430)	0.927 (0.898)	-0.0110 (-0.0135)	-0.0522 (-0.0636)	1.157 (1.059)	-1.757 (-1.247)	-1.198 (-0.878)	-2.581 (-1.509)	-1.525 (-1.042)	-1.388 (-0.960)	-2.885 (-1.629)
Initial income per capita	-0.229* (-1.778)	-0.210* (-1.680)	-0.380** (-2.017)	-0.236* (-1.857)	-0.238* (-1.821)	-0.400** (-1.961)	1.525*** (6.214)	1.709*** (6.636)	2.410*** (5.060)	1.744*** (6.341)	1.753*** (6.343)	2.418*** (5.052)
Independent year			0.00401 (0.890)			0.00340 (0.715)			0.00237 (0.422)			0.00392 (0.616)
Colony: SPA			0.880 (0.990)			0.864 (0.981)			-3.245*** (-2.606)			-3.170** (-2.414)
Colony: GBR			-0.639 (-1.007)			-0.539 (-0.819)			-0.769 (-0.604)			-1.048 (-0.762)
Colony: FRA			-2.146*** (-2.766)			-2.062*** (-2.625)			-2.952 (-1.484)			-3.273 (-1.558)
Legal: GBR			-2.504*** (-3.037)			-2.575*** (-3.031)			4.357*** (2.617)			4.566*** (2.906)
Legal: FRA			-1.830** (-2.519)			-1.961*** (-2.686)			3.560*** (2.583)			3.773*** (2.885)
Constant	1.083 (0.894)	1.782 (1.556)	-2.985 (-0.310)	1.284 (1.057)	1.419 (1.109)	-1.844 (-0.181)	-11.52*** (-5.434)	-14.68*** (-5.783)	-26.06** (-1.977)	-14.11*** (-5.609)	-14.42*** (-5.782)	-28.70** (-2.011)
Observations	164	164	164	164	164	164	165	165	165	165	165	165

Notes. Robust z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 3. *Road Density and State Capacity*

Variables	(1) Panel A: Dependent Variable: Y = 1 if Tax/GDP > 15%; 0 Otherwise	(2)	(3)	(4)	(5) Panel B: Dependent Variable: Y = 1 if Presence of civil war; 0 Otherwise	(6)	(7)	(8)	(9)
RD	0.0480 (0.212)	-0.180 (-0.630)	-0.510 (-1.436)	-0.147 (-0.487)	-0.372 (-0.992)	-0.439 (-1.168)	-0.186 (-0.423)	-0.229 (-0.431)	-0.208 (-0.402)
TRI	-0.252* (-1.855)	-0.417** (-2.284)	-0.474** (-2.360)	1.509*** (3.011)	0.171 (0.794)	0.109 (0.489)	1.495*** (2.764)	1.478*** (2.644)	1.345** (2.448)
TRI sq.				-0.253*** (-2.708)			-0.252*** (-2.668)	-0.248** (-2.484)	-0.237** (-2.563)
TRI * RD		0.273 (1.623)	0.363* (1.934)		0.149 (0.673)	0.244 (1.101)	0.0334 (0.140)	0.0999 (0.209)	0.00147 (0.00294)
TRI sq. * RD								-0.0171 (-0.145)	0.0363 (0.289)
EF	-2.466*** (-2.627)	-2.487*** (-2.661)	-3.988*** (-3.393)	2.114** (1.971)	1.277 (1.360)	1.276 (1.264)	2.112** (1.960)	2.117* (1.951)	1.827* (1.657)
Initial income per capita	0.0704 (0.425)	0.0440 (0.261)	0.183 (0.726)	-0.438** (-2.243)	-0.399** (-2.152)	-0.587*** (-2.846)	-0.439** (-2.251)	-0.438** (-2.209)	-0.596*** (-2.790)
Ind. Year			0.00352 (0.586)			-0.00522 (-1.079)			-0.00422 (-0.809)
Colony: SPA			-0.740 (-0.832)			-0.370 (-0.534)			-0.366 (-0.509)
Colony: GBR			-0.401 (-0.294)			-1.276 (-1.600)			-1.486 (-1.593)
Colony: FRA			-0.791 (-0.831)			-1.273* (-1.674)			-1.055 (-1.403)
Legal: GBR			3.042** (2.154)			1.855* (1.893)			2.238** (1.969)
Legal: FRA			2.341*** (2.656)			1.470* (1.927)			1.430* (1.729)
Gov. Size	0.149*** (3.556)	0.153*** (3.638)	0.150*** (3.210)						
Constant	-1.463 (-0.968)	-1.174 (-0.764)	-9.786 (-0.783)	-0.174 (-0.108)	0.981 (0.611)	11.68 (1.197)	-0.147 (-0.0894)	-0.153 (-0.0924)	8.573 (0.808)
Observations	125	125	125	147	147	147	147	147	147

Notes. Robust z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 4. *Fiscal Decentralisation and State Capacity*

Variables	Panel A					Panel B					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11) (12)
	Dependent Variable: Y = 1 if Inflation > 10%, 0 Otherwise						Dependent Variable: Y = 1 if Rule of Law > 0, 0 Otherwise				
Fiscal decentralisation (FD)	0.00412 (0.127)	0.0979** (2.009)	0.0719 (1.487)	0.0954** (2.125)	0.0209 (0.378)	-0.0750 (-0.766)	-0.0559 (-0.882)	-0.0792 (-1.210)	-0.0594 (-0.841)	-0.0781 (-1.198)	-0.110 (-1.084)
TRI	-0.218 (-0.240)	1.478* (1.937)	0.730 (1.089)	0.429 (0.371)	-2.785 (-1.108)	-5.728 (-1.358)	-0.934 (-0.748)	-0.771 (-1.089)	-0.250 (-0.440)	-1.097 (-0.935)	-2.013 (-0.838)
TRI sq.	0.0867 (0.431)			0.350 (1.076)	1.636 (1.593)	2.499 (1.535)	0.172 (0.584)			0.123 (0.388)	0.520 (0.867)
TRI * FD		-0.0792** (-1.973)	-0.0471 (-1.356)	-0.0802** (-2.193)	0.0882 (0.741)	0.272 (1.272)		0.0260 (0.734)	0.0110 (0.417)	0.0226 (0.606)	0.0614 (0.504)
TRI sq. * FD					-0.0699 (-1.306)	-0.129 (-1.434)				-0.0143 (-0.682)	-0.0132 (-0.500)
EF	-1.377 (-0.921)	-1.322 (-0.867)	1.563 (0.734)	-1.186 (-0.782)	-0.959 (-0.642)	3.460 (1.250)	-0.301 (-0.152)	-0.570 (-0.302)	-7.064*** (-2.757)	-0.424 (-0.209)	-6.965*** (-2.736)
Initial income per capita	-0.831** (-2.441)	-0.891** (-2.517)	-0.577 (-1.426)	-0.913** (-2.543)	-0.924** (-2.369)	-0.533 (-1.192)	2.321** (2.181)	2.293** (2.279)	2.883** (2.224)	2.311** (2.190)	2.981** (2.477)
Ind. Year			0.00892 (1.290)			0.00830 (1.135)			0.00820 (1.192)		0.00835 (1.348)
Colony: SPA			1.843* (1.731)			1.763* (1.669)			-2.418 (-1.558)		-2.332 (-1.395)
Colony: GBR			-1.761 (-1.280)			-1.707 (-1.223)			-0.869 (-0.408)		-0.779 (-0.356)
Legal: GBR			-2.321 (-1.603)			-3.082 (-1.587)			5.343*** (2.413)		5.668*** (2.700)
Legal: FRA			-0.885 (-0.819)			-1.287 (-1.107)			1.645 (1.046)		1.765 (1.100)
Constant	6.992** (2.343)	5.457* (1.717)	-13.54 (-0.968)	6.194* (1.881)	7.713** (1.976)	-10.00 (-0.631)	-	-16.22** (-2.065)	-35.18* (-1.768)	-16.24** (-2.019)	-35.36* (-1.955)
Observations	63	63	63	63	63	63	66	66	66	66	66

Notes. Robust z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 5. *Fiscal Decentralisation and State Capacity*

Variables	Panel A			Panel B					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent Variable: Y = 1 if Tax/GDP > 15%; 0 Otherwise			Dependent Variable: Y = 1 if Presence of civil war; 0 Otherwise					
Fiscal decentralisation (FD)	-0.0751** (-2.164)	-0.0932* (-1.756)	-0.118* (-1.796)	0.0444 (1.055)	0.0699 (1.621)	0.113** (2.324)	0.286** (2.544)	-0.210 (-0.585)	-0.479 (-1.280)
TRI	-0.364 (-1.189)	-0.663 (-0.980)	-0.450 (-0.616)	9.076** (2.441)	0.606 (1.024)	0.910 (1.500)	17.63*** (2.922)	9.924** (2.242)	21.42 (1.298)
TRI sq.				-3.035** (-2.056)			-4.900*** (-2.663)	-2.019** (-1.972)	-5.248 (-1.060)
TRI * FD		0.0148 (0.652)	0.00964 (0.379)		-0.0330 (-1.065)	-0.0423 (-1.068)	-0.181** (-2.457)	0.688 (1.061)	1.467* (1.864)
TRI sq. * FD								-0.329 (-1.313)	-0.650** (-1.977)
EF	-0.909 (-0.606)	-1.075 (-0.702)	-2.799 (-1.264)	1.370 (0.663)	1.134 (0.612)	-0.484 (-0.229)	1.101 (0.450)	1.745 (0.609)	-2.294 (-0.703)
Initial income per capita	0.478* (1.700)	0.455 (1.639)	0.177 (0.600)	-0.620 (-1.515)	-0.705** (-1.967)	-1.100*** (-2.730)	-1.139** (-2.237)	-1.214** (-2.058)	-2.545* (-1.855)
Ind. Year									0.00969 (0.779)
Colony: SPA									-1.228 (-0.651)
Colony: GBR									-0.198 (-0.103)
Legal: GBR									5.324** (2.155)
Legal: FRA									7.557** (2.508)
Gov. Size	0.153** (2.148)	0.155** (2.103)	0.131** (2.166)						
Constant	-4.265 (-1.565)	-3.649 (-1.287)	21.25 (1.407)	-3.478 (-0.749)	2.358 (0.650)	7.304 (0.281)	-7.523 (-1.255)	-2.855 (-0.557)	-25.15 (-0.889)
Observations	56	56	56	62	62	62	62	62	62

Notes. Robust z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 6. *Political Autonomy and State Capacity*

Variables	(1)	(2)	Panel A			Panel B						
	Dependent Variable: Y = 1 if Inflation > 10%; 0 Otherwise						Dependent Variable: Y = 1 if Rule of Law > 0; 0 Otherwise					
Political autonomy (PA)	-0.780 (-1.124)	2.360* (1.958)	2.765** (2.301)	2.911** (2.247)	3.603** (2.174)	4.024** (2.141)	-0.401 (-0.264)	-2.035 (-0.883)	-5.830 (-1.132)	-2.016 (-0.864)	-3.169 (-1.134)	-8.352 (-1.319)
TRI	1.157** (2.370)	0.391 (1.281)	0.463 (1.396)	1.565*** (2.903)	1.579*** (2.908)	1.640*** (2.834)	0.540 (0.716)	-0.317 (-1.088)	-1.115 (-1.622)	0.622 (0.564)	0.151 (0.139)	-1.089 (-0.664)
TRI sq.	-0.212** (-2.248)			-0.270** (-2.550)	-0.274** (-2.558)	-0.252** (-2.315)	-0.217 (-1.087)			-0.317 (-0.872)	-0.155 (-0.457)	-0.0331 (-0.0639)
TRI * PA		-2.604** (-2.034)	-3.245*** (-3.168)	-3.245** (-2.241)	-4.762* (-1.954)	-5.206 (-1.634)		1.422 (1.276)	4.309 (1.607)	1.358 (1.281)	3.261 (1.445)	8.830* (1.934)
TRI sq. * PA					0.648 (1.219)	0.520 (0.474)					-0.554 (-1.149)	-1.393* (-1.727)
EF	-0.114 (-0.118)	-0.262 (-0.256)	1.342 (0.990)	-0.0762 (-0.0727)	-0.0819 (-0.0779)	1.525 (1.107)	-0.587 (-0.324)	-0.878 (-0.494)	-4.373* (-1.938)	-0.941 (-0.543)	-0.951 (-0.549)	-4.575** (-2.002)
Initial income per capita	-0.529** (-2.481)	-0.480** (-2.314)	-0.626** (-1.971)	-0.555** (-2.501)	-0.560** (-2.501)	-0.678* (-1.902)	3.815*** (4.046)	3.774*** (3.924)	5.864** (2.304)	3.759*** (4.022)	3.824*** (4.065)	6.071*** (2.694)
Ind. Year			0.00721 (1.422)			0.00820 (1.552)			0.00681 (1.001)			0.00647 (0.867)
Colony: SPA			2.978** (2.126)			3.052* (1.936)			-3.942** (-1.972)			-4.373** (-2.435)
Colony: GBR			-0.599 (-0.670)			-0.785 (-0.917)			-0.761 (-0.349)			-0.909 (-0.411)
Colony: FRA			-1.688* (-1.938)			-1.572* (-1.678)			-4.452* (-1.670)			-4.791* (-1.865)
Legal: GBR			-2.233** (-2.469)			-2.051** (-2.337)			5.218* (1.856)			5.488** (2.060)
Legal: FRA			-1.614** (-2.271)			-1.688** (-2.204)			5.238* (1.662)			5.630* (1.936)
Constant	3.600* (1.653)	3.624* (1.674)	-8.153 (-0.749)	3.438 (1.522)	3.475 (1.526)	-10.47 (-0.928)	-33.59*** (-3.892)	-32.56*** (-3.720)	-63.74** (-1.996)	-32.83*** (-3.883)	-33.19*** (-3.908)	-64.86** (-2.094)
Observations	121	121	121	121	121	121	122	122	122	122	122	122

Notes. Robust z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1



Table 7. *Political Autonomy and State Capacity*

Variables	(1)	(2)	(3)	Panel B					
	Dependent Variable: Y = 1 if Tax/GDP >15%; 0 Otherwise			Dependent Variable: Y = 1 if Presence of Civil War >0; 0 Otherwise					
Political autonomy (PA)	-0.193 (-0.300)	-0.819 (-0.889)	-1.974 (-1.633)	1.095* (1.723)	1.397 (1.482)	1.053 (1.117)	1.452 (1.440)	-3.690 (-1.249)	-4.058 (-1.223)
TRI	-0.236 (-1.394)	-0.307 (-1.573)	-0.364 (-1.546)	1.962*** (3.032)	0.459* (1.682)	0.438 (1.596)	1.999*** (3.081)	1.700*** (2.755)	1.721** (2.519)
TRI sq.				-0.315** (-2.551)			-0.314*** (-2.617)	-0.254** (-2.323)	-0.262** (-2.218)
TRI * PA		0.423 (1.037)	0.902* (1.854)		-0.183 (-0.389)	0.0760 (0.162)	-0.244 (-0.537)	8.035* (1.929)	8.709* (1.676)
TRI sq. * PA								-2.612** (-2.044)	-2.790* (-1.697)
EF	-1.687 (-1.472)	-1.743 (-1.541)	-2.702** (-2.232)	1.748 (1.318)	1.115 (0.938)	0.767 (0.637)	1.827 (1.347)	1.584 (1.167)	1.138 (0.841)
Initial income per capita	0.209 (0.741)	0.180 (0.633)	0.293 (0.846)	-0.806*** (-2.842)	-0.718*** (-2.640)	-0.875*** (-3.141)	-0.787*** (-2.745)	-0.759** (-2.556)	-0.913*** (-2.756)
Ind. Year			0.00112 (0.187)			-0.00119 (-0.183)			-0.000840 (-0.112)
Colony: SPA			-0.881 (-0.798)			-0.0872 (-0.0935)			-0.0814 (-0.0844)
Colony: GBR			-0.843 (-0.663)			-0.948 (-1.041)			-1.162 (-1.097)
Colony: FRA			-0.574 (-0.553)			-0.647 (-0.682)			-0.425 (-0.430)
Legal: GBR			3.184** (2.302)			1.249 (1.215)			1.489 (1.200)
Legal: FRA			2.256** (2.567)			1.295 (1.319)			1.349 (1.224)
Gov. Size	0.167*** (3.177)	0.169*** (3.152)	0.176*** (2.860)						
Constant	-3.280 (-1.244)	-2.945 (-1.112)	-7.187 (-0.569)	2.858 (1.056)	3.532 (1.339)	6.717 (0.505)	2.611 (0.934)	2.739 (0.953)	5.135 (0.332)
Observations	97	97	97	117	117	117	117	117	117

Notes. Robust z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

## Appendix

### A1. Data Sources and Descriptions

Variable	Source	Description	Link
Inflation	World Bank (2013), World Development Indicators database.	GDP deflator (annual %)	<a href="http://databank.worldbank.org">http://databank.worldbank.org</a>
Rule of law	Kaufmann, Kraay, and Mastruzzi (2010)		<a href="http://info.worldbank.org/governance/wgi/index.asp">http://info.worldbank.org/governance/wgi/index.asp</a>
Tax revenue/GDP	World Bank (2013), World Development Indicators database.	Tax revenue (% of GDP)	<a href="http://databank.worldbank.org">http://databank.worldbank.org</a>
Civil conflict	Uppsala University Conflict Program and International Peace Research Institute (2013), UCDP/PRIO Armed Conflict Dataset	Presence of civil war	<a href="http://www.pcr.uu.se/research/ucdp/datasets/ucdp_prio_armed_conflict_dataset/">http://www.pcr.uu.se/research/ucdp/datasets/ucdp_prio_armed_conflict_dataset/</a>
TRI	Nunn and Puga (2012)		<a href="http://diegopuga.org/data/rugged/">http://diegopuga.org/data/rugged/</a>
Ethnic fractionalisation	Alesina et al. (2003)		<a href="http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls">http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls</a>
Government size	World Bank (2013), World Development Indicators database.	Expense (% of GDP)	<a href="http://databank.worldbank.org">http://databank.worldbank.org</a>
Colonial origins and independence years	Acemoglu et al. (2008) and Olsson (2009)		<a href="http://economics.mit.edu/faculty/acemoglu/data/ajry2008">http://economics.mit.edu/faculty/acemoglu/data/ajry2008</a>
Legal origins	La Porta, Lopez-de-Silanes and Shleifer (2008)		<a href="http://www.economics.harvard.edu/faculty/shleifer/files/JEL_%20web.xls">http://www.economics.harvard.edu/faculty/shleifer/files/JEL_%20web.xls</a>
Latitude, area	Nunn and Puga (2012)		<a href="http://diegopuga.org/data/rugged/">http://diegopuga.org/data/rugged/</a>

## **Chapter 4: Empirically Testing the Persistence of Power, Elites and Institutions: Evidence from Land Reforms around the World, 1900–2010**

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### **4.1. Introduction**

While some scholars find that political institutions are important for economic outcomes, such as income (Persson & Tabellini 2009; Rodrik 1999), others do not find that different political institutions produce any systematically different economic outcomes (Barro 1999; Mulligan, Gil & Sala-i-Martin 2004; Perotti 1996). Recent research in comparative political economy has tried to explain this empirical puzzle by incorporating features of dynamic societal conflict into models of political games. Societal conflict is modelled as two groups—the rich/elite and the poor/citizens—continuously fighting to gain ‘ruling’ power to set their preferred institutional design and thereby control the political and economic sphere, both in the present and in the future (Acemoglu, Johnson & Robinson 2005).

Thus, the set of institutions at a certain point in time corresponds to the equilibrium point as a result of the battle between these two groups. It is important to note that this equilibrium is path dependent in that the set of institutions available at a particular time is constrained by past institutions (Lagunoff 2009). For instance, when the elites are the ruling power, they may choose repressive political institutions that allow them to impose pro-elite economic institutions and have more control over economic resources, such as dictatorship in the political arena and slavery as an economic institution.<sup>1</sup> Furthermore, if the masses hold more political power at a certain point in time, political institutions will be favourable towards accepting a broad political

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<sup>1</sup> One might think of other examples but the main point is that elites are small powerful groups that try to dominate the masses through disproportionate political representation. Thus, dictatorships and oligarchies are more likely to be political regimes used by the elites to exert political control. Conversely, when the citizens are able to control the elites, it is expected that a political institution with broader representation such as democracy will emerge.

representation such as democracy. Citizens in power would try to distribute resources more widely from the economic output and thus economic institutions will be more pro-citizen (e.g. progressive taxation).

However, one question arises: why are there countries with ‘broad’ political representation yet pro-elite economic institutions? Acemoglu and Robinson (2008) contend that the key to explaining this conundrum lies in differentiating two distinct types of political power: *de jure* and *de facto*. The former refers to the way the legal framework allocates political power and the latter to the way political power is allocated and executed in reality. Thus, countries that appear to be democratic by *de jure* political power might have repressive economic institutions if the elites dominate the political spectrum<sup>2</sup> and can impose rules for their own interests by using their *de facto* political power.

The core idea of this essay is to investigate these interactions of power empirically, namely *de jure* and *de facto* political power and their subsequent influence on the adoption of pro-citizen economic institutions. We exploit the historic fact that land has been an economic resource controlled by elites from the agricultural era and that a change in the ownership of this resource, in a collective sense, implies a change in the structure of power within a society (de Janvry 1981; World Bank 2009).

One key historical feature of elite domination of the land is related to the accumulation of extensive amounts of land since the latter has always been seen as an important factor of production, and hence, wealth (Galor, Moav & Vollrath 2009). The feudal system in Europe is an example where the aristocracy could impose their preferred political and economic institutions, as they owned the land and had all the political power. This system came to an end when citizens accumulated enough political power and demanded change. The elites were forced to surrender some power and to adopt a system with broader political representation to make a credible commitment to

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<sup>2</sup> Acemoglu and Robinson (2008) label this situation as a ‘captured democracy’

redistribution and thereby avoid a more costly revolution by the citizens (Acemoglu & Robinson 2001).<sup>3</sup>

Thus, we use a unique and newly-constructed dataset of 280 land reforms enacted in parliaments around the world in the last 110 years in 150 countries to analyse the links between economic policies, political institutions and the distribution of power within countries. The data indicate that 33 per cent of the reforms are either unimplemented or only partially implemented. Thus, we exploit the differences between parliamentary enactment and executive implementation of land reforms and ascribe the lack of full implementation to elite resistance. With this measure of elite strength at hand, we test whether or not pro-citizen economic institutions (e.g. open trade regime, competitive labour markets, regulation of monopolies and oligopolies) are more likely to arise when political institutions are truly representative and the citizens have at least as much political power as the elites. At this point, the essay focuses on a partial scenario, which is the second stage of the game between the elites and the citizens centred on the implementation of already enacted land reforms. Consequently, our results may actually be an understatement of the role of elite strength in economic policy-making; a deeper focus taking into account the first stage of the game (i.e. the enactment itself) could provide a more complete picture of the phenomenon theorised by Acemoglu and Robinson (2008).<sup>4</sup>

This chapter proceeds as follows. Section 4.2 discusses theories regarding the persistence of elites and political transitions, analyses the importance of land as the main determinant of political power and reviews different mechanisms by which land holdings can impact on economic outcomes. Section 4.3 discusses the original dataset generated in this research, the econometric framework, other data used and the results. Section 4.4 concludes.

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<sup>3</sup> The elites could also repress the revolution but this could lead to a larger loss for them in cases where the citizens have *enough* political power. Thus, the rational action for the elites is to lose some political power by democratising the political system rather than losing it all by repressing the masses.

<sup>4</sup> We leave this extension for future research.

## 4.2. Testable Hypothesis

Acemoglu and Robinson (2008) posit that the interaction between different types of political power can lead to different political and economic settings. Specifically, they demonstrate theoretically the existence of a switching political equilibrium with different options for economic institutions depending on which group has more power. In summary, they find that:

- i) Competitive economic institutions are adopted when there is a broad political representation of the masses and where elites are constrained (democracy);
- ii) Pro-elite economic institutions are adopted when the political regime represents the interest of the elites (non-democracy); and
- iii) Pro-elite economic institutions are adopted when elites are able to exert power on the political system (*de facto* political power) even if the *de jure* political power represents the masses. This equilibrium is called captured democracy.

These predictions suggest that changes in political institutions, from non-democracy to democracy, do not imply that economic institutions will necessarily change accordingly (e.g. from repressive economic institutions to competitive economic institutions). In fact, there is a possibility that democracy could co-exist with repressive economic institutions and this equilibrium basically depends on the elites' strength.

The whole process of change from one political regime to the other implies a constant challenge for power between the groups involved. Historically, these two groups have been named elites and citizens. Since the first agrarian societies, land has been an important productive factor in the economic process and therefore a key component in determining people's wealth. Thus, holdings of land have always reflected the structure of power in a society (Baland & Robinson 2012; Barraclough 1973; Galor, Moav & Vollrath 2009). Landowners can therefore be implicitly identified as the elites while peasants or landless people represent the citizens.

For centuries, the elites dominated the political and economic scene and imposed their political system (feudalism) and economic policies. Growing dissatisfaction of the repressed with the political and economic status quo is, however, inevitable under such conditions; the more repressed citizens are the more latent revolt they are likely to harbour. Arguably, in all such cases, citizens were provoked to challenge the system that repressed them and, where possible, demanded stronger political representation linked to redistribution. Famous examples of such changes are the Glorious Revolution and the French Revolution (Huang 2012).<sup>5</sup>

In such a scenario, elites are faced with the question of how to minimise their losses. The least costly option, and that which allows the elites to maintain control over the means of economic production, is the compromise of allowing, at least *de jure*, a higher degree of political representation to the citizen majority. Thus, to avoid total loss—indeed land is very easy to confiscate given that it is a fixed and non-liquid asset (Boix 2003)—the best course of action for the elites is to democratise the system. As Acemoglu and Robinson (2001) state, democratisation is the only credible commitment to redistribution that the elites can make to the citizens. Any commitment that is *not* credible at the time could result in confiscation of their land by the citizens (a prime example is that of Russia in 1917).

Note that the main objective of the elites is to avoid a total loss of both economic and political power and to minimise any loss of each. To do this they need to convince the citizens that the *means* to achieve a less extractive outcome is in their hands. If this is adequate to placate the social upheaval tending towards revolution, then the elites may still be able to retain effective control over much of the political system, as well as the economic resources. Essentially, while granting this means to citizens is necessary, it is not *sufficient* for guaranteeing a more proportionate distribution of resources within an economy. That is, democratisation could just be on paper. In

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<sup>5</sup> Besley and Persson (2009) offer a unified theoretical model of repression and civil war. The incumbent engages in repression to avoid seizure from an opposing group. Civil war emerges when the opposing group sees that the political institutions are non-inclusive and wages are low.

functional terms, the elites could still be in a position to exert control over political outcomes in a less obvious manner, leading to the mitigation of any concrete pro-citizen reform and blocking any effective intent of redistribution. This could explain why some democracies are not functional to citizens' preferences. A commonly observed example of such a process historically is that pertaining to democratisation and land reform; indeed land reforms are an expected outcome in democracy given that the citizens want redistribution. However, if the elites retain their effective power, they may still be able to block any intended land reform from ever being implemented.

In effect, such a process of democratisation is false as it is in name only; there is a redistribution of *de jure* but not *de facto* political representation. The only necessary factor to ensure the success of such a false democratisation from the elites' point of view is the belief of the majority of the citizens that there has been a meaningful transition of political power. If this requires the elites to go so far as to sanction a reform, on paper, then this is a valuable move. So as long as the elites maintain the ability to block the reforms from actually being implemented in the end, then the major achievement of averting costly social upheaval without having to relinquish any real power has succeeded. All the elites require, therefore, is the ability to control the policymakers, the bureaucracy or simply weaken the state so it has limited capability (Acemoglu, Ticchi & Vindigni 2011).

In sum, this could be conceived as a two-stage game. The first priority will be to achieve a perceived compromise by enacting a land reform to avoid any full scale political and economic upheaval and therefore any confiscation of the elites' land resources from the citizens. The second stage will be to invest resources to block the implementation, should the citizen's continue to pursue the reform to its stated end.

### 4.3. Empirical Analysis

We examine the relationship between elites' strength and the adoption of economic policies that are meant to be favourable for the average citizen by



analysing whether the enactment and implementation of land reforms are predictors of those policies.

### 4.3.1. Estimating Equation

To estimate the relations described in the theoretical section, we first introduce our baseline model:

$$Y_{it} = \alpha + \beta_1 P_{it} + \beta_2 I_{it} + \beta_3 (P_{it} * I_{it}) + e_{it}$$

where  $Y_{it}$  is pro-citizen economic policy in country  $i$  at time  $t$ ,  $P_{it}$  denotes elites' power (or lack of it),  $I_{it}$  measures the level of democracy, and  $e_{it}$  is the error term. The interaction term between elites' power and political regimes aims to capture Acemoglu and Robinson's (2008) predictions regarding the way elites behave within the existent political regime.

### 4.3.2. Data Description

#### 4.3.2.1. Pro-Citizen Policy

We use the well-known Sachs and Warner (SW) (1995) indicator of trade openness, updated by Wacziarg and Welch (WW) (2008), to measure pro-citizen economic policies. The Sachs-Warner-Wacziarg-Welch indicator (SWWW) is a binary variable that takes the value of 1 if the country satisfies five criteria for openness or zero otherwise. Our main reasoning with this indicator is related to trade theory. Trade openness is typically beneficial for citizens' welfare as it increases the return to labour in labour-abundant countries and enables access to a variety of goods at relatively lower costs. Countries where elites dominated the political scene are mainly labour-abundant developing countries.<sup>6</sup>

We acknowledge, however, that this indicator may not perfectly reflect pro-citizen economic policies. Other important dimensions of these policies such as inclusiveness, redistribution or fair competition are not explicitly considered by

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<sup>6</sup> Additionally, the SWWW indicator spans over a long period of time, which is necessary to analyse changes in the structure of societies and persistence of institutions.

the SWWW indicator and might be left out of our analysis. However, the measure has an advantage over other (and typically continuous) measures of trade openness, because it captures a shift in *broader* economic policy-making, rather than an incremental change in an openness metric. Regrettably, variables such as public education, social security or health coverage, antimonopoly laws, and income distribution are not available for longer periods for many countries.<sup>7</sup>

#### 4.3.2.2 *Land Reform Enactments and Implementations*

Identification of elites' strength is actually captured by its antithesis, the number of times the elites have been weakened; we consider the number of land reforms that have been implemented in a country as an indicator of the lack of strength of its elites. To this end, a unique and novel dataset constructed by Bhattacharya and Ulubasoglu (2012) is broadened, cross-checked and updated so that it contains all major land reforms that have been enacted and implemented worldwide from 1900 until 2010. The main sources of the dataset are peer-reviewed articles, country studies and handbook series by the Federal Research Division of the US Library of Congress, several databases and publications from FAO, USAID Land Tenure and Property Rights Portal, among others. The Appendix elaborates how this dataset is used for this essay.

A binary variable, 0 or 1, is used to denote the absence or existence of land reform, respectively, for each country and each year. Additionally, another binary variable, 0 or 1, denotes if a specific parliamentary enacted land reform has been implemented. Taking the original documentation used by Bhattacharya and Ulubasoglu (2012), a more refined version of this variable is generated. Specifically a new variable for reform implementation is constructed where the implementation of land reforms attracts a value of 1, and 0 otherwise. This variable can also take a mid-range value (0.5) if the

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<sup>7</sup> The SWWW classification of trade openness starts after 1945. We use the 1945 values for the 1900–1945 period for each country. The error association with this assumption is expected to be minimal because only a handful of countries—predominantly today's developed countries—had a score of '1' in 1945.

information regarding the implementation of a specific land reform indicates that the land reform was implemented only partially.

Bhattacharya and Ulubasoglu (2012) classify each enactment of land reform based on its nature. These authors follow de Janvry (1981), Csaki (2000) and Deininger (2002) to broadly divide land reforms into two main categories: traditional and market oriented. Traditional land reforms took place principally before the nineties and the main aim was to transform different characteristics of the agrarian structures such as modes of production, class structure and regimes of land tenure. Public policy mechanisms, in general, were used to carry out these reforms and the related motives can be subcategorised as: (i) establishment of a landholding cap, (ii) redistribution of private land, (iii) distribution of public land, (iv) restitution of land, (v) privatisation of public land, and (vi) other motives.<sup>8</sup> However, these sub-categories are not mutually exclusive. For instance, land reforms aiming to redistribute private farms were usually accompanied by a landholding cap in order to create room for expropriation and then proceed with the redistribution component.

Market-oriented land reforms, on the other hand, took place mainly during and after the nineties and aimed mainly to establish markets for land, which would minimise direct intervention by government or public authorities. Three main components were necessary for this: the recognition of property rights, the adoption of mechanisms regulating the privatisation of public land, and the development of procedures to regulate the transferability of property rights (Deininger 2002). Note that traditional and market-oriented land reforms are also not mutually exclusive. For instance, some countries in Eastern Europe decided to restore land that was taken by the State during their experience with socialism to its original owners and in doing so also created a market for land.

For this chapter, all of these entries are cross-checked and updated with relevant information. Additionally, this classification is expanded to record

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<sup>8</sup> The 'other' category included land reforms aiming to increase farms productivity, allocate subsidies and public credit, etc.

information as to whether each land reform motive has seen a successful implementation.

We count 280 land reforms as having been enacted, with 48 per cent of them having been fully implemented and 28 per cent partially implemented. Table 1 shows a snapshot of this dataset. It is interesting to note that 65 land reforms aimed to redistribute private land and 77 per cent of them were implemented.

To capture the number of times the elites have been defeated by citizens in the first stage of the game, we count land reform enactments at time  $t$ . We refer to this variable as ‘enactment’. We proceed in the same manner to obtain the variable ‘implementation’ to reflect the number of times elites have lost the battle against citizens in the second stage of the game. These two variables indicate the number of times they have been weakened by the citizens.

#### *4.3.2.3 Political Regime*

To capture the level of formal political regime or *de jure* political power, we use the variable Polity2 obtained from the Polity IV Project database compiled by the Center of Systemic Peace. This variable takes values between -10 and 10 to denote strong autocracy and strong democracy, respectively.

### **4.3.3. Econometric Methodology**

Our econometric methodology is to estimate our baseline equation using panel data techniques by controlling for country fixed effects. The advantage of this methodology is that all time-invariant variables (e.g. legal origins, colonial origins, ethno linguistic fractionalisation, distance to the equator, geographic and topographic characteristics) that are important in the political economy of development literature are accounted for. Additionally, country fixed effects take out any time-invariant unobserved heterogeneity across countries. This means that the bias produced by, for instance, country-specific historical factors affecting both the dependent and independent variables, is removed.

Given the nature and structure of our panel data, the first approach would usually be to use a non-linear limited dependent variable method such as a probit estimation. However, the use of this methodology in a fixed effect panel context attracts reservations as the incidental parameters problem arises, resulting in a serious bias of the estimators (Fernández-Val 2009; Greene 2004). To avoid this problem, our estimation method is initially ordinary least squares (OLS), which is known to produce consistent estimates.

Despite the use of OLS, this estimation procedure does not prevent one from having a reverse causality problem, that is, economic liberalisation and the enactment (or implementation) of land reforms are part of the same data generation process. Thus, we use an instrumental variable (IV) to estimate the impact of *de jure* and *de facto* political power on economic policies. In a single equation framework, the use of IVs requires to have at least one instrument for each endogenous variable. However, this is not the case as some specifications in our estimating equation require the use of the enactment of land reforms together with the implementation of land reforms to disentangle the effect of *de jure* and *de facto* political power on the choice of economic policies. To handle this problem, and given the way our dependent variables are constructed,<sup>9</sup> we rely on a system-equation estimation procedure. That is, we run two separate first-stage regressions, one for each endogenous variable with the instrument and in the second stage we use the resulting instrumented variables of the first stage. This system is estimated using the capabilities of the command CMP in Stata.<sup>10</sup>

#### 4.3.4. Results

We begin by analysing the case where citizens' power is proxied by the number of times that land reforms have been enacted or implemented at time  $t$ . Table 2 displays the findings. Column 1 uses the number of times all land

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<sup>9</sup> Specifically, implementation is a subset of enactment.

<sup>10</sup> This command has the advantage of creating a system of equations indicating which variables are endogenous so that the instrumented endogenous variables are used directly in the second stage without the need to adjust the standard errors. For more references on this command, see Roodman (2011).

reforms have been enacted as a measure of citizens' power against the elites. The estimate is statistically significant and of the right sign, thus the more land reforms that have been legislated in a given country, the more likely it is to have pro-citizen economic policies. However, the parliamentary enactment of a land reform does not mean that the elite are totally defeated, and in fact, the elite may resist the implementation of the reform. We incorporate the number of times that all land reforms have been implemented in Column 2 to analyse if real implementation matters more than just the enactment of the reform. Indeed, the size of the estimate for implementation is statistically significant and of the correct sign. Additionally, in Columns 1 and 2, political regime is statistically significant and positively related to the adoption of open trade, in line with our hypothesis. Column 3 incorporates the interaction term between political regime and enactment into the analysis. All estimates are statistically significant and with a positive correct sign. Column 4 adds the interaction term of implemented and political regime and this has the expected sign but it is statistically insignificant. In Column 5 we add our two main variables, enactment and implementation, and their interaction terms with political regime into the baseline model. The estimate for enactment and its interaction term is positive and statistically significant, in line with our assumption. To analyse the effect of implementation in this column, we first need to realise that this variable is a subset of enactment and given that the latter is statistically significant, implementation captures the number of times that sanctioned land reforms have *not* been implemented. Crucially, the coefficient is negative and statistically significant. This means that countries where land reforms have been sanctioned but not implemented (i.e. strong elites blocking implementation) tend to have a more closed economy.

Although we use country fixed effects to 'control' for time-invariant factors, we cannot rule out that economic liberalisation and the sanctioning of land reforms are part of the same data generation process. This means that there might be some unobservable long-run variables influencing both sides of the equation. We use IVs to tackle this problem. In our search for a plausible instrument for enacted and implemented, we need to find a variable that could

influence the adoption and implementation of land reforms without affecting the trade regime.

In our conceptual overview, we explain that the sanctioning of a land reform might signal a change in the structure of power within a country and this could lead to a tension between the elites and the citizens. Elites, who benefit from the status quo, would try to block any land reform or its implementation. However, local elites might not be able to resist the change if such reforms are demanded by an international power. In the first place, one should ask why international powers would care about land reforms.

After the Second World War (WWII), the US pushed for land reforms in many developing countries in Latin America and Asia to avoid the trend of socialism and communism sweeping across a number of countries. For instance, the US, under the presidency of John F. Kennedy, promoted the so-called Alliance for Progress aiming to reduce social and economic disparities within Latin American countries as a way of avoiding the rise of socialism and the influence of the Soviet Union in the region. Although the program was short-lived, it was relatively successful in pressuring countries to adopt land reform (Dorner 1992, p. 12).<sup>11</sup> Other countries where the US influence led to the enactment of land reforms after WWII were Japan and South Korea. Indeed, these countries were under the US military administration when the adoption of land reforms took place (Jeon & Kim 2002; World Bank 2009).

We use this stylised fact to start searching for a suitable instrument for our model. Specifically, we need to find a variable that is correlated with the enactment or sanctioning of a land reform but not correlated with the trade regime. Berger et al. (2013) construct a dataset measuring the involvement of the US government in foreign countries during the Cold War based on

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<sup>11</sup> Land reform was one of the main components of the Charter of the Alliance for Progress signed in 1961 in Uruguay. Conversely, the main development policy implemented in the region at that time was import substitution, which required the adoption of high tariffs. Thus, we have on one hand a push for land reform from outside players and on the other hand a push for market protection or an unfriendly trade regime from local policymakers.

declassified documents by the CIA.<sup>12</sup> Specifically, they construct a binary variable that takes the value of 1 if there is evidence of CIA participation in undercover operations in a foreign country during a year, or 0 otherwise. We use this variable to instrument our variables enactment and implementation. Given that this indicator is available for years after WWII, we lose 24 enacted and 14 implemented land reforms from our sample.

The IV results are displayed on the right-hand side of Table 2. Specifically, we use system equation estimation with country fixed effects. Columns 6 and 7 show that US influence has a negative effect on both the enactment and the implementation of all land reforms. This might suggest that on average the US presence was not conducive to the enactment and implementation of all land reforms. Dorner (1992) manifests that there were some instances where the US opposed land reforms when they were driven by governments identified with the Soviet Union or where groups promoting land reforms were seen as a threat for the US.<sup>13</sup> Additionally, we could not expect that all land reforms were driven by US influence and hence we cannot be too surprised at the negative result for the instrumented variable. Column 8 presents the estimates using the IV. Enactment is statistically significant and positive as expected. Implementation is negative and statistically significant. This suggests that the sanctioning of any type of land reforms is directly related to pro-citizen economics policies, and that the elite battle for reform mitigation, actually is negatively related to the adoption of these policies. Column 11 adds the interaction effects of political regime with our enacted and implemented land reforms variables. Interestingly, the interaction term between implementation and political regime is statistically significant and of a negative sign, suggesting that elites try to block implementation even in countries that appear to be classified as democracies.

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<sup>12</sup> Berger et al. (2013) find that during the years when the US supported or gave aid directly to install a government in a foreign country, US exports to those countries increased compared to the non-influence years. This, however, does not invalidate our instrument as imports from the US are not part of the criteria used to construct the SWWW indicator.

<sup>13</sup> For instance, the US government during the 1950s blocked any intent of land reform in the Philippines as the land reform movement was led by the Huk insurgency.



Even though all land reforms are positively related to trade openness, it is difficult to assume that all land reforms could pick up the battle between the citizens and the elites. Thus, we further investigate if land reforms whose motives are the establishment of a landholding cap, redistribution of private land, distribution of public land, restitution of land and privatisation of public land (i.e. traditional land reforms) have had a greater impact on pro-citizen economic policies. We use these types of land reforms as we consider that they might better reflect the struggle for power between the citizens and the elites. Table 3 displays the results when using this subset of land reforms. Columns 1 to 5 show the results using a country fixed effects methodology and Columns 6 to 11 present the IV estimates. Interestingly, the estimates are very similar to those obtained in Table 2. In fact, the estimate using the single equation for enactment is statistically significant and with a positive sign, likewise for implementation. The IV estimates show that the US influence is negatively related to the adoption of traditional land reforms; although some estimates are not robust. Again, it is difficult to argue that the majority of traditional land reforms were due to the direct influence of the US in foreign countries. Despite the latter, we still consider that our instrument is valid and thus we proceed with the second stage of the procedure. The instrumented version of enacted is positively related to pro-citizen economic policies and the number of times that land reforms have been enacted but not implemented are negatively related to the adoption of such economic policies. In other words, when elites are strong enough to block anti-elite land reforms, the economic policy outcome is likely to be a closed economy. Additionally, the sign for the interaction term between political regime and the variable implementation is negative, meaning that the elites invest their power trying to block implementation even in political regimes with a positive score for democracy.

#### *4.3.4.1 Redistributive Land Reforms*

A finer way to capture the struggle for power between the elites and the citizens is to use redistributive land reforms. Specifically, these land reforms are aimed at taking private property and redistributing it to peasants. Although we do not consider the different mechanisms used by governments to address

redistribution, land reforms falling into this subcategory are meant to reflect better the battle to maintain or acquire political power. Table 4 show the results using redistributive land reforms. Columns 1 to 4 show that enactment and implementation are directly related to trade openness. In Column 5, both enactment and implementation are used in the same specification. While enactment remains statistically significant and with the correct sign, implementation (or land reforms that have been passed but not put in practice under this specification's reading) becomes insignificant. The interaction terms are statistically significant and of the expected sign. Columns 6, 7, 9 and 10 show the estimates of the first-stage procedure. Contrary to the previous cases, US influence is positively related to the enactment and implementation of redistributive land reforms. It is important to note that the size of the estimates for enactment is almost double that for implementation, suggesting that the US exerted some influence to enact land reforms but that they were less successful in trying to push for implementation of those reforms. Column 8 presents the estimates for enactment and implementation without the interaction terms. Both terms are statistically significant and while enactment is of the correct sign, implemented is of the unexpected sign. Column 11 shows that enactment and its interaction terms are positive and significant as expected. However, the estimate for implemented is unexpectedly positive. This might be the result of the high correlation present (0.88) between enacted redistributive land reforms and their implementation. The interaction term between implementation of land reforms and political regime remain statistically significant and negative as in the previous tables.

In our previous analysis, we used the binary version of the variable implementation for redistributive land reforms. Next, we consider a more refined version for the variable. In concrete terms, we use a variable that can take the values 1, 0.5 and 0 to denote full implementation, partial implementation and non-implementation of parliamentary enacted land reforms, respectively.<sup>14</sup> Table 5 contains the results. Estimates using panel

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<sup>14</sup> Even though the coding this variable uses a systematic approach, the values are subject to a certain unavoidable subjectivity.

fixed effects are relatively similar to the ones obtained previously. Thus, we are more certain that enactment and implementation of redistributive land reforms are positively related to the adoption of trade openness.

#### 4.4. Conclusions

This paper adds empirical support to the theoretical prediction that pro-citizen economic institutions evolve when both the political system is more representative and the elites' *de facto* power is controlled. Generally, our results show that a reduction in the elites' strength is related to the adoption of trade openness; an economic regime that is more pro-citizen.

Our empirical support is based on the observation that enacted and implemented land reforms may signal a change in the structure of power within a country. Thus, more enactments of land reforms could be associated with more open economic policies, like an open-trade regime. Additionally, we account for the fact that the enactment of a land reform can be blocked by powerful elites and therefore may never be implemented. In our study, we find that, given enactment, the lack of implementation of land reforms is negatively related to the adoption of trade openness. We also find that elites' strength interacts with the political regime significantly, and thus, the adoption of pro-citizen economic policies depends on this interaction term. In other words, powerful elites try to block the adoption of pro-citizens economic institutions even in democracies. Even though our results are interesting and could shed light on possible political reforms that could bring beneficial economic outcomes to citizens, we still need to investigate further the mechanisms through which the elites are able to hold *de facto* political power before attempting to provide policy implications. In the present case, we need to pin down the different strategies used by the elites to resist the implementation of a reform, for instance, the role of the bureaucracy or the judiciary when implementing reforms.

Additionally, where data is available, this study could be expanded to account for other economic policies that could be considered pro-citizen such as the adoption of public education, social security or progressive taxation.<sup>15</sup>

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<sup>15</sup> Following Galor, Moav and Vollrath (2009), it would be promising to analyse the role of land reforms in promoting the adoption of broad-based educational policies.

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## Tables

Table 1. *Descriptive Statistics for Land Reforms*

Variables	Frequency	Variables	Frequency
Total number of land reforms enacted	280	Total number of land reforms implemented	213
		Number of land reforms fully implemented	135
		Number of land reforms partially implemented	78
Number of 'traditional' land reforms enacted	155	Number of 'traditional' land reforms implemented	126
Number of redistributive land reforms enacted	65	Number of redistributive land reforms implemented	50



Table 2. *All Land Reforms*

Estimation methodology	Single equation					System equation CMP				
	(1)	(2)	(3)	(4)	(5)	First stage: Continuous	First stage: Continuous	Second stage: Probit	First stage: Continuous	Second stage: Probit
Variables	SSWWWW	SWWW	SWWW	SWWW	SWWW	(6)	(7)	(8)	(9)	(11)
						Enactment	Implementation	SWWW	Enactment	SWWW
US Influence										
Polity 2	0.0217*** (7.915)	0.0229*** (8.096)	0.0177*** (5.708)	0.0177*** (6.339)	0.0177*** (5.714)	-0.00496*** (-4.407)	-0.0509*** (-4.596)	-3.16e-05 (-0.827)	-0.00836*** (-3.827)	-0.000488** (-2.300)
Enactment	0.194*** (8.634)		0.174*** (7.524)		0.181*** (3.644)			2.147*** (137.6)		2.248*** (75.08)
Implemented		0.204*** (8.167)		0.184*** (7.039)	-0.00872 (-0.153)			-0.205*** (-90.94)		-0.331*** (-12.31)
Enactment * Polity2			0.00522* (1.975)		0.00516 (0.873)					0.00633** (2.502)
Implementation * Polity2				0.00427 (1.392)	0.000154 (0.0229)					-0.00607** (-2.468)
Constant	0.146*** (7.108)	0.167*** (8.785)	0.152*** (7.462)	0.171*** (9.114)	0.152*** (7.477)	0.320*** (3.155)	4.47e-05 (0.000477)	-12.56 (-0.0107)	0.320*** (3.151)	-11.78 (-0.0165)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,690	9,690	9,690	9,690	9,690	8,913	8,913	8,913	8,913	8,913
R-squared	0.327	0.313	0.332	0.316	0.332					
Number of countries	130	130	130	130	130					

Notes. z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 3. *Traditional Land Reforms*

Estimation methodology	Single equation					System equation CMP					
	(1) SWWW	(2) SWWW	(3) SWWW	(4) SWWW	(5) SWWW	First stage: Continuous Enactment	First stage: Continuous Implementation	Second stage: Probit SWWW	First stage: Continuous Enactment	First stage: Continuous Implementation	Second stage: Probit SWWW
US Influence											
Polity 2	0.0259*** (9.226)	0.0260*** (9.207)	0.0212*** (6.827)	0.0227*** (7.219)	0.0212*** (6.792)	-0.00798*** (-2.886)	-0.0299*** (-2.910)	-4.05e-05 (-1.013)	-0.00155 (-1.169)	-0.0271 (-1.353)	-4.56e-05* (-1.932)
Enactment	0.194*** (8.435)		0.172*** (7.432)		0.162*** (2.270)			3.061*** (89.06)			2.491** (2.496)
Implemented		0.204*** (8.740)		0.180*** (6.945)	0.0137 (0.176)			-0.818*** (-102.1)			-0.140*** (-3.179)
Enactment * Polity2			0.00859*** (3.608)		0.0130** (2.109)						0.000850** (2.042)
Implementation * Polity2				0.00737*** (2.830)	-0.00509 (-0.792)						-0.000832*** (-2.057)
Constant	0.217*** (18.67)	0.227*** (22.25)	0.223*** (20.07)	0.231*** (22.40)	0.223*** (20.01)	0.000337 (0.00399)	0.000271 (0.00351)	-10.74*** (-19.77)	-0.000590 (-0.00278)	-0.000115 (-0.000200)	-10.44
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,690	9,690	9,690	9,690	9,690	8,870	8,870	8,870	8,870	8,870	8,870
R-squared	0.264	0.259	0.275	0.266	0.276						
Number of countries	130	130	130	130	130						

Notes. z-statistics in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 4. *Redistributive Land Reforms*

Estimation methodology		Single equation					System equation CMP					
		(1)	(2)	(3)	(4)	(5)	First stage: Continuous	First stage: Continuous	Second stage: Probit	First stage: Continuous	First stage: Continuous	Second stage: Probit
Variables	SWWW	SWWW	SWWW	SWWW	SWWW	SWWW	Enactment	(7)	(8)	Enactment	(10)	(11)
								Implementation	SWWW		Implementation	SWWW
US Influence												
Polity 2	0.0305*** (10.41)	0.0305*** (10.35)	0.0282*** (9.154)	0.0290*** (9.354)	0.0283*** (9.196)		0.0714*** (4.540)	0.0337** (2.388)	0.101*** (18.81)	0.0705*** (4.529)	0.0330** (2.357)	0.101*** (18.35)
Enactment	0.174*** (4.693)		0.159*** (5.236)		0.137* (1.759)				2.018*** (8.959)			1.393*** (4.997)
Implemented		0.176*** (4.523)		0.161*** (4.345)		0.0277 (0.277)			0.610** (2.183)			1.338*** (4.183)
Enactment * Polity2			0.00948*** (3.301)		0.0300*** (4.545)							0.124*** (3.711)
Implementation * Polity2				0.00691* (1.952)	-0.0229*** (-2.741)							-0.143*** (-4.244)
Constant	0.279*** (36.68)	0.283*** (40.37)	0.281*** (44.15)	0.285*** (42.28)	0.280*** (41.32)		-0 (-0)	-0 (-0)	-10.93 (-0.0110)	0 (0)	0 (0)	-11.13 (-0.0123)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,690	9,690	9,690	9,690	9,690		8,913	8,913	8,913	8,913	8,913	8,913
R-squared	0.209	0.204	0.217	0.207	0.220							
Number of countries	130	130	130	130	130							

Notes. z-statistics in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 5. *Redistributive Land Reforms with Refined Implementation*

Estimation methodology		Single equation					System equation CMP					
		(1) SWWW	(2) SWWW	(3) SWWW	(4) SWWW	(5) SWWW	First stage: Continuous (6) Enactment	First stage: Continuous (7) Implementation	Second stage: Probit (8) SWWW	First stage: Continuous (9) Enactment	First stage: Continuous (10) Implementation	Second stage: Probit (11) SWWW
Variables												
US Influence												
Polity 2		0.0305*** (10.41)	0.0306*** (10.50)	0.0282*** (9.154)	0.0290*** (9.458)	0.0282*** (9.131)	0.0709*** (4.505)	0.0328** (2.329)	0.101*** (18.81)	0.0692*** (4.472)	0.0315** (2.262)	0.100*** (18.17)
Enactment		0.174*** (4.693)		0.159*** (5.236)		0.144** (2.087)			2.189*** (9.609)			1.769*** (7.130)
Implemented			0.178*** (4.514)		0.162*** (4.354)	0.0191 (0.211)			0.396 (1.372)			0.924*** (3.065)
Enactment * Polity2				0.00948*** (3.301)		0.0250*** (3.270)						0.0935*** (3.581)
Implementation * Polity2					0.00730** (2.113)	-0.0174* (-1.911)						-0.112*** (-4.239)
Constant		0.279*** (36.68)	0.283*** (40.72)	0.281*** (44.15)	0.285*** (42.79)	0.280*** (41.39)	-0 (-0)	-0 (-0)	-10.46 (-0.0173)	-0 (-0)	-0 (-0)	-10.46 (-0.0153)
Country Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		9,690	9,690	9,690	9,690	9,690	8,913	8,913	8,913	8,913	8,913	8,913
R-squared		0.209	0.204	0.217	0.208	0.219						
Number of contries		130	130	130	130	130						

Notes. z-statistics in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

## Appendix

### A1. Dataset: Enacted and Implemented Land Reforms

Bhattacharya and Ulubasoglu (2012) constructed a dataset containing information on the sanctioning and the implementation of land reforms around the world from 1900–2010 over 10-year intervals. They also present information regarding the motive of the land reform enacted.

For this essay, each entry of this dataset was cross-checked by reviewing all results produced by search engines such as Google, Google Scholar and Scopus by typing land reform + name of the country. The outcome of this process was later reviewed and validated by Bhattacharya and Ulubasoglu (2012).

Additionally, the original dataset was converted from 10-year intervals to yearly intervals.

Finally, new binary variables were created to denote whether the particular motive for each land reform is achieved on implementation or not. For instance, an enacted land reform whose motive is privatisation and redistribution could render implementation of the two components, implementation of just one component or no implementation at all. These new variables aim to capture if each motive is implemented or not.

### A2. Data Sources and Descriptions

Variable	Source	Link
SWWW	Wacziarg and Welch. (2008)	<a href="http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/liberalization.xls">http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/liberalization.xls</a>
Polity2	Polity IV Project; Marshall, Gurr and Jagers (2013)	<a href="http://www.systemicpeace.org/inscr/p4v2012.xls">http://www.systemicpeace.org/inscr/p4v2012.xls</a>
US Influence	Berger et al. (2013)	<a href="http://williamesterly.files.wordpress.com/2012/09/cia_us_trade_web_appendix_april_2012.pdf">http://williamesterly.files.wordpress.com/2012/09/cia_us_trade_web_appendix_april_2012.pdf</a>

## Chapter 5: Conclusions

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This thesis empirically explored the role of physio-geography and elite domination of political systems—two main determinants of long-run development—on state's behaviour and the adoption of pro-citizen economic policies, respectively. These two characteristics are seen as obstacles for cooperation between groups within a society, affecting the collective welfare.

The first essay, entitled 'What Underlies Weak States? The Role of Terrain Ruggedness', investigated the research question: Does terrain ruggedness constitute a hurdle for state capacity? State capacity is a multidimensional concept that cannot be directly observed, but its outcomes can. Thus, the thesis adopted a latent variable methodology to estimate the determinants of state capacity. Latent variables were derived from four basic capabilities that a modern state is expected to perform at the minimum—commit to policies (for which inflation is used as proxy), provide and enforce rule of law, tax citizens, and restrict civil violence. Data for terrain ruggedness were based on satellite images from the project GTOPO30, a global dataset developed through international collaboration led by the US Geological Survey Centre, constructed by Riley, DeGloria and Elliot (1999), and updated by Nunn and Puga (2012). Other important covariates incorporated in the estimating equation as controls were ethnic fractionalisation, colonial origins, year of independence, legal origins and distance from the equator. The empirical equation was estimated using a logit model, with the marginal effects computed and presented.

The findings showed that terrain ruggedness has a non-linear negative effect on state capacity when the latent variables are inflation, rule of law and presence of civil war, and a linear negative effect when state capacity is proxied by taxation. The results held to numerous variations in sample composition of countries, such as excluding continents one at a time, small countries, developed countries or countries without a history of colonialism. The array of

specifications and subsamples used in the empirical section showed that there is not a specific country or set of countries driving the results.

Nevertheless, these results were obtained from a reduced form framework. In other words, there is a black box between terrain ruggedness and state capacity that needs to be investigated. As the literature emphasises that cities can be regarded as products of successful cooperation, this essay explored the role of early urbanisation, representing early cooperation in collective action, as a transmission mechanism between terrain ruggedness and state capacity. Results indicated that terrain ruggedness is negatively related to urbanisation in 1900, meaning that more rugged countries had less urbanised cities in 1900. When early urbanisation and terrain ruggedness were taken together as explanatory variables in the estimating equation, early urbanisation was found to constitute a channel through which rugged topography has an impact on three state capabilities; enforcing rule of law, taxing citizens and avoiding civil conflicts.

Although the main argument of the essay was that rugged topography affects state capacity through its impact on transaction costs, other factors might also matter for a capable state, such as initial elite domination and artificial states. To account for these factors, land Gini at independence and Alesina, Easterly and Matuszeski's (2011) fractal measure of artificial states was incorporated into the estimating equation. The estimates showed that these variables do not greatly modify the standard errors of the terrain ruggedness variable. It is important to note, however, that the land Gini coefficient at independence does not totally capture how initial elite domination might shape state capacity (e.g. initial set of institutions, development of bureaucracy, and initial regime type). Indeed, disentangling the linkages between physio-geography, initial elite domination, political inequality and current levels of state capacity are a fruitful avenue for future research in the political economy of development.

The results of the first essay formed the impetus for the second essay in the thesis, entitled 'State Capacity: How to Mitigate the Adverse Consequences of Terrain Ruggedness?'. The statistical finding that countries with more rugged terrain might find it more difficult to build a state apparatus that can support

the achievement of desirable long-term economic and political outcomes does not imply that such countries should be stagnant or idle about state capacity building. Specifically, the essay analysed whether road density, fiscal decentralisation and political autonomy act as mitigating factors to alleviate the negative effect of terrain ruggedness on state capacity outcomes.

As in the previous essay, a latent approach was considered to find suitable indicators for state capacity and the statistical relationships were estimated using a logit model. The estimates showed that a denser road network in fact increased the probability of collecting more tax revenue in rugged countries, compared to non-rugged countries. Conversely, higher road density was statistically associated with a reduced ability to control inflation and enforce the rule of law over the long run in more rugged countries; results that were contrary to the initial hypothesis. There might be other interaction effects through which a higher road density might affect these state capacity outcomes, such as the access to financial institutions and to liquidity, things that people living in rugged areas could then access as a result of the construction of roads connecting those areas with the political or financial centre. An analysis of the effects of geography on the location of the financial institutions and the spread of access to credit are interesting areas of future research. There was no significant statistical association between road density and the outbreak of civil conflict

With respect to fiscal decentralisation, the results showed that decentralisation is beneficial to mitigate the effect of rough geography for controlling inflation and avoiding the outbreak of civil conflict in more rugged countries. This fiscal arrangement is not statistically associated with higher tax collection performance and the ability to enforce rule of law.

Finally, the essay's findings demonstrated that political autonomy robustly reduces the negative effect of terrain ruggedness on inflation in more rugged countries. Political autonomy also reduces the state capacity to prevent the disruption of civil conflict, a result that was opposite to the initial expectation.



There is no clear link between political autonomy and enforcement of rule of law and tax collection in more rugged countries.

The mixed statistical evidence in the second essay suggests the need to handle carefully any policy recommendation. Even though the results showed that fiscal decentralisation could assist to improve capabilities for controlling inflation and preventing civil wars, the scope of the essay was not to analyse what drives fiscal decentralisation in the first place. Understanding the political economy of fiscal decentralisation is indeed a topic for future research.

Finally, the third essay, entitled ‘Empirically Testing the Persistence of Power, Elites and Institutions: Evidence from Land Reforms around the World, 1900–2010’, empirically tested Acemoglu and Robinson’s (2008) predictions regarding the interactions of elites, political power and pro-citizen economic policies. Specifically, it tested whether (i) pro-citizen economic policies arise when the political system is democratic and the elites are constrained, (ii) pro-elite economic policies are adopted when the political system is undemocratic and represents the interest of the elites; and (iii) pro-elite economic institutions arise when elites are able to exert power on the political system (*de facto* political power) even if the *de jure* political power represents the masses.

Generally, elite domination of the political system is seen as a major barrier for a more equitable development process. Excessive concentration of political power is related to the adoption of economic policies that are in line with those holding power and which do not always tend to favour the masses. The literature has identified two main types of political power—*de jure* political power, which comes from the constitution, laws and political regime, and *de facto* political power, which comes from informal institutions and reveals who the real holders of political power are.

Acemoglu and Robinson (2008) theorise that these two types of power plus their interaction matter for the adoption of pro-citizen economic policies. To measure the latter, this thesis adopted Sachs and Warner’s (1995) widely used indicator of trade openness for favourable economic policies. *De jure* political

power is proxied by the Polity2 variable from the Polity IV Project. *De facto* political power comes from a unique dataset that contains detailed information on the enactment and implementation of land reforms on a sample of 150 countries spanning the period 1900 to 2010. The empirical equation is estimated using panel techniques that account for country fixed effects.

The results indicated that countries that are *de jure* more democratic tend to adopt a more open trade regime. Countries that have enacted more land reforms are more likely to be in favour of trade openness, and those that have implemented more land reforms appear to adopt more open trade policies. The results also showed that countries where land reforms have been enacted but not implemented are more likely to have a closed trade policy regime.

An econometric problem in the essay was endogeneity due to omitted variables that may be associated with *de facto* political power. There might as well be reverse causality from trade openness to political power, but this link was less clear-cut. The endogeneity problem in the analysis was addressed by using IV estimation. Despite its limited time span covering less than 110 years, US influence on a country, proxied by covert CIA operations, as an IV for land reforms enactment and implementation, confirmed the previous results.

The essay made a further distinction between land reforms motivated by redistributive goals and other objectives such as the establishment of a landholding cap, distribution of public land, restitution of confiscated land, privatisation of public land, access to credit and allocation of subsidies among others. Redistributive land reforms are likely to capture better the struggle between elites and masses. Recognising this distinction shows that countries where elites opposed the implementation of a redistributive land reform that has already been enacted are more likely to become a closed trade regime.

These findings are important as they confirm Acemoglu and Robinson (2008)'s conjectures and shed light on the political determinants of economic policies. The major finding of the essay was that democratic countries where the elites

have been constrained tend to choose economic policies that are more in line with the benefit of the masses.

In sum, the contribution of these three essays is the discovery of two specific factors—terrain ruggedness and elite domination—as obstacles undermining the cooperation and cohesiveness of different groups in societies. The finding about terrain ruggedness hindering state capacity development is new in the literature; its merit is precisely to demonstrate empirically that this geographical feature constitutes a challenge to build a more capable state apparatus. Current literature emphasises the role of geographical factors in increasing transactions costs within societies and for fostering development and pledges to find solutions to palliate these costs. The findings of the second essay suggest some avenues to mitigate the adverse effects of ruggedness on state capacity. Specifically, fiscal decentralisation is beneficial to reduce inflation and the outbreak of civil wars in more rugged countries. Finally, a unique dataset containing detailed information on land reforms and their motives over 1900–2010 to proxy elite power enabled the third essay to empirically confirm Acemoglu and Robinson’s (2008) predictions, enhancing the current knowledge on the role that elites play in the selection of economic policies and in the long-term development of economies.

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