Explaining cross-country variation in investment: the role of endowments, institutions and finance

Stephen R. Bond

Department of Economics and Nuffield College, Oxford University
and Institute for Fiscal Studies

Adeel Malik

Oxford University and Oxford Centre for Islamic Studies

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Abstract

We present empirical evidence on factors that explain long run differences in investment as a share of GDP in a sample of 61 developing countries. We find robust positive effects from measures of the quality of political institutions and public sector infrastructure provision, and robust negative effects from measures of natural resource endowments. There is little additional information in measures of political instability or macroeconomic volatility when we control for these factors. Financial development is found to have a positive influence on investment shares only in countries that experienced relatively high volatility.

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I. Introduction

This paper investigates the question: Why is investment as a share of national income persistently higher in some countries than in others? In addressing this question, this paper considers a broader range of candidate explanations than has been considered in previous empirical research, but focuses in particular on the role of natural resource endowments, political institutions and financial development.

It is important to understand the factors that result in lower investment in some developing countries. The share of investment in GDP has been found to be one of the more robust explanatory variables in standard empirical growth models, consistent with differences in capital per worker being an important determinant of differences in income per worker. More recently, it has been argued that differences in investment shares may also explain differences in long run growth rates.[1] Even if higher investment would not raise growth rates permanently, it is difficult to envisage achieving the twin objectives of higher growth and poverty reduction over a significant period of time without raising investment levels in poor societies.

While previous empirical papers have addressed this question, there has been much less research into differences in investment shares than into differences in income levels or growth rates.[2] This paper conducts a fresh empirical assessment of the cross-country determinants of investment, and attempts to make at least three new contributions in this regard. *First*, a key aim of this paper is to try to identify differences in relatively permanent characteristics that may predispose certain countries to have low investment rates over long periods, i.e. we are interested in the nature of the 'fixed effects'. In this context, we consider the possible roles of colonial history, resource endowments, and geography, among others. These relatively predetermined and, arguably, deeper characteristics of economies have attracted considerable attention in the recent empirical literature on long run development (Hall and Jones (1998), Acemoglu et al. (2001), Rodrik et al. (2004), and Easterly (2007)). However, their role in explaining variation across countries in investment shares remains empirically unexplored.

Second, this study considers a much wider range of candidate predictors of investment rates than earlier work, including a large number of indicators that have recently proliferated in the growth and development literature. *Third*, the empirical approach used in the paper is relatively systematic, in that we use recently developed approaches to model selection to construct empirical models based on robust predictors.

The empirical analysis in this paper is based on a cross-section of 61 developing countries for the period 1960-2003. Since our primary interest lies in investigating long run differences in investment rates across countries, we restrict the empirical focus of this paper to cross-sectional regressions. An additional reason is that repeated observations on key variables of interest, capturing such diverse dimensions as endowments, geography and institutions, are either not available or show limited

[1] See, for example, Bernanke and Gurkaynak (2001) and Bond, Leblebicioglu and Schiantarelli (2007).
[2] Important earlier papers include Svensson (1998), Aizenman and Marion (1999), Stasavage (2002) and Serven (2003).

variation over time. Both of these aspects of our analysis preclude the use of panel data methods.

The empirical evidence presented in this paper suggests a robust association between the nature of political institutions and investment levels. A relatively novel finding relates to the effect of natural resources: resource abundant countries are found to have systematically lower investment shares. Interestingly, the effect of resource abundance survives even after controlling for institutional quality. As a major departure from the earlier literature on investment, we find that the direct effects of political instability and macroeconomic volatility appear to be limited once we control for natural resources and governance institutions. We also discover a nuance in the relationship between financial development and investment shares. Financial development seems to matter for investment only in countries with relatively high macroeconomic volatility, consistent with the evidence in Serven (2003). Finally, our results also ascribe importance to the role of physical infrastructure. We demonstrate that defective provision of electricity can be an important factor resulting in lower private investment rates in developing countries.

The rest of this paper is organized as follows. Section II reviews the related empirical literature. The data we use in our empirical analysis is discussed in Section III. Section IV presents the empirical results and Section V concludes.

II. Related literature

Several previous empirical contributions have investigated why investment rates vary across countries. This section will briefly sketch the empirical literature on investment in developing countries. A somewhat dated review on this subject is provided by Rama (1993).

Existing attempts to explain cross-country differences in investment can be roughly divided into four broad categories. The first class of explanation centres around the role of macroeconomic factors traditionally considered to be important in determining investment. Studies in this vein have highlighted the role of such factors as the cost of capital, debt, inflation and exchange rate distortions in depressing private investment (see, for example, Hadjimichael and Ghura (1995) and Oshikaya (1994)).

A second strand of empirical studies traces the empirical link between income distribution, political instability and investment. Perotti (1994) proposes a negative association between income inequality and investment. Political instability is suggested as a leading mechanism linking income distribution to investment. Alesina and Perotti (1996) explore this hypothesis more systematically using data on 71 developing countries for the period 1960-85. Their empirical findings suggest that inequality reduces investment by increasing the likelihood of socio-political instability. However an important limitation of these studies is that they neglect the possible role of political or legal institutions. This is considered in Svensson (1998), who finds that indicators of political instability and polarization have no incremental effect on investment after accounting for the quality of property rights. The negative effect of political instability on investment is also contested more directly by Campos and Nugent (2005), who report a positive association with socio-political instability.

The relation between political instability and growth has been more generally called into question by Campos and Nugent (2005).

A third important strand of the literature focuses on the role of macroeconomic instability and uncertainty in explaining investment variation. Some of the influential empirical studies in this tradition include Pattillo (1998), Aizenman and Marion (1999) and Serven (2003). These studies find that higher uncertainty—as measured by volatility in a set of macroeconomic indicators—has a negative effect on private investment. Aizenman and Marion (1999) used alternative volatility measures to demonstrate a significant negative association between volatility and investment.[3]

Serven (2003) confirms a similarly negative effect of uncertainty on private investment using a measure of real exchange rate volatility on cross-country panel data. An interesting finding of this research relates to the potentially heterogeneous effect of uncertainty. Serven (2003) finds that the negative effect of real exchange rate volatility on investment is considerably larger for more open and less financially developed economies. This empirical evidence on the adverse effect of uncertainty on investment is broadly consistent with predictions of the theoretical literature that suggests that investment decisions can be significantly influenced by uncertainty and irreversibility (Dixit and Pindyck, 1994).

The fourth group of studies has begun to shift the analytical focus to a possibly important role of institutions, both political and financial, in shaping investment behaviour. Many papers have demonstrated an association between institutional quality and long run development, but the possible links between institutions and investment are relatively less well-explored. This is despite the fact that the investment channel figures prominently in the institutions story of development. Investment has typically provided an important theoretical link for the effect of institutions on levels or growth rates of output—in the sense that institutions are believed to play a central role in ensuring the security and enforceability of property rights, factors that are deemed critical for promoting investment and growth in a market economy (North, 1991). As North and Weingast (1989) propose, political institutions characterized by checks and balances can have beneficial effects on investment by allowing governments to credibly commit not to engage in *ex post* opportunitism with respect to investors.[4]

Recent studies have attempted to fill this empirical deficit. Brunetti and Weder (1999) and Poirson (1998) have shown that aspects of governance—rule of law, corruption, and bureacratic quality—are correlated with private investment. Clearly, these studies employ somewhat crude measures of political institutions that are unlikely to capture the rich diversity in institutional arrangements that exist across countries. Stasavage (2002) offers a first systematic account of the institutions-investment link by focusing on objectively derived indicators of political checks and balances supplied by Beck et al. (2001) and Henisz (2000). Using generalized least squares (GLS) and quantile regression approaches, Stasavage (2002) furnishes evidence consistent with the

[3] The precise measures considered in this regard are the volatility of the government consumption share of national income, nominal money growth and the real exchange rate.

[4] It is partly for this reason that the early empirical literature on institutions and growth has routinely employed variables capturing investment-related dimensions such as rule of law, security of property rights and protection against the risk of expropriation.

hypothesis that the existence of institutional checks and balances facilitates credible commitment by the government against "opportunistic changes in taxes and regulations". Similarly, the empirical analysis in Gwartney et al. (2006) indicates that institutional quality affects not only the level of investment, but also its productivity—that is, the impact of investment on growth.[5]

A related contribution has been to investigate the association between financial sector development and private investment (Serven (2003), Ndikumana (2005)). The empirical analysis in Serven (2003) consistently finds a favourable effect of financial development on private investment in developing countries. A more recent study, Ndikumana (2005), reaches a similar conclusion: financial development is positively associated with private investment. In particular, financial development increases the response of investment to output growth. However, Ndikumana (2005) does not detect an independent effect of the structure of the financial system (whether bank-based or stock market-based) on investment.

Taken together, these four strands of the literature identify macroeconomic policy, political instability, macroeconomic volatility and institutional quality as key factors explaining the cross-country variation in investment rates. However, the existing literature on investment has largely bypassed the question as to what role a country's deeper characteristics, such as geography and endowments, may play in shaping investment patterns. In contrast, this question—the role of geography and endowments—has inspired a great deal of recent empirical interest in studies of growth and development.

A recent contribution by Gylfason and Zoega (2006) provides some evidence that countries richly endowed with natural resources tend to have relatively low investment rates. Papyrakis and Gerlagh (2004) investigate the possible transmission channels for the resource curse hypothesis and suggest that the adverse effects of resource abundance on growth are mainly transmitted through lower investment.

However, these recent studies highlighting the role of natural resources have made little attempt to control for the factors suggested by the earlier literature on cross-country differences in investment. This provides one motivation for the more systematic empirical evaluation of the link between resource abundance and investment rates that we report in this paper. Another is that the empirical association between resource endowments and investment is not yet settled. One of the earliest proponents of the resource curse hypothesis, Sachs and Warner (1997), argued that natural resource intensity is unrelated to investment behaviour.

The broader relationship between natural resources and economic development is better established in the literature. Resource abundance has been linked to low growth (Sachs and Warner, 1997), higher risk of civil war (Collier and Hoeffler, 2005), more unequal societies (Gylfason and Zoega, 2003), and weak institutions (Ross, 2001). An important insight of this literature is that the *origin* of weak institutions may be at least partly located in natural resource export structures. Resource rich economies

[5] A weak institutional environment is not just inimical to private investment; it can also be an important determinant of the level and productivity of public investment. While a poor institutional environment lowers private investment, there is now some evidence that it may tend to increase public investment and lower its productivity (Tanzi and Davoodi 1997).

offer distinct opportunities for rent-seeking and corruption (Ross, 2001), have lower checks and balances (Collier and Hoeffler, 2005) and a limited institutional capacity to manage shocks (Isham et al., 2005).

Isham et al. (2005) suggest that the political incentives generated by resource endowments are crucial for understanding the economic effects of resource abundance. In particular, point-source resources (oil, gas and minerals) and possibly coffee/cocoa export specialization are typically associated with concentrated ownership, creating a rentier class and weaker institutions.

In this paper, we will pay particular attention to the possible effects of resource endowments, political institutions and financial development on investment shares in national income, while taking care to control for a host of other influences suggested by the earlier literature, including political instability and macroeconomic volatility.

III. Data

In this section, we will describe the key variables used in our analysis. The core set of regressions reported in this paper is based on a sample of 61 developing countries. The choice of this sample is mainly dictated by issues of data availability. A complete list of these countries is provided in Appendix 2.

The main aim of our paper is to investigate why some countries invest a higher proportion of their GDP than others. We consider two different measures of investment. The broadest measure is the share of total investment in GDP, averaged over the period 1960-2003, and obtained from the Penn World Tables, release 6.2 (Heston, Summers and Aten, 2006). This includes both public sector and private sector investment. Since many of the explanations offered in the literature may be particularly relevant for explaining variation in private sector investment, we also report results using the share of private sector investment in GDP as the dependent variable. In this case we use the disaggregated investment series compiled for the World Bank by Glen and Sumlinksi (1998).

Our empirical investigation considers a wide range of candidate predictors of investment. In choosing these indicators, we were principally guided by the existing literature on investment and more generally by cross-sectional studies of long-run development outcomes. As noted in the introduction, the primary focus of this paper is to explore the impact of relatively fixed or slow moving characteristics of countries, such as geography, resource endowments and institutions. Our analysis starts by considering 43 potential explanatory variables – the most important of these are described below.

(a) Geography

The role of geography in influencing patterns of long-run development is well-explored in the literature on per capita income. Selected studies in this vein include Hall and Jones (1998), Acemoglu et al. (2001), Sachs (2003) and Rodrik (2004). There is a growing consensus that geography impacts on development outcomes, whether directly or indirectly. As section 2 suggests, geographic indicators have seldom been considered in the context of explaining cross-country variation in

investment rates. In this study, we include a wide range of geographic variables that may play a role in explaining investment, proxying for such characteristics as location, distance to major markets, coastal distance, climatic and disease conditions. The main source for these indicators is the geography database complied by Jeffrey Sachs and associates at the Centre for International Development at Harvard University.

Key indicators of tropics in our analysis include distance from the equator (*Latitude*) and percentage of a country's land area in the tropics. Following the suggestion by Sachs, we also include indicators of tropicality that are defined on an ecological basis and define climatic boundaries based on vegetation types, temperature and precipitation levels. The main variable considered in this respect is *KGPTEMP*, the share of a country's population that lives in a Koeppen-Geiger temperate zone. We also include the country's average annual mean temperature.

Another important geographic dimension is coastal access, measured as the log of mean distance from the nearest coastline or sea-navigable river (*Coastal distance*). Besides proximity to the coast, we also include direct measures of market access, principally the log of minimum distance to major markets (*Market distance*).[6] We also consider a zero-one dummy for landlocked countries (*Landlock*).

Influential work by Frankel and Romer (1999) has highlighted the role of geography in determining a country's natural predisposition towards trade. Frankel and Romer construct a predicted trade share (*Frankel-Romer Trade*), which is derived from a bilateral gravity model of trade that controls for population, land area, and distance. High values of the Frankel-Romer Trade measure indicate that a country is relatively likely to engage in external trade, either due to proximity to large markets, or a small domestic population and, therefore, fewer opportunities for internal trade. We use the natural logarithm of the predicted trade share, and also control for Frankel-Romer measure of land area.[7]

(b) Other fixed characteristics

A range of indicators attempting to measure relatively fixed characteristics were included in the empirical analysis. An influential line of studies have highlighted the potentially important role of colonial origin in explaining present day development outcomes (Hall and Jones (1998), La Porta et al. (1998), Persson and Tabellini (2003)). Two aspects of the colonial influence deserve particular attention: the identity of the colonizer, and the origin of countries' legal systems. A significant contribution of La Porta et al. (1998) established a connection between legal origin and finance. Following this line of work, we explore the role of legal origin dummy variables that categorize if a country has a British, French, German or other legal origin.

In order to test for any effect of colonial origin, we include four dummy variables that characterize whether a country was colonized by France, Spain, the UK or other

[6] The three major markets being Japan, United States and Belgium.
[7] Various indicators of disease ecology, such as the malaria indicators compiled by Jeffrey Sachs, were also included in initial explorations but were found to be relatively uninformative.

countries (*col_othera*). Following Persson and Tabellini (2003), we adjust for the timing of independence.

We also consider the role of other arguably predetermined characteristics, such as ethnic diversity and polarization. There is a well known association between ethnic diversity and development outcomes, including investment levels. We include the widely used measure of ethnic diversity (*ethnic*) compiled by Alesina et al. (2003). This can be interpreted as the probability that two randomly selected individuals in a given country will not belong to the same ethnic group. Another indicator of ethnic heterogeneity recently introduced by Reynol-Querol and Montalvo (2005) is the index of ethnic polarization (*ethpol*) that aims to capture the extent of polarization in a society as opposed to fractionalization. As is common in the literature, we also include a full set of regional dummy variables defined according to the World Bank regional classifications.

(c) Resource endowments

An influential body of evidence has recently begun to explore the association between natural resources and various facets of economic development. This paper provides a first systematic exploration of the empirical relationship between resource abundance and investment.

An important challenge in this literature relates to the measurement of natural resource wealth. Earlier studies have relied on the share of primary exports as a ratio of total exports (or GDP) as the main measures. A more direct and much improved measure of resource abundance has been recently constructed by a World Bank report: *Expanding the measure of wealth: Indicators of environmentally sustainable development* (World Bank, 1997). This report provides new measures of national wealth and its three disaggregated components: produced assets, human resources and natural capital. The measure of natural capital includes the following elements: agricultural land, pasture lands, forests, protected areas, metals and minerals, and coal, oil and natural gas. Estimates for the value of subsoil assets (metals, minerals, coal, oil and natural gas) are derived by taking present values of the total rents over the life of the resource deposit.[8] This World Bank data provides two potential measures of resource abundance: the share of natural capital in total wealth and the value of natural capital per capita. In the context of explaining variation across countries in investment rates, we focus on the logarithm of the natural capital share in total wealth (*Lncs94*) as our main variable of interest.

Another innovative way of capturing the effect of resource abundance is suggested by Isham et al. (2005), who construct export classifications based on a country's natural resource base. We use three classifications of resource-exporting economies: point-source (fuels, minerals and plantation crops, *RESPOINT*), diffuse (animals and

[8] Yearly production (extraction) of these subsoil assets is valued using estimates of resource rents (net operating surplus less a normal return on produced assets). The return is smoothed over the period 1990-94 and then capitalized at a 4 percent discount rate over the remaining time to exhaustion. Present value is calculated by assuming an optimal path for unit scarcity rents and a constant revenue stream.

agricultural produce grown on small family farms such as rice and wheat, *RESDIFF*) and coffee and cocoa (*RESCOFF*).[9]

As suggested by Sokoloff and Engerman (2000), resource endowments can also shape paths of income inequality. Easterly (2007) provides an empirical test of this hypothesis using the wheat-sugar ratio as a possible instrument for inequality. This measures the ratio of land suitable for wheat to land suitable for sugar cane. It is a crop endowment measure based on FAO data on the percent of national arable land area suitable for different crops, taking into account such factors as soil, rainfall, temperature and elevation.[10] A related measure compiled by Vanhanen (2005) is the share of family farms in total agricultural land, averaged over the period 1948-98.

(d) Indicators of institutions

In order to assess the association between institutional quality and investment, we consider a wide range of institutional indicators now popular in the empirical literature. We divide existing measures of political institutiions into two basic categories: (a) subjective (or outcome-based) indicators, which are essentially based on subjective assessments; and (b) objective indicators measuring institutional features that define political structures. We also consider measures of financial development.

Some of the earlier work relating institutions, investment and growth has emphasized such variables as rule of law, security of property rights and protection against the risk of expropriation (see, for example, Knack and Keefer, 1995). Some of the more well-known measures in this category include indicators from the International Country Risk Guide (ICRG). In order to decrease the noise in these subjective indicators, Kaufmann et al. (1999, 2005) aggregate various subjective indicators. We consider their *Aggregate Governance Index*, which is a simple average of six separate indicators on voice and accountability, political instability, government effectiveness, regulatory burden, rule of law, and graft.[11]

Perception-based indicators suffer from the well-known problem of evaluation bias, in the sense that individual evaluations may not accurately reflect the underlying institutional strength in a particular country, making it difficult to disentangle the institutional effect from recent political and economic developments. These indicators may thus reflect policy choices rather than the deeper political constraints.

The use of perception-based indicators may also lead to a spurious relationship between institutions and investment. For example, investment may be lower in countries that are perceived to be risky by managers, but this may be unrelated to the "fundamental sources of risk".[12]

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[9] The classification of export structures is based on UNCTAD's Handbook of International Trade and Development Statistics, 1988.

[10] More precisely, the measure is constructed as the logarithm of (1+ share of arable land suitable for wheat)/(1+share of arable land suitable for sugar cane).

[11] These indicators are themselves based on several hundred individual variables measuring perceptions of governance from 37 separate data sources constructed by 31 different organizations.

[12] W. J. Henisz and B. A. Zelner, "Measures of Political Risk", Mimeograph, University of Pennsylvania.

There is a more fundamental point here. The mere existence or non-existence of democracy or the extent of political instability may be unconnected to long-term investment prospects. Henisz and Zelner ask a pertinent question: "Does Zaire, which from the time it became independent in 1967 until 1994 had no change in the identity of its executive, provide a more attractive investment climate than does Italy, which had twenty-one leadership changes in the same period?" It may not be surprising that many studies have failed to discover a robust association between such indicators and outcomes like growth or investment; see Alesina et al. (1992), Barro (1997), Brunette (1997), Svensson (1998), Rodrik (1999) and Campos and Nugent (2003, 2005).

According to Henisz and Zelner, "The relevant political variable of interest to investors is not democracy or instability *per se*, but rather the ability of the government to craft a credible commitment to an existing policy regime." Objective features of political systems may also be more theoretically relevant. This is because, as North and Weingast (1989) argue, the beneficial effect of political institutions on investment comes through checks and balances that allow governments to credibly commit against *ex post* opportunism.

Thus it appears important to consider deeper and more permanent features of political institutions, such as the extent of political constraints on the executive, the nature of constitutional change, and the existence of checks and balances. The World Bank's Database on Political Institutions (DPI), developed by Beck et al. (2001), provides a number of these objective indicators. A relatively well-known measure in this database is the indicator of checks and balances (*CHECKS2a*) which "counts the number of veto players in a political system, adjusting for whether these veto players are independent of each other, as determined by the level of electoral competitiveness in a system, their respective party affiliations, and the electoral rules". *CHECKS2a* ranges between 1 and 15, with 15 indicating the highest level of checks and balances. This measure has also been subjected to some theoretical objections though (see the note by Henisz and Zelner).

Another useful dataset of political regime characteristics is the Polity IV database compiled by Monty G Marshall and Keith Jaggers. The most recent release of this database contains a new measure (*POLITY 2*), that combines all regime characteristics. An important measure of the quality of political institutions in the Polity IV database is given by the measure of constraints on the executive (*XCONST*). We use the average of this measure over the period 1960-2003.

Another notable indicator in this class of measures is the Political Constraints Index (*PCI*) constructed by Henisz (2000). This measure is objectively derived from a spatial model of political interaction to measure the extent to which any one political actor is constrained in his or her choice of future policies. The measure is based on the number of independent veto points in various tiers of the political system—executive, legislative, judicial and sub-federal branches of government. It also takes into account the distribution of political preferences both across and within these branches.

As well as the quality of political institutions, we are interested in the relationship between investment shares and the structure of the financial system. Our key source for data on financial development is the well-known Financial Structure Database

compiled by World Bank researchers (see Beck et al., 2001). This dataset provides around 37 indicators capturing various facets of financial systems. The main indicator that we use in this paper is the ratio of private sector credit to GDP, averaged over the estimation period.[13]

(e) Volatility and other macroeconomic determinants

We also consider a range of possible macroeconomic determinants of investment shares suggested by the earlier literature. These include the relative price of capital goods, the initial level of GDP per capita at the start of our sample period, and measures of volatility in several macroeconomic variables, constructed either as standard deviations or as coefficients of variation for the annual series over our sample period.

IV. Empirical results

A first look at the determinants of investment

There has recently been a renewed interest in studying the determinants of investment as a share of GDP, especially in considering the role of financial development and political institutions in explaining differences in investment shares across countries (e.g. Ndikumana (2005); Gwartney et al. (2006)). These studies often test competing hypotheses by presenting results from parsimonious models and testing the robustness of their conclusions to the addition of an *ad hoc* selection of further controls. The extent of model uncertainty behind these results is often downplayed – or at least not systematically considered.

However, as research by Brock and Durlauf (2001) has shown, the implications of this model uncertainty may be potentially serious. The issue of model selection in the context of cross-country regressions assumes a greater significance and needs to be considered before any systematic investigation of the deeper causes of differences in investment shares can be conducted. In this section, we will first consider the association between investment shares in GDP and a large range of potential explanatory variables using two leading model selection approaches: Bayesian Model Averaging (BMA) and the automated general-to-specific PcGets approach. These approaches are outlined in Appendix 1.

These model selection procedures are used here mainly as a first step that guides our choice of variables to include in subsequent models. By running these somewhat mechanical horse races between various candidate predictors of investment shares, we intend to identify a subset of variables that appear to receive the greatest support from the underlying data. Variables flagged as being important by these procedures are then used in formulating our preferred models.

Our BMA analysis considers three different groups of explanatory variables, which differ in how likely they are to be jointly determined with the investment shares. We begin by emphasizing characteristics that are fixed or relatively predetermined, such

[13] In earlier investigations we also considered other financial indicators, such as the ratio of liquid liabilities to GDP.

as the geographic variables. We then move along a spectrum of potential endogeneity, successively moving from the relatively predetermined variables to the plausibly more endogenous ones. The dependent variable is either the log of the share of total investment in GDP or the log of the share of private sector investment in GDP, averaged over the period 1960-2000. Our main sample includes 61 developing countries.

Using the BMA approach described in Appendix 1, we compute posterior probabilities of inclusion, namely the sum of posterior model probabilities for all models in which a variable appears. We also provide some indication of the sign of the relationship, based on the total posterior probability for models in which a variable acts in a given direction (e.g. with a positive coefficient). Due to the inclusion of potentially endogenous variables, like measures of institutional quality or financial development,[14] we do not attach any causal interpretation to these results at this stage, but regard them merely as showing robust associations.

The results are shown in Appendix Table A1. Column (1) presents results for models with the log of the total investment share as the dependent variable. We use 43 potential predictors of investment in the most general version of this analysis, drawing from the range of variables discussed in the previous section. The results indicate a possibly important role for natural resource abundance (*Natural capital share* (*Lncs94*) and *RESCOFF*), political institutions (*XCONST*), financial development (*Private Credit (%GDP)*), and the relative price of capital goods. The BMA analysis flags several other variables as being potentially important as well, as demonstrated by their high posterior probabilities of inclusion. These include volatility in the investment shares (*IVOL*), school enrolment rates, variables indicating Western colonial experience, and terms of trade shocks.

Column (2) presents the results of a similar exercise where the dependent variable is the log of the average private investment share in GDP. These results also suggest an important role for resource abundance, political institutions and financial development. Additionally, external debt, some regional dummy variables, and electricity transmission and distribution losses also appear potentially important predictors of private investment shares, while the relative price of capital goods appears to be unimportant.

We also conducted an automatic model selection exercise using the general-to-specific methodology emphasized by Hendry and Krolzig (2004), as implemented in PcGets. This approach starts from a general model that includes all 43 explanatory variables and searches for statistically acceptable reductions of this general model. The final models selected by PcGets to explain total investment shares and private investment shares are reported in Appendix Table A2. These specifications contain a broadly similar set of explanatory variables to those highlighted by the BMA analysis.

[14] i.e. these outcomes may be partly the result of differences in investment levels, rather than simply the cause of differences in investment levels; or they may be determined jointly, together with investment levels, by other variables that are omitted from the model.

Main findings: total investment shares

We now present the main results of this study. We begin with the results from relatively parsimonious regression specifications that contain our key variables of interest. The choice of variables is informed by the model selection exercise discussed above and documented in the appendix.

Table 1 presents these results for models where the dependent variable is the log of the share of total investment in GDP. The specification in column (1) includes three explanatory variables: the relative price of capital goods (*pi_p*), a dummy variable for coffee and cocoa exporting countries (*rescoff*) and the log of the share of natural capital in total national wealth (*Lncs94*). As expected, the relative price of investment goods, sometimes treated as a proxy for cross-country variation in the user cost of capital, helps to explain variation in these investment shares. The coefficient is negative, suggesting that countries with a higher relative price of capital goods tend to invest less, on average.

To explore the role of natural resource endowments in explaining these investment shares, column (1) adds two measures suggested by our model selection procedures. First, following the influential paper by Isham et al. (2005), we add a dummy variable for countries whose export structure predominantly relies on the export of coffee and cocoa. The idea put forward by Isham et al. is that different types of resource endowments can influence economic growth by shaping socio-economic and political institutions. In particular, resource-rich countries with a point-source or coffee/cocoa type of natural resource base tend to have weaker institutions and poorer economic performance. We explore this for the first time in the context of investment performance. Consistent with their hypothesis, column (1) suggests that countries with coffee/cocoa natural resources are more likely to have lower shares of investment in GDP.

Column (1) also adds a generic measure of natural resource abundance: the log of the share of natural capital in total capital, which comprises physical, human and natural capital (valued in 1994). As is clear from Table 1, the coefficient on *Lncs94* is negative and statistically significant at the 1% level, even after controlling for the presence of coffee/cocoa exports. Collectively, these significant coefficients on both the *rescoff* and *Lncs94* variables suggest that resource abundance may exert an important negative effect on total investment shares. This tends to support the correlations between investment shares and resource abundance presented in Papyrakis and Gerlagh (2004) and Gylfason and Zoega (2006). The basic specification in column (1) explains around 60 percent of the total variation across countries in these average shares of total investment in GDP.

In columns (2) to (4), we assess the robustness of this result. The potential importance of political institutions and governance structures in explaining investment rates is suggested by earlier studies, for example Stasavage (2002). Importantly it has been suggested that the negative impact of natural resources on economic performance may be mediated through their effect on the strength and quality of institutions (Ross (2001), Isham et al. (2005), Collier and Hoeffler (2005)). Our model selection procedures suggested that the Polity IV measure of constraints on the executive

(*xconst*) may be a particularly informative measure of political institutions in the context of explaining these investment shares.

Column (2) adds this measure of institutional quality to the specification considered in column (1). We find a positive and significant coefficient on *xconst*, suggesting that countries with less power concentrated in the hands of the executive level of government tend to have higher shares of investment in GDP. However the two variables capturing the effect of resource abundance (*rescoff* and *Lncs94*) continue to have statistically significant negative coefficients in this more general specification. This suggests that the negative effect of resource abundance on investment shares does not work only through the quality of political institutions, at least as measured by constraints on the executive.

Finally, we control for trade openness, measured by the log of the World Bank measure of trade shares in GDP (*Lopenwb*), in column (3), and regional dummy variables in column (4). The coefficient on trade openness is positive and weakly significant at the 10% level. There does not seem to be any significant additional information in the regional dummy variables for Sub-Saharan Africa, Latin America and Caribbean, or East Asia and Pacific. In both specifications we continue to find a significant positive coefficient on our measure of political institutions (*xconst*), and significant negative coefficients on at least one of our natural resource variables (*rescoff* and *Lncs94*). Together with the relative price of capital goods and trade openness, these variables account for the relatively low total investment shares observed in Sub-Saharan Africa, and the relatively high total investment shares observed in East Asia during our sample period.

Main findings: private investment shares

Table 2 presents the results for a similar set of regression models where the dependent variable is the log of private sector investment in GDP. In column (1) we start with the same simple specification considered in column (1) of Table 1. As before, the relative price of capital goods and the resource abundance variables (*rescoff* and *Lncs94*) appear to have a significant negative effect on private investment shares. However it is noticeable that these variables here explain only about one third of the total variation across countries in average shares of private investment in GDP.

The measure of political institutions (*xconst*) that we include in column (2) is again found to have a highly significant positive coefficient. The inclusion of this variable renders the coefficient on *rescoff* insignificantly different from zero, hinting that the effect of coffee/cocoa natural resources on private investment shares may be mediated through the quality of political institutions. However the coefficient on our broader measure of the importance of natural resources remains negative and significant at the 1% level.

Evidence suggests that the quality of public sector infrastructure may play an important role in the context of private sector investment. Firm surveys carried out as part of the 2005 World Development Report on investment climate show that firms regard electricity infrastructure as an especially important public input for a sound investment climate. In fact, firms across Africa have repeatedly mentioned defective provision of electricity as a significant constraint on investment (World Bank, 2005).

To investigate this, we use a proxy for the quality of electricity provision: losses in the transmission and distribution of electricity, measured as a percentage of total supply (*SystemLoss*). This variable was also suggested as a potentially relevant explanatory variable in the context of private investment shares by our model selection procedures.

This indicator of the quality of electricity supply is included in the specification reported in column (3). As expected, defective provision of electricity is associated with significantly lower private investment shares. It should be noted that higher electricity system losses may be a manifestation of weak public sector institutions more broadly—and so may also act as a proxy for more general aspects of institutional quality. However, the coefficient on our measure of political institutions (*xconst*) remains positive and significant at the 1% level here, despite the inclusion of *SystemLoss*. Moreover the coefficient on the log of the natural capital share (*Lncs94*) also remains negative and significant at the 1% level. These variables can jointly explain about 60 percent of the variation in average private investment shares.

Finally, columns (4) and (5) add the World Bank measure of trade openness and the regional dummy variables. Trade openness does not have significant additional explanatory power in this specification. However the coefficients on two of the regional dummy variables, for East Asia and Pacific, and Latin America and Caribbean, are found to be positive and statistically significant. Our measures of natural resource abundance and institutional quality thus appear able to account for the very low private investment shares observed in Sub-Saharan Africa, but not completely for the very high private investment shares observed in East Asia during our sample period.

Robustness to other explanations

This section will explore the robustness of these basic findings to other explanations suggested by the previous empirical literature on investment shares in GDP. We will consider, in particular, the role of political instability, macroeconomic volatility and financial development in explaining investment patterns. In this section we focus on models for the log of private sector investment as a share of GDP.

Political instability

Previous empirical research has flagged political instability as a potentially important determinant of private investment shares (e.g. Alesina and Perotti (1996), Svensson (1998)). We have considered a wide range of possible indicators of political instability as additional explanatory variables. Results from this empirical exercise are presented in Table 3.

Column (1) starts with a simple regression of the log of private sector investment shares on the Alesina et al. (2003) measure of ethno-linguistic fractionalization (*ethnic*). This measure of ethnic diversity is often used as an indicator of the potential for conflict or civil strife. The result in column (1) confirms that there is a significant negative correlation between these two variables in our sample. However column (2) shows that the coefficient on this measure of ethnic diversity becomes insignificantly different from zero once we control for the effects of political institutions (*xconst*) and

natural resource endowments (*rescoff* and *Lncs94*) in the model. This remains the case when we add the measure of electricity transmission and distribution losses (*SystemLoss*) and dummy variables for Latin America and East Asia in column (3).

Columns (4)-(8) show that there is little or no additional information that helps to explain differences across countries in private investment shares in a range of other indicators of political instability. These include a measure of ethnic polarization (*ethpol*, Marta Querol (2005)), the measure of socio-political instability (*SPI*) proposed by Campos and Nugent (2003), and an indicator of the incidence of civil wars (*warciv*). The *SPI* measure is constructed as a principal component of three underlying counts of the number of political assassinations (*assass*), revolutions (*revols*) and successful coups. Of these political instability measures, only the number of political assassinations (*assass*) appears to have significant additional explanatory power in our models of private investment shares (see column (6)). Even in this specification, we continue to find strong negative effects from our measure of political institutions (*xconst*) and natural resource capital (*Lncs94*).

Taken together, these results do not provide strong evidence for an important effect of political instability in explaining differences across countries in private investment shares, while they confirm the robustness of our earlier results on the role of institutional quality and resource endowments.

Macroeconomic volatility

Indicators of macroeconomic volatility or uncertainty have also been suggested as potentially important determinants of cross-country differences in average investment shares in earlier studies (e.g. Aizenman and Marion (1999), Serven (2003)). We have also considered a wide range of possible volatility measures as additional explanatory variables. Results are presented in Table 4.

Column (1) again confirms that there is a significant negative correlation in our sample of countries between the log of private sector investment as a share of GDP and a measure of volatility in the terms of trade (*TOTv*). This indicator is measured as the standard deviation of the annual observations for each country on the underlying terms of trade series during our sample period. Column (2) shows that the inclusion of our measures of political institutions (*xconst*) and natural resource endowments (*rescoff* and *Lncs94*) is sufficient for the coefficient on terms of trade volatility (*TOTv*) to become insignificantly different from zero. Column (3) confirms that this remains the case when we add electricity system losses and the regional dummies to the specification.

Columns (4)-(7) indicate that there is also no statistically significant additional explanatory power in a range of other measures of macroeconomic volatility.[15] These

[15] The one exception to this pattern occurs if we include the coefficient of variation of the investment shares themselves. This variable is found to have a significant negative coefficient. However the same result is not found using the standard deviation of the investment shares, indicating that dividing the standard deviation by the mean of the investment shares to construct the coefficient of variation is crucial to this result. This is a concern since the mean of the investment shares is also the dependent variable in our regression models. Any measurement error in these mean investment rates would induce a negative correlation with the coefficient of variation, so we view this result with suspicion. Note that

include the standard deviation of the ratio of M1 to GDP (*monVOL*), the share of government consumption in GDP (*gconsVOL*), the share of total government spending in GDP (*govVOL*) and the coefficient of variation of quarterly inflation rates (*cvINF*). In all cases the significance of the coefficients on our measures of institutional quality (*xconst*) and resource endowments (particularly the broader measure of natural capital, *Lncs94*) is found to be robust to the inclusion of these additional volatility measures.

In sum, having controlled for resource abundance and institutional quality, we do not find additional explanatory power in these measures of macroeconomic volatility. One possible interpretation is that volatile outcomes are a symptom of certain deeper characteristics, which may predispose some economies to be more unstable than others. In this context it is interesting to note that resource abundance tends to increase a country's exposure to some economic shocks, and this has been suggested to be an important channel explaining the relationship between resource abundance and poor economic performance (Collier, 2006).

Financial development

Several previous studies have highlighted the possible relationship between private investment shares and financial development (e.g. Serven (2003), Ndikumana (2005)). Column (1) of Table 5 reports that we find a significant positive coefficient on a standard measure of financial development (the ratio of private sector credit to GDP, denoted *Credit*) in a basic specification for the log of private investment shares. Column (2) however shows that this coefficient becomes insignificantly different from zero when we control for the presence of valuable natural resources. Again the coefficients on political institutions (*xconst*) and natural capital (*Lncs94*) remain highly significant in this specification.

The results reported in Table 4 and column (2) of Table 5 suggest that we do not find significant *linear* effects of either the macroeconomic volatility variables or this measure of financial development, in explaining the variation across countries in average private investment shares, once we control for institutional quality and resource abundance. This does not rule out the possibility of important non-linear effects, and the specifications reported in columns (3) and (4) suggest there may be a significant interaction term. Here we use the sample distribution of our measure of inflation volatility to classify countries to 'high volatility' and 'low volatility' groups, depending on whether their coefficient of variation for quarterly inflation rates is above or below the 33rd percentile of this sample distribution.[16] The dummy variable *VOL* used in columns (3) and (4) of Table 5 is equal to one for countries that experienced relatively high inflation volatility during our sample period. By interacting this dummy variable with our measure of financial development (*Credit*), in effect we allow the coefficient on the ratio of private sector credit to GDP to take different values in the 'high volatility' and 'low volatility' countries.

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the coefficient of variation of the investment rates, denoted *IVOL*, is however included in the model selection exercises reported in Appendix 1 of this draft of the paper.

[16] Similar but slightly weaker results were found using the median of the sample distribution of inflation volatility as the cut-off point to define this dummy variable.

The results of these non-linear specifications suggest that a higher level of financial development may have a positive effect on private investment shares in countries that experience relatively high levels of inflation volatility, but has little or no effect on private investment shares in countries that experience lower levels of inflation volatility. This in turn suggests that financial development may play an important role in cushioning the impact of macroeconomic volatility on private sector investment. Serven (2003) also reports evidence that the relationship between financial development and investment may depend on the level of macroeconomic volatility.

Instrumental Variables results

Our final robustness check considers the possibility that our main measure of natural resource endowments should be treated as an endogenous variable in these models for investment shares in GDP. While the geological and geographical factors that determine the location of potentially valuable natural resources are surely unaffected by investment levels in the second half of the 20th Century, the ability of countries to exploit these resources profitably may be jointly determined with current levels of investment. Since the World Bank's measure of the share of natural capital in total capital is based on the profitability of these resource endowments measured in the early 1990s, we consider how our results are affected by treating this measure of natural resources as an endogenous variable in our investment models.

Our initial model selection exercises indicated that several of the geographical variables that we considered as potential explanatory variables for investment shares could safely be excluded from these models. These geographical characteristics are therefore available as instruments for the natural capital share. Here we consider using mean temperature, coastal distance and the landlocked dummy as instrumental variables. Figures 1 and 2 illustrate that there are significant positive correlations between the natural capital share and both mean temperature and coastal distance.

Table 6 presents the results of two-stage least squares estimates of basic specifications for both total investment shares and private investment shares. OLS estimates of the same specifications are reported for comparison, and the first stage regressions explaining differences across countries in the natural capital share variable are also reported.

These first-stage regressions indicate that our three instrumental variables have significant explanatory power for natural capital shares, even conditional on the remaining explanatory variables that are included in these investment models. Nevertheless the 2SLS estimates of both the coefficient on *Lncs94* and the other explanatory variables are very similar to the OLS estimates, both in terms of signs, magnitudes and statistical significance. The Sargan tests of over-identifying restrictions also suggest that it is appropriate to exclude these instrumental variables from the investment models.

In sum, these IV results do not suggest that the possible endogeneity of our value-based measure of natural resource endowments is likely to be driving the significant negative coefficients found on this natural capital share measure in our main investment models.

V. Conclusions

This paper explores why investment as a share of GDP is persistently higher in some countries than in others. We focus on the role of variables that measure natural resource endowments, political institutions and financial development. However our approach is distinctive in this context in considering a wide range of candidate explanatory variables.

Given our focus on long run differences in investment levels, and our interest in the role of explanatory variables that are either time-invariant or which have limited time series variation, we rely on cross-section regression models where the dependent variable is the average share of investment in GDP over long periods of time. We present results both for total investment and for private sector investment, using a sample of 61 developing countries in the period 1960-2003.

Our results highlight the role of resource endowments and political institutions in accounting for differences across countries in these investment shares. Specifically we find a robust positive influence from a measure of constraints on the executive level of government, and a robust negative influence from the share of natural resource capital in the country's total wealth. In some specifications we find an additional negative effect from a high share of coffee or cocoa in the country's exports. We also find that a proxy for the efficiency of the electricity supply sector helps to explain variation across countries in the share of private sector investment in GDP.

Given that we control for these factors, we find little additional information in measures of political instability or macroeconomic volatility. Nor do we find an important linear relationship between investment shares and a standard measure of financial development. However we do find some evidence of a more subtle effect, with financial development helping to explain higher private investment shares in the sub-sample of countries that experienced relatively high inflation volatility.

The striking aspect of these results is the robustness of the findings for our basic measures of political institutions and natural resources to the inclusion of a wide variety of alternative controls. While it would be hazardous to infer any causal relationship from these cross-section regressions, we can be confident that the significant coefficients we find on these basic variables are not driven by the omission of a large number of candidate explanatory variables. Moreover we find no indication that the significant negative coefficient on our main measure of natural resource capital is explained by the potential endogeneity of this variable in our investment models.

We should also be cautious in drawing simple conclusions for policy from this largely descriptive empirical analysis. Still the results hint at the potential importance of a focus on strengthening political institutions and improving the quality of public sector infrastructure if the objective is to raise private sector investment levels on a sustainable basis. These considerations may be particularly important in the context of resource rich developing countries. This raises enormous questions about how such improvements could be achieved, but our findings at least highlight the potential importance of research on these issues in the broad area of political economy.

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Table 1: Models for the log of total investment shares

	(1)	(2)	(3)	(4)
pi_p	-0.224**	-0.222**	-0.232***	-0.219**
	(0.092)	(0.085)	(0.081)	(0.082)
rescoff	-0.428***	-0.379***	-0.346***	-0.371***
	(0.13)	(0.12)	(0.11)	(0.12)
Lncs94	-0.180***	-0.164***	-0.147**	-0.146*
	(0.063)	(0.061)	(0.061)	(0.076)
xconst		0.0240***	0.0241***	0.0215**
		(0.0088)	(0.0087)	(0.010)
Lopenwb			0.143*	0.164*
			(0.079)	(0.083)
reg_ssa				0.0827
				(0.20)
reg_lac				0.191
				(0.16)
asia				0.108
				(0.18)
Constant	3.345***	3.263***	2.679***	2.465***
	(0.14)	(0.15)	(0.39)	(0.42)
Observations	61	61	61	61
R-squared	0.63	0.67	0.68	0.69

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Models for the log of private investment shares

	(1)	(2)	(3)	(4)	(5)
pi_p	-0.0659**	-0.0606**	-0.0519**	-0.0618**	-0.0392
	(0.028)	(0.025)	(0.024)	(0.027)	(0.034)
rescoff	-0.262*	-0.162	-0.165	-0.135	-0.160
	(0.14)	(0.11)	(0.11)	(0.11)	(0.11)
Lncs94	-0.274***	-0.241***	-0.204***	-0.192***	-0.193***
	(0.076)	(0.065)	(0.058)	(0.059)	(0.068)
xconst		0.0493***	0.0427***	0.0434***	0.0409***
		(0.013)	(0.014)	(0.014)	(0.015)
SystemLoss			-0.212**	-0.191**	-0.133*
			(0.084)	(0.086)	(0.079)
Lopenwb				0.132	0.117
				(0.081)	(0.082)
reg_lac					0.254**
					(0.095)
reg_eap					0.451***
					(0.12)
reg_ssa					0.0856
					(0.13)
Constant	3.294***	3.127***	3.616***	3.029***	2.736***
	(0.17)	(0.18)	(0.29)	(0.49)	(0.47)
Observations	61	61	61	61	61
R-squared	0.34	0.53	0.57	0.59	0.65

Table 3: Private investment and political instability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ethnic	−0.620**	−0.193	0.0134					
	(0.26)	(0.19)	(0.18)					
xconst		0.0493***	0.0377**	0.0383***	0.0347**	0.0386***	0.0340**	0.0379**
		(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)	(0.015)
rescoff		−0.197*	−0.193*	−0.220**	−0.192*	−0.160	−0.183*	−0.185
		(0.11)	(0.11)	(0.11)	(0.10)	(0.11)	(0.11)	(0.12)
Lncs94		−0.240***	−0.196***	−0.203***	−0.196***	−0.229***	−0.203***	−0.196***
		(0.063)	(0.057)	(0.058)	(0.056)	(0.063)	(0.057)	(0.057)
SystemLoss			−0.165**	−0.169**	−0.143*	−0.142*	−0.142*	−0.159**
			(0.080)	(0.075)	(0.081)	(0.077)	(0.082)	(0.079)
reg_lac			0.214**	0.231***	0.230***	0.251***	0.245**	0.214**
			(0.089)	(0.083)	(0.085)	(0.086)	(0.093)	(0.083)
reg_eap			0.436***	0.440***	0.503***	0.449***	0.470***	0.451***
			(0.11)	(0.10)	(0.13)	(0.10)	(0.12)	(0.12)
ethpol				−0.243				
				(0.20)				
revols					−0.264			
					(0.22)			
assass						−0.118**		
						(0.059)		
SPI							−0.0409	
							(0.039)	
warciv								−0.0336
								(0.12)
Constant	2.763***	3.116***	3.257***	3.431***	3.260***	3.295***	3.223***	3.248***
	(0.14)	(0.18)	(0.31)	(0.35)	(0.31)	(0.31)	(0.31)	(0.32)
Observations	61	61	61	61	61	61	61	61
R-squared	0.10	0.52	0.63	0.64	0.64	0.64	0.64	0.63

Table 4: Private investment and macroeconomic volatility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TOTv	-2.626**	0.533	0.414				
	(1.21)	(0.83)	(0.86)				
rescoff		-0.226**	-0.207*	-0.189*	-0.194*	-0.191*	-0.199*
		(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)
Lncs94		-0.279***	-0.206***	-0.205***	-0.193***	-0.203***	-0.184***
		(0.068)	(0.067)	(0.058)	(0.059)	(0.061)	(0.060)
xconst		0.0518***	0.0395***	0.0389***	0.0379**	0.0393***	0.0364**
		(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)
SystemLoss			-0.163**	-0.165**	-0.164**	-0.166**	-0.159**
			(0.079)	(0.079)	(0.079)	(0.079)	(0.077)
reg_lac			0.205**	0.176**	0.210**	0.232**	0.222**
			(0.088)	(0.087)	(0.087)	(0.087)	(0.089)
reg_eap			0.438***	0.436***	0.433***	0.453***	0.442***
			(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
monVOL				0.0283			
				(0.033)			
gconsVOL					-0.00213		
					(0.019)		
govVOL						0.0591	
						(0.090)	
cvINF							-0.0398
							(0.13)
Constant	2.774***	3.041***	3.234***	3.214***	3.263***	3.248***	3.260***
	(0.15)	(0.18)	(0.30)	(0.32)	(0.32)	(0.30)	(0.31)
Observations	61	61	61	61	61	61	61
R-squared	0.11	0.51	0.63	0.63	0.63	0.63	0.63

Table 5: Private investment and financial development

	(1)	(2)	(3)	(4)
COEFFICIENT	Lprinv	Lprinv	Lprinv	Lprinv
xconst	0.0434**	0.0414***	0.0435***	0.0428***
	(0.016)	(0.014)	(0.014)	(0.014
SystemLoss	-0.235*	-0.199**	-0.216**	-0.203**
	(0.13)	(0.090)	(0.092)	(0.083
Credit	0.780**	0.298	-0.170	
	(0.34)	(0.38)	(0.32)	
rescoff		-0.181	-0.208*	-0.197*
		(0.11)	(0.11)	(0.10)
Lncs94		-0.201***	-0.205***	-0.196***
		(0.069)	(0.070)	(0.064)
VOL*Credit			0.655***	0.578**
			(0.23)	(0.25)
Constant	2.858***	3.406***	3.476***	3.390***
	(0.42)	(0.41)	(0.42)	(0.33)
Observations	61	61	61	61
R-squared	0.47	0.56	0.59	0.59

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: IV Results

Dependent variable:	Total investment share		Private investment share	
	(1)	(2)	(3)	(4)
Estimator	OLS	2SLS	OLS	2SLS
LNCS94	-.164	-.215	-.222	-.241
	(2.70)	(2.27)	(3.94)	(2.41)
Rescoff	-.379	-.381	-.202	-.201
	(3.15)	(3.98)	(1.91)	(2.15)
xconst	.024	.023	.043	.043
	(2.73)	(2.43)	(3.10)	(4.28)
pi_p	-.222	-.216		
	(2.60)	(5.96)		
SystemLoss			-.227	-.218
			(2.78)	(2.19)
	First-stage for LNCS94			
Mean Temperature		.098		.091
		(4.75)		(4.21)
Coastal Distance		.195		.159
		(2.46)		(1.97)
LandLock		.388		.498
		(1.71)		(2.19)
Rescoff		-.097		-.009
		(0.55)		(0.05)
xconst		.019		.027
		(1.03)		(1.41)
pi_p		.108		
		(1.74)		
SystemLoss				.288
				(1.70)
First-Stage F-Statistic		11.08 (.000)		10.02 (.000)
Sargan (P-value)		0.433		0.104

The 2SLS results treat the log of the natural capital share (*LNCS94*) as an endogenous explanatory variable, and use mean temperature, coastal distance and landlocked as additional instrumental variables.

Figure 1: Natural capital share and mean temperature

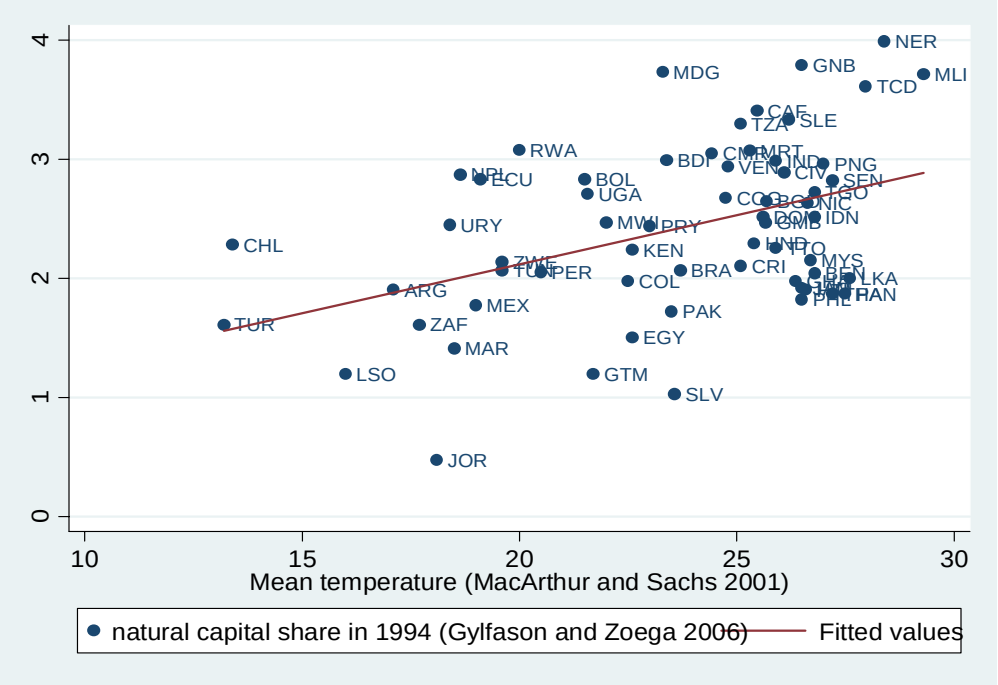
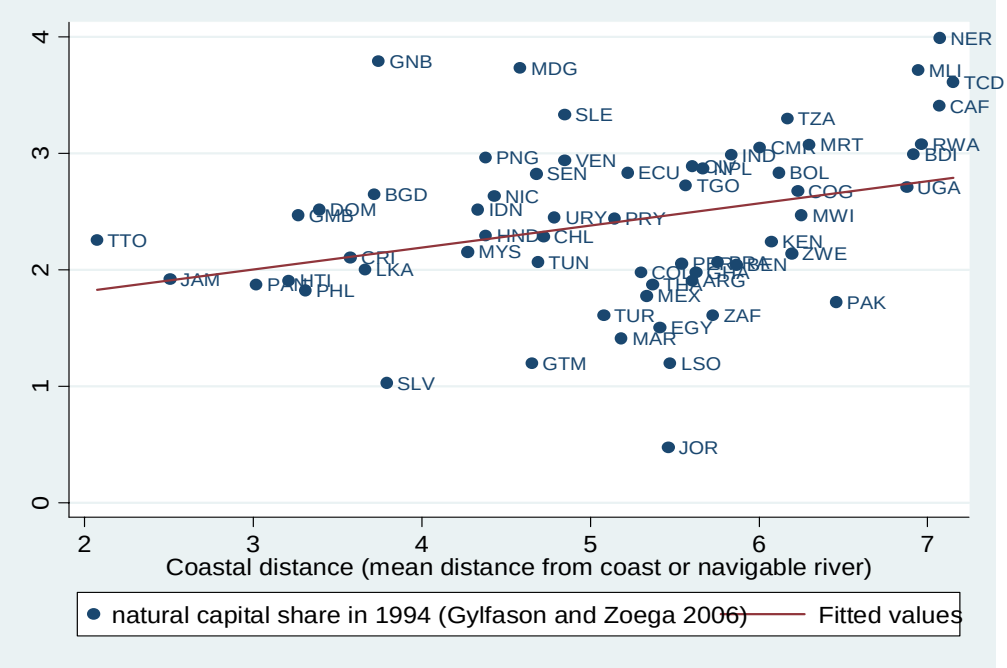


Figure 2: Natural capital share and coastal distance



APPENDIX 1: MODEL SELECTION PROCEDURES AND RESULTS

This appendix will briefly sketch the BMA and PcGets approaches to model uncertainty. If we acknowledge that the underlying data generating process is inherently unknowable, conventional methods for arriving at a preferred model may seem arbitrary, especially if the number of candidate predictors is large and theories are open-ended. Model uncertainty is a fundamental problem for empirical research in social sciences. This paper has employed two main approaches as a guide for model selection: the Bayesian Model Averaging (BMA) and PcGets approaches.

Bayesian Model Averaging (BMA)

Recent work by Raftery (1995) and Sala-i-Martin et al. (2004) have provided convenient empirical applications for the use of Bayesian Model Averaging (BMA). The BMA approach to model selection is well described in Sala-i-Martin et al. (2004) and Brock and Durlauf (2001). This appendix will only provide a brief description of the essential elements of this approach, and draws heavily on Malik and Temple (2005).

We consider the case of K possible models, and assume throughout that one of these models generated the observed data D. We denote the models by M1...MK and their corresponding parameter vectors by θk. The Bayesian approach to model uncertainty is to assign a prior probability to each model, p(Mk), as well as a prior probability distribution p(θk | Mk) to the parameters of each model. Using this structure a Bayesian can then carry out inference on a quantity of interest, such as a slope parameter, by using the full posterior distribution. In the presence of model uncertainty, this distribution is a weighted average of the posterior distributions under all possible models, where the weights are the posterior probabilities that a given model generated the data (Leamer 1978).

To illustrate in the case of just two possible models, the full posterior distribution of a parameter of interest Δ can be written as:

$$p(\Delta \mid D) = p(\Delta \mid D, M1)p(M1 \mid D) + p(\Delta \mid D, M2)p(M2 \mid D)$$

Here p(Δ | D, Mk) are the conventional posterior distributions obtained under a given model and the terms p(Mk | D) are the posterior model probabilities, namely the probability, given a prior and conditional on having observed D, that model Mk is the one that generated the data.

This approach requires the evaluation of posterior model probabilities (see appendix 1 in Malik and Temple (2005) for further details on this). Briefly, as in Raftery et al. (1997) and Sala-i-Martin et al. (2004), we use the Bayesian Information Criterion (BIC) of Schwarz (1978) to approximate the Bayes factors that are needed to compute the posterior model probabilities. We can then implement a systematic form of model selection, and conduct inference in a way that acknowledges model uncertainty. For example, we can easily investigate the hypothesis that a slope coefficient βz is non-zero, by summing the posterior model probabilities for all models in which $\beta z \neq 0$. We can also assess the weight of evidence that a coefficient is strictly positive, by summing the posterior model probabilities for all models in which $\beta z > 0$, and so on.

PcGets

PcGets is a computer program that automates the general-to-specific methodology of econometric model building. This methodology is motivated by the theory of reduction, in that it mimics the theoretical reduction stages in a practical setting. *PcGets* commences from a general unrestricted model (GUM) and selects downwards, discarding irrelevant variables and retaining relevant variables whilst ensuring a well-specified model at every selection stage. This algorithm results in a final, specific model that is congruent and encompasses other models. A good introduction to *PcGets* in a broad context is Hendry and Krolzig (2004). A discussion of *PcGets* and its algorithm is provided in Hendry and Krolzig (2001, 2004). Campos, Hendry, and Krolzig (2003) establish the consistency of the *PcGets* selection procedures. For a practical application of *PcGets*, see Hendry and Krolzig (2004).

The aim is to start off with a congruent model, evaluated by applying a battery of mis-specification tests, and to maintain congruence by applying the same tests, as diagnostic tests, through every stage of the simplification process. In general, specification testing of the GUM is based on five mis-specification tests, selected on the basis of their behaviour in Monte Carlo simulations: two F-tests for parameter constancy, denoted Chow(n), for breakpoints at the sample mid-point (n = 0.5N, where N is the number of sample observations) and 90th percentile (n = 0.9N); Doornik and Hansen's (1994) χ^2 test for normality of the error terms; the F-form of a Lagrange multiplier test for up to p-th order autocorrelation; the F-form of a test of autoregressive conditional heteroskedasticity (ARCH) for up to p-th order; and a χ^2 (or F-form) test for heteroskedasticity (denoted hetero) based on regressing the squared residuals on the original regressors and all their non-redundant squares (White, 1980). Once a GUM has been specified, the next step is to simplify the model using 'pre-search' tests. The aim of this pre-search testing stage is to remove any obvious 'dead wood' from the set of potential regressors, which can significantly reduce the number of search paths required at the next stage of the algorithm.

Our application here uses the 'liberal strategy' within the program, which aims to minimize the probability of not selecting relevant variables. However, a potential caveat is that by attempting to retain relevant variables, it also runs the risk of also retaining irrelevant variables (Owen 2002). We also use the option for a multi-path encompassing search. The basic 'liberal' strategy settings lead to nine regressors being retained from the original set of 43 included in the GUM for total investment shares, and five variables being retained in the case of private investment shares. Results for specific models selected by this application of the *PcGets* program are reported in Table A2 below, for specifications for both total and private investment shares.

TABLE A1: RESULTS OF BMA ANALYSIS

		Log of total investment share				Log of private investment share	
	Regressor		(1)			(2)	
1	IVOL			1.000	(+)	0.910	(–)
2	RELATIVE PRICE OF CAPITAL		1.000	1.000	(–)	0.000	
3	XCONST		0.724	0.999	(+)	0.852	(+)
4	UK COLONY	0.162	0.130	0.997	(–)	0.007	
5	FRENCH LEGAL ORIGIN	0.068	0.064	0.966	(–)	0.000	
6	Natural capital share		0.374	0.963	(–)	0.405	(–)
7	RESCOFF	0.898	0.861	0.922	(–)	0.330	(–)
8	Gross enrollment rate			0.896	(+)	0.098	
9	TOT shock			0.863	(–)	0.000	
10	PRIVATE CREDIT (% GDP)		0.357	0.412	(+)	0.523	(+)
11	Latitude	0.089	0.051	0.220	(–)	0.028	
12	Electricity T&D Losses			0.195		0.276	(–)
13	FRANKEL–ROMER AREA	0.691	0.001	0.182	(+)	0.040	
14	CHECKS		0.056	0.165		0.020	
15	External debt (% GDP)			0.125		0.379	(+)
16	RESDIFF	0.147	0.237	0.125	(+)	0.266	(–)
17	LATIN AMERICA	0.096	0.055	0.109		0.491	(+)
18	RESPOINT	0.102	0.134	0.081		0.249	(–)
19	col_othera	0.000	0.000	0.074		0.018	
20	PERCENT AREA IN TROPICS	0.008	0.000	0.074		0.104	
21	Share of family farms	0.002	0.010	0.069		0.000	
22	Trade openness			0.051		0.271	(+)
23	Coastal distance	0.071	0.002	0.049		0.200	
24	French colony	0.008	0.000	0.046		0.004	
25	Initial income			0.045		0.000	
26	KGPTEMP	0.000	0.000	0.038		0.000	
27	Mean temperature	0.002	0.015	0.034		0.000	
28	Frankel–Romer Trade	0.180	0.001	0.034		0.033	
29	Landlock	0.555	0.611	0.000	(–)	0.282	(–)
30	Inflation volatility			0.017		0.007	
31	Political instability			0.009		0.104	
32	Spanish Colony	0.000	0.000	0.007		0.010	
33	South Asia	0.055	0.025	0.002		0.038	
34	Agg. Governance Index		0.000	0.000		0.829	(+)
35	Output volatility			0.000		0.432	(+)
36	Terms of trade volatility			0.000		0.016	
37	Middle East & N. Africa	0.000	0.000	0.000		0.188	
38	East Asia & Pacific	0.000	0.000	0.000		0.598	(+)
39	Sub-Saharan Africa	0.948	0.022	0.000		0.414	(–)
40	Market distance	0.000	0.000	0.000		0.000	
41	Wheat sugar ratio	0.000	0.000	0.000		0.001	
42	British legal origin	0.068	0.066	0.000		0.000	
43	Ethnic fractionalization	0.217	0.049	0.000	(+)	0.000	

Table A2: Results of PcGets Model Selection

Dependent variable: Total investment share

Final model for total investment share

```
           Coefficient   Std.Error  t-value   t-prob    unbiased
ln_FRarea      0.13003     0.02867    4.536   0.0000     0.12793
reg_sa         0.44124     0.18434    2.394   0.0205     0.44124
pi_p          -0.14117     0.04107   -3.438   0.0012    -0.12536
Lncs94        -0.22089     0.06620   -3.337   0.0016    -0.19236
Lopenwb        0.52646     0.05022   10.484   0.0000     0.52646
col_uka       -0.42712     0.14528   -2.940   0.0050    -0.33432
rescoff       -0.27436     0.09819   -2.794   0.0074    -0.20316
IVOL           0.92150     0.29767    3.096   0.0032     0.75712
checks7503     0.14624     0.03977    3.677   0.0006     0.13479

RSS        5.18701   sigma     0.32209   R^2       0.69957   Radj^2
0.65150
LogLik    71.72572   AIC      -2.12630   HQ       -2.00259   SC       -
1.80938
T             59   p               9   FpNull    0.00000   FpGUM
0.14810

                               value     prob
normality test  chi^2(  2)    4.2064   0.1221

The following regressors have been removed despite their significance:
             t-value    t-prob
Lgr_enrol      4.268    0.0001
Constant       3.107    0.0031
lmdist         2.948    0.0049
col_fra       -2.929    0.0051
reg_lac        2.827    0.0068
```

Dependent variable: private investment share

Final model for private investment share

```
         Coefficient   Std.Error  t-value   t-prob    unbiased
Constant     3.53868     0.29366   12.050   0.0000     3.53868
Lncs94      -0.15892     0.06571   -2.419   0.0190    -0.12249
xconst       0.04179     0.01206    3.466   0.0010     0.04001
SystemLoss  -0.20729     0.09761   -2.124   0.0383    -0.13665
IVOL        -0.59587     0.29180   -2.042   0.0460    -0.36998

RSS        5.69611   sigma     0.32478   R^2       0.56785   Radj^2
0.53584
LogLik    68.96374   AIC      -2.16826   HQ       -2.09953   SC       -
1.99220
T             59   p               5   FpNull    0.00000   FpGUM
0.80701

                               value     prob
normality test  chi^2(  2)    1.2238   0.5423

The following regressors have been removed despite their significance:
             t-value    t-prob
rescoff       -2.616    0.0116
kkz_av         2.519    0.0148
reg_eap        2.472    0.0167
landlock      -2.276    0.0269
pcrof6003      2.021    0.0483
```

Appendix 2: List of 61 countries included in the sample

code	country	code	country
ARG	Argentina	MDG	Madagascar
BDI	Burundi	MEX	Mexico
BEN	Benin	MLI	Mali
BGD	Bangladesh	MRT	Mauritania
BOL	Bolivia	MWI	Malawi
BRA	Brazil	MYS	Malaysia
CAF	Central African Republic	NER	Niger
CHL	Chile	NIC	Nicaragua
CIV	Cote d'Ivoire	NPL	Nepal
CMR	Cameroon	PAK	Pakistan
COG	Congo, Rep.	PAN	Panama
COL	Colombia	PER	Peru
CRI	Costa Rica	PHL	Philippines
DOM	Dominican Republic	PNG	Papua New Guinea
ECU	Ecuador	PRY	Paraguay
EGY	Egypt, Arab Rep.	RWA	Rwanda
GHA	Ghana	SEN	Senegal
GMB	Gambia, The	SLE	Sierra Leone
GNB	Guinea-Bissau	SLV	El Salvador
GTM	Guatemala	TCD	Chad
HND	Honduras	TGO	Togo
HTI	Haiti	THA	Thailand
IDN	Indonesia	TTO	Trinidad and Tobago
IND	India	TUN	Tunisia
JAM	Jamaica	TUR	Turkey
JOR	Jordan	TZA	Tanzania
KEN	Kenya	UGA	Uganda
LKA	Sri Lanka	URY	Uruguay
LSO	Lesotho	VEN	Venezuela, RB
MAR	Morocco	ZAF	South Africa
		ZWE	Zimbabwe