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Intellectual Property Rights as Development Determinants[1]

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Abstract

Intellectual property rights (IPRs) have been identified as key drivers of economic performance in R&D based growth models, but their impact on development has not been fully explored in the empirical literature. We introduce IPRs to this literature, using Two-Stage Least Squares Bayesian Model Averaging (2SBMA) to address endogeneity and model uncertainty at the instrument and income stages. We show that IPRs exert similar effects as "Rule of Law," which has long been heralded as a core development determinant in cross country regressions. Our results thus provide robust evidence that *both* dimensions of property rights, physical and intellectual, are crucial prerequisites to economic development. Most importantly, we document that IPRs which are simply written into law, but are unenforced, exert no effect on development. Instead, it is the level of *enforced* IPRs that causes development.

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1 Introduction

Development determinants have long been the focus of cross-country growth regressions, which are well known to be subject to substantial model uncertainty (Barro, 1997; Durlauf et al., 2005). This model uncertainty manifests itself in the vast number of candidate regressors that have been suggested by competing strands of growth and development theories. Durlauf et al. (2005) survey no fewer than 140 growth determinants for the *Handbook of Economic Growth.* Therefore it is not surprising that prominent approaches to development regressions conduct robustness exercises that juxtapose literally dozens of theories and candidate regressors.[2]

Conspicuously absent from this entire literature is, however, one approach that includes the strength of intellectual property rights (IPRs) as a potential development determinant.[3] The omission is surprising, given that IPRs are the central driving force of economic performance in all R&D based growth models.[4] Property rights over innovations guarantee returns for investors, whose inventions constitute the ultimate engine for long term development. In sharp contrast, the protection of *physical* property (e.g., capital investment) has long been widely accepted as a core determinant regressor in development empirics (as measured by "Rule of Law" or "risk of expropriation").[5]

We follow the canonical development determinant approach of Hall and Jones (1999), Acemoglu et al. (2001), and Rodrik et al. (2004), and introduce IPRs as an additional candidate regressor into this well established line of development regressions. Conceptually we could simply add IPRs to each one of the regressions suggested by the previous literature and report the IPR significance levels. Raftery (1995) points out, however, that significance levels are inflated when coefficients are based on a single statistical model whenever the uncertainty surrounding the validity of the particular

[2] Acemoglu et al. (2001) and Rodrik et al. (2004) alone introduce more than 50 candidate regressors.

[3] While the relationship between IPRs and *growth* is the subject of a voluminous literature (Gould and Gruben, 1996; Kim et al., 2010; Mohtadi and Ruediger, 2010) the effect of IPRs is usually not studied in cross-country *development* regressions, and never before with explicit endogeneity controls, see, e.g., Maskus and Penubarti (1995), Ginarte and Park (1997), Maskus (2000), Chen and Puttitanun (2005).

[4] Romer (1990) and Aghion and Howitt (1992) assume perfect IPRs; and it is easily shown that the canonical R&D based growth model produces reduced growth and welfare with imperfect IPRs (see Eicher and Garcia-Penalosa, 2008).

[5] An alternative strand of the literature focuses on the effect of political institutions, see, e.g., Persson and Tabellini (2002), and Besley et al. (2005).

theory is ignored. Instead, we thus utilize a statistical methodology that allows us to introduce IPRs while simultaneously addressing the profound model uncertainty that has been highlighted by the vast number of development specifications in the previous literature.

We analyze the impact of IPRs on development using Bayesian Model Averaging (BMA), which is designed to resolve model uncertainty as part of the statistical methodology.[6] The added complication that development regressions posit is that their model uncertainty is not confined by development determinants, but it is also present at the instrument level. Instruments are used to address the endogeneity of development determinants and to identify their exact effects on income. Appropriate instruments have also been the subject of a voluminous literature comprised of a sizable set of alternative theories. Instead of juxtaposing particular instrument specifications in what Rodrik et al. (2004) call a "horse race" approach, we employ the Lenkoski et al. (2009) Two-Stage Least Squares BMA (2SBMA) procedure to account for model uncertainty at the development determinant and instrument levels.

To explore the effects of IPRs, we use Acemoglu et al. (2001) and Rodrik et al.'s (2004) own data and augment it with Park's (2008) IPR index. Figure 1 plots the dependent variable in Acemoglu et al./Rodrik et al., per capita income, against Park's (2008) IPR index and reveals a clear positive relationship. We are not the first to highlight the correlation between the intellectual property rights index and development;[7] we are, however, the first to address causality and model uncertainty to clarify whether better IPRs foster high incomes or whether high levels of development produce excellent IPRs.[8]

The 2SBMA methodology addresses the issue of causality by introducing instruments that identify the particular effect of IPRs on development. To motivate potential instruments for IPRs we follow the law and economics literature, which suggests that a particular type of legal origin provides the necessary identification for legal institutions today (see La Porta et al. 1998, 1999; Djankov, 2003).

[6] See, e.g., Fernandez et al. (2001), Sala-i-Martin et al. (2004), and Papageorgiou and Masanjala (2008).
[7] See, e.g., Maskus and Penubarti (1995), Maskus (2000), and Ginarte and Park (1997).
[8] Ginarte and Park (1997) tested the latter hypothesis, but do not control for endogeneity.

After addressing model uncertainty and causality, we find that IPR protection, specifically patent protection, exerts an important impact on development. This impact is separate and parallel to the impact of Rule of Law on development. The result highlights that *both* dimensions of property rights protection are crucial development determinants. We can also show that the impact of IPRs is causal, as our identification strategy posits that IPRs drive income, and our tests of instrument validity support this hypothesis. In addition we show that the impact of patent rights on development depends crucially on the degree of intellectual property rights *enforcement*. As long as patent rights are simply "on the books" but not enforced, they are shown to exert no effect on development. It is the level of enforced patent rights that is positively correlated with development.[9]

The magnitude of the impact of IPR enforcement on development is remarkable: increasing enforcement by one standard deviation causes a 42% increase in long term development. Coincidentally this effect is just about identical in magnitude as the impact of Rule of Law on development. To illustrate the importance of the two dimensions of property rights protection, we can consider two countries at either end of the development spectrum in 1995: The US, with $27,806 per capita income and Brazil, with $6,820. Our results suggest that if Brazil adopted the same level of Rule of Law and IPR enforcement as the US, its predicted per capita income would more than triple to $24,323.

We are not the first to attempt to resolve endogeneity and identify proximate and fundamental development determinants. Alternative approaches to explain development include Mauro (1995), who first suggested ethnolinguistic fragmentation as a fundamental determinant of corruption although the subsequent literature focuses on "Rule of Law" as a more basic development determinant. Hall and Jones (1999) introduced latitude and common language as instruments for an institutional proxy that is a composite of trade, corruption and rule of law. We include these candidate instruments below and highlight the importance of the latter. La Porta et al. (2004) presented yet another "horse race" of theories, juxtaposing judicial independence vs. constitutional review; we employ their hypothesis that judicial characteristics matter in order to

[9] Enforcement is measured in terms of the stringency of preliminary injunctions, the existence of contributory infringement pleadings, and burden-of-proof reversals.

motivate candidate instruments in our analysis. Lenkoski et al. (2009) apply 2SBMA to development determinants, but neglect IPRs.

We proceed as follows: Section 2 outlines the statistical approach that underlies 2SBMA and discusses theoretical properties of the technique, Section 3 describes the data, Section 4 discusses the key results and highlights the importance of both determinant and instrument uncertainty in the recent development literature, and Section 5 concludes.

2 Methodology

2.1 The Econometric Approach

Acemoglu et al. (2001) suggest a particular theory of development, namely that private property rights (as measured by government risk of expropriation) are a crucial development determinant, and that the security of such property rights is crucially dependent on the type of colonial history a country experienced. Rodrik et al. (2004) broaden the definition of development determinants and conduct an all out "horse race" of three potential determinants (private property rights, trade, and geography) against a host of alternative theories. Acemoglu et al. (2001) and Rodrik et al. 2004 constitute the most rigorous robustness tests that have been conducted; the studies employ the largest set of potential development theories to justify and juxtapose candidate regressors.

Both studies acknowledge that the effects of proximate development determinants are endogenous and apply the 2SLS instrumental variable technique to identify the specific effect that each determinant exerts on development. A complicating factor is, however, that competing theories suggest alternative sets of different instruments. Acemoglu et al. and Rodrik et al. approach this issue by juxtaposing not only theories of development determinants, but also theories that motivate alternative instruments against another. Profound model uncertainty thus contaminates coefficient estimates at both the instrument and the determinant level. To examine the effects of IPRs on development we adopt the Acemoglu et al. and Rodrik et al. approach and data augmented by Park's IPR index.

2.2 Statistical Foundations

Instead of producing numerous robustness regressions, we resolve the model uncertainty using a statistical methodology that was specifically designed for that task, Two-Stage Least Squares Bayesian Model Averaging (2SBMA). 2SBMA combines the instrumental variable and BMA methodologies to process the data like a two stage estimator, while addressing model uncertainty in both stages. It is a nested approach that first determines the posterior model probabilities in the first stage via straight BMA to ascertain whether any instruments receive support from the data. Then 2SBMA model averages using the fitted values to derive second stage posterior model probabilities, means, and standard deviations. The weight of each model in the second stage depends not only on its performance, but also on the performance of the particular set of instruments that gave rise to the particular second stage model.

In addition to resolving model uncertainty, Bayesian model averaging minimizes the sum of Type I and Type II error, the mean squared error, and generates predictive distributions with optimal predictive performance (Raftery and Zheng, 2003). 2SBMA is also consistent and it reduces the many instrument bias that is especially relevant in approaches that juxtapose a number of alternative candidate regressors (Lenkoski et al., 2009). Below we provide a sketch of the 2SBMA methodology, limiting our discussion to the properties relevant to our application and refer the interested reader to the comprehensive tutorial and derivations by Raftery et al. (1997) and Lenkoski et al. (2009) for further discussion.

The standard approach to addressing endogeneity of development determinants is to apply two-stage least squares (2SLS) and impose over-identification and instrument restrictions according to

$$Y = \alpha + \sum_{j=1}^{p} \beta_j X_j + \eta, \qquad (1)$$

in which Y is the dependent variable, X is a vector of candidate regressors which is comprised of a vector of W endogenous and D exogenous variables. Reverse causality is of utmost interest in development regressions. Are countries rich because they have good institutions or property rights, or are property rights strong in countries that are sufficiently wealthy to maintain them?

In the presence of endogeneity, the determination of W leads to inconsistent estimates of the entire coefficient in (1). The 2SLS estimator solves the consistency problem, but relies on the existence of a set of instruments, Z, which are independent of Y, given the vector of covariates X. To identify the effect of W on Y, the researcher must suggest a set of instruments, Z such that

$$W = \delta + \theta_Z Z + \theta_D D + \varepsilon . \tag{2}$$

The IV estimates derived in a second stage by using the fitted values from the first stage (2) are consistent only if the conditional independence assumptions are valid. Theories seldom present clear-cut instruments that have both strong explanatory power on the endogenous variables and unquestionable conditional independence properties in relation to the dependent variable. Over-identification tests such as the one proposed by Sargan (1958) help verify the validity of the instrument assumptions.

The 2SBMA setup can be concisely summarized as follows. Let Δ be a quantity of interest and M the set of potential models that is comprised of I individual models in the first stage. The posterior distribution of Δ given the data, D, is given by the weighted average of the predictive distribution under each model,

$$pr(\Delta \mid D) = \sum_{i=1}^{I} pr(\Delta \mid M_i, D)\ \pi_i \tag{3}$$

in which $pr(\Delta \mid M_i, D)$ is the predictive distribution and the model weight is

$$\pi_i = pr(M_i \mid D) \propto \int pr(D \mid \theta_i, M_i)\mu(\theta_i)d\theta_i\ \gamma(M_i). \tag{4}$$

The model weight is thus comprised of the posterior probability for model M_i and the prior densities for parameters and models, $\mu(\theta_i)$ and $\gamma(M_i)$, respectively. Intuitively, this implies that a model's weight is proportional to its relative efficiency in describing the data.

Posterior model probabilities are also the weights used to establish the posterior means and variances

$$\hat{\theta}^{BMA} = \sum_{i \in M}^{I} \hat{\theta}_i \, \pi_i \, , \tag{5}$$

$$\hat{\sigma}^{2\,BMA} = \sum_{i \in M}^{I} \pi_i \, \hat{\sigma}_i^2 + \sum_{i \in M}^{I} \pi_i \, \left(\hat{\theta}_i - \hat{\theta}_i^{BMA} \right)^2 . \tag{6}$$

The BMA posterior mean is thus the weighted sum of all posterior means, where the weight is the quality of the model that generated a particular coefficient. The posterior variance is the sum of the weighted variance for each model plus a second term that indicates how much the estimates differ across models. To provide economically meaningful coefficient estimates we condition the posterior mean and variance on whether a regressor is included in the model. By summing the posterior model probabilities over all models that include a candidate regressor, we obtain the posterior inclusion probability

$$pr\left(\hat{\theta}_i \neq 0 \mid D \right) = \sum_{i \in M} \pi_i \, . \tag{7}$$

The posterior inclusion probability of a regressor is the probability that a variable is included in the true model. It provides a probability statement regarding the importance of a regressor that directly addresses the researchers' prime concern: what is the probability that the coefficient has a non-zero effect on the dependent variable? The posterior inclusion probability thus also carries an important interpretation that goes beyond the information contained in standard p-values.

General rules developed by Jefferies (1961) and refined by Kass and Raftery (1995) stipulate effect-thresholds for posterior probabilities. Posterior probabilities < 50% are seen as *evidence against* an effect, and the evidence for an effect is either *weak*, *positive, strong*, or *decisive* for posterior probabilities ranging from 50-75%, 75-95%, 95-99%, and > 99%, respectively. In our analysis, we refer to a regressor as "effective" if its posterior inclusion probability exceeds 50%.

To address endogeneity, 2SBMA first determines the posterior model probabilities as outlined above as well as the first stage fitted values, $\tilde{w}_i$, for each model M_i. Denoting the set of *j* second stage models as L, 2SBMA then uses the fitted values to derive second stage posterior probabilities and estimates, $\nu_j(\tilde{w}_i)$ and $\hat{\beta}_j(\tilde{w}_i)$ to obtain the posterior mean

$$\hat{\beta}^{2SLSBMA} = \sum_{i \in M}^{I} \sum_{j \varepsilon L}^{J} \nu_j(\tilde{w}_i) \pi_i \hat{\beta}_j(\tilde{w}_i). \tag{8}$$

The posterior mean consists of the combination of weighted fitted values from the first stage models and the weighted posteriors means of the second stage models. The model weight, or the quality of the first stage instrumentation thus influences the overall model weight of a second stage coefficient. The posterior variance and inclusion probability are then

$$\hat{\sigma}^{2\,2SLSBMA} = \sum_{i \in M}^{I} \pi_i \left(\sum_{j \in L}^{J} \nu_j \sigma_j^2 + \sum_{j \in L}^{J} \nu_j \left(\hat{\beta}_j - \overline{\beta} \right)^2 \right) + \sum_{i \in M}^{I} \pi_i \left(\overline{\beta}_i - \hat{\beta}_i^{2SLSBMA} \right)^2 \tag{9}$$

$$pr\left(\hat{\beta}_j \neq 0 \mid D \right) = \sum_{i \in M} \sum_{j \varepsilon L} \nu_j \, \pi_i \,, \tag{10}$$

in which $\overline{\beta}$ is the model averaged estimate for a given first stage model, M_i. The 2SBMA variance has a similar interpretation as the BMA variances. The first term is the average of BMA variances associated with the first stage models, and the second term represents the variation of a given first stage model's BMA estimates relative to the overall 2SBMA estimate.

3 Data

Our data was collected from four major sources. Acemoglu et al. (2001) provide data on settler mortality and religion, Park (2008) provides the IPR index, which is in fact an index of patent protection, and La Porta et al. (1998) provide data on the legal origins of a country. All other variables suggested in the comprehensive robustness approach are obtained from Rodrik et al. (2004). Acemoglu et al.'s (2001) sample covers 64 countries, but the combination with IPR data limits our sample to 54 observations.

Table 1 provides the key descriptive statistics for all variables. For example, GDP per capita ranges from \$519 (Tanzania) to \$27,806 (US) with a mean of \$4,825, and Rule of Law ranges from 1.71 (New Zealand) to -1.49 (Angola), with a mean of -0.28. Park's patent index is the sum of five equally weighted sub-indices (patent length, scope, enforcement, the protection from loss of patent rights and membership in patent treaties).[10] It evaluates the strength of a country's patent system on a scale of 0 (poor patent system) to 5 (strong patent system) with US (4.48) being the strongest and Angola (0.0) the weakest. Patent enforcement is measured on a scale of 0 to 1 scale where 1 is obtained if a country has all of the following enforcement mechanisms: preliminary injunctions, contributory infringement pleadings and burden-of-proof reversals.

To identify the effect of physical and intellectual property rights on development requires instruments that influence property rights directly but are unlikely to impact the income level in 1995 directly. To identify the security of physical property rights, Acemoglu et al. (2001) propose settler mortality, which indicates whether a country was a settlement or extraction colony. Countries with the latter history are presumed to have adopted weaker property rights institutions. Alternative instruments for physical property rights are the fractions of the English or European language speaking population in a country (Hall and Jones, 1999), which are hypothesized to serve as measures of the colonial powers' commitment to building good property rights institutions.

To introduce IPRs, we are required to propose additional instruments, and we rely on a country's type of legal origin. Specifically we follow the law and economics literature, which suggests either English common law or Roman (in particular French) civil law (La Porta et al., 1998, 1999*)* legal origins to have a profound impact on how intellectual property rights are considered by today's legal system*.* David and Brierley (1985) show that corporate law and commercial laws vary systematically by legal origin, and that French legal origins (civil law) are associated with greater formalism of judicial procedures (Djankov et al. 2003) and less judicial independence (La Porta et al. 2004). The latter has been associated with better contract enforcement and greater security of property rights. Since the legal traditions were typically introduced into various countries through conquest and colonization, they are considered largely exogenous, which qualifies them as strong candidate instruments. The remaining variables included in our

[10] This index is an updated version of the Ginarte and Park (1997) index, see Park (2008).

estimation are candidate regressors that have been previously argued to exert an effect on development and that were included in Rodrik et al.'s (2004) robustness checks.

4 Quantifying the Effects of IPRs on Development

This section reports the results of the 2SBMA estimation that introduces IPRs to the canonical development regressions by Acemoglu et al. (2001) and Rodrik et al. (2004) and resolves model uncertainty as part of the statistical procedure. We commence with the results for the aggregate patent index. Columns 2-4 and 5-6 in Table 2 reveal that our instrument strategy provides two effective instruments for patents (fraction of English speaking population in a country and French legal origin) and that physical property rights are also well identified. The Bayesian Sargan test (see Lenkoski et al., 2009) confirms that the exogeneity condition is fulfilled and the instruments are not correlated with the error term in the equation of interest. In other words, the legal and colonial history instrument regressors do exert an effect on development, but not directly, only indirectly through their impact on IPRs. We can thus be confident that the endogeneity of IPRs has been addressed successfully and are able to discuss causal effects of IPRs on development.

The impact of the aggregate patent index on development is, however, disappointing: The aggregate patent index does not surpass the effectiveness threshold. Instead, "Rule of Law" and geographic variables, such as tropics, malaria, and the South-East Asia dummy show inclusion probabilities that are significantly larger than 50%. One hypothesis could be that the weak effect of the aggregate patent index reflects the sizable number of developing countries that achieve high marks for the breadth of their patent laws, but whose intellectual property rights laws are not well enforced.

By disaggregating the patent index, we can find that the average patent duration is largely identical for developing and developed countries. In contrast, a number of developing countries exhibit a dismal score for the enforcement of their stringent patent rights. With an average patent enforcement index of 0.11, developing countries' enforcement mechanisms are almost *eight* times weaker than the average protection afforded by developed economies.

To test our hypothesis formally, we replace the aggregate patent index by the patent *enforcement* index and reestimate the above specification. With three valid instruments (settler mortality, fraction of population speaking English, and French legal origin), patent enforcement is well identified. The result of the Sargan test confirms the exogeneity of the instruments, which allows us to discuss causal results. Table 3 reports strong positive effects of the enforcement of intellectual property rights on development. Given the coefficient estimates in column 9, we find that a one standard deviation increase in patent enforcement increases income by 42.0%. This magnitude is impressive given that a one standard deviation increase in "Rule of Law", the key regressor in the previous literature, increases income by a similar magnitude (by 41.7%). This result strongly suggests that both dimensions of property protection, physical and intellectual, are crucial for development.[11]

To illustrate the impact of these two dimensions, consider two examples: 1995 per capita income in the US has been about 4.3 times higher than in Venezuela. Our results suggest that if Venezuela adopted the degree of intellectual property rights enforcement and the level of Rule of Law to match the levels in the US, the income difference between the two countries would only be about 11%. Our other example compares the US and India. In 1995 US per capita income was about 14 times greater than India's. If India adopted US intellectual and physical property rights, the predicted result would be a *tenfold* reduction in the income differences between the two countries.

Apart from highlighting the impact of the two dimensions of property protection on development, our results also emphasize the importance of accounting for model uncertainty at both the instrument and income stages. The approach allows us to augment the findings by Rodrik (2004) and Acemoglu et al. (2001). Our approach discovers, for example, additional income determinants: While Rodrik et al. (2004) and Acemoglu et al. (2001) find at best weak direct evidence of geography on development we find strong effects for geographic variables that influence the level of development (e.g., Latin

[11]Our results are robust to the inclusion of alternative measures of IPRs and IPR enforcement. In regressions that are available from the authors, we introduce sub-indices for duration, coverage and protection from loss of rights. None of these indices changed our results or surpassed effective thresholds.

America, East Asia, tropics, and malaria).[12] These results are consistent with the results obtained by Lenkoski et al. (2009) who account for model uncertainty by using 2SBMA. In line with the results by Rodrik et al. (2004), we also find that trade does not surpass the effectiveness threshold. Our first stage results confirm those of Lenkoski (2009) and Albouy (forthcoming, AER) in that settler mortality is not an effective instrument for Rule of Law in contrast to the findings of Rodrik (2004) and Acemoglu (2001). However, we do find that settler mortality serves as a strong instrument for the *intellectual* property dimension of institutions as its inclusion probability for patent enforcement is almost 90%. All other results conform to Lenkoski et al. (2009), Rodrik et al. (2004), and Hall and Jones (1999) in that common language variables are shown to be excellent instruments for institutions.

5 Conclusion

The literature that attempts to isolate development determinants has long focused on the effects of physical property rights protection as a key determinant of the observed differences in per capita incomes. Rule of Law (Rodrik et al., 2004) or Risk of Government Expropriation (Acemoglu et al., 2001) had previously been identified as crucial institutional development determinants. Theoretical models of development also highlight, however, the importance of intellectual property rights, which we introduce to the development empirics literature in our paper.

Cross-country growth and development regressions are well known to suffer from substantial model uncertainty, and numerous candidate regressors and theories have been proposed by the voluminous literature in outright "horse races" (Rodrik et al., 2004; La Porta et al., 2004). Not only is the uncertainty about development determinants substantial, but theories which suggest instruments to resolve endogeneity are equally abundant. In this paper, while introducing IPRs into the cross country development literature, we account for endogeneity of the development determinants and address

[12] Kourtellos et al. (2010) previously challenged Rodrik et al.'s (2004) results on the basis of parameter heterogeneity.

model uncertainty at the income determinant and instrument levels using Two-Stage Least Square Bayesian Model Averaging (2SBMA).

We find that intellectual property rights exert a strong impact on development if they are properly enforced. The important insight is thus that both intellectual and physical property rights are crucial determinants of cross-county income differences. Interestingly, our results suggest that the two dimensions of property rights protection hold equally strong explanatory power: a one standard deviation increase in “Rule of Law” increases per capita income by 42%, and this effect is identical to the impact of a one standard deviation increase in patent enforcement, which is also estimated to raise per capita income by the same amount. In line with previous studies, we also find evidence for an effect of geographical variables (as malaria and tropics) on development. We conclude from the data that the effective protection of both physical and intellectual property rights, along with geography, are the key determinants of a country’s economic development.

Figure 1: Development and Intellectual Property Rights

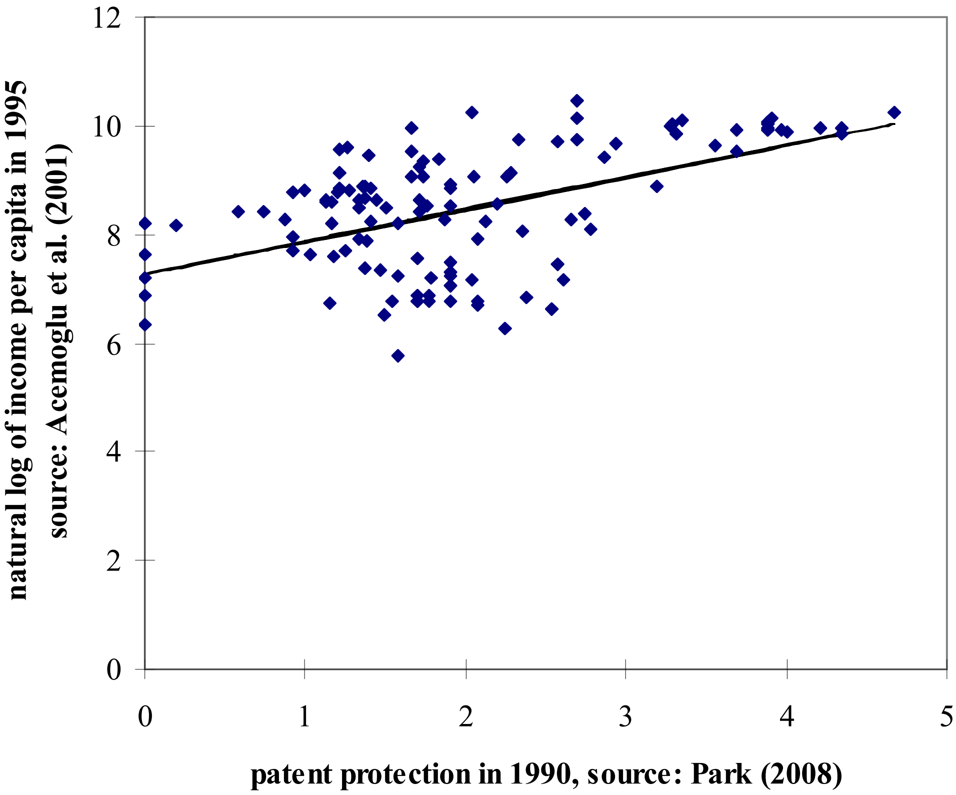

Table 1: Descriptive Statistics and Data Sources

Variable	Max	Min	Mean	StDev	meaning, source
lcgdp95	10.23	6.25	7.99	0.97	natural log of GDP per capita in PPP in 1995, RST (2004), orig.: PWT, Mark 6.
gdp95	27806.08	519.00	4824.67	5659.47	GDP per capita in 1995, same as above
rule	1.71	-1.49	-0.28	0.80	Rule of Law, RST (2004), originally: Kaufmann, Kraay, and Zoido-Lobaton (2002)
logem4	7.99	2.15	4.79	1.19	Settler Mortality, AJR (2001)
logfrankrom	3.74	0.94	2.49	0.63	natural log of predicted trade shares, RST (2004), originally: Frankel and Romer (1999)
engfrac	0.95	0.00	0.08	0.22	Fraction of population speaking English, RST (2004), originally: Hall and Jones (1999)
eurfrac	1.00	0.00	0.32	0.41	Fraction of population speaking English, French, German, Portuguese or Spanish, RST (2004), orig.: Hall and Jones (1999)
legor_fr	1.00	0.00	0.68	0.46	1 if origins of the legal system are French, La Porta et al. (1998)
disteq	45.00	0.00	15.82	12.03	Distance from Equator, RST (2004)
laam	1.00	0.00	0.34	0.47	1 if country belongs to Latin America or the Caribbean, RST (2004)
safrica	1.00	0.00	0.41	0.49	1 if country belongs to Sub-Saharan Africa, RST (2004)
catho80	96.60	0.10	44.23	37.42	1 if population is predominantly Catholic, AJR (2001)
muslim80	99.40	0.00	23.95	33.75	1 if population is predominantly Muslim, AJR (2001)
protmg80	58.40	0.00	11.04	13.99	1 if population is predominantly Protestant, AJR (2001)
tropics	1.00	0.00	0.73	0.41	percentage of tropical land area, RST (2004), orig.: Gallup and Sachs (1998)
access	1.00	0.00	0.18	0.37	1 for countries without access to the sea, RST (2004)
oil	1.00	0.00	0.11	0.29	1 if country is major oil exporter, RST (2004)
frstarea	1.00	0.00	0.17	0.29	Proportion of land with >5 frost-days/month in winter, RST (2004), orig.: Masters and McMillan (2001)
frstdays	29.68	0.02	3.42	5.91	Av. number of frost-days/month in winter, RST (2004), orig.: Masters and McMillan (2001)
malfal94	1.00	0.00	0.44	0.44	Malaria index for 1994, RST (2004), originally: Gallup and Sachs (1998)
meantemp	29.30	-0.20	22.70	5.09	Average temperature in Celsius, RST (2004)
lcopen	4.64	2.55	3.76	0.47	natural log of nominal openness, RST (2004), originally: PWT, Mark 6.
asiae	1.00	0.00	0.07	0.23	1 if country belongs to South-East Asia, RST (2004)
pat_1990	4.68	0.00	1.74	0.81	Patent index (0-5 scale, zero=weak, 1=strong), Park (2008)
enf_1990	1.00	0.00	0.17	0.26	Patent enforcement index (0=weak, 1=strong), Park (2008)

Table 2: Instrumented Effects of Property Rights on Development

	Patent Protection			Rule of Law			Income		
	Incl. Prob.	**Posterior Mean**	**Posterior StDev.**	**Incl. Prob.**	**Posterior Mean**	**Posterior StDev.**	**Incl. Prob.**	**Posterior Mean**	**Posterior StDev.**
INSTRUMENTS									
Engl Lang Frac	**100.0**	1.807	0.536	9.3	0.839	0.531			
French Legal Orig	**55.6**	-0.424	0.206	11.8	0.203	0.160			
Euro Lang Frac	1.7	-0.633	0.458	**98.7**	1.298	0.294			
Implied Trade Share	26.8	0.240	0.148	3.5	0.110	0.139			
Settler Mortality	8.4	-0.144	0.118	8.1	0.095	0.077			
DEVELOPMENT DETERMINANTS									
South-East Asia							**84.9**	1.043	0.472
Rule of Law							**80.7**	0.702	0.260
Malaria 1994							**75.9**	-0.716	0.307
Oil							**70.1**	0.572	0.277
Tropics							**58.0**	-0.592	0.325
Muslim							**56.3**	-0.006	0.003
Sub-Saharan Africa							**51.7**	-0.585	0.318
Catholic							47.4	0.008	0.004
Trade							34.1	0.252	0.192
Patent Protection							29.4	0.285	0.390
Latin America							18.4	0.433	0.394
No Sea Access							13.3	-0.233	0.210
Distance Equator							12.2	-0.016	0.016
Mean Temperature							8.8	-0.012	0.034
Frost Area							6.9	0.351	0.417
Frost Days							4.0	0.006	0.026
Protestant							0.9	-0.001	0.008
Bayes Sargan P-value							0.59		

Table 3: Instrumented Effects of Patent *Enforcement* on Development

	Patent Enforcement			Rule of Law			Income		
	Incl. Prob.	**Posterior Mean**	**Posterior StDev.**	**Incl. Prob.**	**Posterior Mean**	**Posterior StDev.**	**Incl. Prob.**	**Posterior Mean**	**Posterior StDev.**
INSTRUMENTS									
Engl Lang Frac	**100.0**	0.647	0.162	9.3	0.839	0.531			
Settler Mortality	**89.5**	-0.081	0.033	8.1	-0.095	0.077			
French Legal Orig	**51.5**	-0.114	0.060	11.8	-0.203	0.160			
Euro Lang Frac	21.5	0.143	0.088	**98.7**	1.298	0.294			
Impl. Trade Share	0.4	-0.042	0.042	3.5	-0.110	0.139			
DEVELOPMENT DETERMINANTS									
South-East Asia							**90.9**	0.987	0.317
Oil							**75.6**	0.566	0.257
Patent Enforcement							**78.9**	1.600	0.704
Malaria 1994							**75.1**	-0.603	0.267
Tropics							**65.5**	-0.591	0.295
Rule of Law							**61.2**	0.524	0.284
Latin America							**51.8**	0.658	0.314
Catholic							38.2	0.008	0.003
Trade							31.8	0.257	0.170
Sub-Saharan Africa							22.2	-0.544	0.345
Mean Temperature							18.9	-0.026	0.029
Muslim							17.5	-0.005	0.003
No Sea Access							13.5	-0.237	0.186
Frost Area							7.8	0.490	0.389
Distance Equator							7.5	-0.013	0.015
Frost Days							6.9	0.020	0.020
Protestant							0.5	-0.003	0.007
Bayes Sargan P-value							0.55		

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