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Governance and Agricultural Production Efficiency: A Cross-Country Aggregate Frontier Analysis

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Abstract

This study uses a stochastic frontier approach to investigate the relationship between six governance indicators and agricultural efficiency. We find that improvements in rule of law, control of corruption and government effectiveness enhance agricultural productivity significantly if each indicator enters the inefficiency equation independently. When all six indicators are included in the equation, we find that an improvement in rule of law raises agricultural efficiency significantly, but increases in voice and accountability and political stability appear to significantly reduce agricultural efficiency. Grouping the six indicators into three dimensions, we find that an improvement in 'respect for institutional framework' raises agricultural efficiency significantly, but an enhancement in 'selection of authority' reduces agricultural efficiency significantly. Our results imply that poorer countries can enhance their agricultural efficiency substantially by strengthening the state and citizens' respect for institutional framework. However, our results show that greater democracy is associated with lower agricultural efficiency. This finding is consistent with interest group capture and political failure arguments of the political economy literature.

Keywords: *Agricultural efficiency and productivity; governance; stochastic frontier analysis.*

JEL classifications: *O13, O47, Q19.*

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1. Introduction

The recent past has seen much research devoted to explaining why farmers in poor countries do not produce as much as their counterparts in rich countries. It is natural to ask whether agricultural production in poor countries is efficient. One main stream of thought, represented by Schultz (1964), argues that farmers in poor countries are 'poor but efficient'; they allocate available resources rationally, but cannot achieve high levels of productivity, because they have a shortage of local-specific modern agricultural technologies. Therefore, in order to improve the agricultural performance of developing countries, more effort should be made to enhance the capacity of agricultural research institutions, the capacity of technology-supply industries, and the schooling and extension education of rural people (Ruttan, 2002).

In recent years, researchers have recognised that, even though a country has the potential to develop and use modern technologies, its economic performance may still be disappointing if its institutions are insufficient or inappropriate. As Olson (1996) suggests, many poor countries just waste money and resources because they do not have the necessary institutional framework to realise fully the gains from specialisation and trade. In other words, individual rationality does not guarantee that a society produces efficiently. Individual rational behaviour may still lead to socially inefficient outcomes because of institutional failure.

This is evident in the case of agricultural production. An obvious example is that war and local conflict destroy law enforcement and the effectiveness of the government, thus discouraging and even preventing local agricultural production, leading in extreme conditions to mass starvation (e.g. Somalia in the 1990s). If the protection of property rights and the enforcement of contracts are weak, then it is unlikely that significant private investments in agriculture will take place. A secure title to land is necessary for people to have confidence in making long-term investments crucial to improving productivity. As has been dramatically illustrated in China and Vietnam in recent years, providing farmers with secure land rights and strong opportunities for farm labour to do something else have led to remarkable agricultural development (Duncan and Pollard, 2002).

Regarding the development and utilisation of modern agricultural production methods characterised by the use of many highly specialised inputs, such as machinery and chemical fertilisers, a sufficiently large exchange network supporting a significant division of labour is required to provide enough specialists to invent, develop and maintain these specialised inputs (Stigler, 1951). For such a complex network of exchanges, traditions, culture and social pressure alone are insufficient to enforce adherence to agreements. Contract law and the system of justice constitute the infrastructure of a democratic society. Parties to a contract must each believe that they can obtain equal treatment under laws that are fair to all sides. Without such an institutional environment, modern agricultural production methods that employ many specialised inputs would be too expensive to adopt because of high transaction costs.

It is therefore reasonable to hypothesise that governance, providing the necessary institutions for effective development, will significantly influence a country's agricultural production efficiency. For instance, Hayami and Ruttan (1985) suggest that in agriculture poor institutions and policies impede both the adoption of appropriate technology and the outcome of organisational innovation. In the recently published *World Development Report 2008*, World Bank (2007) argues that governance is

essential to agricultural development, and ongoing processes of democratisation, civil society participation, public sector management reforms, and corruption control hold great potential for improving agricultural performance.

In this study, we employ the stochastic frontier approach to examine the relationships between governance and agricultural productivity (value-added) at the national (country) level. This approach has been widely adopted by researchers to study the determinants of inter-farm efficiency differences (e.g. Liu and Zhuang, 2000). It has also recently been employed by a number of researchers, such as Adkins *et al*. (2002) and Méon and Weill (2005), to estimate the relationships between macroeconomic performance and institutional variables. In this paper, technical inefficiencies in agricultural production, as measured by the deviations from an agricultural value-added frontier, are functions of certain governance variables such as rule of law, control of corruption, or government effectiveness.

The rest of this paper is organised as follows: section 2 introduces the methodology and discusses our empirical model. Section 3 presents the data sources and variable definitions. Section 4 reports and discusses our empirical findings. Section 5 concludes the paper.

2. The Model

This study follows the one-stage model suggested by Battese and Coelli (1995) to simultaneously estimate the stochastic frontier production function and the equation of inefficiency by the maximum likelihood estimation. Our model deals with a panel dataset, with N countries and T periods. We assume a Cobb–Douglas production function (widely used in the literature) expressed as follows:

$$\begin{aligned}\ln(\text{Output}_{it}) = {} & \beta_0 + \beta_1 \ln(\text{Labour}_{it}) + \beta_2 \ln(\text{Land}_{it}) + \beta_3 \ln(\text{Livestk}_{it}) \\ & + \beta_4 \ln(\text{Fert}_{it}) + \beta_5 \ln(\text{Tractor}_{it}) + \beta_6 \text{Edu}_{it} + \beta_7 \ln(\text{Landqual}_{it}) \\ & + \beta_8 \ln(\text{Precip}_{it}) + \beta_9 \ln(\text{Precipsd}_{it}) + \beta_{10} \text{Temp}_{it} + \beta_{11} \text{Tropical}_{it} \\ & + \beta_{12} \text{Landlock}_{it} + (V_{it} - U_{it}), \quad i = 1, \ldots, N, \quad t = 1, \ldots, T,\end{aligned} \tag{1}$$

where Output_{it} is the agricultural total output (agricultural GDP) of country i in period t and β is a vector of unknown parameters to be estimated. This stochastic frontier function characterises the transformation from the major agricultural inputs (such as labour, land and capital) into the agricultural value added, while controlling the individual country's geographical and climatic differences.

Five essential agricultural inputs are included in the agricultural production, including agricultural labour (Labour), areas of agricultural land (Land), livestock (Livestk), fertiliser (Fert), and machinery (Tractor). In addition, seven control variables are considered. Edu is the general education level, proxied by the combined primary, secondary and tertiary enrolment ratio. Previous studies of the aggregate agricultural production function usually find positive (but frequently insignificant) coefficients for the general education variable (Bravo-Ortega and Lederman, 2004). The second control variable, Landqual, is the land quality, measured by the percentage of total land being permanent cropland, which is a basic land quality index (Masters and Weibe, 2000; Weibe, 2003). The expectation is that better land quality should increase agriculture productivity.

To control for climate conditions, three variables are employed: annual precipitation (Precip); standard deviation of annual precipitation (Precipsd), accounting for

rainfall variability; daily mean temperature (Temp). To control for geographic characteristics, two dummy variables are included. The first is Landlock, 1 if a country is landlocked, as this property appears to have substantial negative impacts on a country's development (Faye *et al*., 2004). The second is Tropical, 1 for a tropical country. Although the reasons are still under debate, it has been frequently observed that tropical economies show weaker agricultural performance (Sachs, 2001).

The variable V_{it} in equation (1) is a random disturbance term which is assumed to be independently and identically $N(0, \sigma_V^2)$ distributed and independent of U_{it}. U_{it} is the relative inefficiency effect term as a non-negative term with a variance σ_U^2. The variance of the error component term $V_{it} - U_{it}$ is σ^2 with $\sigma^2 = \sigma_U^2 + \sigma_V^2$.[2]

The inefficiency term U_{it} in equation (1) can be specified as:

$$U_{it} = \delta Z_{it} + \varepsilon_{it}, \tag{2}$$

where δ is a vector of unknown parameters to be estimated; Z_{it} is a vector of explanatory variables; and ϵ_{it} is a random variable following a half-normal distribution as usually assumed. Therefore, the technical inefficiency of the ith country at time t is

$$\mathrm{TE}_{it} = \exp(-U_{it}). \tag{3}$$

The software Frontier 4.1 provided by Coelli (1996) is used in this study to perform the maximum likelihood estimation of the stochastic frontier model. Sauer *et al*. (2006) point out that for the consistently reliable application of the stochastic frontier approach, certain necessary conditions should be met (e.g. monotonic convexity of the frontier). As the aggregate function employed in this study uses value added instead of real output (because of data availability), these conditions are not likely to be met. Our specification of the agricultural 'aggregate production function' can only be regarded as an approximation of the underlying production relationships. However, using value added in the estimation of aggregate agricultural production relations is a common practice in the existing literature (e.g. Hayami and Ruttan, 1985; Fulginiti and Perrin, 1993). Agricultural value added is also adopted by Kudaligama and Yanagida (2000), who employ the stochastic frontier approach to estimate inter-country agricultural production functions. Despite the flaws of inexactness and possible theoretical inconsistency, the present specification is likely to reflect differing country performances, albeit the theoretical coherence is subject to challenge and debate. Value added by agriculture does reflect something, particularly when explained by the land, labour and capital seeking to earn a living from this value added. It is reasonable to suppose that this particular characterisation of the differences between national agricultural value added does reflect genuine underlying differences between countries' economic performance, and that

[2] In the OLS regression there is only one random variable in the error term V_{it} which follows the normal distribution. However, in the stochastic frontier there is a composite error term $U_{it} - V_{it}$ where U_{it} is the inefficiency level. As a result, the OLS regression will seriously misestimate the production frontier by mixing up the inefficiency term and statistical noise in one residual term. The term γ measures the proportion of the variance in the error caused by inefficiency. If γ is significantly different from zero, then the stochastic frontier model should be applied instead of the OLS regression.

exploration of the apparent associations between these differences and their governance scores is potentially revealing.

2.1. Modelling inefficiency

Equation (2) models technical inefficiencies as functions of several exogenous determinants which explain differences in agricultural efficiency between countries. The determinants used in this study are governance variables taken from the six governance indicators developed by Kaufmann *et al.* (2006), which proxy the governance infrastructure for a broad sample of 199 countries for 1996, 1998, 2000 and 2002.[3]

The six governance indicators characterise governance in three dimensions. Following Méon and Weill (2005), we call the first governance dimension 'respect for institutional framework', which is the respect of citizens and the state for the institutions governing economic and social interactions. This dimension consists of two aspects: 'rule of law' and 'control of corruption'. 'Rule of law' measures the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police and the courts, as well as the likelihood of crime and violence. In other words, 'rule of law' measures the success of a society in developing an environment in which fair and predictable rules form the basis for economic and social interactions, and importantly, the extent to which property rights are protected. 'Control of corruption' measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests. The presence of corruption is often a manifestation of a lack of respect on the part of both the corrupter and the corrupted for the rules that govern their interactions (Kaufmann *et al.*, 2004, 2006).

The second dimension – 'government action' – is the capacity of the government to formulate and implement sound policies effectively. This dimension also has two aspects: 'government effectiveness' and 'regulatory quality'. 'Government effectiveness' measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The main focus of this index is on inputs required for the government to be able to produce and implement good policies and deliver public goods. 'Regulatory quality' measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. It includes measures of the incidence of market-unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens

[3] In brief, Kaufmann *et al.*'s (2006) methodology identifies many individual sources of data on perceptions of governance that can be assigned to six broad categories. An unobserved components model is then used to construct aggregate indicators from these individual measures. These aggregate indicators are weighted averages of the underlying data, with weights reflecting the precision of the individual data sources. The data sources consist of surveyed firms and individuals, as well as the assessments of commercial risk rating agencies, non-governmental organisations, and a number of multilateral aid agencies. The data rely on a total of 276 individual variables measuring different dimensions of governance. These are taken from 31 different sources, produced by 25 different organisations (Kaufmann *et al.*, 2006).

imposed by excessive regulation in areas such as foreign trade and business development (Kaufmann *et al*., 2004, 2006).

The third dimension – 'selection of authority' – is concerned with the process by which governments are selected, monitored and replaced. This dimension also has two aspects: 'voice and accountability' and 'political stability'. 'Voice and accountability' refers to the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association and free media. It includes a number of indicators measuring various aspects of the political process, civil liberties and political rights. 'Political stability' is related to the perception of the likelihood that the government in power will be destabilised or overthrown by possibly unconstitutional and/or violent means. This index captures the idea that the quality of governance in a country is compromised by the likelihood of wrenching changes in government, which not only has a direct effect on the continuity of policies, but also at a deeper level undermines the ability of all citizens to peacefully select and replace those in power (Kaufmann *et al*., 2004, 2006).

Governance may affect agricultural efficiency through several possible channels. First, bad governance can act as a tax on productive activities, which leads not only to accumulation of less productive resources, but also to less intensive use of those resources, resulting in lower efficiency (Méon and Weill, 2005). An obvious example is that corruption can be seen as the levying of unpredictable taxes, which are harmful to production performance (Campos *et al*., 1999). Another example is that many governments with poor regulatory quality tend to engage in industrial protectionism and implement macroeconomic policies, levying heavy indirect taxes on agriculture. Krueger *et al*. (1991), in characterising policy mixes for 18 countries from 1960 to 1983, find that the indirect tax on agriculture arising from market-unfriendly macroeconomic policies can be three times the direct tax, which is likely to severely discourage production.

Second, bad governance, especially corruption, encourages transfer activities and diverts efforts from productive activities, and thus can result in low agricultural efficiency. In a country with a weak rule of law, widespread theft will force individuals to allocate more efforts to the protection of property. In a society where corruption is prevalent, many resources will be diverted to rent-seeking instead of productive activities. Land administration agency is often one of the most corrupt government agencies, and agricultural projects, such as those for irrigation, are often prone to corruption, which can blunt agricultural development (World Bank, 2007).

Third, governance matters as agricultural production efficiency is affected by the quantities and quality of public goods and services such as roads, irrigation systems, communications infrastructure, schooling, and agricultural research and extension programs. A high 'government effectiveness' implies that these public goods and services are provided more effectively. Political instability may influence the characteristics of public investments as rulers in strong nations tend to invest in public goods to enhance long-term growth, while rulers in weak nations tend to redistribute resources as bribes to potential contenders because the lack of broad popular support and the inability to hold on to power indefinitely shorten the rulers' time horizons (Moe, 1990).

Fourth, governance may have an impact on agricultural efficiency by affecting political outcomes. Political outcomes, which influence agrarian relations and determine agricultural taxation, subsidisation and the provision of public goods, can

result from political bargaining between interest groups. Better 'voice and accountability' may improve transparency and decentralisation of political, fiscal and administrative power, which may change incentive structures for political participation and the ability of previously powerless agrarian groups to participate. This may create conditions for bargaining which can be more conducive to agricultural production (World Bank, 2007).

However, there are counter arguments asserting that bad performance in some aspects of governance may be compatible with high economic efficiency, and that good performance in some aspects of governance may be associated with low efficiency. A well-known example is the 'grease the wheels hypothesis' which argues that corruption may raise efficiency in a country plagued with a very slow and ineffective bureaucracy (Huntington, 1968). Another instance is where permissive intellectual property rights may facilitate and speed up technology transfers (Méon and Weill, 2005). It can also be contended that political stability may not always be beneficial to efficiency, because many efficiency-enhancing economic reforms become possible only when the regimes face serious crisis (Binswanger and Deininger, 1997).

Moreover, it is frequently noted in the literature that empirical work does not provide unambiguous evidence supporting the hypothesis that democracy is associated with better economic performance (Brunetti, 1997). It is possible that greater democracy can reduce agricultural efficiency. The most obvious reason is that, instead of competing with each other in the market, producers in a democratic society may find that an alternative route to prosperity is to persuade the government to act in producers' rather than consumers' interests (Harvey, 2004), and greater political participation and organisation can lead to political capture of the policy agenda which is in favour of the producers but efficiency-reducing (Rausser, 1982; World Bank, 2007).

Harvey (2004) identifies three major conditions that can strengthen the political pressure for government intervention and protection of the agricultural sector. First, by Engel's law, agriculture is inevitably subject to relative decline during economic progress, which will increase the political pressure for protection (de Gorter and Tsur, 1991). Second, the agricultural sector is usually coherent with electoral constituency sympathies, and agricultural products are considered to be fundamental to survival and prosperity. As a result, government support for the agricultural sector is frequently politically attractive during the development process. This condition can been illustrated by the cases of post-war Europe and Japan, in which recent memories of food insecurity bred domestic policies aimed at food self-sufficiency and security. Third, the atomistic characteristic of the agricultural sector suggests that producers may find that there are more benefits to gain from political persuasion relative to market competition. As producers are more concentrated than consumers because of specialisation, producers' individual gains from market protection will outweigh individual consumer and taxpayer losses. Therefore, based on the logic of collective action (Olson, 1965), producers have an incentive to put more effort into persuading the political system of protection than consumers and taxpayers can be expected to spend on opposing such protection (Harvey, 2004).

Adkins *et al.* (2002) use the production frontier approach to investigate the effects of three institutional variables – namely, economic freedom, political rights and civil liberties – on macroeconomic efficiency for 76 countries for 1975, 1980 and 1985. They find that economic freedom is significantly associated with technical efficiency. However, the effects of political rights and civil liberties on efficiency are

insignificant, and for different model specifications the coefficients of both variables range from negative (efficiency-improving) to positive (efficiency-reducing). Méon and Weill (2005) also utilise the stochastic frontier method to test the relationship between governance, measured by the six governance indicators used here, and macroeconomic technical efficiency on a sample of 62 countries. Their results show that, when entering the inefficiency model individually, each governance indicator is positively and significantly associated with efficiency. However, if all six indicators enter the inefficiency model and are tested against each other, then only 'government effectiveness' appears significantly efficiency-enhancing. 'Political stability', 'regulatory quality' and 'control of corruption' appear to be associated with inefficiency, though insignificantly. Therefore, although it seems reasonable to hypothesise that good governance is efficiency-improving for agricultural production, there are still reasons to be cautious as to the *a priori* relationship between governance and agricultural efficiency.

To test the relationship between governance and agricultural efficiency empirically, we specify agricultural inefficiency for country i in period t as follows:

$$U_{it} = \delta_0 + \delta_1 \text{Governance}_{it} + \varepsilon_{it}, \tag{4}$$

where 'Governance' is the relevant variable of governance. The effect of a country's governance on agricultural performance is characterised by this inefficiency equation.

3. Data Sources and Variable Definitions

We use a sample of 118 countries with data for the years of 1996, 1998, 2000 and 2002. The list of sample countries is provided in Table A1. Two main datasets are employed. The first incorporates figures from the World Bank's *World Development Indicators* (2005) on agricultural total output and also from the FAOSTAT (2005) on agricultural inputs. The agricultural total output is measured by agricultural value added in constant 2000 international dollars (PPP). For the estimation of the aggregate agricultural value-added function, five agricultural inputs are used, including labour, land, livestock, fertilisers and machinery. The definitions of these inputs are as follows. Labour is measured as the economically active population in the agricultural sector (in thousands of participants). Land is measured as thousands of hectares of arable land and permanent cropland. Livestock is measured as thousands of cow-equivalent livestock units, following Hayami and Ruttan (1970). Fertiliser is measured by the sum of the nitrogen, potash and phosphate content of various fertilisers consumed, measured in metric tons. Machinery is measured by the number of agricultural tractors.

For the control variables, general education level (Edu) is measured by the combined primary, secondary, and tertiary enrolment ratio, provided by *Human Development Report* (UNDP, 1999–2004). Land quality (Landqual) is measured by the percentage of total land being permanent cropland, obtained from *World Development Indicators* (2005). The climate variables, including Precip, Precipsd and Temp, are obtained from Mitchell *et al*. (2004).

The second main dataset is from Kaufmann *et al*. (2006), which provides aggregate indicators for six aspects of governance, including measures for the rule of law (Rulelaw), control of corruption (Concorr), government effectiveness (Goveff), regulatory quality (Reguqual), voice and accountability (Voiacc), and political stability (Polstab). The six governance indicators are measured in indices ranging from about

Table 1
Definitions and sources of main variables

Variables	Definitions	Sources
Agricultural output and essential inputs		
Output	Agricultural total output (PPP), measured by agricultural value-added in constant 2000 international dollars	World Bank (2005)
Labour	Agricultural labour force, measured by thousands of participants in an economically active population in agriculture	FAOSTAT (2005)
Land	Arable land and permanent cropland, in thousands of hectares	FAOSTAT (2005)
Livestk	Thousands of cow-equivalent livestock units as calculated by Hayami and Ruttan (1970)	FAOSTAT (2005)
Fert	Sum of nitrogen, potash, and phosphate content of various fertilisers consumed, measured in metric tons	FAOSTAT (2005)
Tractor	Number of agricultural tractors	FAOSTAT (2005)
Governance variables		
Rulelaw	Index for the 'rule of law'	Kaufmann *et al.* (2006)
Concorr	Index for the 'control of corruption'	Kaufmann *et al.* (2006)
Goveff	Index for the 'government effectiveness'	Kaufmann *et al.* (2006)
Reguqual	Index for the 'regulatory quality'	Kaufmann *et al.* (2006)
Voiacc	Index for the 'voice and accountability'	Kaufmann *et al.* (2006)
Polstab	Index for the 'political stability'	Kaufmann *et al.* (2006)
Respinst	Respect for institutional framework, measured by the mean value of Rulelaw and Concorr	Kaufmann *et al.* (2006)
Govact	Government action, measured by the mean value of Goveff and Reguqual	Kaufmann *et al.* (2006)
Selauth	Selection of the authority, measured by the mean value of Voiacc and Polstab	Kaufmann *et al.* (2006)
Econfree	Economic freedom index	Gartzke *et al.* (2005)
Polright	Political rights index, rescaled so that 7 is the highest political rights rating and 1 is the lowest political rights rating	Freedom House (2008)
Control variables		
Edu	Education index, measured by the combined primary, secondary and tertiary gross enrolment ratio	UNDP (1999–2004)
Landlock	Dummy variable, landlocked countries = 1	CIA (2005)
Landqual	Land quality, measured by percentage of total land being permanent cropland	World Bank (2005)
Precip	Annual precipitation, in millimetres, averaged over 1961–1990	Mitchell *et al.* (2004)
Precipsd	Standard deviation of annual precipitation over 1961–1990, in millimetres	Mitchell *et al.* (2004)

Table 1
(*Continued*)

Variables	Definitions	Sources
Temp	Daily mean temperature, in degrees Celsius, averaged over 1961–1990	Mitchell *et al.* (2004)
Tropical	Dummy variable, tropical countries = 1	Easterly (2001)

***Notes*:** The Output value of the United States for 2002 is adopted from the 2001 data instead.
Except for the governance indicators, the data for Taiwan are drawn from various government statistical sources.
The Econfree value for 1996 is adopted from the 1995 data instead. The Econfree value for 1998 is derived from the 1995 and 2000 data.

Table 2
Summary statistic for variables (118 countries, 472 observations)

	Mean	SD	Min	Max
Agricultural output and essential inputs				
ln(Output)	22.64	1.55	18.49	27.48
ln(Labour)	7.19	1.83	1.10	13.14
ln(Land)	8.10	1.67	0.69	12.11
ln(Livestk)	15.03	1.70	10.33	19.43
ln(Fert)	11.74	2.32	5.01	17.50
ln(Tractor)	10.02	2.52	2.94	15.38
Governance variables				
Rulelaw	−0.02	0.94	−1.78	2.24
Concorr	−0.04	0.98	−1.68	2.57
Goveff	0.03	0.95	−1.68	2.59
Reguqual	0.13	0.89	−2.70	2.31
Voiacc	−0.01	0.91	−1.85	1.73
Polstab	−0.01	0.91	−2.78	1.72
Respinst	−0.03	0.95	−1.73	2.37
Govact	0.08	0.89	−2.02	2.40
Selauth	−0.01	0.84	−2.19	1.70
Econfree	6.33	1.07	3.30	8.80
Polright	4.64	2.05	1.00	7.00
Control variables				
Edu	68.41	19.22	20.00	114.0
ln(Landqual)	0.07	1.84	−7.36	2.87
ln(Precip)	6.80	0.82	3.92	8.14
ln(Precipsd)	4.69	0.77	2.08	6.18
Temp	17.37	8.42	−5.40	28.20

***Note*:** The Econfree variable has 380 observations for 95 countries.

−2.5 to 2.5, with higher values corresponding to better governance outcomes. Following Kaufmann *et al.* (2006), the six aspects are further grouped into three dimensions of governance. The first dimension is 'respect for institutional framework' (Respinst), measured by the mean value of Rulelaw and Concorr. The second

dimension is 'government action' (Govact), measured by the mean value of Goveff and Reguqual. The third dimension 'selection of the authority' (Selauth) is measured by the mean value of Voiacc and Polstab.

Two additional governance-related variables are also employed in this study. The first is the economic freedom index (Econfree) provided by the Economic Freedom of the World (EFW) project (Gartzke *et al*., 2005). The other variable is the Political Rights index (Polright) from the *Freedom in the World* dataset provided by Freedom House (2008). We re-scale Polright such that 7 is the highest political rights rating and 1 is the lowest political rights rating. We use these indices as alternative reflections of aspects of governance to the Kaufmann *et al*. (2006) data, to test the robustness of the apparent relationships between governance and productivity. Table 1 summarises definitions and sources of the main variables used in this study. Table 2 presents the descriptive statistics for each variable.

4. Results

Tables 3–5 display the results of models (1)–(6), which include each of the six basic governance indicators as the determinant of inefficiency. Table 3 shows the results

Table 3

Maximum likelihood estimates of the agricultural production frontier and determinants of technical inefficiency – results for the 'respect for institutional framework' variables: Rulelaw and Concorr

	Model (1) Rulelaw		Model (2) Concorr	
Variable	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Production function				
Constant	15.06***	44.87	15.07***	44.79
ln(Labour)	0.34***	13.14	0.34***	13.17
ln(Land)	0.09***	2.84	0.09***	2.84
ln(Livestk)	0.12***	4.42	0.11***	4.18
ln(Fert)	0.21***	11.52	0.21***	11.60
ln(Tractor)	0.05**	2.22	0.05**	2.51
Edu	0.00	0.94	0.00	1.00
ln(Landqual)	0.09***	6.06	0.09***	5.97
ln(Precip)	0.27***	3.93	0.27***	4.00
ln(Precipsd)	−0.39***	−4.88	−0.39***	−4.92
Temp	0.01**	2.26	0.01**	2.40
Tropical	−0.25***	−2.57	−0.25***	−2.62
Landlock	−0.24***	−3.98	−0.23***	−3.93
Inefficiency function				
Constant	0.01	0.02	−0.12	−0.24
Governance variable	−0.22**	−2.32	−0.24**	−2.19
σ^2	0.42***	2.72	0.46***	2.66
γ	0.87***	14.98	0.88***	16.37
Log-likelihood	−267.05		−267.09	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**) and 1% (***).
Number of countries = 118.
Number of observations = 472.

Table 4

Maximum likelihood estimates of the agricultural production frontier and determinants of technical inefficiency – results for the 'government action' variables: Goveff and Reguqual

	Model (3) Goveff		Model (4) Reguqual	
Variable	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Production function				
Constant	15.05***	44.27	14.81***	41.60
ln(Labour)	0.34***	13.12	0.33***	12.23
ln(Land)	0.09***	2.90	0.10***	3.20
ln(Livestk)	0.12***	4.33	0.12***	4.37
ln(Fert)	0.21***	11.60	0.21***	11.26
ln(Tractor)	0.05**	2.33	0.05**	2.18
Edu	0.00	0.99	0.00	1.48
ln(Landqual)	0.09***	5.93	0.09***	5.88
ln(Precip)	0.27***	3.93	0.30***	4.31
ln(Precipsd)	−0.38***	−4.85	−0.40***	−5.04
Temp	0.01**	2.42	0.01***	2.59
Tropical	−0.26***	−2.67	−0.30***	−3.07
Landlock	−0.23***	−3.87	−0.25***	−4.28
Inefficiency function				
Constant	−0.08	−0.17	−0.55	−0.51
Governance variable	−0.23**	−2.23	−0.05	−0.52
σ^2	0.46***	2.64	0.61	1.62
γ	0.87***	15.57	0.88***	12.86
Log-likelihood	−267.33		−271.06	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**), and 1% (***).
Number of countries = 118.
Number of observations = 472.

for Rulelaw and Concorr, the governance aspects of 'respect for institutional framework'. Table 4 contains the results for Goveff and Reguqual, which are aspects of 'government action'. The results for Voiacc and Polstab, aspects of 'selection of authority', are shown in Table 5.

Note that all the γ parameters in these tables are significant, implying that the variance caused by inefficiency is significantly larger than zero and hence stochastic frontiers are appropriate. The coefficients of the agricultural inputs and control variables in the function are fairly stable across different models used here. Tables 3–5 show that the coefficients of five essential agricultural inputs, Labour, Land, Livestk, Fert and Tractor, all exhibit expected signs with high statistical significance. Moreover, the magnitudes of the coefficients are similar to those reported in the literature using agricultural value added as the agricultural total output (e.g. Fulginiti and Perrin, 1993; Kudaligama and Yanagida, 2000).

The coefficients of Edu are positive but insignificant, consistent with findings in the literature. As expected, the coefficients of Landqual, the land quality variable, are positive and significant. For the climate variables, the coefficients of Precip and Temp are positive and significant. The coefficients of Precipsd are negative and significant. The coefficients of Landlock and Tropical are negative and significant,

Table 5

Maximum likelihood estimates of the agricultural production frontier and determinants of technical inefficiency – results for the 'selection of the authority' variables: Voiacc and Polstab

	Model (5) Voiacc		Model (6) Polstab	
Variable	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Production function				
Constant	14.67***	40.30	14.74***	43.00
ln(Labour)	0.31***	11.23	0.32***	11.95
ln(Land)	0.10***	3.30	0.10***	3.25
ln(Livestk)	0.13***	4.48	0.13***	4.51
ln(Fert)	0.21***	11.39	0.21***	11.53
ln(Tractor)	0.05**	2.24	0.05**	2.21
Edu	0.00	1.61	0.00	1.62
ln(Landqual)	0.09***	5.80	0.09***	5.88
ln(Precip)	0.30***	4.39	0.30***	4.45
ln(Precipsd)	−0.39***	−4.85	−0.40***	−5.08
Temp	0.01***	2.71	0.01***	2.69
Tropical	−0.31***	−3.17	−0.31***	−3.15
Landlock	−0.26***	−4.51	−0.25***	−4.47
Inefficiency function				
Constant	−0.58	−0.52	−0.59	−0.53
Governance variable	0.08	0.92	0.06	0.69
σ^2	0.61	1.59	0.62	1.61
γ	0.87***	11.52	0.88***	12.50
Log-likelihood	−270.92		−271.01	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**), and 1% (***).
Number of countries = 118.
Number of observations = 472.

indicating that being landlocked or in the tropics have negative impacts on a country's agricultural value added. These results are also consistent with findings in the literature.

For the governance variables, it is found that different dimensions of governance seem to have different impacts on agricultural efficiency. As shown in Table 3, both Rulelaw and Concorr have significantly negative effects, implying that greater respect for institutional framework improves efficiency. Both coefficients of Goveff and Regugual appear to be negative (Table 4), but only the former is significant. Both coefficients of Voiacc and Polstab appear to be positive (Table 5), although neither is significant. The questionable hypothesis that 'selection of authority' enhances agricultural efficiency does not hold for these countries over this time period.

To test the six governance indicators against each other, model (7) includes all six.[4] Table 6 displays the results. When the effects of other governance variables are

[4] Because the six governance indicators are highly correlated with each other (see Table A2), multicollinearity problems may arise when all governance variables are present in the inefficiency equation. Therefore, the results in Table 6 should be treated with care. However, the results in Table 6 are basically consistent with the findings in Tables 3–5.

Table 6
Estimates of the agricultural production frontier and determinants of technical inefficiency – results for six governance indicators

	Model (7)	
Variable	Coefficient	*t*-Ratio
Production function		
Constant	14.74***	43.08
ln(Labour)	0.30***	10.75
ln(Land)	0.12***	3.71
ln(Livestk)	0.14***	4.83
ln(Fert)	0.20***	10.90
ln(Tractor)	0.05**	2.43
Edu	0.00	0.81
ln(Landqual)	0.09***	6.16
ln(Precip)	0.26***	3.96
ln(Precipsd)	−0.32***	−4.23
Temp	0.01**	2.00
Tropical	−0.20**	−2.15
Landlock	−0.22***	−3.61
Inefficiency function		
Constant	0.22	0.85
Rulelaw	−0.40**	−1.96
Concorr	−0.02	−0.12
Goveff	−0.24	−1.32
Reguqual	0.16	1.23
Voiacc	0.26**	2.04
Polstab	0.22**	1.99
σ^2	0.32***	3.34
γ	0.82***	10.80
Log-likelihood	−252.38	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**), and 1% (***).
Number of countries = 118.
Number of observations = 472.

controlled, Rulelaw, Concorr and Goveff appear to improve efficiency (negative coefficiants), though only Rulelaw is significant. Reguqual, Voiacc and Polstab all appear to promote inefficiency (positive coefficients). In particular, better 'voice and accountability' and 'political stability' both seem significant in reducing agricultural efficiency, which is consistent with the interest group capture and political failure arguments of the political economy literature (especially among developed countries).

To examine the robustness of the empirical findings in Tables 3 and 6, in models (8)–(11) we employed governance-related indicators from sources other than Kaufmann *et al.* (2006) in the inefficiency function. The first is the economic freedom index (Econfree) from Gartzke *et al.* (2005), which measures the degree to which the policies and institutions of countries are supportive of economic freedom.

Table 7 shows the results of models (8) and (9). In model (8) we use Econfree as the governance variable in the inefficiency equation. In model (9) we include six

Table 7
Estimates of the agricultural production frontier and determinants of technical inefficiency – replacing Reguqual by Econfree

	Model (8)		Model (9)	
Variable	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Production function				
Constant	14.28***	43.10	14.21***	45.26
ln(Labour)	0.38***	16.18	0.36***	15.15
ln(Land)	0.08***	3.16	0.08***	3.46
ln(Livestk)	0.09***	3.48	0.12***	4.49
ln(Fert)	0.17***	7.64	0.15***	6.98
ln(Tractor)	0.08***	4.01	0.10***	4.86
Edu	0.01***	2.91	0.01**	2.55
ln(Landqual)	0.11***	6.97	0.11***	7.08
ln(Precip)	0.41***	5.84	0.35***	5.18
ln(Precipsd)	−0.41***	−5.20	−0.34***	−4.41
Temp	0.01***	2.90	0.01**	2.45
Tropical	−0.42***	−4.46	−0.33***	−3.50
Landlock	−0.30***	−4.19	−0.31***	−4.22
Inefficiency function				
Constant	-0.87	-0.62	-0.95	-1.14
Econfree	-0.06	-0.55	0.12	1.28
Rulelaw			-0.39	-1.41
Concorr			-0.33	-1.35
Goveff			-0.26	-1.12
Voiacc			0.39***	2.26
Polstab			0.53***	2.44
σ^2	0.96	1.49	0.52	2.96
γ	0.96***	39.97	0.95***	43.88
Log-likelihood	−196.03		−178.18	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**), and 1% (***).
Number of countries = 95.
Number of observations = 380.

governance indicators in the inefficiency equation as in model (7), but with Econfree replacing Regqual. Comparing the results of model (4) with those of (8), both Econfree and Regqual appear to improve efficiency, but are insignificant. Comparing the results of model (7) with those of (9), Econfree and Regqual have very similar coefficients, both in magnitude and statistical significance, indicating that the two variables are very close substitutes in this case.

The Political Rights index (Polright) from Freedom House (2008) is derived from the following factors: Participate freely in the political process; Vote freely in legitimate elections; Have representatives that are accountable to people. In other words, the dimension of governance measured by Polright is very close to that measured by the 'voice and accountability' index in the Kaufmann *et al.*'s (2006) governance indicators. In model (10) we use Polright as the governance variable in the efficiency equation, and in model (11) we include six governance indicators in the efficiency equation with Polright replacing Voiacc. Comparing

Table 8
Estimates of the agricultural production frontier and determinants of technical inefficiency – replacing Voiacc by Polright

	Model (10)		Model (11)	
Variable	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Production function				
Constant	14.55***	39.29	14.78***	42.57
ln(Labour)	0.31***	10.83	0.31***	11.01
ln(Land)	0.11***	3.43	0.12***	3.61
ln(Livestk)	0.13***	4.74	0.13***	4.71
ln(Fert)	0.21***	11.33	0.20***	11.01
ln(Tractor)	0.05**	2.28	0.05**	2.24
Edu	0.00	1.56	0.00	0.77
ln(Landqual)	0.09***	5.80	0.09***	6.23
ln(Precip)	0.30***	4.54	0.27***	3.98
ln(Precipsd)	−0.38***	−4.71	−0.34***	−4.30
Temp	0.01***	2.64	0.01**	1.97
Tropical	−0.32***	−3.29	−0.21**	−2.19
Landlock	−0.26***	−4.62	−0.22***	−3.62
Inefficiency function				
Constant	−0.73	−0.74	−0.10	−0.28
Polright	0.07	1.64	0.07*	1.92
Rulelaw			−0.38**	−2.01
Concorr			−0.01	−0.04
Goveff			−0.21	−1.23
Reguqual			0.19	1.51
Polstab			0.25**	2.22
σ^2	0.53	1.83*	0.32***	3.29
γ	0.86	10.59***	0.82***	10.84
Log-likelihood	−270.06		−253.50	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**), and 1% (***).
Number of countries = 118.
Number of observations = 472.

the results of model (5) with (10), Polright and Voiacc are both positive. Comparing the results of model (7) with those of (11), both Polright and Voiacc are positive and significant. Again, Polright and Voiacc appear to be close substitutes in explaining agricultural inefficiency (Table 8).[5]

Utilising the classification system of Kaufmann *et al*. (2006), we group the governance indicators into three dimensions of governance – 'respect for institutional framework' (Respinst), 'government action' (Govact) and 'selection of the authority'

[5] Freedom House provides another freedom index, the Civil Liberties index, which is also very close to the 'voice and accountability' indicator provided by Kaufmann *et al*. (2006). We had performed tests which used this index to replace Voiacc in the inefficiency function. The results showed that this index generates estimation results very similar to that of Voiacc.

Table 9

Estimates of the agricultural production frontier and determinants of technical inefficiency – results for three governance aspects

	Model (12)		Model (13)		Model (14)		Model (15)	
Variable	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio	Coefficient	*t*-Ratio
Production function								
Constant	15.08***	44.89	14.95***	42.52	14.70***	41.64	14.85***	45.38
ln(Labour)	0.34***	13.13	0.33***	12.67	0.32***	11.51	0.32***	11.83
ln(Land)	0.09***	2.77	0.09***	2.93	0.10***	3.27	0.11***	3.69
ln(Livestk)	0.12***	4.29	0.12***	4.25	0.13***	4.50	0.12***	4.49
ln(Fert)	0.21***	11.61	0.21***	11.71	0.21***	11.52	0.20***	11.17
ln(Tractor)	0.05**	2.38	0.05**	2.24	0.05**	2.23	0.06***	2.79
Edu	0.00	0.93	0.00	1.25	0.00	1.63	0.00	0.89
ln(Landqual)	0.09***	6.02	0.09***	5.82	0.09***	5.83	0.09***	6.07
ln(Precip)	0.27***	3.95	0.28***	4.11	0.30***	4.42	0.26***	3.98
ln(Precipsd)	−0.39***	−4.90	−0.40***	−5.00	−0.40***	−4.97	−0.34***	−4.41
Temp	0.01**	2.32	0.01**	2.49	0.01***	2.71	0.01**	2.10
Tropical	−0.25**	−2.57	−0.28***	−2.89	−0.31***	−3.16	−0.21**	−2.23
Landlock	−0.23***	−3.96	−0.24***	−4.06	−0.26***	−4.54	−0.21***	−3.43
Inefficiency function								
Constant	−0.04	−0.08	−0.26	−0.38	−0.57	−0.52	0.12	0.40
Respinst	−0.24**	−2.32					−0.61**	−2.51
Govact			−0.17*	−1.69			0.04	0.22
Selauth					0.08	0.86	0.54***	2.65
σ^2	0.44***	2.71	0.52**	2.08	0.61	1.61	0.36***	3.22
γ	0.87***	15.78	0.87***	14.31	0.88***	11.99	0.84***	13.47
Log-likelihood	−266.87		−269.72		−270.94		−255.27	

***Notes*:** Asterisks indicate significance at 10% (*); 5% (**), and 1% (***).
Number of countries = 118.
Number of observations = 472.

(Selauth).[6] These three governance variables were then used to estimate the inefficiency equation. Table 9 reports the results.

The first three columns of Table 9 display the estimates of models (12)–(15). In models (12)–(14) we use three dimensions of governance independently in the inefficiency equation. In model (12), Respinst is significantly negative at the 5% level. Model (13) finds that Govact significantly reduces inefficiency at the 10% level, suggesting that improving these two dimensions of governance can increase agricultural efficiency. In model (14) the estimated coefficient of Selauth in the inefficiency equation is positive though insignificant.

Model (15) includes all three dimensions of governance together. Table 9 shows the result in the last column. The results indicate that Respinst significantly

[6] There are other methods, such as principal components analysis or factor analysis, which could be used to reduce the number of governance variables. However, these approaches are likely to reveal one component or factor because of the high correlation between the six governance indicators. Therefore, we divided the six governance indicators into three aspects according to Kaufmann *et al*.'s (2006) theoretical concepts.

Table 10
The differences in the agricultural efficiency scores based on model (15): countries classified by income level

	Agricultural efficiency scores (%)				
	1996	1998	2000	2002	Average
High income ($N = 22$)	77.27	76.20	76.97	75.19	76.41
Upper middle income ($N = 24$)	59.48	58.27	54.69	58.18	57.66
Lower middle income ($N = 38$)	64.95	64.92	64.08	64.61	64.64
Low income ($N = 34$)	61.94	61.80	62.25	62.55	62.13
All countries ($N = 118$)	65.27	64.77	64.05	64.68	64.69

improves efficiency, while Govact seems not to, though insignificant. On the other hand, Selauth significantly reduces efficiency according to this specification, echoing the previous results based on the twin aspects of this dimension of governance.

Table 10 reports the differences in the average agricultural efficiency score between different groups of countries. The average agricultural efficiency score for all countries over the 1996–2002 period is 64.7. High-income countries have the highest average agricultural efficiency score, 76.4, which is 14.3 points higher than the average efficiency score of low-income countries (62.1) and 11.8 points higher than the average efficiency score of lower middle-income countries (64.6).

These results suggest that there is still much scope to improve the agricultural efficiency of poor countries, especially by improving the 'respect for institutional framework' in these countries. However, we also find that upper middle-income countries have the lowest average agricultural efficiency score, 57.7, which is 7.0 points lower than the average score of all countries and 18.7 points lower than the average score of the high-income countries (76.4). A possible explanation of this result is that in some of the upper middle-income countries the speed of improvement in 'selection of authority' is much faster than that in 'respect for institutional framework' as the latter aspect of governance usually needs more time to develop, and this imbalanced development of the two dimensions of governance is associated with negative impacts on agricultural efficiency.[7]

5. Conclusion

Applying the stochastic frontier approach to a sample of 118 countries for 1996, 1998, 2000 and 2002, we investigate how differences in governance variables may explain cross-country differences in agricultural efficiency. The governance variables used in this study include the six governance indicators developed by Kaufmann *et al*. (2006).

[7] Over the 1996–2002 period, the average scores of 'respect for institutional framework' for high-income, upper middle-income, lower middle-income and low-income countries are 1.57, 0.18, −0.50 and −0.67, respectively. The average scores of 'selection of authority' for high-income, upper middle-income, lower middle-income and low-income countries are 1.10, 0.40, −0.40 and −0.60, respectively. The difference in the average scores of 'selection of authority' between upper middle-income and low-income countries is 1.00, which is higher than the difference in the average scores of 'respect for institutional framework' between upper middle-income and low-income countries (0.84).

Our results indicate that the hypothesis of 'better governance fosters efficiency' may be only partly true for agricultural production, because different dimensions and aspects of governance appear to have different impacts on agricultural efficiency.

Our results are consistent with findings in the related literature. For example, Adkins *et al.* (2002) do not find significant impacts of political rights and civil liberties on efficiency. Furthermore, for some model specifications the two variables appear to be efficiency-reducing. Méon and Weill (2005) also present a significantly positive coefficient for the 'political stability' variable when all six governance indicators are present in the inefficiency equation.

Several policy implications can be drawn from this study. The first is obvious: to enhance agricultural efficiency, one of the most important things for a government to do is to provide an environment where property rights are secure and the gains from investments and efforts are well protected. The political institutions need to encourage people to engage in production instead of transfer activities. Governments should refrain from arbitrary actions and unpredictable policies which may make people hesitant to undertake long-term investments.

The last several decades have seen many international efforts devoted to enhancing the agricultural performance of developing countries. Substantial effort has focused on improving the quality of government action. However, our results suggest that, if the institutional framework has provided farmers the necessary incentive to use their resources efficiently, then the quality of government action plays a rather insignificant role in improving agricultural efficiency. Therefore, in order to improve agricultural efficiency in many developing countries, in addition to helping their governments to be more active, more emphasis should be put on encouraging these governments to fulfil what North (1990) calls the role of the 'impartial third party', reduce rent-seeking activities and strengthen citizens' faith in the rule of law.

As regards the role of democracy in determining agricultural efficiency, one should be cautious in drawing out policy implications from our empirical results. Our results do *not* imply that autocracy is better than democracy in fostering agricultural efficiency. The reason is that democracy may help improve other dimensions of governance such as the rule of law and corruption control, which are important for farmers to produce efficiently. However, our results do imply that democracy itself may generate some negative effects, causing agricultural production (value added) to become less efficient. This finding is consistent with arguments in the political economy literature that highly democratic and participatory systems allow producers to capture the political system and to engineer distorting policies in their favour, at the expense of efficiency (de Gorter and Tsur, 1991). In this case, as Harvey (2004) points out, the key to improving agricultural efficiency will lie in how to overcome the difficulties in reconciling economic efficiency and political acceptability in democratic systems.

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Appendix

Table A1
List of 118 sample countries

Albania	Ethiopia	Lithuania	Singapore
Algeria	Finland	Macedonia, FYR	Slovenia
Argentina	France	Madagascar	South Africa
Armenia	Gabon	Malawi	Spain
Australia	Gambia, The	Malaysia	Sri Lanka
Austria	Georgia	Mali	Sudan
Azerbaijan	Germany	Mauritius	Sweden
Bangladesh	Ghana	Mexico	Syrian Arab Republic
Belarus	Greece	Moldova	Taiwan
Bolivia	Guatemala	Mongolia	Tajikistan
Botswana	Guinea	Morocco	Tanzania
Brazil	Guinea-Bissau	Mozambique	Thailand
Bulgaria	Guyana	Nepal	Togo
Burkina Faso	Haiti	Netherlands	Trinidad and Tobago

Table A1
(*Continued*)

Cameroon	Honduras	New Zealand	Tunisia
Canada	Hungary	Nicaragua	Turkey
Chile	India	Nigeria	Turkmenistan
China	Indonesia	Pakistan	Uganda
Colombia	Iran, Islamic Rep.	Panama	Ukraine
Congo, Rep.	Italy	Papua New Guinea	United Kingdom
Costa Rica	Jamaica	Paraguay	United States
Cote d'Ivoire	Japan	Peru	Uruguay
Croatia	Jordan	Philippines	Uzbekistan
Czech Republic	Kazakhstan	Poland	Venezuela, RB
Denmark	Kenya	Portugal	Vietnam
Dominican Republic	Korea, Rep.	Romania	Yemen, Rep.
Ecuador	Kyrgyz Republic	Russian Federation	Zambia
Egypt, Arab Rep.	Lao PDR	Saudi Arabia	Zimbabwe
El Salvador	Latvia	Senegal	
Estonia	Lebanon	Sierra Leone	

Table A2
Correlation between governance variables

	Rulelaw	Concorr	Goveff	Reguqual	Voiacc	Polstab	Respinst	Govact	Selauth
Rulelaw	1.00	0.95	0.94	0.84	0.81	0.78	0.99	0.93	0.85
Concorr		1.00	0.93	0.81	0.78	0.74	0.99	0.90	0.82
Goveff			1.00	0.85	0.78	0.76	0.95	0.97	0.83
Reguqual				1.00	0.82	0.67	0.83	0.96	0.80
Polstab					1.00	0.73	0.80	0.83	0.93
Voiacc						1.00	0.77	0.74	0.93
Respinst							1.00	0.93	0.85
Govact								1.00	0.85
Selauth									1.00

***Notes*:** All correlation coefficients are significant at 1% level.
Number of countries = 118.
Number of observations = 472.