

The devil is in the shadow

Do institutions affect income and productivity or only official income and official productivity?

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Abstract:

The paper investigates whether institutional quality affects output, once controlled for the size of the shadow economy. While institutions have been shown to increase output, they have been shown to decrease the size of the underground sector at the same time. The overall impact of institutions on total output is thus a priori ambiguous. The paper corrects official output for the size of the shadow economy and compares the distribution of per capita incomes using both raw and corrected figures. We present a development accounting exercise and decompose differences in incomes to differences in factor endowments and total factor productivity. The decomposition is used to determine the channels through which institutions affect income per capita. Our results confirm the positive impact of institutional quality on official output and total factor productivity, and a negative one on the size of the underground economy. Overall, there is no significant impact of institutions on total (“corrected”) factor productivity.

Keywords: shadow economy, income, aggregate productivity, development accounting.

JEL Classification: O11, O17, O47, O5.

1. Introduction

The consensus that institutions are a key determinant of economic development has led international organizations to devote attention and resources to improving the institutional frameworks of developing countries. Various conventions have accordingly been set up, such as the 1998 UN resolution or the 1999 OECD’s “Convention on combating bribery.” That political consensus is indeed backed by a parallel consensus based on results from a decade of empirical research. Spurred by the seminal papers of Mauro (1995) or Knack and

Keefer (1995), that line of research has repeatedly concluded that ailing institutions are associated with lower GDP per capita growth. Later studies, such as Hall and Jones (1999) and Acemoglu et al. (2000), extended that finding to the level of per capita incomes. Hall and Jones (1999) furthermore observed that the bulk of that relationship ran through the impact of institutions on total factor productivity.

Although those consonant observations have drawn a consistent picture of the relationship between institutions and development, they all share a common drawback that may turn out crucial in the context of developing economies: they use official output figures. Nevertheless, official output figures neglect a sizeable part of economic activity, which takes place in the informal sector, and therefore remains unrecorded in official statistics, namely the shadow economy. According to Schneider (2005), defining the underground economy as currently unregistered economic activities that contribute to the officially calculated (or observed) Gross National Product, the shadow economy amounted on average to 39 percent in developing countries, and up to 40 percent in transition countries in 2002/2003. Those figures consequently call for caution in interpreting empirical results emphasizing the negative impact of defective institutions on incomes. They in fact emphasize that official incomes decrease when, for instance, corruption increases or the rule of law deteriorates. They do not guarantee however that the same holds for total income, defined as the sum of official and unofficial incomes.

Previous research has shown that the shadow economy frolics in countries mired with defective institutions, thus acting as a substitute for the official economy. Johnson et al. (1997), model good institutions to reduce the shadow economy. In their model, corruption increases the shadow economy, as corruption can be viewed as one particular form of taxation and regulation (driving entrepreneurs underground). Hindriks et al. (1999) also show that the shadow economy is a complement to corruption. This is because, in this case, the tax payer colludes with the inspector so the inspector underreports the tax liability of the tax payer in exchange for a bribe. According to the results in Dreher and Schneider (2006), better institutions reduce the size of the shadow economy. Similarly, Johnson et al. (1998a) observed a one-point increase in Transparency International's corruption index to imply a 5.1 points fall in the share of the shadow economy.

To summarize, good institutions seem to increase official output, while at the same time reducing unofficial output. One may accordingly contend that the observed correlation between bad institutions and income may be less substantial than it first seems. It may only result from a drop in recorded output. In other words, production might not disappear, it might

only go underground, which is a special case of Hirschman (1970)'s exit option as Schneider and Enste (2000) argue. Even if the substitution from official to shadow production would be imperfect, the negative impact of bad institutions on overall income would be dampened. This intuition is consistent with Johnson et al. (1998b) reporting the relationship between corruption and growth to become insignificant once the shadow economy is added as an explanatory variable. At any rate, a systematic investigation of the relationship between institutions and total income, as opposed to official income, is warranted. This is precisely the aim of the present paper.

With this aim in view, our line of reasoning is along the following steps. In a first section, we will correct official output figures for the shadow economy. We will then compare the distribution of per capita incomes using both raw and corrected figures. In a second section we will probe deeper on the impact of the shadow economy on output by running a development accounting exercise, following Hall and Jones (1999) and Caselli (2005). Namely, differences in incomes will be decomposed to differences in factor endowments and differences in total factor productivity. The next section uses that decomposition to determine the channels through which institutions affect income per capita. We will thus check whether institutions are still significantly correlated with output per capita and total factor productivity. The last section concludes.

2. Correcting output figures

The prerequisite to correcting output figures is to measure the shadow economy. Data for the shadow economy are taken from Schneider (2005a, 2005b). Schneider calculates the size and development of the shadow economy of 145 countries, including developing, transition, and highly developed OECD countries over the period 1999 to 2003. In a first step Schneider (2005b) estimates the size of the shadow economy of 96 developing countries with the help of structural equation modeling (DYMIMIC). The sample covers Central and South America, Africa, Asia and South-West-Pacific Islands. Moreover, the data cover 25 Central and Eastern European Former Soviet Union countries, 3 Communist countries, and 21 high developed OECD countries. While the DYMIMIC approach produces estimated relative sizes of the shadow economy, another step is necessary to get to absolute values. In order to calibrate absolute figures of the size of the shadow economies from the relative DYMIMIC

estimation results, Schneider uses previous estimates for a number of countries (e.g. Australia, Austria, Germany, Hungary, Italy, India, Peru, Russia and the United States).¹

The resulting average size of the shadow economy in percent of official GDP in 37 African states is 41 percent. In Central and South America the size of the shadow economy amounts to 41 percent. In Asia the average value is much lower (29 percent). Regarding the transition countries among the sample, the respective value is 38 percent, and for the OECD 17 percent. Looking at the unweighted average of the 145 countries in the sample, the average size of the shadow economy is 34 percent in 1999/2000.

We added the shadow economy output to the official output figures, thereby obtaining what we refer to as total output. The data on official output stem from the Penn World Tables version 6.2. Table 1 below compares official (y) and total (y_{tot}) output per worker measured in PPP dollars. We focus on the year 2000, because it maximizes the number of observations in our sample. We report data on two samples: First, we describe the largest sample for which we could find data on output per worker and the shadow economy, which features 136 countries. Second, we use a restricted sample for which we could not only find data on output per worker and the shadow economy but also on the human and physical capital stocks. The latter will be the focus of subsequent sections, and thus deserves specific attention.

Table 1: Distribution of official and total output

	Largest sample		Restricted sample	
	y	y_{tot}	y	y_{tot}
Mean	18940.73	23640.14	22834.13	27998.54
Standard deviation	18995.49	21998.34	20338.46	23058.87
Coefficient of variation	100.29	93.06	89.07	82.36
Minimum/Maximum	75.83	59.46	38.50	31.14
Number of observations	136	136	76	76

y denotes official output per worker and y_{tot} total output per worker defined as official output plus the shadow economy.

As Table 1 shows, adding the output produced in the shadow economy to official output increases both the mean and the standard deviation of output. This is not surprising. Since the shadow economy can by definition not be negative, our correction can only increase

¹ These external estimates are derived employing the currency demand method. For the sources of these external estimates see Schneider (2005b, page 21).

output. The evolution of the coefficient of variation is more interesting. Namely, the coefficient of variation decreases when output is corrected for the shadow economy. Table 1 also reports the ratio of minimum to maximum output. This ratio also decreases with the inclusion of the shadow economy in output figures.

These results are due to the fact that the shadow economy tends to be larger in poorer countries. To be more specific, the coefficient of correlation between the share of the shadow economy and official output per worker is -0.668 in the larger sample and -0.7123 in the restricted sample. Official figures therefore tend to overestimate the differences in output across countries. It is therefore unsurprising that the observed differences in outputs are reduced when the shadow economy is taken into account. In the next section we investigate the impact of that correction on development accounting.

3. Development accounting with the shadow economy

As official figures are biased downward in poorer countries, they may lead to underestimating these countries' productivities. In this section, we therefore estimate productivities across countries with and without the shadow economy, and compare the results. We thus need estimates of countries' total factor productivity. This is where development accounting comes into play. The basic feature of that method is to estimate countries' outputs as a function of their factor endowments and compare estimated figures with actual output figures. The difference between the two gives total factor productivity (TFP), or the Solow residual, depending on the author's optimism.

To do so, the standard method in the literature is the calibration approach surveyed by Caselli (2005), and used by King and Levine (1994), Klenow and Rodriguez-Clare (1999), Prescott (1998) and Hall and Jones (1999), among others. According to that method, an aggregate production function of the following form is assumed:

$$Y = AK^\alpha(Lh)^{1-\alpha} \quad (1)$$

where Y is the country's output, and K its aggregate capital stock. L measures that country's number of workers, and h is the average human capital stock. Lh is therefore a measure of the labor force adjusted for its quality. α is a parameter, and A is total factor productivity.

We rewrite the production function in per-worker terms, giving:

$$y = Ak^\alpha h^{1-\alpha} \quad (2)$$

where lower-case letters refer to per-worker variables.

To compute A , one therefore needs a value for α and data on Y , K , L , and h . It is commonly assumed that a reasonable estimate for α is 0.3. However, although this parameter's value is critical in development accounting exercises, as Caselli (2005) shows, the value is admittedly arbitrary. True, it corresponds to the US long run average, but may be quite different for other countries. Indeed, the estimates of α that are reported in the literature can vary wildly. Thus, Cavalcanti Ferreira et al. (2004) report estimates of α that are approximately equal to 0.43. Moreover, estimates of α obtained when the production function is estimated thanks to efficiency frontiers techniques frequently reach 0.8, as in Kneller and Stevens (2003) or Méon and Weill (2005). Finally, Abu-Qarn and Abu-Bader (forthcoming) assess α in MENA countries and conclude that the share of capital often exceeds 0.6 in those countries. They even report estimates exceeding 0.9 for the region's α . As 0.3 therefore seems a very small value for α , and any exogenously imposed value is completely arbitrary, we endogenized the magnitude of the parameter. Specifically, we estimated the coefficient of the Cobb-Douglas production function on our sample with output being measured by total output. This resulted in a value of $\alpha = 0.57$, which we will use in our calculations below. This value of α remains a conservative guess. That value allows investigating the impact of increasing the capital share in the production function, while leaving a role for differences in TFP in explaining cross-country differences in per worker output. As Caselli (2005) showed, variations in factor endowments explain the totality of cross-country differences in output per worker with values of α exceeding 0.6. However, we test the robustness of our results setting $\alpha = 0.3$ also.

The number of workers was computed from the Penn World Tables 6.2 dataset.² The human capital stock is usually computed as a function of years of schooling in the population. Following Hall and Jones (1999) and Caselli (2005), we accordingly defined h as:

$$h = e^{\phi(s)} \quad (3)$$

where s is the average number of years of schooling in the population over 25 years old in Barro and Lee's (2001) dataset, and ϕ a piecewise linear function such that $\phi(s) = 0.134*s$ if $s \leq 4$, $\phi(s) = 0.134*4 + 0.101*(s - 4)$ if $4 < s \leq 8$, and $\phi(s) = 0.134*4 + 0.101*4 + 0.068*(s - 8)$ if $s > 8$. Since Hall and Jones (1999), this definition of human capital is used in development accounting. Its motivation is the following. According to our model, a worker's wage should be proportional to his human capital. The

² The number of workers was obtained by dividing total GDP by GDP per worker, that is $\text{rgdpch} \times \text{pop} \times 1000 / \text{rgdpwok}$ according to notations in the PWT6.2.

relationship between wage and education is commonly assumed log-linear at the country-level, but the cross-country pattern of the education-wage profile seems convex. Hall and Jones therefore resorted to a piecewise linear specification to take stock of within and cross-country evidence. In Barro and Lee's dataset, the last year for which this statistic is available is 2000.

The last set of data required for our calculations is the capital stock. We again followed the literature and computed it by applying the perpetual inventory method, where the capital stock of a particular year is defined as the sum of past investments to which a depreciation rate is applied. Hence, we assume that the capital stock is:

$$K_t = K_{t-1}*(1 - \delta) + I_{t-1} \quad (4)$$

Again, data on real investment in PPP terms were obtained from the Penn World Tables 6.2.³ That data is available from 1950 until 2004. However, not all countries have complete series for the entire period. We therefore restricted our analysis to countries for which the information was available at least from 1970.

To apply the above formula one, however, needs the initial capital stock. Still following Caselli (2005) and Hall and Jones (1999), we assumed that the capital stock in the initial year was equal to its steady-state value in the Solow growth model, namely $K_0 = I_0 / (g + \delta)$, where δ is the depreciation rate, which is usually set to 0.06 in the literature, I_0 is the value of investment in the first year for which an observation is available, and g the average rate of growth for the investment series between that year and 1970.⁴

Finally we used two definitions of output per worker. One was directly taken from the Penn World Tables 6.2 dataset.⁵ The other was corrected for the shadow economy, like in the previous section. Overall we could obtain data on output per worker, physical capital, human capital, and the shadow economy for 76 countries in the year 2000.

The key point now is to determine the extent to which the inclusion of the shadow economy in output figures affects the observed role of the residual in explaining cross-country income differences. Put differently, we aim at measuring the impact of that correction on the capacity of factor endowments to predict the income differences.

³ That is $rgdpl*pop*ki$ in PWT6.2.

⁴ Note that the impact of K_0 on the capital stocks in 2000 is quite small, as we use no base year subsequent to 1970. Since the annual rate of depreciation is six percent, the maximum share of the initial capital stock still in use in 2000 cannot exceed 15% of its initial value.

⁵ It is referred to as $rgdpwok$ in PWT6.2.

To do so, we compare actual output per worker figures with that predicted by a model that only considers factor endowments, that is $y_{KH} \equiv k^\alpha h^{1-\alpha}$, called the factor-only model. We then assess its relevance by computing the two measures of success defined in Caselli (2005). The first one is the ratio of the log-variance of the factor-only output to the log-variance of observed output. As it is sensitive to outliers, it is complemented by the ratio of the 90th to the 10th percentile of the factor-only output to the ratio of the 90th to the 10th percentile of observed output. More precisely, those measures are defined as:

$$success_1 \equiv \frac{var[\log(y_{KH})]}{var[\log(y)]} \quad (5a)$$

$$success_2 \equiv \frac{y_{KH}^{90} / y_{KH}^{10}}{y^{90} / y^{10}} \quad (5b)$$

Those two measures of success were computed once with official output figures and once with output figures corrected for the shadow economy, and with the two values of α . Table 2 below displays the results of our calculations:

Table 2: Measures of success of the factor-only model

	success ₁	success ₂
Official output	0.571	0.705
Total output	0.797	0.901

The results displayed in table 2 are consistent with the usual findings of the literature. Namely, it appears that the factor-only model fails to account for all the variance of output. However, the key finding of table 2 appears when comparing the results obtained with official figures to those obtained with corrected figures. We thus observe that the measures of success of the factor only model are systematically greater when corrected figures are used instead of official figures. In our sample, that correction adds around twenty percentage points to those measures.

Table 3: Descriptive statistics of implied productivity

	Mean	Standard deviation	Max/Min
A	2.559	0.699	4.708
A_{tot}	3.337	0.913	4.584

A stands for TFP computed using official figures. A_{tot} denotes TFP computed with corrected figures.

Table 3 above provides more information on the impact of adding the shadow economy to official output figures. The distribution of official TFPs is described in the first line of that table and the distribution of total TFPs in the following line. The results of table 3 are reminiscent of those in table 1. Namely, it appears that both the mean and the standard deviation of TFPs increase when the shadow economy is taken into account. However, the distribution of TFPs becomes more concentrated around its mean, as the drop in the ratio of maximum to minimum TFP suggests. Here again, the rationale for that result stems from the fact that a smaller share of output is officially reported in poorer countries. Their TFP therefore stands to be relatively more underestimated than that of richer countries. As a result, correcting for the shadow economy leads to a more concentrated distribution of TFP.

To illustrate those results, table 4 picks some countries from the sample, and displays their official incomes, total incomes, and productivities relative to the U.S. It also recalls summary statistics for the entire sample, and the correlation of each displayed variable with official output per worker.

Table 4: Productivity calculations: ratios to U.S. values

Country	y	y_{tot}	A	A_{tot}
USA	1	1	1	1
Norway	0.953	1.044	0.859	0.941
Singapore	0.876	0.911	0.854	0.889
France	0.824	0.873	0.914	0.968
Italy	0.758	0.886	0.915	1.070
Hong-Kong	0.750	0.804	0.905	0.970
Canada	0.743	0.793	0.823	0.878
Great Britain	0.734	0.761	0.978	1.014
Japan	0.664	0.680	0.655	0.671
Argentina	0.417	0.481	0.821	0.947
Mexico	0.293	0.350	0.763	0.913
Brazil	0.231	0.297	0.725	0.933
Egypt	0.178	0.221	1.226	1.524
Philipines	0.138	0.182	0.623	0.822
China	0.100	0.103	0.510	0.529
India	0.090	0.102	0.727	0.823
Kenya	0.037	0.045	0.455	0.563
Malawi	0.026	0.034	0.551	0.711
Mean	0.340	0.384	0.765	0.918
Correlation with y	1	0.995	0.435	0.140

y denotes official output per worker and y_{tot} total output per worker defined as official output plus the shadow economy. A stands for TFP computed using official figures. A_{tot} denotes TFP computed with corrected figures.

All the variables displayed in table 4 appear to be positively correlated with official output per worker. Namely richer countries also tend to be more productive. What is more remarkable however, is the fact that the correlation of TFP with output becomes looser when the shadow output is added to official output. The intuition of that finding is that the share of the shadow economy tends to increase when income decreases. Poorer countries therefore report a smaller fraction of their total output. This therefore introduces a systematic bias that results in underestimating TFP in poor countries, which increases the correlation between output and TFP. When this statistical artifact is corrected, the correlation between output and TFP consequently becomes less clear. This is precisely what our calculations reveal.

These results may also cast some doubt on the usual finding that the quality of institutions is positively correlated with productivity, because the observed relationship may also be driven by unreported output. The next section investigates that possibility.

4. Do institutions affect output?

Our explanatory variables of main interest are the World Bank's five governance measures (Kaufman et al. 2006) for the year 2000. The control of corruption index is an aggregate measure of the extent of corruption (defined as the exercise of public power for private gain). Voice and accountability refers to the extent to which a country's citizens can participate in selecting their governments, as well as to freedom of expression, association and the media. Political stability captures a population's perception of its government's stability. It is the perceived likelihood that the government could be overthrown by violent or unconstitutional means. Government effectiveness reflects the credibility of a government. It focuses on inputs that governments need to produce and implement sound policies and deliver public goods. Regulatory quality measures the government's ability to formulate and implement sound policies and regulations enabling private sector development. Rule of Law, finally, measures whether and to what extent institutions protect property rights and reliably enforced laws and regulations govern economic and social interactions. The indices are mainly based on perceptions recorded in a huge number of polls and surveys.

As a first step, we see whether we can replicate previous results on the impact of institutions on the underground economy with our sample. We chose a parsimonious model, including per capita GDP as only additional explanatory variable. As the individual measures of institutional quality are highly correlated (ranging between 0.70-0.95), we include them one at the time. Table 1 in the Appendix presents the results. As can be seen, GDP per capita reduces the share of the underground economy according to five of the six specifications, at the five percent level of significance at least. The results also confirm previous research, showing that institutions are negatively related to the shadow economy. At the one percent level of significance, the absence of corruption reduces the shadow economy. The same is true for greater political stability, higher government effectiveness, better regulatory quality, and better rule of law. Voice and accountability, to the contrary, does not significantly affect the share of the shadow economy.

Our results for 133 countries are in line with the models of Johnson et al. (1997) and Hindriks et al. (1999) and the results reported in Johnson et al. (1997, 1998) showing that

corruption affects the shadow economy positively in a cross section of 15 and, respectively, 39 countries. We proceed by examining the impact of institutions on official and unofficial output per worker.

Table 5 shows the results. Again, we opted for a parsimonious specification, including only institutional variables as explanatory variables. While column 1 refers to official GDP, column 2 employs corrected output figures, i.e. overall output including the shadow economy. Given the negative impact of institutional quality on the shadow economy reported in the Appendix, we would expect the impact of institutional quality on output to be smaller or vanish completely once the underground economy is included. As can be seen, this is indeed what happens. In all regressions is the impact of good institutions on total output smaller as compared to their impact on official output. However, most importantly, the results also show that institutional quality still increases output when the shadow economy is taken into account – the positive impact on official GDP apparently dominates the negative impact on the size of the shadow economy. According to the coefficients, an increase in the control of corruption index by one point, for example, increases official output by 0.1 points increases official output by 8.4 percent, while increasing total output by 7.7 percent only. With the control of corruption index varying from -1.56-2.49 among the countries included in our sample, this is a substantial impact. The standardized regression (beta) coefficients are 0.76 and, respectively, 0.73. This general picture holds for the other measures of institutional quality employed here also. All of them are significant at the one percent level, with coefficients of similar size.

As one potential problem with the analysis, institutions might well depend on GDP and could as such be endogenous. To control for potential endogeneity bias, we instrument corruption employing the variables suggested in Hall and Jones (1999) as instruments for institutional quality. Their instruments measure the extent of Western influence in the sixteenth through nineteenth century, being exogenous to GDP, but being highly correlated with institutions. According to Hall and Jones, European influence is unlikely to have been stronger in regions more likely to have higher GDP today. This is, first, because Europeans were conquering above all resource rich regions, which are not among the countries with high output per worker today. Second, European influence concentrated on sparsely settled regions. As these were frequently regions with low productivity, there should again be no tendency for these regions to be among those with high output per worker today.

Still, past European influence is likely to be highly correlated with institutions. As Hall and Jones point out, countries most strongly influenced by Western Europe are among

those most likely to adopt favorable infrastructure. We employ the percentage of a country's population speaking one of the five primary Western European languages as their mother tongue. In addition, we use the absolute value of a country's latitude in degrees, measuring the distance from the equator.⁶

Columns 3 and 4 of Table 5 report the results of our instrumental variables approach. As shown in the table, the overidentifying restrictions are not rejected at conventional levels of significance. The instruments are jointly significant at the one percent level in all first-stage regressions. In fact, the F-test-statistic easily exceeds the rule-of-thumb threshold of 10 proposed by Staiger and Stock (1997), indicating some power of the instruments.

As can be seen, the impact of institutional quality on output remains significant at the one percent level in all specifications, with a positive coefficient. The coefficients show, for example, that an increase in the control of corruption index by 0.01 increases official output by 12.8 percent, and total output by 12.1 percent. Again, the impact of corruption is thus smaller when focusing on total output as compared to official output; and the same is true for the other five measures of institutional quality.

Table 6 replicates the analysis focusing on total factor productivity. When instrumenting institutional quality with latitude and the percentage of major European languages spoken the Sargan test does reject the overidentifying restrictions in some specifications, casting doubts on the exogeneity of the instruments. The analysis presented in the table therefore employs the share of native English speakers instead of focusing on five languages (as suggested by Hall and Jones 1999). While the results for institutional quality are not affected by the choice of instruments, the Sargan test now accepts the overidentifying restrictions at conventional levels of significance.

According to the results, institutional quality significantly increases total factor productivity when official output is concerned. All six measures of institutional quality increase factor productivity at the one percent level of significance. However, turning to total output, this result no longer holds. According to the instrumental variables estimates, no single measure of institutional quality significantly affects productivity once controlled for the size of the shadow economy. This result has important implications for empirical research on the impact of institutional quality on productivity. While good institutions increase official output, at the same time, they decrease the size of the underground economy. As a

⁶ Hall and Jones provide two plausible reasons for this: First, Western European settlers were more likely to migrate to sparsely populated areas in the fifteenth century. Second, they were more likely to settle in regions with climate similar to Western Europe, which is true for regions far from the equator.

consequence, total factor productivity does not seem to be affected by the quality of institutions.

Table 7 decomposes the effect of institutional quality on the components of total output. The results are fairly consistent among our six measures of institutions. They imply that the by far biggest share of the impact of institutional quality on output is via capital stock per worker.

5. Summary

We investigated whether institutional quality affects output, once controlled for the size of the shadow economy. While the previous literature has shown that high quality institutions increase output, they have been shown to decrease the size of the underground sector at the same time. The overall impact of institutions on total output is thus a priori ambiguous. The paper corrects official output for the size of the shadow economy and compares the distribution of per capita incomes using both raw and corrected figures. We present a development accounting exercise and decompose differences in incomes to differences in factor endowments and total factor productivity. The decomposition is used to determine the channels through which institutions affect income per capita. Our results confirm the positive impact of institutional quality on official output and total factor productivity, and a negative one on the size of the underground economy. Overall, there is no significant impact of institutions on total (“corrected”) factor productivity.

Table 5: Institutions and output, year 2000

	(1)	(2)	(3)	(4)
Method	OLS	OLS	2SLS	2SLS
Observations	133	133	124	124
Dependent variable	Official output	Total output	Official output	Total output
Control of corruption	0.84 (17.28)***	0.77 (16.21)***	1.28 (9.74)***	1.21 (9.33)***
R-squared	0.57	0.54	0.40	0.35
First-stage F-test			32.32	32.32
Sargan test (P-value)			0.37	0.30
Voice and accountability	0.77 (10.46)***	0.73 (10.39)***	1.28 (10.81)***	1.21 (10.82)***
R-squared	0.38	0.38	0.21	0.21
First-stage F-test			52.48	52.48
Sargan test (P-value)			0.24	0.30
Political stability	0.79 (10.86)***	0.73 (10.42)***	1.38 (9.96)***	1.30 (9.72)***
R-squared	0.44	0.41	0.18	0.14
First-stage F-test			36.05	36.05
Sargan test (P-value)			0.55	0.47
Government effectiveness	0.90 (18.00)***	0.82 (16.69)***	1.34 (10.44)***	1.26 (9.97)***
R-squared	0.59	0.55	0.44	0.40
First-stage F-test			34.99	34.99
Sargan test (P-value)			0.57	0.47
Regulatory Quality	0.82 (7.76)***	0.76 (7.40)***	1.67 (9.47)***	1.59 (9.27)***
R-squared	0.40	0.38	0.12	0.09
First-stage F-test			25.79	25.79
Sargan test (P-value)			0.01	0.02
Rule of Law	0.93 (19.53)***	0.86 (17.93)***	1.31 (11.20)***	1.23 (10.66)***
R-squared	0.64	0.60	0.54	0.50
First-stage F-test			36.52	36.52
Sargan test (P-value)			0.14	0.11

Robust t statistics in parentheses.

Constant term included.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Institutions and Total Factor Productivity, 76 countries, year 2000

	(1)	(2)	(3)	(4)
Method	OLS	OLS	2SLS	2SLS
Dependent variable	Official TFP	Total TFP	Official TFP	Total TFP
Control of corruption	0.23 (3.95)***	0.08 (0.99)	0.25 (2.71)***	0.04 (0.29)
R-squared	0.14	0.01	0.14	0.01
First-stage F-test			38.45	38.45
Sargan test (P-value)			0.78	0.87
Voice and accountability	0.22 (2.52)**	0.12 (1.01)	0.37 (2.69)***	0.06 (0.31)
R-squared	0.08	0.01	0.04	0.01
First-stage F-test			22.31	22.31
Sargan test (P-value)			0.99	0.89
Political stability	0.20 (2.65)***	0.06 (0.55)	0.33 (2.64)**	0.05 -0.29
R-squared	0.08	0.00	0.05	0.00
First-stage F-test			24.79	24.79
Sargan test (P-value)			0.71	0.86
Government effectiveness	0.32 (5.17)***	0.17 (1.95)*	0.28 (3.01)***	0.04 (0.30)
R-squared	0.22	0.04	0.22	0.02
First-stage F-test			35.47	35.47
Sargan test (P-value)			0.77	0.87
Regulatory Quality	0.36 (4.64)***	0.26 (2.37)**	0.50 (2.97)***	0.08 (0.33)
R-squared	0.17	0.05	0.15	0.03
First-stage F-test			13.29	13.29
Sargan test (P-value)			0.75	0.92
Rule of Law	0.25 (3.91)***	0.07 (0.83)	0.26 (2.77)***	0.04 (0.29)
R-squared	0.15	0.01	0.15	0.01
First-stage F-test			47.61	47.61
Sargan test (P-value)			0.76	0.87

Robust t statistics in parentheses.

Constant term included.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Decomposing the impact of institutions on output, 2SLS, 76 countries, year 2000

Dependent variable	(1) log y	(2) α log k	(3) (1- α) log h	(4) log tfp	(5) log (1+shadow)
Control of corruption	0.96 (8.88)***	0.81 (8.21)***	0.10 (7.93)***	0.13 (3.28)***	-0.08 (8.68)***
R-squared	0.53	0.50	0.48	0.15	0.46
First-stage F-test	34.71	34.71	34.71	34.71	34.71
Sargan test (P-value)	0.02	0.14	0.26	0.07	0.10
Voice and accountability	1.23 (8.62)***	1.01 (7.83)***	0.12 (7.02)***	0.19 (3.58)***	-0.09 (5.67)***
R-squared	0.31	0.30	0.33	0.03	0.05
First-stage F-test	34.26	34.26	34.26	34.26	34.26
Sargan test (P-value)	0.20	0.06	0.07	0.73	0.00
Political stability	1.20 (8.34)***	1.00 (7.94)***	0.12 (6.75)***	0.18 (3.34)***	-0.10 (6.83)***
R-squared	0.21	0.23	0.20	0.02	0.21
First-stage F-test	28.48	28.48	28.48	28.48	28.48
Sargan test (P-value)	0.58	0.95	0.87	0.25	0.02
Government effectiveness	1.08 (9.77)***	0.91 (8.05)***	0.11 (7.78)***	0.15 (3.76)***	-0.09 (9.16)***
R-squared	0.61	0.53	0.49	0.25	0.47
First-stage F-test	33.02	33.02	33.02	33.02	33.02
Sargan test (P-value)	0.03	0.22	0.36	0.07	0.06
Regulatory Quality	1.68 (8.04)***	1.36 (7.14)***	0.16 (6.81)***	0.27 (3.80)***	-0.11 (6.39)***
R-squared	0.22	0.16	0.27	0.11	0.09
First-stage F-test	18.00	18.00	18.00	18.00	18.00
Sargan test (P-value)	0.11	0.04	0.04	0.87	0.00
Rule of Law	0.99 (11.17)***	0.83 (9.85)***	0.10 (9.54)***	0.14 (3.32)***	-0.09 (9.59)***
R-squared	0.64	0.63	0.60	0.16	0.54
First-stage F-test	42.16	42.16	42.16	42.16	42.16
Sargan test (P-value)	0.00	0.06	0.14	0.06	0.11

Robust t statistics in parentheses.

Constant term included.

* significant at 10%; ** significant at 5%; *** significant at 1%

References

- Abu-Qarn A.S. and S. Abu-Bader “A versus K revisited: evidence from selected MENA countries”, forthcoming in *World Development*.
- Acemoglu, D., S. Johnson, and J.A. Robinson “The Colonial Origins of Comparative Development: An Empirical Investigation”, *American Economic Review*, vol 91 n°5, p.1369-1401, 2001.
- Caselli, F., 2005, “Accounting for cross-country income differences”, in: P. Aghion and S. Durlauf, eds., *Handbook of economic growth*, Elsevier, 679-742.
- Cavalcanti Ferreira, P., J.V. Issler, and S. de Abreu Pessôa “Testing production functions used in empirical growth studies”, *Economics Letters*, vol. 83, p.29-35, 2004.
- Dreher, A. and F. Schneider, 2006, *Corruption and the Shadow Economy: An Empirical Analysis*, KOF Working Paper 123, ETH Zurich.
- Hall R. and C.I. Jones “Why do some countries produce so much more output per worker than others?”, *Quarterly Journal of Economics*, vol 114 n°1, p.83-116, 1999.
- Hindriks, J.; A. Muthoo and M. Keen, 1999, Corruption, extortion and evasion, *Journal of Public Economics* 74: 395-430.
- Hirschman, A.O. *Exit, voice and loyalty*, Cambridge, Harvard University Press, 1970.
- Johnson, S.; D. Kaufmann and A. Shleifer, 1997, The unofficial economy in transition, *Brookings Papers on Economic Activity* 2: 159-221.
- Johnson, S., D. Kaufmann, and P. Zoido-Lobaton “Regulatory discretion and the unofficial economy”, *American Economic Review*, vol 88 n°2, p.387-392, 1998a.
- Johnson, S., D. Kaufmann, and P. Zoido-Lobaton “Public Finances and the unofficial economy”, World Bank discussion paper, 1998b.
- Kaufmann, D., A. Kraay, and M. Mastruzzi “Governance matters V: governance indicators for 1996-2005”, World Bank, September 2006.
- Knack P. and S. Keefer “Institutions and economic performance: cross-country tests using alternative institutional measures”, *Economics and Politics*, vol 7, p.207-227, 1995.
- Kneller, R., and P.A. Stevens, 2003, The specification of the aggregate production function in the presence of inefficiency, *Economics Letters*, vol. 81, p.223-226.
- Mauro P. “Corruption and Growth”, *Quarterly Journal of Economics*, vol. 110 n°3, p.681-712, 1995.
- Schneider F. and D.H. Enste “Shadow economies: size, causes, and consequences”, *Journal of Economic Literature*, vol. 38 n°1, p.77-114, 2000.

Appendix A: Regression results

Table A-1: Institutions and shadow economy, 133 countries, year 2000

	(1)	(2)	(3)	(4)	(5)	(6)
Official output p.c. (log)	-0.08 (2.92)***	-0.24 (8.32)***	-0.16 (6.03)***	-0.07 (2.36)**	-0.19 (7.15)***	-0.03 (1.00)
Control of corruption	-0.25 (7.36)***					
Voice and accountability		-0.03 (0.60)				
Political stability			-0.17 (4.31)***			
Government effectiveness				-0.27 (7.10)***		
Regulatory Quality					-0.13 (3.10)***	
Rule of Law						-0.32 (7.86)***
R-squared	0.55	0.41	0.48	0.55	0.44	0.58

Robust t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

