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Institutions, policies and economic development. What are the causes of the shadow economy?*

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Abstract

What are the causes of the shadow economy? We provide new answers to this old question. The sharp distinction between theoretical priors on the institutional determinants of the shadow economy and the technique used for its measurement is the first novel contribution of the paper. The second innovation is that, unlike previous contributions, we document a specific role for institutional variables in shaping economic incentives to "go underground", irrespective of the stage of economic development. The third innovation is that - after controlling for institutional quality and for the level of development - public expenditures have a negative impact on the shadow economy.

Keywords: Institutional quality, shadow economy.

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1 Introduction

The existence of a shadow economy has attracted considerable attention by economists and policymakers. This is hardly surprising. On the one hand, the unobserved component of national economies accounts for a large share of GDP in poor countries (La Porta and Shleifer, 2008) and remains important at least in some developed economies like Belgium, Greece, Italy, Portugal and Spain (Dell'Anno, 2003; Alañón-Pardo and Gómez-Antonio, 2005; Dell'Anno, Gómez-Antonio and Alañón-Pardo, 2007). On the other hand, the existence of a relatively large informal sector may have important economic consequences. For instance, the productive potential of unofficial firms is typically constrained by limited access to public goods (De Soto, 1989, 2000), but tax evasion also limits governments ability to supply such public goods and may give unofficial firms a substantial cost advantage (Farrell, 2004; Farrell, Baily and Remes, 2005).

Three different views have been put forward to interpret this phenomenon. The first one emphasizes the role of institutional quality in shaping incentives to enter the official sector of the economy and is supported by several empirical studies (Friedman, Johnson, Kaufmann, and Zoido-Lobaton, 2000; Loayza and Rigolini, 2006; Torgler and Schneider, 2007; Chong and Gradstein, 2007; Dabla-Norris, Gradstein and Inchauste, 2008). The second one gives importance to the inherent inefficiency of unofficial firms (Amaral and Quintin, 2006; De Paula and Scheinkman, 2008) and looks at the formal and informal sectors as two parallel economies, where the inefficient informal sector is bound to recede when growth-enhancing policies raise the skills of the labour force and the quality of the public goods accessible to official firms. In this framework, cross country differentials in the relative size of the shadow economy are strictly related to different stages of economic development. Institutional quality therefore matters insofar as it is a pre-requisite for growth of the official economy, but does not play a specific role in determining the size of the shadow economy. The third one (Dessy and Pallage, 2001) sees government size and the relative dimension of the shadow economy as jointly endogenous outcomes, suggesting that a "big push" policy strategy may force the economy to settle in favourable equilibria, where the supply of public infrastructure and - more generally - of public goods is relatively large whereas the size of the shadow economy is relatively small.

This paper investigates the distinct roles played by institutions, growth of the official economy and government size in determining the unobserved economy. To this aim, we must first obtain measures of the shadow economy. Unlike previous contributions,

[1] we cannot rely on estimates based on the Multiple Indicators and Multiple Causes (MIMIC) approach. The MIMIC method is used for inferring the dimension of the unrecorded activity through a set of "causal variables" (taxation, regulatory burden, moral attitudes toward the state) and "likely indicators" (changes in the demand for currency, in the labour force participation rate and in official GDP). Since variables that identify institutional quality are typically related to the "causal variables", interpreting MIMIC estimates on the grounds of institutional factors would be tautological. We must therefore rely on shadow economy estimates which are independent from the theoretical priors that drive our subsequent analysis. For this reason, we apply a version of the Modified Total Electricity (MTE) approach (Eilat and Zinnes, 2002) to a large panel of countries. This method obtains shadow economy estimates from electricity consumption data which are filtered to remove the influence of additional factors such as variations in electricity prices and in the relative weight of energy-intensive industrial sectors.

The sharp distinction between theoretical priors on the institutional determinants of the shadow economy and the technique used for its measurement is the first novel contribution of the paper. The second innovation is that, by exploiting the time series dimension of our panel, we are able to better investigate the link between stage of economic development - proxied by the official level of per-capita income - and the relative size of shadow economy. The third innovative aspect is that we are able to test the theoretical contribution of Dessy and Pallage (2001) apparently neglected in previous empirical contributions.

In a nutshell, our results suggest that all the interpretations of the shadow economy discussed above contain a grain of truth. We do find that the stage of development has a negative effect on the size of the shadow economy. But we also find an additional negative impact for indicators of institutional quality (such as measures of rule of law, government stability, democratic accountability and regulation of labour). In contrast with La Porta and Shleifer (2008), these results suggest that the shadow economy should not be dismissed as the unpleasant side effect of economic underdevelopment. Instead this phenomenon seems to be related to some specific institutional aspects that may well survive even when the economy reaches higher development stages. This may explain why even some developed economies are characterized by a relatively large share of unrecorded income. Finally, we find that - after controlling for institutional quality and for the level of

[1] Loayza (1996), Giles (1999a, 1999b, 1999c), Chatterjee, Chaudhury and Schneider (2003), Giles, Tedds and Werkneh (2002), Tedds and Giles (2002), Dell'Anno (2003), Bajada and Schneider (2005), Schneider (2004, 2005, 2008), Alañón and Gómez-Antonio (2005), Buehn, Karmann and Schneider (2007), Dell'Anno, Gómez-Antonio and Alañón-Pardo (2007), Brambila-Macias (2008).

development - public expenditure still has a negative impact on the shadow economy. It is intriguing to relate this latter result to a long-standing controversy about the distinct roles of "institutions" and "macroeconomic policies" in determining economic outcomes. Our findings support the view that macroeconomic policies should not be seen as a mechanical consequence of a country's institutional setting (Glaeser et al., 2004) in contrast with Acemoglu et al. (2003) who claim that macroeconomic policies play a minor role in shaping economic outcomes once institutional variables are taken into account.

The remainder of the paper is organized as follows. Section 2 describes the model. Section 3 defines the empirical methodology. Section 4 presents the results. Section 5 concludes.

2 The model

La Porta and Shleifer (2008) group the determinants of the unofficial economy into three broad categories. *Costs of becoming formal.* These may be defined as "entry costs" in the official market. They are typically associated with the resources devoted to fulfilling the procedures required to legally start a business. *Costs of staying formal.* They include tax payments and government regulations. Among government regulations, those related to workers' welfare are considered the most restrictive and costly for firms (Loayza, 1996).[2] As described in Botero et al. (2004), regulation of labour markets may take several forms. First, governments forbid discrimination in the labour market and endow the workers with some basic rights (maternity leaves, minimum wage, etc.). Second, governments regulate employment relationships and may affect hiring and firing costs. Third, governments may legally empower labour unions to represent workers collectively. In addition, corruption is widely believed to raise the cost of staying formal, thereby inducing entrepreneurs to flee to the underground economy (Friedman et al. 2000). *Benefits of being formal.* These are typically related to expanded access to public goods. Dessy and Pallage (2001) argue that the provision of a productive public infrastructure creates a productivity premium from formalization and, symmetrically, an opportunity cost of informality. Thus a relatively large government sector may be associated to a smaller size of the shadow economy. In addition, the inability to sign enforceable contracts creates uncertainty and increases the transaction and monitoring costs in all business dealings conducted in the unobserved sector (De Soto, 1989; Loayza, 1996).

[2]Nipon (1991) estimated that informal firms in Thailand, by ignoring labour-protection laws, saved about 13 to 22 percent of labour wages. Tokman (1992) reported that labour regulations increased costs for small firms in Latin America by an average of around 20 percent.

Such costs and benefits may be proxied by institutional factors and policy variables. We therefore estimate the following model:

$$SH_{i,t} = \beta_0 + \sum_{j=1}^{h} \beta_j IQ_{j,i,t} + \beta_{h+1} y_{i,t} + \beta_{h+2} G_{i,t} + \varepsilon_{i,t} \quad (1)$$

where i,t respectively denote country and time indexes[3], SH defines the size of the shadow economy as a percentage of the official GDP, y is the log of per-capita GDP, G is the ratio of public expenditure to official GDP and IQ_j is one of h indicators of institutional quality, to be defined below.[4] As pointed out in the introduction, equation (1) includes y as a proxy for the stage of economic development, to control whether institutions and policies play a specific role in determining the size of the shadow economy.

2.1 Variables definition

Estimates for SH are obtained as in Onnis and Tirelli (2010), who apply a version of the MTE approach proposed by Eilat and Zinnes (2002). This involves a two-stages procedure. In the first stage, the series of electricity consumption growth is filtered to remove the influence of changes in the weight of the industry sector and in the relative price of electricity. In the second stage, the growth rate of the shadow economy is obtained by subtracting the growth rate of the official economy from the filtered series of electricity consumption growth - where the latter proxies the growth rate of the overall economy.[5]

2.2 Institutional variables

Some of the institutional variables most commonly used in the literature (Torgler and Schneider, 2007; Chong and Gradstein, 2007) may be seen as proxies for the costs and benefits associated to formality. The variable *rule of law* is the sum of two components. The *law* component assesses the impartiality of the legal system, and the *order* component assesses common observance of the law. We take this index as an index of the benefits of formalization. The variable *democratic accountability* captures how responsive the

[3] We analyse 48 economies over the period 1981-2005. See the Appendix for details.

[4] Data on y are taken from United Nations, constant (1990) prices, US Dollars. Data on G, are taken from Penn World Tables.

[5] Our analysis is based on the assumption that changes in the domestic real price of electricity capture the effects of energy supply shocks and of long term efficiency gains caused by technical change, whereas changes in the industry share of GDP affect the component of electricity consumption which is directly related to the country-specific evolution in the composition of domestic output. See the Appendix for a detailed presentation of the methodology.

government is to the electorate. The intuition is that accountability reduces policymakers' rent seeking activities, thus lowering the costs of being formal. The variable *government stability* rates government's ability to stay in office and carry out its declared program. The variable is the sum of three subcomponents: *government unity*, *legislative strength* and *popular support*. We posit that *government stability* is an inverse proxy for political uncertainty, where the latter lowers the benefits from staying in the formal economy. As a proxy for the regulation of labour, we use an index of workers' rights protection. Finally, the variable *corruption* measures corruption within the political system. Alternatively, the *corruption perception index* (*cpi*) measures the degree to which corruption is perceived to exist among public officials and politicians. The *cpi* is based on 13 different expert and business surveys.[6]

To test the robustness of our results, we consider four alternative measures of institutional quality. The *democracy indicator* is derived from coding of the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. The subcomponent *executive constraints* refers to institutionalized constraints on the decision-making powers of chief executives, whether individuals or collectivities. In addition, the variable *civil liberties* measures the freedoms of expression and belief, associational and organizational rights, rule of law, and personal autonomy without interference from the state. The indicator *political rights* refers to the freedom of participation in the political process, including the right to vote freely for distinct alternatives in legitimate elections, compete for public office, join political parties and organizations, and elect politicians who are accountable to the electorate.[7]

Only for the post-1995 subsample, the Heritage Foundation publishes an *index of economic freedom*, defined as the simple average of 7 variables - *business freedom*, *fiscal freedom*, *trade freedom*, *monetary freedom*, *financial freedom*, *investment freedom* and *property rights*.[8] *Business freedom* is a quantitative measure of the ability to start, operate

[6] The variables *rule of law*, *democratic accountability*, *government stability* and *corruption* are taken from the International

Country Risk Guide (ICRG). The variables *rule of law* and *democratic accountability* range between 0 and 6 with increasing quality; *government stability* ranges between 0 and 12 with increasing quality; *corruption* ranges between 0 and 6 (very high level of corruption).

The *corruption perception index* (*cpi*) - based on 13 different expert and business surveys- is published by Transparency International and ranges between 1 and 10 (very high corruption).

The index of workers' rights protection is taken from Human Rights Dataset. Worker's rights may be: (0) severely restricted, (1) somewhat restricted, (2) fully protected.

[7] The *democracy indicator* is taken from Polity IV and ranges between 0 and 10 (very high democracy). Its subcomponent *executive constraints* ranges between 1 and 7. The variables *civil liberties* and *political rights* (source: Freedom House) range between 1 (least free) and 7 (most free).

[8] The *index of economic freedom* and its subcomponents range between 0 and 10 (very high freedom).

and close a business that represents the overall burden of regulation as well as the efficiency of government in the regulatory process. *Fiscal freedom* is a measure of the tax burden imposed by governments.[9] *Trade freedom* is a measure of the absence of tariff and non-tariff barriers that affect imports and exports of good and services. *Monetary freedom* combines a measure of price stability with an assessment of price controls.[10] *Financial freedom* is a measure of banking security as well as a measure of independence from government control. In fact, state ownership of banks and other financial institutions generally lowers the level of available services. *Investment freedom* measures freedom to allocate resources into and out of specific activities, both internally and across the country's borders. Finally, the *property rights* component is an index of the capability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state. We shall include these variables in our analysis for the post-1995 subsample.

3 Methodology

We employ the System GMM technique (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998) that is considered particularly appropriate for our panel data.[11] This estimator has been, in fact, designed for situations with "small T, large N" panels, independent variables that are not strictly exogenous, fixed effects, heteroskedasticity and autocorrelation within countries.

The consistency of the System GMM estimator depends on whether lagged values of the explanatory variables are valid instruments in the regression. We address this issue by considering three specification tests: the Arellano-Bond test, the Hansen J test and the difference-in-Hansen test. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation and is applied to the differenced residuals. The first-order serial correlation test usually rejects the null hypothesis. Second-order serial correlation of the differenced residuals indicates that the original error terms are serially correlated and follow a moving average process at least of order one. If the $AR(2)$ test fails to reject the null, the original error terms are, therefore, serially uncorrelated. The Arellano-Bond test is run on differenced residuals even after estimation in deviations.[12] The Hansen

[9] *Fiscal freedom* includes both the direct tax burden in terms of the top tax rates on individual and corporate incomes and the overall amount of tax revenues as a percentage of GDP.

[10] Price controls distort official markets activity.

[11] Given the presence of gaps in our panel data, we use orthogonal deviations (Arellano and Bover, 1995).

[12] The autocorrelation test assumes no correlation across individuals in the idiosyncratic disturbances. According to Roodman (2006), time dummies make this assumption more likely to hold.

J test (robust to heteroskedasticity and autocorellation) tests the overall validity of the instruments, i.e. it tests of whether the instruments, as a group, appear exogenous. Failure to reject the null hypothesis gives support to the model. Finally, the difference-in-Hansen methodology tests the exogeneity of each subgroup of instruments. We split each instrument subgroup in two for difference-in-Hansen purposes, one each for the transformed and level equations. This is especially useful for testing the instruments for the levels equation based on lagged differences of the dependent variable, which are the most suspect in System GMM.

As reported in the literature on GMM methodology, a large collection of instruments, even if valid in specification tests, can be collectively invalid in finite samples because they overfit endogenous variables.[13] Moreover, a large number of instruments also weaken the Hansen test for overidentifying restrictions. According to Roodman (2006, 2008), we combine two approaches to instrument containment. The first one is to use only certain lags instead of all available lags for instruments.[14] The second one is to adopt the "collapse" suboption which creates one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance.[15]

4 Results

To facilitate discussion we present our estimates in stages. [16] The first striking result is that, even if we observe a negative and statistically significant effect of official per-capita GDP, measures of institutional quality retain a significant impact on SH: variables *rule of law*, *democratic accountability* and *government stability* have the expected negative signs (Table 1). We also find evidence of a positive and statistically significant relationship between *protection of workers' rights* and our estimates of unrecorded income (Table

[13] Tauchen (1986) demonstrates in simulations of very small samples (50-75 observations) that the bias of GMM rises as more instruments, based on deeper lags of variables, are introduced. Similar results are obtained in Ziliak (1997). In Monte Carlo tests of Difference GMM, Windmeijer (2005) reports that, on 8×100 panels, reducing the instruments from 28 to 13 reduces the average bias in the two-step estimate of the parameter of interest by 40%.

[14] For each variable, the choice of the lags as instruments has been based on the results of the difference-in-Hansen tests.

[15] Following Roodman (2006), to avoid weakening the Hansen test, in the present analysis the instruments count never exceed N.

[16] For all our system GMM regressions we report the results of the Arellano-Bond and Hansen tests. We always fail to reject the null hypotheses of no (second-order) autocorrelation and exogeneity of the entire group of instruments. The results of the single difference-in-Hansen tests are not reported in the tables. For both the transformed and the level equation, we always fail to reject the null hypothesis of exogeneity for each subgroup of instruments. Results available upon request.

2). In addition, in line with the theoretical results in Dessy and Pallage (2001), public expenditures have a negative impact on the shadow economy. To check whether our results are distorted by plausible correlations among the variables *rule of law*, *democratic accountability* and *government stability*, we re-estimate equation (1) for the entire panel of countries by using the simple average of the three institutional indicators.[17] The relationship between this aggregate measure and the size of unobserved sector is still negative and statistically significant. We also apply a Principal Component Analysis to these three institutional variables and extract the first component (PCA).[18] Again, we observe a negative and statistically significant relationship between PCA and SH. As a robustness check we substitute *rule of law*, *democratic accountability* and *government stability* with *democracy indicator*, *executive constraints*, *civil liberties* and *political rights* (Tables 3 and 4). All expected results are confirmed.

In Table 5 we explore the impact of corruption on the size of unobserved economy. Adopting the two alternative measures of corruption, we find that the effect on the unobserved economy is always negative and statistically significant. [19] This is consistent with the theoretical predictions of Choi and Thum (2005, p. 829). In their model the entrepreneurs' option to operate in the shadow economy constrains a corrupt official's ability to extract rents and strengthens the productivity of the official sector. The existence of the unofficial sector therefore acts as a complement to the official economy. In their framework corruption depends on the policymaker's ability to monitor official firms activity. Therefore, when the monitoring technology improves participation in the shadow economy becomes relatively less attractive compared to participation in the official economy and corruption will increase. In addition, the average dimension of unofficial firms will shrink in order to escape monitoring. Both effects might therefore induce a fall in the share of the unobserved economy.

Finally, we focus on the post-1995 subsample. The first step is to re-estimate the regression in column 2 of Table 2 over the shorter sample. Variables *rule of law*, *govern-*

[17] These have been normalized to the same scale range.

[18] The Principal component analysis (PCA) involves a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called principal components. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.

[19] In a very small sample, Johnson et al. (1998), find a positive relationship between different measures of corruption and the shadow economy. Dreher and Schneider (2010), who apply the MIMIC method to obtain shadow economy estimates in a large sample of countries over the period 2000-2002, distinguish between high and low income countries. They cannot find a robust relationship between corruption and the size of the shadow economy when perceptions-based indices of corruption are used. An alternative corruption index estimated applying the MIMIC method is found to positively affect the shadow economy only in low income countries .

ment stability, protection of workers rights and *public expenditure* remain significant with the expected signs, whereas *democratic accountability* is no longer significant (Table 6). Then we add the *index of economic freedom* and, in separate regressions, its components as defined in Section 2 above. We present results for those regressions where these latter variables affect previous results. We find that the *index of economic freedom* is significant with the expected negative sign, but *rule of law* no longer matters. Similar results obtain when we replace the *index of economic freedom* with its components *business freedom* and *fiscal freedom*. By contrast, we couldn't find evidence of a specific role for other components of the index, such as *financial freedom* and *investment freedom*. This latter result suggests that restrictions to business activity and tax policies play a paramount role in determining the shadow economy.

5 Conclusions

Theoretical models suggest that the shadow economy is a constraint on economic efficiency. Our results show that triggering faster growth of the official economy is not a panacea for this, even though it has unambiguously beneficial effects. In fact, institutional design and even government size may determine additional cross-country differences in the relative size of the shadow economy. Thus, both institutional design and public expenditure policies should specifically target private sector's incentives to enter the official economy. This is a promising field for future research.

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Tables

Table 1- Shadow Economy (SH) and Quality of Institutions

Dependent Variable: SH	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rule of law	-0.016**	-0.02***					-0.097**	-0.01**
Government stability			-0.006***	-0.008**			-0.007***	-0.008**
Democratic accountability					-0.02***	-0.016**	-0.012*	-0.01*
Log_gdp	-0.155***	-0.06**	-0.118***	-0.087***	-0.14***	-0.09***	-0.075***	-0.07***
Observations	1030	1030	1030	1030	1026	1026	1026	1026
AR(2)	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8
Hansen	0.5	0.2	0.3	0.2	0.3	0.1	0.2	0.5
Time dummies	NO	YES	NO	YES	NO	YES	NO	YES

Regressions with constant terms and two step-robust standard errors (not reported).

Statistical significance at: 10% (*), 5% (**) or 1%(***).

Table 2- Shadow Economy (SH), Public Expenditure and Labour Regulation								
Dependent Variable: SH	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rule of law	-0.012**	-0.019**	-0.013*	-0.028**				
Government stability	-0.005**	-0.008*	-0.007***	-0.005**				
Democratic accountability	-0.015**	-0.005	-0.018*	-0.005				
Quality of institutions					-0.034***	-0.024**		
Quality of institutions (pca)							-0.03***	-0.034**
Protection workers' rights	0.012**	0.009**	0.017**	0.008*	0.022***	0.009*	0.015**	0.007*
Public expenditure			-0.9**	-0.69**	-1.08*	-1.03***	-0.73*	-0.82***
Log_gdp	-0.09***	-0.06**	-0.08***	-0.06***	-0.067**	-0.06***	-0.075***	-0.067***
Observations	978	978	959	959	959	959	959	959
AR(2)	0.9	0.7	0.9	0.8	0.9	0.9	0.9	0.9
Hansen	0.2	0.4	0.2	0.9	0.3	0.2	0.1	0.4
Time dummies	NO	YES	NO	YES	NO	YES	NO	YES
Regressions with constant terms and two step-robust standard errors (not reported).								
Statistical significance at: 10% (*), 5% (**) or 1%(***).								

Table 3- Robustness check I: changes in institutional measures								
Dependent Variable: SH	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Democracy indicator	-0.016**	-0.018**	-0.027**	-0.017**				
Executive Constraints					-0.019**	-0.02**	-0.041***	-0.027*
Protection workers' rights			0.013*	0.003			0.018**	0.007*
Public expenditure			-0.89*	-0.88***			-1.18*	-0.88**
Log_gdp	-0.13***	-0.06**	-0.08**	-0.07**	-0.16***	-0.06**	-0.097**	-0.06**
Observations	1161	1161	1090	1090	1161	1161	1090	1090
AR(2)	0.6	0.6	0.8	0.8	0.5	0.6	0.4	0.6
Hansen	0.4	0.5	0.5	0.4	0.18	0.3	0.3	0.4
Time dummies	NO	YES	NO	YES	NO	YES	NO	YES
Regressions with constant terms and two step-robust standard errors (not reported).								
Statistical significance at: 10% (*), 5% (**) or 1%(***).								

Table 4- Robustness check II: changes in institutional measures								
Dependent Variable: SH	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Civil Liberties	-0.04**	-0.039**	-0.039**	-0.026**				
Political Rights					-0.035**	-0.038**	-0.043*	-0.029*
Protection workers' rights			0.019*	0.028			0.02*	0.012
Public expenditure			-0.67*	-0.94*			-0.81*	-0.92**
Log_gdp	-0.14***	-0.07**	-0.09***	-0.07***	-0.16***	-0.08**	-0.09**	-0.05*
Observations	1122	1122	1052	1052	1122	1122	1052	1052
AR(2)	0.5	0.4	0.6	0.7	0.8	0.5	0.8	0.6
Hansen	0.28	0.13	0.3	0.46	0.27	0.12	0.34	0.75
Time dummies	NO	YES	NO	YES	NO	YES	NO	YES
Regressions with constant terms and two step-robust standard errors (not reported).								
Statistical significance at: 10% (*), 5% (**) or 1%(***).								

Table 5- Shadow Economy (SH) and Corruption								
Dependent Variable: SH	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rule of law	-0.017***	-0.022**	-0.018***	-0.024**	-0.012**	-0.026*	-0.013**	-0.022**
Government stability	-0.004*	-0.021***	-0.007***	-0.009***	-0.005**	-0.016***	-0.009***	-0.018**
Democratic accountability	-0.012*	-0.015*	-0.013*	-0.015**	-0.017**	-0.015*	-0.012*	-0.02**
Corruption	-0.02***	-0.02*	-0.02***	-0.019**				
CPI					-0.03**	-0.024*	-0.018*	-0.026**
Log_gdp	-0.079***	-0.045*	-0.07***	-0.06***	-0.14***	-0.06**	-1.01***	-0.06**
Protection workers'rights			0.01**	0.006			0.017**	0.005
Public expenditure			-0.56*	-0.64**			-0.67*	-0.49*
Observations	1026	1026	959	959	704	704	644	644
AR(2)	0.9	0.15	0.9	0.9	0.5	0.06	0.6	0.105
Hansen	0.29	0.4	0.29	0.5	0.76	0.75	0.35	0.46
Time dummies	NO	YES	NO	YES	NO	YES	NO	YES
Regressions with constant terms and two step-robust standard errors (not reported).								
Statistical significance at: 10% (*), 5% (**) or 1%(***).								

Table 6- Shadow Economy (SH) and Economic Freedom					
Dependent Variable: SH	(1)	(2)	(3)	(4)	(5)
Rule of law	-0.014**	-0.002		-0.02*	-0.002
Governmentstability	-0.006*	-0.005**		-0.007**	-0.006**
Democraticaccountability	-0.003	-0.000		-0.008	-0.008
Protection workers'rights	0.02*	0.03***	0.023**	0.02**	0.02**
Publicexpenditure	-1.53**	-0.88**	-1**	-1.02***	-0.92**
Fiscalfreedom				-0.03***	-0.026***
Businessfreedom					-0.022**
Economic freedom		-0.06**	-0.057**		
Log_gdp	-0.09***	-0.06**	-0.074***	-0.09***	-0.077***
Observations	465	459	462	459	459
AR(2)	0.9	0.3	0.28	0.9	0.97
Hansen	0.6	0.46	0.54	0.55	0.5
Regressions with constant terms and two step-robust standard errors (not reported).					
Statistical significance at: 10% (*), 5% (**) or 1%(***).					

6 Appendix

Any attempt to exploit electricity consumption to estimate the shadow economy should address the issue of the empirical stability of the energy-consumption-to-GDP ratio. Critics emphasize the potential downward bias caused by energy-saving technological change. The argument is straightforward and quite intuitive, but it neglects a long-standing debate on the Jevons' Paradox: it cannot be taken for granted that energy-saving technological change will reduce the energy intensity of aggregate production (Jevons, 1865, 1965; Iorgulescu and Polimeni, 2007; Polimeni and Iorgulescu, 2007Grant, Hanley, McGregor, Swales and Turner, 2007). In fact, computable general equilibrium models support the view that energy consumption might "rebound" because energy demand is at best weakly correlated with a more efficient energy use. The reason why this might happen is easily explained. Following an improvement in energy efficiency, market forces drive some countervailing effects: (i) the fall in energy prices triggers a substitution effect towards more energy-intensive goods and production techniques; (ii) the income effect raises household consumption of all commodities, including energy consumption. In addition, the downward bias might be offset by other forms of technological change, such as labor-saving innovations, which increase the energy intensity of the production function. For instance, early econometric work has shown that in the US manufacturing sector technical change has been energy intensive (Jorgenson and Fraumeni, 1981; Hogan and Jorgenson, 1991). Finally, one should bear in mind that sectoral specialization might change as the economy develops, thereby affecting the energy intensity of production.

The first stage of our application of the MTE procedure is therefore based on the following equation:

$$\Delta Elec_{i,t} = \alpha_i + \beta_1 \Delta Eprice_{i,t} + \beta_2 \Delta IndGdp_{i,t} + \varepsilon_{i,t} \tag{2}$$

where subscripts t, i are time and country indexes, $\Delta Elec$, $\Delta Eprice$ and $\Delta IndGdp$ respectively describe annual percentage changes in electricity consumption, in the real price of electricity and in the industry share of GDP.

Once the relative-price and demand-composition effects have been identified, the residual changes in electricity consumption, $\Delta Elec^{res}$, may be used as a proxy for the growth rate in the overall (recorded and unrecorded) economic activity:

$$\Delta Elec^{res}_{i,t} = \Delta Elec_{i,t} - [\beta_1 \Delta Eprice_{i,t} + \beta_2 \Delta IndGdp_{i,t}] \tag{3}$$

Then, the growth rate of the unrecorded economy, ΔSH, was obtained as follows:

$$\Delta SH_{i,t} = \Delta Elec_{i,t}^{res} - \Delta Gdp_{i,t} \tag{4}$$

where ΔGdp denotes the official GDP growth rate. Finally, by applying ΔSH to pre-existing base-year estimates, we obtain our measures of the unrecorded economy as a share of official GDP.[20]

The panel composition depends on the availability of data about electricity consumption, electricity price and share of industry[21]. Data on electricity consumption, real price of electricity, share of industrial income and official GDP have been obtained from Energy Information Administration, International Energy Agency, World Bank and United Nations, respectively.

Since the time series dimension of the panel is relatively long, the econometric methodology is based on a preliminary stationarity and cointegration analysis of the relevant variables. Variables $\Delta Elec$, $\Delta Eprice$, $\Delta IndGdp$ exhibit non stationarity, tested using Im, Pesaran and Shin (2003), Pesaran (2003, 2007), Hadri (2000), Kwiatkowski, Phillips, Schmidt and Shin (1992), ADF and Phillips-Perron unit root tests. A cointegrating relationships between $\Delta Elec$, $\Delta Eprice$ and $\Delta IndGdp$ has been, therefore, detected using the residual-based procedure developed by Pedroni (1999, 2004).

Due to the presence of cointegrated time series, in our estimate of equation (2) we use the group-mean panel Fully Modified Ordinary Least Squares (FMOLS) method proposed by Pedroni (2000, 2001). The group-FMOLS estimates suggest that a positive and statistically significant relationship exists between the changes in electric consumption and those in the share of industry. On the contrary, a negative and statistically significant relationship exists between the changes in electric consumption and those in electricity price. [22]

[20] We have adopted the estimates of Johnson et al. (1997)- for the transition economies- and Lacko (1996, 1998)- for the OECD and Developing countries. The base-year estimate for Tanzania is from Bagachwa and Nasho (1995).

[21] Countries in the sample are Australia, Austria, Belgium, Botswana, Bulgaria, Brazil, Canada, Chile, Colombia, Costa Rica, Czech R., Denmark, Egypt, Finland, France, Germany, Greece, Guatemala, Hungary, Ireland, Israel, Italy, Japan, Korea, Malaysia, Morocco, Mexico, Netherlands, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Singapore, Slovak R., Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Tunisia, Thailand, United Kingdom, United States, and Venezuela.

[22] To use changes in country-specific electricity price as an explanatory variable for changes in electricity consumption may generate problems of endogeneity. Firstly, we have re-estimated equation (2) adopting an alternative more exogenous real price of energy for 26 OECD countries and a global index of energy price for the remaining 22 countries. Second, we have used the global price of energy for the entire panel. In both situations we have obtained the same result. There is a positive and statistically significant relationship between changes in electricity consumption and changes in industry share of GDP. There is a negative and statistically significant relationship between changes in electricity usage and changes in the price of energy.