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E-Government and the shadow economy: evidence from across the globe

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Abstract. The shadow economy can be defined as economic activities that escape detection in the official estimates of the Gross Domestic Product (GDP). A larger size of the informal sector poses a significant challenge for policymaking as it reduces the reliability of official estimators and increases the likelihood of adopting ineffective policies. Furthermore, the shadow economy may also influence the allocation of resources. The phenomenon is particularly bigger in the developing world. This paper aims to investigate a possible contribution of e-Government (eGov) to mitigate the problem of the shadow economy. We argue that eGov implementation will allow the government to reduce the administrative burden costs, reduce tax evasion and allow citizens to act as whistle-blowers, all of which may eventually lower the size of the shadow activities. Since the implementation of eGov corresponds to the stage of infrastructure development in the Information and Communications Technologies (ICTs), the diffusion of eGov also requires particular threshold points by which the impact can only be seen. We investigate the data of 147 countries during the period 2003-2013, where the data on estimated shadow economy (based on [1]) and eGov index (based on [2]) are both available. We found that increasing the eGov index significantly reduces the size of the shadow economy. Moreover, the marginal impact is greater in the developed and higher income countries. This sheds a light on the importance to achieve a sufficient level of critical mass in eGov infrastructure before countries are able to reap the benefits of the initiatives.

Keywords: e-Government, shadow economy, growth, developing countries, public administration

1 Introduction

The shadow economy (SE) -unrecorded and unreported economic activities- has been a long problem hampering economic progress in many countries [1]. Among others, [3] highlight its impact on tax revenue, [4] on regional public debts, and [5, 6] on the unemployment rate. On the financial sector, SE associates with a higher inflation rate

[7], higher interest rates, a greater probability of sovereign default [8] and an adverse effect on credit ratings [9]. At the industry level, [10] concluded that firms choosing to enter the SE tend to produce negative spillover effects denoted by lower productivity and the propensity to innovate.

The study by [11] found that the SE is negatively correlated with the wealth of nations. [12] corroborated this result with a finding that a 1%, increase in the SE lowers the growth rate of the "official" GDP by 0.6% in developing countries. [13] warned that once SE is established, it is hard to remove. The size of the SE is quite enormous especially in the developing regions. Table 1 shows the distribution between regions and the World Bank's income level.

Table 1. The size of shadow economy (% to GDP) between region and income, average 2003-2013 and the *standard deviation*

Regions	The World Bank income classifications			
	High income	Higher Middle income	Lower Middle income	Low income
East Asia & Pacific	17.63 (*7.22*)	38.25 (*13.19*)	31.11 (*14.87*)	
Europe & Central Asia	21.65 (*7.83*)	41.02 (*8.84*)	50.64 (*9.55*)	
Latin America & Caribbean	33.59 (*14.20*)	38.70 (*10.51*)	62.96 (*10.98*)	51.11 (*3.53*)
Middle East & North Africa	17.46 (6.22)	24.46 (7.91)	36.44 (5.20)	
North America	21.97 (*13.84*)			
South Asia		21.32 (*2.65*)	35.09 (*11.54*)	42.98 (*5.99*)
Sub-Saharan Africa		29.36 (11.20)	36.39 (11.56)	45.14 (*14.82*)

Table 1 shows that the average ratios of the SE on GDP ranges between 43 to 51% in low income countries, and that those in Latin America and the Caribbean are more prone to these activities than those in South Asia, and Sub-Saharan Africa. We also see an indication of spatial effect in Latin America and South Asia based on the values of the standard deviation. Thus, adding to its enormous size, the lower standard deviation indicates a contagion of the SE phenomenon across countries in these regions. In the Sub-Saharan Africa, on the opposite, there is a more clustered outcome due to the disparities of economic progress between countries. Furthermore, the range of the SE in the lower middle income countries is wider (between 30 to 63%) than the low-income group, again showing a higher incidence in Latin America and Caribbean than in any other regions. In the East Asia and Pacific, we see a greater deviation in the Pacific region. The proportion of the SE in the higher middle income countries is somewhat lower (between 20-40%) compared with previous two groups, where countries in (Eastern) Europe and Central Asia have the greatest proportion of SE. The performance of countries is relatively uniform when looking into its standard deviation especially in South Asia where the standard deviation is very low. Moving towards higher income countries the proportion is much smaller (between 17-34%), but the largest incidence is still found in Latin America and the Caribbean also with a greater variation between countries.

Three preliminary conclusions can be drawn from this table. First, that SE is relatively clustered in specific countries (in this case Latin American and Caribbean countries), second, the incidence is significantly larger in low income countries, and third, the phenomenon is contagious across countries in specific regions inferred from

the lower standard deviations like those in South Asia and Latin America and the Caribbean.

A study by [14] defined e-Government as the use of ICTs in the public sector involving several actors and encompassing various interaction patterns in a continuously changing environment. [15] emphasized a need to conduct more studies on the effects of eGov on economic and business activities and s such, our paper aims to contribute to this niche in the literature.

Conceptually, the link between the potential roles of eGov on economic sustainability, and specifically, the SE can be inferred from [13]. The study mentioned that the primary cause of a shadow activity is an attempt to avoid predatory and obstructive regulations. Thus, if institutional and regulatory problems are addressed, the government might expect a reduction of the shadow activities. The size of the administrative burden can be astounding. [16] estimated that the total administrative burden on businesses within the European Union was around 600 billion euros per year, ranging from 1.5% of GDP in the UK and Sweden to 6.8% of GDP in Hungary, Greece and the Baltic States. Thus, the eGov implementation aimed at reducing the administrative burden on businesses is believed to gauge better policies, better implementation, better compliance and ultimately, better government. Since 2007 Europe has targeted to reduce administrative by 25% in 2012 leading to an increase of 1.4% of EU GDP [17].

The purpose of the study is to investigate a possible role of digital government in reducing the SE through administrative burden reduction. This paper answers two research questions. First, does the implementation of eGov contribute to a reduction in the size of the SE? Second, is there a threshold point by which eGov development is more effective to reducing the size of the SE? The analysis is carried out at different levels of income and regions, to see the heterogeneity between groups of countries (mainly contrasting the phenomenon in the developed versus developing countries).

2 On the determinants of the shadow economy

Previous studies (e.g. [18]) defined the SE as activities operating outside the principal legal and social structures of the economic system. In the Eastern Europe, the SE primarily concerns with a market sector but operates outside the system of economic planning, and involves the private mobilization of means of production. Contrary, in the Western Europe, the SE is associated with the 'black economy' dealing with the tax evasion, fraudulent claims for unemployment benefit and all non-marketed productive activities not included in the national accounts.

There are several determinants affecting the size of the SE. In a phenomenon called as a hysteresis, [13] found a negative association but asymmetric between GDP and SE. To illustrate, a US$1 decrease of GDP is associated with a 31-cent increase in the size of the SE, whereas, a US$1 increase of GDP results in only a 25-cent decrease SE. The study also showed that firms in a more specialized economy have a lower incentive to enter the shadow activities.

Other main determinants concern with the taxation regime and institutional setting. The studies by [19], [20] and [21] found that the burden of taxation is among the main determinants in the EU countries and particularly in Spain ([22]). [23] pointed out that bureaucratic complexity also contributes to the SE. [24] stressed the role of institutional factors by which [4] exemplified with the degree of the corruption level. [25] backed this argument by analyzing 126 countries over 1996–2012, and found that corruption and the SE are related complementarily.

There are other factors worth addressing. [5] stressed the role of inequality, [26] on literacy rates and [27] on ICT usage (e.g. the Internet). Moreover, while most studies found negative sides of SE, [28, 29] found a positive relationship between formal economic activities and SE in Greece and Mexico, respectively.

3 The role of technology and e-Government

The eGov policy is a complex interaction, [30, 31] showed that implementing workable e-Government systems requires bringing together different perspectives of stakeholders during implementation. [32] found that transforming Business-to-Government information exchange might result in more efficiency and reduction of redundant controls. [33] summed that implementing eGov in the U.S. Government's General Services Administration (GSA) helps federal agencies to better serve the public by offering superior workplaces, expert solutions, and management policies.

Moreover, as the main vein in eGov implementation is ICT devices, we argue that the nature of network externality as it exhibits in ICT also applies in eGov. The value of ICT services depends on its network: if there are enough adopters, the good becomes valuable. The point of critical mass is mentioned in many ICT studies (e.g. [34, 35]). Details of the study by [35, 36] ascertained the need to achieve a critical mass in order to obtain increased economic growth. Based on these studies, we also assume that a critical mass is also required in the eGov implementation.

4 Methodology and Data

4.1 On collection of the data on the shadow economy

There are two possible avenues which can be employed to estimate SE: the direct and indirect approaches [37]. The direct approach is operationalized by assigning a well-designed surveys or samples based on voluntary replies, or tax auditing and other compliance methods. The main disadvantages of this method are the flaws inherent in all surveys hence the results depend greatly on the respondent's willingness to cooperate.

The second avenue is to use indirect approaches or indicator approach. Among these, six main strategies can be implemented. *First,* by measuring the discrepancy between national expenditure and income statistics, *second,* between the official and actual labor force, *third,* between the volume of transaction and GNP (see [38] for

detail), *fourth,* by assuming that the SE increases the demand for currency, *fifth,* by estimating the physical inputs (for instance electricity (see [50] for details), and *sixth* by using econometric modeling. The main weakness of indirect approaches concerns with the double accounting issue. Thus, comparing the direct and indirect approaches, [38] suggested that the later should be used as the upper-bound.

In this study, the data on the size of the SE was obtained from [1] which uses the multiple indicators multiple causes (MIMIC) approach to estimate the SE. The concept of the MIMIC model is to examine the relationships between a latent variable "sizes of SE" with a number of observable variables by using their information of covariance. The detail of MIMIC model is thoroughly explained in [37].

The estimated SE used in this study covers all market-based legal production of goods and services that are hidden from public authorities for one or combinations of the following reasons: to avoid payment of taxes, to avoid payment of social security contributions, to avoid certain legal labor market standards and to avoid complying with certain administrative procedures, such as completing statistical questionnaires [1].

4.2 On the e-Government index

Taking into account the analysis implemented by [39] we decided to use the UNDESA index [2] in this study. The study [39] compared the following three indices published internationally based on the reproducibility, coverage of observation, qualitative assessments, and national scope

- The index constructed by Accenture, which assesses, on a yearly basis, e-government efforts in 20+ countries since 2000;
- The Brown University's (Prof. West and his research team) index which is released annually since 2001;
- And [1], which assesses the e-government readiness among UN's members, since 2002.

The UNDESA eGov development index (EGDI) is reported based on a comprehensive survey of the online presence of all 193 United Nations Member States, which assesses national websites and how e-government policies and strategies are applied in general and in specific sectors for delivery of essential services. The EGDI is not designed to capture e-government development in an absolute sense; but to give a performance rating of national governments relative to one another. Although the basic model has remained consistent, the precise meaning of these values varies from time to time. Moreover, the index is a simple average of the normalized scores of the three most important dimensions of e-government, namely: (1) scope and quality of online services (Online Service Index, OSI), (2) development status of telecommunication infrastructure (Telecommunication Infrastructure Index, TII), and (3) inherent human capital (Human Capital Index, HCI).

4.3 Other data and econometric model

Our main variable of interest to explain the level of the SE is the eGov index. However, to avoid the omitted variable bias problem, other control variables commonly used in the literature are also considered. These include the GDP per capita at purchasing power parity in thousands of 2011 US dollars (*GDPpc*), the general government final consumption expenditure as a percentage of GDP (*Gov%GDP*), the degree of openness of the economy measured by the sum of exports and imports over GDP (*Openness*), and the inflation rate (*Inflation*). All variables were obtained from the World Bank dataset. These variables were also chosen because they exist for 145 of the 147 countries for which data on the SE and the EGDI is available.[1]

The estimated baseline model was the following:

$$SE_{it} = \propto + \beta EGDI_{it-1} + \gamma \sum_{j=1}^{n} Control_{jit-1} + \theta \sum_{k=1}^{6} Region_{kit} + e_{it}$$

Where *i* stands for country, *t* for year, *SE* for shadow economy, *EGDI* for the e-government development index, *Control* for a vector of control variables, *Region* for a vector of dummies for the World Bank's regions, and *e* for the error term. α and β represent coefficients, and γ and θ vectors of coefficients to be estimated. The EGDI and all control variables were lagged one year because it takes time for them to have an impact on the SE and to mitigate endogeneity problems.

Since the EGDI is only available for specific years (2003, 2004, 2005, 2008, and every two years thereafter), the index was not built to capture e-government development in an absolute sense but rather to assess the diffusion of e-government through a comparison of national governments relative to one another. Moreover, as the index's methodology changed over time [2], we decided to work with cross-sections of countries for each year that the index is available. The model was first estimated by OLS, using heterokedasticity-consistant error terms. Since the estimated SE never yields values below zero or above 100, the data is censored, which implies that performing a Tobit estimation is a more appropriate estimation method.

In addition, as a robustness test, and taking into account that the size of the informal sector is always between zero and one (or one hundred), the model was also estimated with the Fractional Probit model [40].

5 Results

The econometric results for the three methods mentioned above are presented in

[1] Several other variables, for which less data is available, were also used in preliminary analysis but results remained essentially the same. Among others, we used the share of taxes on GDP, the share of part-time/long-term employment on total employment, and the real interest rate from the World Bank dataset; a dummy for democracies from POLITY IV; the human capital index from the World Economic Forum; the economic freedom of the world index and the black-market exchange rates index from the Fraser Institute; and finally, the index of socio-economic conditions from the International Country Risk Guide.

Table 2. Columns 1 to 3 are for a cross-section of countries in 2013, and column 4 for 2004. These two years are, respectively, the most recent and first year for which we were able to run the cross-section. As can be seen from the table, results are very similar regardless of the estimation procedure used, or the year analyzed.[2] The estimated coefficient for the EGDI is negative and statistically significant in all specifications indicating that countries with a better performance in the EGDI tend to have a lower SE. As expected, countries with a higher GDP per capita have a smaller informal sector. This result is consistent with previous studies, even though [8] found a non linear relationship between the two variables. The dummies for the World Bank's regions reveal that the share of the SE in GDP is significantly larger in Latin American and Caribbean countries (Region 3). For OLS and fractional probit estimations, in 2013, there is evidence that it is lower in the Middle East & North Africa (Region 4) and South Asia (Region 6). Finally, the control variables *Gov*, *Open* and *Inflation* did not turn out as statistically significant in any regression. Given that results are similar across the three methods, and the nature of our dependent variable, results for subsequent estimations are reported only for the Tobit estimation.

Table 2. Results using different econometric methods and years

VARIABLES	OLS 2013	Tobit 2013	Frac. Probit 2013	Tobit 2004
EGDI	-0.263***	-0.263***	-0.21**	-0.237***
	(-2.967)	(-3.432)	(-2.35)	(-3.965)
GDPpc	-0.246***	-0.246***	-0.0035***	-0.175**
	(-3.073)	(-2.855)	(-3.67)	(-2.606)
Gov	0.170	0.170	0.18	0.072
	(0.680)	(0.636)	(0.76)	(0.348)
Open	-0.032	-0.032	-0.017	-0.089
	(-0.506)	(-0.514)	(-0.27)	(-1.246)
Inflation	-0.015	-0.015	-0.026	-0.084
	(-0.0882)	(-0.0807)	(-0.17)	(-0.582)
Region3	9.934***	9.934***	0.093***	7.747***
	(3.144)	(3.331)	(3.37)	(2.911)
Region4	-5.239**	-5.239	-0.051**	-3.819
	(-2.098)	(-1.482)	(-1.99)	(-1.198)
Region6	-8.231*	-8.231	-0.077*	-3.323
	(-1.832)	(-1.508)	(-1.82)	(-0.765)
Constant	50.02***	50.02***	-0.21**	43.84***
	(9.709)	(11.33)	(-2.35)	(11.75)
N. observations	145	145	145	145
R-squared	0.433			
Log-likelihood		-571.0	-90.2	-543.5

Notes: The estimation method used in each regression and the year is indicated in the title of the respective column. Marginal effects (in percentage points) are reported for the Fractional Probit method. Robust t-statistics in parentheses. ***p<0.001, **p<0.05, *p<0.1.

[2] Estimations were also performed for each year for which the EGDI is available. Results are available from the authors upon request.

In order to test which component of the EGDI is most influential on the size of the SE, we included each of them in the same regression. Results reported in column 1 of Table 3[3], suggest that only the telecommunication infrastructure index (TII) is a significant determinant of the SE.[4] The estimated coefficient is negatively signed and highly statistically significant. However, since the three components of the EGDI are strongly correlated, we decided to include each of them separately in the estimations. Results indicate that they are all statistically significant and negatively signed. Therefore, there is also evidence that progress in the Online Service Index (OSI) and Human Capital index (HC) reduce the size of the informal sector though TII shows the biggest magnitude among three sub- indices.

Table 3. EGDI and its components

VARIABLES	(1)	(2)	(3)	(4)
TII	-0.277***	-0.296***		
	(-2.715)	(-4.120)		
OSI	0.0402		-0.141**	
	(0.505)		(-2.218)	
HCI	-0.0705			-0.203***
	(-0.840)			(-3.054)
N. observations	145	145	145	145
Log-likelihood	-568.2	-568.6	-574.3	-572.2

Notes: Results for a cross-section of countries for the year 2013 using the Tobit estimation method. Estimations include the same controls as those of Table 3. Robust t-statistics in parentheses. ***p<0.001, **p<0.05, *p<0.1.

The following step of the analysis was to split the sample according to the World Bank's income groups and regions. Results are presented in Table 4. In order to economize space we only show the estimated coefficients for the EGDI, but all estimations include the same controls as those of equation 1, except for the regions' dummies. Table 4 reveals that EGDI seems to exert a bigger influence on the size of the SE in high income countries, suggesting that the ability of e-government to reduce the SE can only be expected after countries reach certain levels of economic and e-government development. The mean value of the EGDI in the high-income countries is 0.68, much higher than for the other income groups.

[3] To economize space, in Table 3 we only report the estimated coefficients associated with the e-indices but the estimated regressions included the same controls as those of Table 3 (equation 1).

[4] TII currently takes into account the number of: internet users, fixed-broad band subscriptions, wireless broadband subscriptions, fixed-telephone subscriptions and mobile-cellular subscriptions.

Table 4. Results by income class

VARIABLES	High income	Low income	Lower middle income	Upper middle income
EGDI	-0.306**	-0.325	0.357	0.240
	(-2.359)	(-1.102)	(1.144)	(1.352)
N. observations	47	23	35	40
Log-likelihood	-162.3	-85.1	-143.4	-149.8

Notes: Results for a cross-section of countries for the year 2013 using the Tobit estimation method. Robust t-statistics in parentheses. ***p<0.001, **p<0.05, *p<0.1.

We also estimated the same analysis by region and found that the largest coefficient (in absolute terms) was obtained for the East Asian and Pacific countries, and the smallest for the Middle East, North African and Sub-Saharan countries. Only for the countries in the Latin America and Caribbean region did the EGDI turn out not to be statistically significant.

6 Discussion

As the Digital Government landscape is continuously and dynamically evolving, it is important that policymakers and government executives evaluate the Digital Government decisions and foresee its impact on society. The purpose of this study is to investigate a possible role of digital government in reducing the SE activities - a long problem which has hampered many countries, especially the developing ones. We investigate whether the implementation of eGov has contributed to a reduction in the size of the SE and if a minimum level of eGov development is required for it to effectively decrease the size of the informal sector.

The contribution of this study is twofold: (1) we provide empirical evidence, based on a large sample of countries, on the potential impact of eGov (proxied by EGDI-UNDESA) to mitigate the problem of the SE, (2) we show that the impact differs across income and geographic groups of countries, which suggests that it is necessary to achieve a minimum level of economic and eGov infrastructure before a country can reap the benefits from the initiative. Decomposing the sample by income groups, we found the impact of the EGDI on the reduction of the SE is statistically significant in the high-income group. The result is consistent when the analysis is performed at the region level showing the greater impact at the regions entailing a greater economic progress. Our findings are consistent with previous studies on the need to achieve critical mass of ICT (telecommunications and broadband) before expecting a wider spill of the impacts on the economy and society. By disentangling the sub-indices, we can interpret these results as follow: unless a country has achieved at least 26% fixed broadband subscribers and 70% internet users, they might not be able to expect the spillover effect of the eGov development. These figures are obtained from the mean values of both variables in the high-income countries.

The paper also stresses the need to implement a more concrete and thorough eGov road map, especially in developing countries, to reduce the administrative burden and the size of the SE. We acknowledge there is room for improvement on methodological aspects and econometric modeling. We are also aware that, given the complexity of the problems associated with these phenomena, our recommendation

should not be seen as a sole panacea. However, we believe that improvements in e-government may represent a more efficient and socially acceptable strategy to control SE activities than the adoption of punitive measures.

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