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DISCUSSION PAPER SERIES

IZA DP No. 12385

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ABSTRACT

Nonlinearity between the Shadow Economy and Level of Development*

This paper is the first attempt to directly explore the long-run nonlinearity of the shadow economy. Using a dataset of 158 countries over the period from 1996 to 2015, our results reveal a robust U-shaped relationship between the shadow economy size and GDP per capita. Our results imply that the shadow economy tends to increase when economic development surpasses a given threshold or at least does not disappear with economic growth. Our findings suggest that special attention should be given to the country's level of development when designing policies to tackle issues related to the shadow economy.

JEL Classification: E26, H26, O17, O43, I25

Keywords: shadow economy, level of development, nonlinearity, GDP per capita

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CONTENTS

I. INTRODUCTION

The shadow economy has been labelled with many names, such as the informal economy, hidden economy, black economy or underground economy. Although existing studies provide a broad range of definitions or descriptions of the shadow economy, most of them are similar. This paper follows the definition proposed by Medina and Schneider (2018) since their estimated data is used for the size of the shadow economy: *"…The shadow economy includes all economic activities which are hidden from official authorities for monetary, regulatory, and institutional reasons. Monetary reasons include avoiding paying taxes and all social security contributions, regulatory reasons include avoiding governmental bureaucracy or the burden of regulatory framework, while institutional reasons include corruption law, the quality of political institutions and weak rule of law. For our study, the shadow economy reflects mostly legal economic and productive activities that, if recorded, would contribute to national GDP…."*

One of the intensively studied topics in economics is the causes of the shadow economy (SE) around the world. Although our understanding of the potential shadow economy drivers has improved substantially in the past two decades[1], questions regarding its long-run behavioral pattern are still open to debate. For example, does the size of the shadow economy converge to a certain level, or does it have a robust long-run linear relationship with its determinants? This paper aims to fill the gap in the literature by investigating the long-run relationship between the shadow economy and its key determinants.

The paper identifies a U-shaped relationship between the size of the shadow economy[2] and the level of economic development, using a panel dataset covering 158 countries or regions from 1996 to 2015. We take into account a wide range of the shadow economy's determinants and adopt various regression specifications to test the robustness of the nonlinearity between the shadow economy and GDP per capita[3]. Our results reveal that, after controlling for key economic, policy, and institutional variables, the economies at a low development level witness a negative relationship between the size of the shadow economy and GDP per capita, but when GDP per capita exceeds a threshold, the size of the shadow economy goes up with per capita income. These findings are consistent with economic intuition that economic development may have two opposite impacts on the size of the shadow economy. On the one hand, economic development, characterized by productivity improvement and technology

[1] See Schneider and Enste (2000), La Porta and Shleifer (2008), Feld and Schneider (2010), Schneider (2017), and Williams and Schneider (2016).

[2] In the paper, the size of the shadow economy is expressed as the percentage ratio of the shadow economy to official GDP.

[3] The paper uses GDP per capita as proxy for the level of economic development.

advance, may support the long-run expansion of the shadow economy. Because high level of development means high level of human capital, which helps individuals to make a living relatively easy. When less constrained by financial pressure, more people like to consider informal jobs to gain more work flexibility or to reach a better life-work balance, especially if there is a catch-up in the wage difference between the formal and informal sectors. In addition, technology innovation can support the growing trend of the shadow economy by providing more convenient jobs and reliable decentralized payment systems[4]. On the other hand, economic development can help downsize the shadow economy by offering high quality public goods and services. High level of economic development is normally featured by stronger institution capacity and better social infrastructure, all of which help absorb firms and individuals from the informal sector or encourage them to stay formal. The two competing forces jointly determine the net effect of economic development on the shadow economy: at low level, the downsizing effect associated with economic development plays a dominate role, people join or switch to the formal sector to enjoy more benefits of economic growth, and thus the shadow economy shrinks; at high level, more household members obtain financial freedom to an extent that they are willing consider informal jobs to pursue diverse goals and thus there is a gradual resurgence of the informal sector.

The U-shaped curve[5], as Figure 1 displays, discloses a different development pattern from most of existing studies which assume or identify a linear relationship between the size of the shadow economy and its determinants. The non-linearity finding implies that the shadow economy is able to co-exist with different levels of development and the long-run trend is not to disappear from the economy. This is contrary to the inference of a linear relationship which predicts a shrinking trend or final disappearance of the shadow economy. One question from Figure 1 is related to the observation that GDP per capita of most countries lies at the downward part of the U-shaped curve while only a few on the other part especially including four oil-exporting countries[6]. The paper examines the robustness of nonlinearity by dropping the four countries and still gets positive confirmation.

The paper also seeks to identify the potential factors which boost GDP per capita. Consistent with the growth literature, we find that educational attainment plays a vital role in improving GDP per capita, especially a college degree or above. This result helps shed some light on the possible mechanism at the micro level. From the individual perspective, people work to make themselves better off. When the level of development is low, education helps build up labor productivity and skilled workers with college education or above choose to stay in the formal

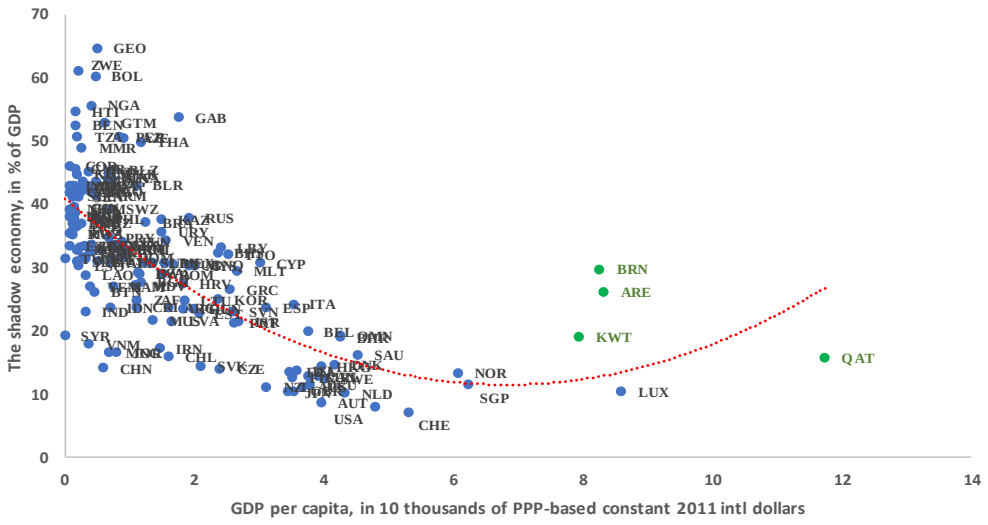
[4] Going forward, new waves of digital economy and the sharing and gig economy are expected to play a key role in boosting the shadow economy. Also, blockchain technology and cryptocurrency can be utilized to pay workers in the informal sector.

[5] The following sections examine the nonlinearity with rigorous econometric methods. In addition, the non-linear relationship may not necessarily be symmetric around the turning point. We leave the investigation of the asymmetric nonlinearity to future research.

[6] They are Brunel, United Arab Emirates, Kuwait, and Qatar (as BRN, ARE, KWT and QAT in Figure 1).

sector to enjoy benefits from high productivity position and social security net. When the economy advances to a new level at which income of skilled workers becomes high enough and one household member can easily cover the whole family's daily expenses, demand for informal work is likely to increase due to work flexibility or other desirable perks. Hence the size of shadow economy.

Figure 1: Nonlinear relationship between the shadow economy and GDP per capita



Sources: The World Bank, and Medina and Schneider (2018).
Note: GDP per capita is the average value of PPP-based constant 2011 international dollars from 1996 to 2015.

The rest of the paper is organized as follows: Section II reviews the literature on the shadow economy and highlights the paper's contribution; Section III explains the methodology and the dataset; Section IV presents the empirical results and conducts robustness checks; and Section V concludes.

II. LITERATURE REVIEW

There has been a considerable amount of economic research studying the shadow economy or the informal economy, particularly with a focus on its estimated size and causes[7]. The

[7] A recent survey is by Elgin and Erturk (2018).

estimation approaches include survey-based methods, observable-variable methods and model-based methods[8]. One of the latest examples is the paper by Medina and Schneider (2018) that uses the Multiple Indicators Multiple Causes (MIMIC) approach to find that the estimated average size of the shadow economy in 158 countries over 1991 to 2015 is 31.9 percent relative to GDP. The causes of the shadow economy can be categorized into three groups, namely economic, policy-related, and regulatory and institutional factors[9]. Among the key factors are access to financing, political stability, public services provision, tax burden, labor market regulations and institutional quality. Many papers identify the potential determinants of the shadow economy by assuming a simple linear impact while some take advantage of various interactions among the variables to revise or complement early findings. Almost all the papers, explicitly or implicitly, assume or agree that the shadow economy should be expected to shrink with economic growth, the upgrading in financial and public services, the improvement of institutional quality and regulatory effectiveness.

One related question is whether this shrinking trend of the shadow economy is a long-run irreversible phenomenon. Suppose that all the countries in the world keep making progress in strengthening their capacity in supervision and regulation, providing efficient public services, and effectively reducing their institutional weaknesses, then is it reasonable to predict that the shadow economy will continue shrinking until it disappears or become negligible?

The paper is the first attempt to investigate the non-linear long-run trend of the shadow economy and our major contribution includes the revelation of a U-shaped relationship between the shadow economy and the level of development. This paper uses GDP per capita to serve as proxy for the level of development. Although some papers already use GDP per capita in their studies, their purposes are to control for the level of development (La Porta and Shleifer, 2008). We allow for a U-shaped relationship by including squared GDP per capita. Our main results disclose the significance of the squared GDP per capita term, and the following regressions support its robustness.

Furthermore, this paper explores the possible long-run factors for the level of development and it is not surprising to find that educational attainment plays a vital role, especially college degrees and above. However, our finding regarding this variable contrasts with earlier work. Buehn and Farzanegan (2013) find that higher education levels can decrease the shadow economy in a strong institution environment by interacting education and institutional quality in their regression model. Their finding suggests that the sign of the educational impact on informality depends on the institutional quality. When the quality of institutions is high enough, their model implies that improved educational achievement contributes to the decline

[8] See Medina and Schneider (2018) for detailed discussion, as well as Gerxhani (2003), Kirchgaessner (2016) and Adair (2016).

[9] See Schneider (2014, 2017), La Porta and Shleifer (2008, 2014), and Williams and Schneider (2016) for details. Regarding the role of the shadow economy on the economic development, see the dual view proposed by Lewis (1954) and advocated by La Porta and Shleifer (2008), La Porta and Shleifer (2014), Feld and Larsen (2009), and Feld and Schneider (2010).

of the shadow economy. The issue with their work is the estimated effect of institutional quality on the shadow economy. As their paper shows, the institution has an overall positive impact on the size of the shadow economy and the impact declines with education level due to the same interaction item mentioned above, which contradicts with economic intuition and is hard to explain.

The paper's finding is contrary to Elgin and Erturk (2016) that support the negative relationship. Regression in Elgin and Erturk (2016) uses a longer time series on the size of shadow economy while it relies on only fixed effect dummies to control for all other factors. In addition, Elgin and Erturk (2016) set up a model to capture the underlying mechanism in which it assumes the value of TFP is constant. Instead, their model implies the size of the shadow economy depends on the relative TFP values between the formal and informal sectors. If there is a catch up from the informal sector productivity, its size tends to increase, which is consistent with our paper's finding.

The paper focuses on the long-term determinants of the size of the shadow economy while Elgin and Birinci (2016) explores the nonlinear impact of the shadow economy on economic growth. The first difference of these two papers is the direction of the impact as Elgin and Birinci (2016) aims to identify one new factor of growth. Second, there is no direct inference between the two papers findings. Elgin and Birinci (2016) finds the inverted-U between the shadow economy and growth of GDP per capita. Given that growth of GDP per capita has no simple monotone relationship with the level of GDP per capita, it is hard to derive from their findings a relationship between the shadow economy and GDP per capita and thus to judge whether our paper is consistent with theirs or not. Though, one key finding of Elgin and Birinci (2016) is that the informal sector has positive spillover effects on TFP growth. If one major source of TFP growth is research and development activities, how can we reconcile their finding with existing empirical ones or what aspect of the informal economic activities is instrumental to TFP growth?

III. METHODOLOGY AND DATA

In this section, we set up a framework for the comprehensive econometric analysis to identify the nonlinear relationship between the size of the informal economy and GDP per capita.

3.1 Empirical methodology

We conduct several regressions with different estimators. The benchmark cross-sectional regression is based on the following setting:

$$SE_i = \beta_0 + \beta_1 y_i + \beta_2 y_i^2 + \sum_{k=3}^{n} \beta_k x_{k,i} + \varepsilon_i \quad (1)$$

where SE_i is the percentage ratio of the shadow (or informal) economy relative to GDP of country i; y_i stands for GDP per capita for country i; $x_{k,i}$ represents other control variables; and ε_i denotes the error term. The inclusion of the squared GDP per capita term in the regression is to check the potential existence of a nonlinear relationship between the size of the informal economy and GDP per capita.

In the subsequent parts, we first do the cross-sectional regression using variables constructed as 20-year averages. Then, the robustness check is conducted with various settings: (i) dummy variables are used to control for country group effects which is complemented by separate regressions on each country group; (ii) regressions on variables of 10-year average are conducted to further confirm the original findings; (iii) the panel regression method with 5-year average is adopted to continue checking the validity of the empirical results, which includes regressions with one-period lagged variable to control for endogeneity; (iv) regressions to control for other potential economic and institutional factors.

For the panel regression, the equation is set up as follows:

$$SE_{it} = \beta_0 + \beta_1 y_{it} + \beta_2 y_{it}^2 + \sum_{k=3}^{n} \beta_k x_{k,it} + \theta_i + \delta_t + \varepsilon_{it} \quad (2)$$

where dummies of θ_i and δ_t are inserted to reflect the country and time effects. Both the fixed-effect and random-effect estimators are reported in the paper.

3.2 Data

Our paper collects the annual cross-country panel data covering 158 countries or regions from 1996 to 2015[10]. In our regressions, the variables are 20-year, 10-year or 5-year averages. Variables constructed as 20-year and 10-year averages are used in the cross-sectional regressions and the 5-year average variables are fed into the panel data regressions.

The size of the shadow economy relative to GDP is borrowed from Medina and Schneider (2018), which revise the standard MIMC approach by using light intensity instead of GDP as an indicator variable. By limiting GDP only as a cause variable, this revision helps improve the estimation results. To make the paper's findings reliable, the paper also uses the shadow

[10] Most of the key time series are from 1990 to 2015 except for the World Governance Index which starts from 1996. Therefore, our regressions change the sample period to the range of 1996 to 2015.

economy data from Elgin and Oztunali (2012)[11] as a robustness check. Elgin and Oztunali (2012) estimates the shadow economy based on a deterministic dynamic general equilibrium model. As Table A2 in the Appendix shows, the two estimated series are quite correlated with each other.

The choice of control variables is based on the existing empirical literature, including GDP per capita, political stability index, growth of GDP per capita, CPI inflation, trade openness, financial depth, tax burden, education-related variables, and capital stock. Detailed information about these variables is list below:

- GDP per capita comes from the World Development Indicators (WDI) database and two measurements are used to ensure the robustness of the results: one is PPP-based constant 2011 international dollars and the other is constant 2010 US dollars. This is the main series used to establish the paper's major finding.

- To control for institutional differences, the index of political stability is extracted from the database of the World Governance Indicators (WGI). Its original values range from -2.5 to 2.5 which the paper changes into 0 to 100.

- The non-institutional variables of GDP per capita growth, CPI inflation, trade openness, financial depth and tax burden are also from the WDI. GDP per capita growth is calculated with national currency and the lowest GDP per capita growth occurs in Libya in 2011. Inflation is measured with CPI data and expressed in percent. Trade openness is defined as the sum of exports and imports of goods and services as a percentage of GDP. Financial depth is measured as domestic credit to private sector provided by financial corporations[12], such as through loans, nonequity securities and trade credits. Tax burden is captured by the ratio of taxes and mandatory contributions payable to commercial profits.

- The regression, aiming to explore the determinants of GDP per capita, also uses data on educational attainment from the WDI and total capital stock from the IMF. Three educational variables are constructed: the percentages of people completing primary school only, completing high school only, and completing college and above[13]. The IMF Investment and Capital Stock Dataset (ICSD) includes three measurements of

[11] The estimated size of the shadow economy from Elgin and Oztunali (2012) spans from 1950 to 2014.

[12] Financial corporations include monetary authorities, deposit money banks and other financial corporations like finance and leasing companies and insurance corporations.

[13] Please note that for most countries, data on completing high school or above is available only after 2012. This is why the number of observations for high-school-or-above education attainment is so small compared with that of the primary school attainment.

capital stock, namely public capital, private capital and public-private-partnership (PPP) capital. The paper calculates the total capital stock as the sum of the three time series.

IV. EMPIRICAL RESULTS

This section presents the empirical findings on the nonlinear interaction between the shadow economy and GDP per capita.

In this paper, endogeneity can come from two main possible sources: (i) the impacts of the informal activities on the formal sector, via channels of households or firms decisions, may imply that institution and economic variables on the right side of the regression equation may be influenced by the size of the shadow economy[14]; (ii) the measurement error embedded in the estimated size of the shadow economy may also lead to the two-way causality between regressors and dependent variables. The paper adopted various specifications to check the sensitivity of the results and to ensure that endogeneity has been effectively mitigated.

4.1 Findings of the benchmark model

The results of the benchmark static panel regression are reported in Table 1, which uses each country as one observation by taking 20-year average on all relevant time series.

The first column reports the regression results using the estimated shadow economy size from Medina and Schneider (2018) and GDP per capita in PPP-based international dollars, while the second column reports the regression on GDP per capita in 2010-based US dollars. The third column reports the results of regressing the estimated informality numbers from Elgin and Oztunali (2012) on PPP-based GDP per capita. All three regressions identify, at the 1-percent significance level, the positive coefficient for the squared shadow economy size and thus support the existence of the U-shaped relationship between the shadow economy and GDP per capita. That is, the shadow economy shrinks with the increase of GDP per capita until it reaches a threshold; after that point, the shadow economy and GDP per capita are positively related and the shadow economy size grows with GDP per capita.

The benchmark regression uses the indicator of political stability from the WGI to proxy for institutional factors, which is motivated by Elbahnasawy et al (2016). The coefficient for political stability is constantly negative, implying that institutional factors help contain the expansion of the shadow economy.

[14] See Table A2 of the correlation matrix.

In addition, the estimated negative coefficient of financial depth reveals that financial development is instrumental in dampening the activities of the shadow economy, which is consistent with the findings of World Bank Enterprise Surveys[15].

Table 1: Nonlinearity between the shadow economy and GDP per capita: average of 1996-2015

Dependent Variable		SE		SE		SE2
GDP_PPP$	-5.314***	(1.142)			-5.246***	(1.214)
(GDP_PPP$)^2	0.352***	(0.110)			0.348***	(0.112)
GDP_2010$			-5.611***	(1.238)		
(GDP_2010$)^2			0.398***	(0.123)		
Institutional Factor						
PolStability	-0.129**	(0.0570)	-0.114*	(0.0585)	-0.0848	(0.0567)
Non-institutional Factor						
GDPGrowth	-0.310	(0.367)	-0.362	(0.363)	0.00131	(0.376)
Inflation	0.109	(0.113)	0.115	(0.115)	0.0514	(0.122)
Openness	0.0168	(0.0114)	0.00458	(0.0109)	0.00981	(0.0117)
FinDepth	-0.0581**	(0.0278)	-0.0479*	(0.0279)	-0.0624**	(0.0271)
constant	45.23***	(2.613)	43.82***	(2.689)	44.26***	(2.626)
R-squared	0.574		0.569		0.556	
Observations	152		152		147	
F-test	44.03		56.07		43.69	

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

4.2 Further investigation of non-linear relationship

What factors determine the long-run value of GDP per capita and thus indirectly influence the size of the shadow economy? The classic production function implies that physical capital, human capital and technology are three fundamental variables. In addition, Barro (2013) argues that inflation is negatively related to economic growth. Guided by the existing literature, the regression equation of GDP per capita is set as following:

$$y_i = \beta_0 + \beta_1 * college_i + \beta_2 * HighSch + \beta_3 * PrimSch + \beta_4 * inflation + \beta_5 * CapStock + \varepsilon_i \quad (3)$$

Results in Table 2 reveal that educational attainment contributes to the increase of GDP per capita, especially college and graduate degrees. It is not surprising to see that a bachelor degree and above are significant and more important than high school and primary school in boosting GDP per capita. College and post-graduate education helps employees to reach

[15] La Porta and Shleifer (2014) highlight the role of financial access, one important aspect of financial development. They compare perceived obstacles to doing business reported by informal and formal entrepreneurs and list access to financing as the top 1 factor for firm-owners to make decisions of whether to stay formal or not.

higher productivity and the skill-complementary technology trend in recent decades has create constant demand for skilled labor as Acemoglu (2002) shows. In addition, the regression confirms that inflation is detrimental to GDP per capita, supporting the existing study on the long-run negative relationship between inflation and economic growth.

Then, what is the economic intuition behind the implied long-run relationship between education and the shadow economy? The formal sector is more productive than the informal sector and firms tend to move out of the informal sector to hire skilled workers when more people become well-educated, thus reducing the size of the shadow economy. However, when education attainment reaches a certain level as GDP per capita hits a threshold, further increases in education attainment not only pushes up GDP per capita but also reverses the declining trend of the shadow economy. This reversal could be attributed to the increase in the informal sector's salary due to the growing productivity level. When household revenue exceeds a critical level, financial pressure becomes less intense. Some family members may become more willing to take temporary unregistered assignments than formal full-time or part-time positions in exchange for flexibility, which leads to the expansion of the shadow economy.

It is worth noting that the R-squared value indicates that education, capital stock and inflation can explain about 30.6 percent of the level of GDP per capita and a large share of GDP per capita remains unexplained in the regression. In addition, capital stock's impact on GDP per capita is not significantly different from zero in the long run.

Table 2: Long-run determinants of GDP per capita: average of 1996-2015

Dependent Variable	GDP_PPP$	
College	0.0787**	(0.0309)
HighSch	0.00682	(0.0132)
PrimSch	0.0196*	(0.0110)
Inflation	-0.0868***	(0.0311)
CapStock	-0.000232	(0.00014)
Constant	1.796*	(0.976)
R-squared	0.306	
Observations	70	
F-test	13.86	

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

4.3 Robustness check

Besides the initial robustness regressions in Table 1, this sub-section continues to conduct robustness checks to test the observed U-shaped relationship between the shadow economy and GDP per capita. Specifically, we implement four types of tests. First, this sub-section explores the robustness of the U-shaped relationship with an additional control variable, tax burden, and then within different country groups, which includes regressions with country group dummies and separate estimations for each country group. Second, the paper uses 10-year averages to run the benchmark regression to check the results' consistency. Third, the paper calculates 5-year averages and runs panel regressions with different estimators to check if the same relationship exists. Lastly, the section tests the robustness of the result by dropping the four oil-exporting countries on the upward part of the U curve.

4.3.1 Robustness check by controlling for tax burden and for country groups

This subsection investigates the robustness of our results by controlling for tax burden and for different country groups. One motivation for firms to remain unregistered and in the informal sector is to avoid taxes[16]. A potential question is whether, in the long-run and at the national level, the tax burden is a factor in affecting a firm's decision to stay formal or whether it has any implication for the long-run nonlinearity. In the regression, we add the ratio of corporate tax to corporate profit as proxy for a firm's tax burden. The first column of Table 3 shows a positive but insignificant coefficient for the tax variable while the two GDP-per-capita variables remain significant.

It is interesting to check if the nonlinear relationship significantly exists within different country groups. To achieve this goal, the paper divides the countries with two criteria. The paper borrows the definition of advanced economy (AE) from IMF (2017) and splits the 158 countries into AEs and non-AEs. The paper also follows the World Bank's classification, using 2015 gross national income (GNI) per capita, to group all countries or regions into three categories: low-income countries (LICs) with annual income below $1,025; middle-income countries (MILs) with annual income from $1,026 to $12,475; and high-income countries (HILs) with income of $12,476 or more[17].

[16] Recent research provides empirical and quantitative evidence to support the negative correlation between taxes and the informal sector and attributes it to high quality institutional factors (Friedman et al., 2000) or public turnover and public trust in government (Elgin and Solis-Garcia, 2012). The appearance of the negative correlation is due to the failure of the analysis to identify or control for other important determinants.

[17] See Appendix for the country list of each group.

Table 3: Robustness check I

Dependent Variable	SE	SE	SE
	With tax burden	With dummy for AEs	With dummies for HICs and LICs
GDP_PPP$	-5.301*** (1.143)	-4.562*** (1.181)	-3.769** (1.474)
(GDP_PPP$)^2	0.352*** (0.110)	0.286** (0.111)	0.239* (0.125)
Institutional Factor			
PolStability	-0.129** (0.0571)	-0.112* (0.0574)	-0.111* (0.0591)
Non-institutional Factor			
GDPGrowth	-0.301 (0.372)	-0.271 (0.377)	-0.270 (0.357)
Inflation	0.109 (0.113)	0.103 (0.115)	0.0985 (0.118)
Openness	0.0172 (0.0114)	0.0149 (0.0117)	0.0156 (0.0119)
FinDepth	-0.0577** (0.0281)	-0.0439 (0.0303)	-0.0546* (0.0277)
TaxBurden	0.00461 (0.0184)	0.0107 (0.0186)	-0.000863 (0.0200)
Dummy			
AE		-3.987* (2.251)	
HIC			-3.749 (2.867)
LIC			2.123 (2.144)
Constant	44.91*** (3.062)	43.39*** (3.112)	43.31*** (3.297)
R-squared	0.574	0.581	0.580
Observations	152	152	152
F-test	39.33	38.50	32.17

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

The second and third columns of Table 3 presents the regression results with country group dummies. One advantage of this method is to utilize all the observations instead of regressing on a subsample of the data. We can see the nonlinear relationship remains significant even with the dummies. To further investigate the robustness of the U-shaped relationship for each country group, the paper runs separate regressions for country groups of AEs, non-AEs, HICs and non-HICs. Table 4 shows that the squared GDP per capita remains significant for AEs, non-AEs and HICs. In contrast, non-HICs demonstrate a significant linear relationship between the shadow economy and GDP per capita. The negative linear relationship for non-HICs stems from the fact that almost all non-HICs lie far away from the threshold, where observations suggest a predominantly downward relationship.

The fact that the R-squared values for AEs and HICs are above 50 percent while those for non-AEs and non-HICs below 50 percent implies that nonlinearity is mainly driven by AEs or HICs whose GDP per capita lie around the threshold.

Table 4: Robustness check II

Dependent Variable	SE	SE	SE	SE	SE
	For AEs	For non-AEs	For HICs	For non-HICs	For non-HICs
GDP_PPP$	-8.954***	-4.081***	-6.728***	-4.549	-3.345*
	(2.771)	(1.302)	(2.309)	(5.626)	(1.773)
(GDP_PPP$)^2	0.555**	0.249*	0.426**	0.590	
	(0.224)	(0.126)	(0.179)	(2.331)	
Institutional Factor					
PolStability	-0.152*	-0.0977	-0.125	-0.107	-0.110
	(0.0876)	(0.0651)	(0.0865)	(0.0774)	(0.0737)
Non-institutional Factor					
GDPGrowth	-1.938**	-0.239	-2.589***	-0.194	-0.187
	(0.936)	(0.366)	(0.824)	(0.421)	(0.407)
Inflation	0.774	0.0764	1.151*	0.0680	0.0636
	(0.821)	(0.121)	(0.672)	(0.139)	(0.130)
Openness	0.0450**	0.0176	0.0317**	0.0175	0.0186
	(0.0171)	(0.0182)	(0.0127)	(0.0256)	(0.0254)
FinDepth	0.0258	-0.0869**	-0.0234	-0.0792	-0.0829
	(0.0276)	(0.0428)	(0.0289)	(0.0563)	(0.0506)
Constant	45.65***	44.22***	45.11***	44.50***	44.32***
	(8.057)	(2.867)	(7.061)	(3.016)	(3.181)
R-squared	0.623	0.310	0.517	0.155	0.155
Observations	34	118	49	103	103
F-test	5.202	10.80	9.271	2.988	3.500

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

4.3.2 Robustness check with 10-year averages

In the previous subsections, all the regressions are conducted with variables of 20-year averages to explore the long-run nonlinear relationship. One associated question is whether this nonlinear relationship remains unchanged if empirical analysis concentrates on shorter time horizons, such as a 10-year average or a 5-year average. This subsection conducts analysis based on two 10-year averages while the next one on four separate 5-year averages.

We run separate regressions for the periods of 1996-2005 and 2006-2015 and summarizes the results in Table 5. Despite the changes in coefficient values between these two decades, the nonlinear relationship remains as expected, which indicates that the identified nonlinear

relationship is stable in the medium term. This finding provides support to the results of the benchmark model.

Table 5: Robustness check III

Dependent Variable	SE (10 year average of 1996-2005)		SE (10 year average of 2006-2015)	
GDP_PPP$	-6.510***	(1.358)	-5.088***	(1.062)
(GDP_PPP$)^2	0.458***	(0.137)	0.306***	(0.0853)
Institutional Factor				
PolStability	-0.112**	(0.0548)	-0.109*	(0.0573)
Non-institutional Factor				
GDPGrowth	-0.109	(0.184)	-0.569	(0.437)
Inflation	0.0696	(0.0581)	-0.0922	(0.158)
Openness	0.0148	(0.0115)	0.0102	(0.00988)
FinDepth	-0.0610**	(0.0302)	-0.0585**	(0.0250)
Constant	47.09***	(2.679)	45.05***	(2.695)
R-squared	0.601		0.552	
Observations	144		149	
F-test	55.83		35.91	

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

4.3.3 Robustness check with 5-year averages

This subsection of robustness check utilizes panel data regressions with 5-year averages. These results are shown in Tables 6 and 7. The growth literature suggests that 5-year averages can substantially smooth the cyclical elements contained in time series. Both the FE and RE estimators are listed in Table 6 below although the Hausman test suggests that the RE estimator may be inconsistent.

Finally, one concern with the panel regression is endogeneity. To check the impact of endogeneity, the paper also conducts panel data regressions with one-period lags and two-period lags. All the panel regression results support the U-shaped relationship identified previously. These robustness checks clearly demonstrate that all results are very robust after undertaking the usual tests.

Table 6: Robustness check IV: panel regression

Dependent Variable	SE (5 year average)		SE (5 year average)	
	robust FE		robust RE	
GDP_PPP$	-11.59***	(1.640)	-8.755***	(1.141)
(GDP_PPP$)^2	0.838***	(0.215)	0.656***	(0.157)
Institutional Factor				
PolStability	-0.0559*	(0.0336)	-0.0418	(0.0292)
Non-institutional Factor				
GDPGrowth	0.0261	(0.0659)	-0.000569	(0.0512)
Inflation	0.0704***	(0.0221)	0.0846***	(0.0185)
Openness	-0.0476***	(0.0148)	-0.0308***	(0.00995)
FinDepth	-0.0136	(0.0119)	-0.0278**	(0.0122)
Constant	52.02***	(3.032)	46.89***	(2.079)
Observations	558		558	
F-test	25.50			

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Robustness check V: panel regression with one-period lags

Dependent Variable	SE (5 year average)		SE (5 year average)	
	robust FE with lags		robust RE with lags	
GDP_PPP$(-1)	-9.444***	(1.391)	-7.814***	(0.934)
(GDP_PPP$(-1))^2	0.665***	(0.173)	0.565***	(0.122)
Institutional Factor				
PolStability(-1)	-0.00467	(0.0391)	-0.0272	(0.0289)
Non-institutional Factor				
GDPGrowth(-1)	-0.317***	(0.0847)	-0.331***	(0.0723)
Inflation(-1)	0.0770***	(0.0191)	0.0828***	(0.0172)
Openness(-1)	-0.0159	(0.0138)	-0.00515	(0.00957)
FinDepth(-1)	-0.00410	(0.0118)	-0.0223*	(0.0123)
Constant	43.24***	(2.817)	42.13***	(1.717)
Observations	414		414	
F-test	27.36			

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Robustness check VI: panel regression with two-period lags

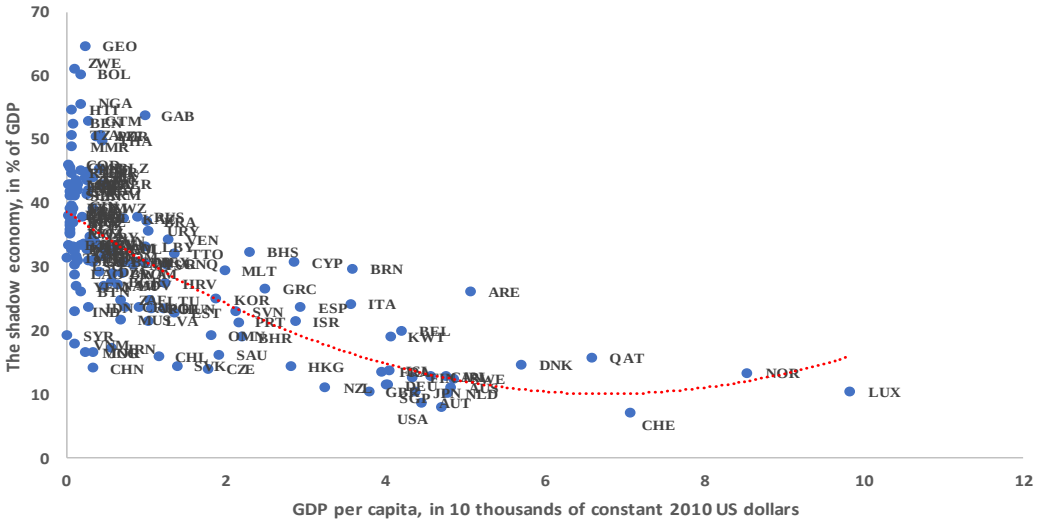
Dependent Variable	SE (5 year average)		SE (5 year average)	
	robust FE with lags		robust RE with lags	
GDP_PPP$(-2)	-4.636***	(1.754)	-6.294***	(1.138)
(GDP_PPP$(-2))^2	0.717***	(0.210)	0.465***	(0.139)
Institutional Factor				
PolStability(-2)	0.0281	(0.0459)	-0.0401	(0.0337)
Non-institutional Factor				
GDPGrowth(-2)	-0.104	(0.0853)	-0.221***	(0.0774)
Inflation(-2)	0.0776***	(0.0221)	0.0641***	(0.0150)
Openness(-2)	-0.0251	(0.0181)	-0.00326	(0.00999)
FinDepth(-2)	-0.0105	(0.0130)	-0.0285	(0.0182)
Constant	33.29***	(3.822)	39.51***	(1.837)
Observations	266		266	
F-test	6.587			

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

4.3.4 Robustness check by controlling for the four oil-exporting countries

This subsection aims to isolate the impact of some outliers and check the robustness of the U-shaped curve. As Figure 1 suggests, one valid concern is that the four oil-exporting countries which lie on the upward part of the curve, namely Brunei, United Arab of Emirates, Kuwait and Qatar[18], may play a disproportionately large role in determining the nonlinear relationship. One way to check their role is to switch to another measurement of GDP per capita. With GDP per capita measured by constant 2010 US dollars, these four countries move to the downward part of the U curve in the Figure 2. When this measurement of level of development is used, the regression outcome in Table 9 supports the U-shaped relationship.

Figure 2: Nonlinear relationship between the shadow economy and GDP per capita in 2010 US$



Sources: The World Bank, and Medina and Schneider (2018).
Note: GDP per capita is the average value of constant 2010 US dollars from 1996 to 2015.

Another way to check its impact, which may be relatively convincing, is to do the regression with the same measurement while dropping the four outliers. The results are summarized below, and it is worth noting that the same U curve is still identified although at a less significant level than before.

[18] They are highlighted with green color.

Table 9: Robustness check VII: the average of 1996-2015

Dependent Variable	SE		SE	
	using GDP per capital in 2010 US$		using GDP per capita in PPP-based $ and dropping the four oil exporting countries	
GDP_PPP$			-5.391***	(1.294)
(GDP_PPP$)^2			0.256*	(0.154)
GDP_2010$	-5.611***	(1.238)		
(GDP_2010$)^2	0.398***	(0.123)		
Institutional Factor				
PolStability	-0.114*	(0.0585)	-0.129**	(0.0569)
Non-institutional Factor				
GDPGrowth	-0.362	(0.363)	-0.251	(0.379)
Inflation	0.115	(0.115)	0.117	(0.112)
Openness	0.00458	(0.0109)	0.0205	(0.0124)
FinDepth	-0.0479*	(0.0279)	-0.0452	(0.0282)
Constant	43.82***	(2.689)	44.48***	(2.603)
R-squared	0.569		0.585	
Observations	152		148	
F-test	64.94		64.94	

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

4.4 More Discussions on Labor Market and Policy Implications

One view on the shadow economy is that labor market rigidity makes the job-labor searching and matching process lengthy and costly, thus discouraging firms to register new hired workers with the authorities or to stay formal and causing workers, especially migrant workers, to be less interested in the formal jobs in order to earn income easier and earlier. Thus, it is important to control for the institutional effect of labor market when examining the determinants of the shadow economy. In response, the paper uses the indicator of the labor market flexibility from the World Economic Forum Global Competitiveness Index (GCI) to control for the institutional factors of the labor market. The indicator is on a scale of 1-7 with high value meaning more flexibility. The results are summarized in the table below. Labor market flexibility helps reduce the size of the shadow economy in the long run although not significant. Meanwhile, the coefficient of squared GDP per capita remains significant to support the U-shaped curve.

Table 10: Robustness check VIII: the average of 1996-2015

Dependent Variable	SE
	With labor market indicator
GDP_PPP$	-6.086*** (1.310)
(GDP_PPP$)^2	0.413*** (0.124)
Institutional Factor	
PolStability	-0.125** (0.0614)
Non-institutional Factor	
GDPGrowth	-0.594 (0.573)
Inflation	0.0480 (0.128)
Openness	0.0179 (0.0121)
FinDepth	-0.0544* (0.0292)
LabMarket	-0.205 (1.606)
Constant	47.81*** (7.582)
R-squared	0.578
Observations	139
F-test	34.75

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

It is arguable that not only institutional factors but also the labor force composition of the market can exert some influence on the relative size of the shadow economy. For example, Goldin (1994) finds the U-shaped curve between female labor participation and economic development. The female participation declines initially with economic development and then pick up after a turning point. If the estimated trend in Goldin (1994) is true, it is reasonable to predict that more male individuals tend to work informally with the economy growing. It can be a good topic for further investigation with more data available.

To set out appropriate and effective measures to tackle the associated issues, it is necessary first to have a comprehensive and updated view on the role of the shadow economy on economic growth and social welfare[19]. First, the existence of the shadow economy poses a severe threat to fiscal revenue and thus undermines the government's ability to provide adequate public goods and services. Second, empirical evidence shows that firms in the shadow economy are smaller and less productive than those in the formal sector. Third, the authorities have very limited access to the information related to the shadow economy, which weakens their efforts to implement the function of economic monitoring and management. Fourth, the shadow economy keeps evolving and gets adapted for new developments and thus it is crucial for the policy makers to update their knowledge on the shadow economy on a regular basis. However, the shadow economy does play a positive role, at some aspects, in improving workers welfare. For example, the informal sector supports workers to make a living by providing temporary and low-paid jobs when the economy does not have a well-established social security net. Also, the informal sector helps the economy to maintain an untapped reservoir of labor supply. When a positive shock to demand emerges, the economy

[19] La Porta and Shleifer (2008, 2014) has a good summary about the views of the role of the shadow economy.

can quickly grab the opportunity to step up production by utilizing extra labor supply in the shadow economy.

Besides the mixed views above on the shadow economy, the paper's finding provides another reason for policy-makers to be cautious when handling issues related to the shadow economy. Just as the paper reveals, if the long-run trend of the shadow economy can be reversed with economic development, then it is key to be aware of the current state of the economy and remains alert to the policy effectiveness. If the economy is less-developed or experiences a catch-up phase, its shadow economy is expected to go through a downsizing process. In this period, the authorities can harness the trend to attract more firms and workers out of the shadow economy by promoting financial development, containing inflation, stabilizing the political situation, and expanding educational spending. By contrast, when the economy has reached the threshold of GDP per capita and starts to show the positive relationship between GDP per capita and the shadow economy, the authorities should put additional efforts to make working in the formal sector more beneficial, for example by reducing labor market rigidity to improve the labor match efficiency, simplify the tax compliance procedure with recent technology innovations.

Against all the previous views and my empirical findings, it should be clear first that taking harsh measures with a view to dramatically reducing or even to eradicating the shadow economy is not a first-best solution at any period of time. The appropriateness of the policy depends on the level of economic development. This section sets out the following policy recommendations for consideration:

The authorities should strengthen their capacity in data collecting and processing. In order to assess the current stage of the relationship between the shadow economy and level of development, it is crucial for the policy makers to exploit all available data sources, especially when the digital economy grows rapidly in recent years, and to call for the relevant government agencies to work collectively to cross check the data quality. The authorities should be able to measure the impacts of its policy in a relatively accurate way and thus to keep adjusting its policy to achieve the ideal effect.

The authorities should streamline the administrative procedures to reduce the compliance costs of firms and households and make public goods and services more accessible by taking advantage of technology innovations. The growing digital economy provides new merits and convenience for workers to stay inform. In response, the associated government agencies should revise their policy measures to create a business-friendly environment and ensure that firms and workers can get more advantages to stay formal.

The authorities should keep educating people, not only to improve their human capital but also to teach the role of the shadow economy and promote healthy social norms to influence people's economic behavior. It is important to advise all firms and households on the merits

and risks of the shadow economy and ensure that there is a positive attitude toward formal jobs and the importance of transparency for economic monitoring and policy designing.

V. CONCLUSION

In this paper, we reveal a long-run U-shaped relationship between GDP per capita and the size of the shadow economy with a dataset of 158 countries. Further, this paper examines the possible long-run determinants of GDP per capita and finds that the share of the population with a bachelor degree or above plays a vital role in promoting the average production, which is consistent with existing literature.

The U-shaped pattern between the shadow economy and GDP per capita is worth further investigation. One possible direction is whether the non-monotonic relationship before and after the threshold are symmetric. Although this paper discloses long-run nonlinearity in the shadow economy using the quadratic regression equation, it is possible for the relationship between GDP per capita and the size of the shadow economy to be asymmetric. One possible scenario could be that the productivity increase of the shadow economy may accelerate when the country's level of development exceeds a certain stage, resulting from the formal sector's industrial upgrading and technological innovation.

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APPENDIX

Table A1: Country names and ISOs

Albania	ALB	Gabon	GAB	Netherlands, The	NLD
Algeria	DZA	Gambia, The	GMB	New Zealand	NZL
Angola	AGO	Georgia	GEO	Nicaragua	NIC
Argentina	ARG	Germany	DEU	Niger	NER
Armenia	ARM	Ghana	GHA	Nigeria	NGA
Australia	AUS	Greece	GRC	Norway	NOR
Austria	AUT	Guatemala	GTM	Oman	OMN
Azerbaijan	AZE	Guinea	GIN	Pakistan	PAK
Bahamas, The	BHS	Guinea-Bissau	GNB	Papua New Guinea	PNG
Bahrain	BHR	Guyana	GUY	Paraguay	PRY
Bangladesh	BGD	Haiti	HTI	Peru	PER
Belarus	BLR	Honduras	HND	Philippines	PHL
Belgium	BEL	Hong Kong SAR, China	HKG	Poland	POL
Belize	BLZ	Hungary	HUN	Portugal	PRT
Benin	BEN	Iceland	ISL	Qatar	QAT
Bhutan	BTN	India	IND	Romania	ROM
Bolivia	BOL	Indonesia	IDN	Russian Federation	RUS
Bosnia and Herzegovina	BIH	Iran, Islam Rep.	IRN	Rwanda	RWA
Botswana	BWA	Ireland	IRL	Saudi Arabia	SAU
Brazil	BRA	Israel	ISR	Senegal	SEN
Brunei Darussalam	BRN	Italy	ITA	Sierra Leone	SLE
Bulgaria	BGR	Jamaica	JAM	Singapore	SGP
Burkina Faso	BFA	Japan	JPN	Slovak Republic	SVK
Burundi	BDI	Jordan	JOR	Slovenia	SVN
Cabo Verde	CPV	Kazakhstan	KAZ	Solomon Islands	SLB
Cambodia	KHM	Kenya	KEN	South Africa	ZAF
Cameroon	CMR	Korea, Rep.	KOR	Spain	ESP
Canada	CAN	Kuwait	KWT	Sri Lanka	LKA
Central African Republic	CAF	Kyrgyz Republic	KGZ	Suriname	SUR
Chad	TCD	Laos	LAO	Swaziland	SWZ
Chile	CHL	Latvia	LVA	Sweden	SWE
China	CHN	Lebanon	LBN	Switzerland	CHE
Colombia	COL	Lesotho	LSO	Syrian Arab. Rep.	SYR
Comoros	COM	Liberia	LBR	Taiwan	TWN
Congo, Dem. Rep.	COD	Libya	LBY	Tajikistan	TJK
Congo, Rep.	COG	Lithuania	LTU	Tanzania	TZA
Costa Rica	CRI	Luxembourg	LUX	Thailand	THA
Côte d'Ivoire	CIV	Madagascar	MDG	Togo	TGO
Croatia	HRV	Malawi	MWI	Trinidad and Tobago	TTO
Cyprus	CYP	Malaysia	MYS	Tunisia	TUN
Czech Republic	CZE	Maldives	MDV	Turkey	TUR
Denmark	DNK	Mali	MLI	Uganda	UGA
Dominican Republic	DOM	Malta	MLT	Ukraine	UKR
Ecuador	ECU	Mauritania	MRT	United Arab Emirates	ARE
Egypt, Arab. Rep.	EGY	Mauritius	MUS	United Kingdom	GBR
El Salvador	SLV	Mexico	MEX	United States	USA
Equatorial Guinea	GNQ	Moldova	MDA	Uruguay	URY
Eritrea	ERI	Mongolia	MNG	Venezuela, RB	VEN
Estonia	EST	Morocco	MAR	Vietnam	VNM
Ethiopia	ETH	Mozambique	MOZ	Yemen, Rep.	YEM
Fiji	FJI	Myanmar	MMR	Zambia	ZMB
Finland	FIN	Namibia	NAM	Zimbabwe	ZWE
France	FRA	Nepal	NPL		

Source: the IMF.

Table A2: Table of correlations of variables for 1996-2015

		SE	SE2	GDP_PPP$	GDP_2010$	PolStability	GDPGrowth	Inflation	Openness	FinDepth	TaxBurden	LabMarket
SE	The size of the Shadow Economy in % of GDP, from Medina and Schneider (2018)	1										
SE2	The size of the Shadow Economy in % of GDP, from Elgin and Oztunal (2012)	0.945***	1									
GDP_PPP$	GDP per capita, in 10 thousands of PPP-based constant US$	-0.670***	-0.676***	1								
GDP_2010$	GDP per capita, in 10 thousands of 2010-based constant US$	-0.682***	-0.683***	0.901***	1							
PolStability	Index of Political Stability and absence of Violence and Terrorism, from the WGI database	-0.608***	-0.556***	0.583***	0.618***	1						
GDPGrowth	Growth of GDP per capita, in %	0.147***	0.224***	-0.239***	-0.242***	-0.0900**	1					
Inflation	CPI Inflation, in %	0.254***	0.239***	-0.303***	-0.339***	-0.318***	0.146***	1				
Openness	Trade openness, the sum of exports and imports of goods and services in % of GDP	-0.308***	-0.315***	0.427***	0.345***	0.394***	0.0295	-0.155***	1			
FinDepth	Credit to the private sector, in % of GDP	-0.562***	-0.591***	0.536***	0.630***	0.483***	-0.236***	-0.340***	0.278***	1		
TaxBurden	Tax and mandatory contributions as a share of commercial profit, in %	0.207***	0.200***	-0.251***	-0.177***	-0.189***	-0.0216	0.0693*	-0.222***	-0.200***	1	
CapStock	Capital stock in billions of constant 2011 international dollars	-0.0568	-0.0223	-0.0620	-0.0379	-0.100**	0.0750*	0.0532	-0.0381	0.00406	-0.0469	1
LabMarket	The indicator measures the flexibility of labor market with a scale of 1-7(best)	-0.205***	-0.225***	0.311***	0.234***	0.243***	-0.00701	-0.180***	0.397***	0.246***	-0.207***	-0.223***

Notes:

The correlation matrix is calculated with 958 annual observations.

Educational variables are not included because of their small numbers of observations.

In addition, * p<0.10, ** p<0.05, *** p<0.01.

Sources: Medina and Schneider (2018), Elgin and Oztunal(2012), WDI, WGI, IMF ICSD and GCI.

Table A3: Summary statistics of variables for 1996-2015

Variable	Description	Mean	Std. Dev.	Min	Max	Observations
SE	The size of the Shadow Economy in % of GDP, from Medina and Schneider (2018)	31.016	12.788	6.160	71.332	3,160
SE2	The size of the Shadow Economy in % of GDP, from Elgin and Oztunal (2012)	31.536	12.192	7.924	67.801	2,888
GDP_PPP$	GDP per capita, in 10 thousands of PPP-based constant US$	1.667	1.960	0.026	12.935	3,099
GDP_2010$	GDP per capita, in 10 thousands of 2010-based constant US$	1.280	1.831	0.012	11.197	3,099
PolStability	Index of Political Stability and absence of Violence and Terrorism, from the WGI database	48.39	18.49	0.35	85.20	2,652
GDPGrowth	Growth of GDP per capita, in %	2.55	5.90	-62.23	140.50	3,107
Inflation	CPI Inflation, in %	7.24	12.29	-4.01	198.52	2,987
Openness	Trade openness, the sum of exports and imports of goods and services in % of GDP	88.11	55.44	0.17	531.74	3,045
FinDepth	Credit to the private sector, in % of GDP	46.93	45.16	0.49	312.12	2,932
TaxBurden	Tax and mandatory contributions as a share of commercial profit, in %	48.08	39.79	8.00	339.10	1,607
College	people completing the college, in % of the population of age of 25+	17.22	9.21	0.00	36.95	165
HighSch	people completing the high school, in % of the population of age of 25+	38.81	18.41	0.96	82.46	164
PriSch	people completing the primary school, in % of the population of age of 25+	31.50	14.86	3.02	78.77	571
CapStock	Capital stock in billions of constant 2011 international dollars	4839.89	1762.20	218	8543	3,010
LabMarket	The indicator measures the flexibility of labor market with a scale of 1-7(best)	4.51	0.62	2.41	6.39	1,301

Sources: Medina and Schneider (2018), Elgin and Oztunal(2012), WDI, WGI, ICSD and GCI .

Table A4: Analytical categorization of the global economy

Advanced Economies (AEs)	Non-Advanced Economies (non-AEs)		High-income Countries (HICs)	Non-high-income Countries (Non-HICs)	
				Middle-income Countries (MICs)	
Australia	Albania	Kuwait	Australia	Albania	Peru
Austria	Algeria	Kyrgyz Republic	Austria	Algeria	Philippines
Belgium	Angola	Laos	Bahamas, The	Angola	Romania
Canada	Argentina	Lebanon	Bahrain	Argentina	Russian Federation
Cyprus	Armenia	Lesotho	Belgium	Armenia	Solomon Islands
Czech Republic	Azerbaijan	Liberia	Brunei Darussalam	Azerbaijan	South Africa
Denmark	Bahamas, The	Libya	Canada	Bangladesh	Sri Lanka
Estonia	Bahrain	Madagascar	Chile	Belarus	Suriname
Finland	Bangladesh	Malawi	Croatia	Belize	Swaziland
France	Belarus	Malaysia	Cyprus	Bhutan	Syrian Arab. Rep.
Germany	Belize	Maldives	Czech Republic	Bolivia	Tajikistan
Greece	Benin	Mali	Denmark	Bosnia and Herzegovina	Thailand
Iceland	Bhutan	Mauritania	Estonia	Botswana	Tunisia
Ireland	Bolivia	Mauritius	Finland	Brazil	Turkey
Israel	Bosnia and Herzegovina	Mexico	France	Bulgaria	Ukraine
Italy	Botswana	Moldova	Germany	Cabo Verde	Venezuela, RB
Japan	Brazil	Mongolia	Greece	Cambodia	Vietnam
Korea, Rep.	Brunei Darussalam	Morocco	Hong Kong SAR, China	Cameroon	Yemen, Rep.
Latvia	Bulgaria	Mozambique	Hungary	China	Zambia
Lithuania	Burkina Faso	Myanmar	Iceland	Colombia	
Luxembourg	Burundi	Namibia	Ireland	Congo, Rep.	
Malta	Cabo Verde	Nepal	Israel	Costa Rica	Low-income Countries (LICs)
Netherlands, The	Cambodia	Nicaragua	Italy	Côte d'Ivoire	Benin
New Zealand	Cameroon	Niger	Japan	Dominican Republic	Burkina Faso
Norway	Central African Republic	Nigeria	Korea, Rep.	Ecuador	Burundi
Portugal	Chad	Oman	Kuwait	Egypt, Arab. Rep.	Central African Republic
Singapore	Chile	Pakistan	Latvia	El Salvador	Chad
Slovak Republic	China	Papua New Guinea	Lithuania	Equatorial Guinea	Comoros
Slovenia	Colombia	Paraguay	Luxembourg	Fiji	Congo, Dem. Rep.
Spain	Comoros	Peru	Malta	Gabon	Eritrea
Sweden	Congo, Dem. Rep.	Philippines	Netherlands, The	Georgia	Ethiopia
Switzerland	Congo, Rep.	Poland	New Zealand	Ghana	Gambia, The
United Kingdom	Costa Rica	Qatar	Norway	Guatemala	Guinea
United States	Côte d'Ivoire	Romania	Oman	Guyana	Guinea-Bissau
	Croatia	Russian Federation	Poland	Honduras	Haiti
	Dominican Republic	Rwanda	Portugal	India	Liberia
	Ecuador	Saudi Arabia	Qatar	Indonesia	Madagascar
	Egypt, Arab. Rep.	Senegal	Saudi Arabia	Iran, Islam Rep.	Malawi
	El Salvador	Sierra Leone	Singapore	Jamaica	Mali
	Equatorial Guinea	Solomon Islands	Slovak Republic	Jordan	Mozambique
	Eritrea	South Africa	Slovenia	Kazakhstan	Nepal
	Ethiopia	Sri Lanka	Spain	Kenya	Niger
	Fiji	Suriname	Sweden	Kyrgyz Republic	Rwanda
	Gabon	Swaziland	Switzerland	Laos	Senegal
	Gambia, The	Syrian Arab. Rep.	Taiwan	Lebanon	Sierra Leone
	Georgia	Taiwan	Trinidad and Tobago	Lesotho	Tanzania
	Ghana	Tajikistan	United Arab Emirates	Libya	Togo
	Guatemala	Tanzania	United Kingdom	Malaysia	Uganda
	Guinea	Thailand	United States	Maldives	Zimbabwe
	Guinea-Bissau	Togo	Uruguay	Mauritania	
	Guyana	Trinidad and Tobago		Mauritius	
	Haiti	Tunisia		Mexico	
	Honduras	Turkey		Moldova	
	Hong Kong SAR, China	Uganda		Mongolia	
	Hungary	Ukraine		Morocco	
	India	United Arab Emirates		Myanmar	
	Indonesia	Uruguay		Namibia	
	Iran, Islam Rep.	Venezuela, RB		Nicaragua	
	Jamaica	Vietnam		Nigeria	
	Jordan	Yemen, Rep.		Pakistan	
	Kazakhstan	Zambia		Papua New Guinea	
	Kenya	Zimbabwe		Paraguay	

Notes:
1/ The country group of Advanced Economies (AE) is consistent with IMF (2017).
2/ The income country groups are based on the World Bank definition.
Sources: IMF WEO and the World Bank.