Intelligence and Shadow Economy: a Cross-Country Empirical Assessment

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Abstract: This paper empirically assesses the influence of intelligence on a shadow economy, using data from 158 countries, over the period 1999-2007. The results provide strong evidence for the claim that intelligence is negatively associated with an underground economy. This paper establishes that, on average, a one standard deviation increase in IQ is associated with an 8.5 percentage point reduction in a shadow economy relative to GDP. The negative effect of intelligence remains intact when controlled for conventional antecedents of a shadow economy.

1. **Introduction**

Shadow economies have become a serious problem in developing countries, as they have been linked with crime (Schneider, 2004), drug dealing (Ardizzi et al., 2013) budget deficits (Dabla-Norris & Feltenstein, 2003) and human rights abuse (Donna, 2000). Naturally, rampant levels of shadow economies have deteriorating consequences for society as they lead to inefficient allocation of resources. Therefore, understanding the antecedents and effects of shadow economies has been an important object of research in social sciences, especially over the last decade (Schneider & Enste, 2000). While the usefulness of underground economy data is often dismissed by critics because of the complex, multidimensional concept involved, there is substantial empirical evidence that tax pressure, economic structure, political system and institutions are strong predictors of underground activities at the national level (e.g. Schneider, 2004).

With the publication of IQ data for a majority of the nations of the world by Lynn & Vanhanen (2002), some researchers have devoted particular attention to the contribution of intelligence to 'formal rules', political systems and stronger law enforcement (see e.g. Rinderman, 2008; Potrafke, 2012). While these studies seem to lend support to the idea that intelligence influences institutional quality, the relationship between intelligence and underground activities is another promising avenue of research. The aim of this study is to explore that relationship.

In this paper, we explore the effect of intelligence on shadow economies. Although many studies investigate the antecedents of shadow economies, 'blurred edges exist to this definition' (Williams, 2013 p.736)[1]. To that end we rely on Schneider's (2012 p. 6) widely used definitions of a shadow economy, i.e., 'all market-based legal production of goods and services that are deliberately concealed from public authorities'.

There are a number of reasons why intelligence may be negatively linked to shadow economies, the first of which is institutions. While greater degrees of bureaucracy and a weak legal system are associated with a larger underground economy (Friedman et al., 2000), there is evidence that efficiently functioning institutions supply motivation to behave legally and also raise the costs of underground activities. As suggested in a seminal work by Lipset (1960), informed agents are more likely to settle problems through institutions rather than through illegal behavior - and institutional outcomes are the function of these individual actions (Djankov et al., 2003). Indeed, Glaeser et al (2004), using data from more than 50 countries, find that human capital does seem to be factor enhancing institutional environment in the short run.

Potrafke (2012) uses the ordinary least squares (OLS) method to analyze the relationship between intelligence and corruption for the year 2010. He documents a statistically significant negative effect of IQ on corruption. Thus, countries with higher average individual intelligence have lower levels of corruption. More recently, Kanyama (2014), using data from 164 countries, shows a positive relationship between IQ, as a proxy for human capital, and institutions. Since a strong legal system demands higher human capital, we would expect that intelligence would decrease the size of a shadow economy.

[1] For discussion of the definitions of shadow economy see e.g. Pedersen (2003, pp. 13-19)

Another possible effect of intelligence on the size of informal economy is social capital. Extant literature identifies low degree of social capital and unethical behavior as principal causes of shadow economies. For example, lack of social trust has been linked to underground economies (D'Hernoncourt & Méon, 2012), tax morale (Torgler & Schneider, 2007) and rent-seeking (Crudeli, 2006). While informal activity and rent seeking may benefit the individual, economic agents engaged in informal activities have short time horizons. Based on these findings, we can argue that there is less underground activity in countries with a more intelligent population, because intelligent agents possess greater patience (Jones & Podemska, 2010), and are more willing to cooperate in favor of long-term rewards (Shamosh and Gray, 2008). Moreover, intelligence captures the level of social trust (Sturgis et al., 2010) instrumental to generate outcomes that are efficient for the public.

In addition, a shadow economy is also characterized by criminal activity, a behavior that has also been linked to cognitive skills. For example, Hirschi & Hindelang (1977) report that IQ is a statistically significant predictor of crime after controlling for other antecedents of criminal behavior. Other studies have documented that cognitive skills correlate negatively with antisocial behavior (Mõttus et al., 2012), serious assault (Rushton & Templer, 2009), and positively with risk aversion (Frederick, 2005) and moral behavior (Oesterdiekhoff, 2014).

The proposed link between intelligence and shadow economies is tested on a sample of 161 countries. The measure of underground economy is from Schneider et al (2010) and is represented by average size for 1999-2007. The results show that a 10 point increase in mean national IQ score is associated with 6.9 percentage point reduction in the size of informal economy. This negative effect of intelligence remains significant after controlling for conventional determinants of shadow economies. This paper is organized as follows. Section 2 presents data and methodology. Section 3 discusses the main results and Section 4 concludes the paper.

2. **Data and Methodology**

2.1. *Dependent variable*

The data on shadow economies is drawn from Schneider et al. (2010), who apply an MIMIC (Multiple Indicators Multiple Causes) estimation approach to calculate the size of shadow economy relative to GDP for 162 countries over the period 1999 - 2007.

2.2. Independent variables

The main independent variable is average national IQ score as a key proxy for national intelligence. The data on IQ test results is from Lynn & Vanhanen (2012). The data set is an updated version of that of Lynn & Vanhanen (2002) and contains national IQ scores for 190 nations of the world. For countries with missing data, IQ scores were recovered based on school achievement results or provincial data from neighboring regions with a similar culture.

In line with extant studies on the determinants of shadow economies, we use a set of control variables (Friedman et al., 2000; Dreher et al., 2009; Singh et al., 2012), namely GDP per capita and size of agricultural economy relative to GDP from WDI, democratic index from

Freedom House, government effectiveness (Kaufman et al., 2003), and fiscal burden from The Heritage Foundation. The descriptive statistics and variable descriptions are presented in Table 1. Table 2 provides the correlation between key variables.

(Table 1 about here)

(Table 2 about here)

Taking into account cross-sectional nature of the data, we estimate the following econometric model:

$$SE_i = \alpha + \beta IQ_i + X'\lambda + \varepsilon_i \qquad (1)$$

where SE is the size of informal economy in country I during 1999-2007, IQ is intelligence, X is a set of control variables suggested by the empirical literature, and ε represents possible error term. Throughout this paper, we use STATA 13 for our estimations.

3. Results

To demonstrate the association between shadow economy and intelligence, we present scatterplot between size of shadow economies relative to GDP and intelligence as measured by IQ scores. Figure 1 suggests that overall intelligence is negatively associated with informal economy. For example, the size of the shadow economy is low and intelligence is high in countries such as South Korea, Singapore, Japan and China.

(Figure 1 about here)

(Table 3 about here)

Table 3 presents econometric results for the shadow economy using IQ and the additional controls. Column 1 provides the results from estimating equation 1, where only intelligence is on the right hand side. As anticipated, intelligence has a negative effect on the size of a shadow economy. The coefficient is significant at a 1% level and indicates that if IQ increases by 10 points, the size of informal economy relative to GDP decreases by about 6.9 percentage points. In column 2, we include the level of economic development, measured by GDP per capita, in the regression. Both intelligence and GDP per capita are significant and negatively related to shadow economy. The significance level for intelligence remains unaffected, which indicates that intelligence, measured by IQ scores, seems to be an important determinant of underground economy after controlling for the level of per capita wealth.

In columns 3 and 4, we include democratic index and government effectiveness indicator. While correlation between these two indices is moderately high ($r = .652$), extant research suggests that they do not measure the same phenomena. We choose to control for democratic index and

government effectiveness in the same regression, as democracy restrains informal economy by 'plac[ing] the government under constant scrutiny' (Didia, 1997 p. 73), while government effectiveness captures the probability of being punished for rent-seeking behavior (Andvig & Moene, 1990). The results indicate that only government effectiveness is statistically significant at $p < .01$, demonstrating negative relationship with shadow economy. Intelligence preserves the same significance level as in previous columns.

Column 5 provides the results when fiscal variable is included in the regression: a measure of national tax burden is included as a proxy for fiscal regulation. The coefficient on the fiscal burden is positive and statistically significant throughout Table 3. This result is in line with previous literature showing that higher tax regulation decreases willingness to work within the official economy (Dreher & Schneider, 2010).

Finally, in Column 6, we include the size of agricultural economy relative to GDP. This variable is insignificant in the regression, while the coefficient for IQ and other determinants of shadow economy is qualitatively high.

Therefore, the findings in Table 3 indicate that intelligence is significantly related to national differences in the level of informal economy. Moreover, standardized betas in Column 7 show that the effect of intelligence on the size of informal economy is stronger relative to the impact of GDP per capita.

(Table 4 about here)

We run robustness tests in Table 4. In column 1 we present results that take into account feedback from a shadow economy's link with intelligence. As suggested by the literature, efficiently functioning markets create an environment promoting distribution of resources that encourage education and improved cognitive skills. On the other hand, countries with a high level of informal economy tend to see more human capital devoted to unproductive (rent-seeking) activities. To control for possible endogeneity, a possible simultaneity that is driven by unobserved factor correlated with intelligence and the size of shadow economy, we estimate equation (1) using an instrumental variable regression (IV) approach. We instrument intelligence by per capita dietary daily energy consumption from FAO Statistics (2010) and continental dummies from La Porta et al. (1999). The literature suggests that these variables correlated with intelligence but not with the residuals of regression (e.g. Kanayama, 2014). Instrumented intelligence is negatively and significantly related to shadow economy at $p < .05$. The coefficient is at the same magnitude, compared to Table 3. It is important to highlight that even after controlling for the endogeneity of intelligence; there is significant effect on underground economy.

Certain studies document that measurement of GDP in developing countries is 'plagued by serious measurement error' (Henderson et al., 2011 p. 194). For example, recent methodological improvements to calculate GDP in Sub-Saharan Africa led to substantial upward revisions of GDP per capita estimates for Ghana and Nigeria (Jerven, 2012). To address this issue, we rely on Henderson et al. (2012) to generate predicted GDP per capita by employing visible

light, byproduct from human activity, emitted from earth as captured by a series of US Air Force weather satellites. To estimate true GDP per capita we apply a weight of 0.5 to the official GDP per capita and a weight of 0.5 to the predicted GDP per capita from satellite data. In column 3, the alternative measure of income has significant effect on shadow economy. Its coefficient is negative and significant at $p < .01$. More specifically, a one standard deviation increase in true income (11 900 USD) results in a decrease in informal economy relative to GDP of 3.6 percentage points. The coefficient of intelligence remains intact.

Column 4 reports the results for LAD (median) regression. In cross-country studies OLS estimates may be inefficient and seriously influenced in the presence of outlier observations. While OLS regression minimizes the sum of the squares of the residuals, median regression minimizes the sum of the absolute residuals (Kroenker, 2006). Intelligence still has a negative effect on the size of underground economy.

4. Conclusion

This paper makes use of cross-country data on the size of shadow economies to provide a first estimate of the link between intelligence, measured by mean IQ scores, and underground economy. We document that intelligence has a statistically significant negative effect on underground economy. We also find that the results hold when we control for endogeneity of intelligence and for the presence of influential observation.

However, it is important to note that while estimates show that higher-IQ countries are negatively associated with the size of informal economy, they should not be treated as direct evidence that a more intelligent population is a prerequisite to constrain shadow economy. These results suggest that if a government implements policies designed to reduce underground economy, intelligence offers a reasonable estimate of the level of acceptance of these policies. Indeed, more intelligent individuals are more likely to vote in elections be more engaged civically (Schlozman, 2002). Better-educated electorates are more likely to recognize and penalize rent-seeking behavior (DelliCarpini & Keeter, 1996; Galston, 2001).

These findings are in line, for example, with Kanayama (2014), who reports that high-IQ population are associated with better institutions, and with Glaeser et al. (2007), who shows that education increases political participation and enhances political knowledge.

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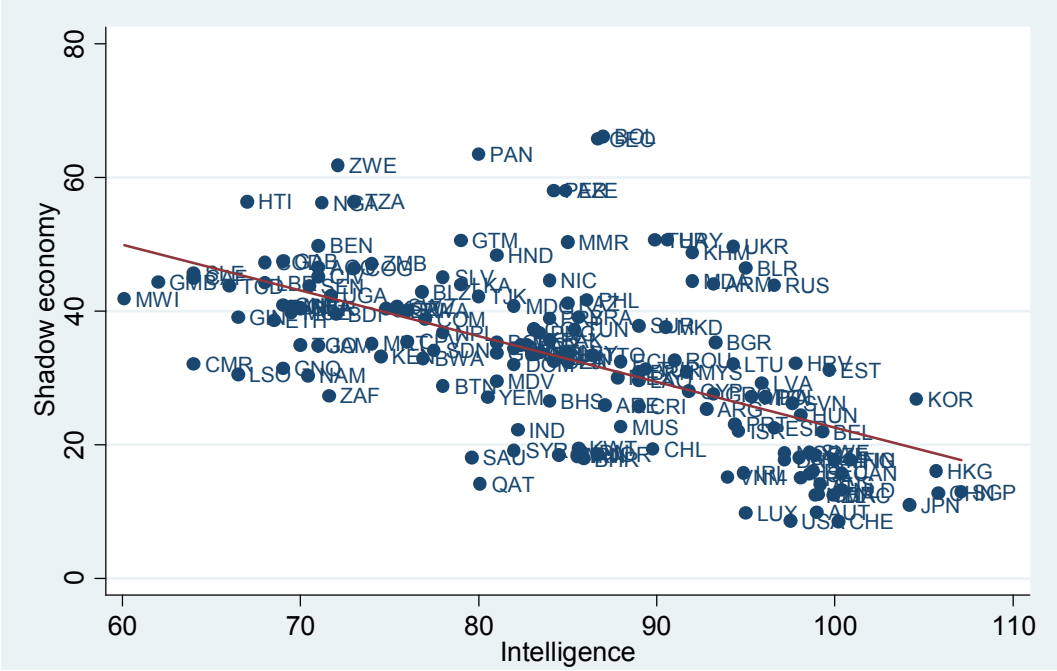
Table 1
Descriptive statistics

Variable	Description	Mean (Std.)
Shadow economy	The size of shadow economy relative to GDP, %	33.061 (12.809)
IQ	Average national IQ scores	84.102 (10.848)
GDP per capita	GDP per capita in 1999 in PPP, '000$	11.801 (17.836)
Democratic Index	Average of political rights and civil liberties	3.635 (1.940)
Government effectiveness	World Bank's government effectiveness index	-0.034 (1.014)
Fiscal burden	Tax burden index	66.281 (16.846)
Agriculture	Agriculture value added as % of GDP	15.086 (14.027)

Table 2
Correlation matrix

	I	II	III	IV	V	VI
Shadow economy	1					
IQ	-0.58	1				
GDP per capita	-0.62	0.52	1			
Democracy	-0.38	0.47	0.34	1		
Government effectiveness	-0.68	0.64	0.71	0.69	1	
Fiscal burden	0.27	-0.12	-0.06	-0.07	-0.19	1
Agriculture	0.48	-0.64	-0.60	-0.45	-0.65	-0.00

Figure 1
Shadow economy and IQ



Three letter ISO country codes are from World Bank

Table 3
IQ and the size of shadow economy: main results

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	OLS (6)	OLS Standardized betas (7)
IQ	-0.686***	-0.465***	-0.413***	-0.276***	-0.263***	-0.286***	-0.247***
	(0.061)	(0.076)	(0.096)	(0.093)	(0.095)	(0.107)	
GDP per capita		-0.278***	-0.277***	-0.145***	-0.189***	-0.185***	-0.240***
		(0.056)	(0.053)	(0.050)	(0.051)	(0.071)	
Democracy			-0.535	0.826	0.889	0.743	0.105
			(0.548)	(0.581)	(0.611)	(0.629)	
Government effectiveness				-5.868***	-5.452***	-5.582***	-0.422***
				(1.148)	(1.282)	(1.292)	
Fiscal Burden					0.111**	0.119**	0.148**
					(0.048)	(0.050)	
Agriculture						-0.049	-0.050
						(0.068)	
Constant	91.097***	76.485***	74.106***	55.722***	47.713***	50.462***	-
	(5.097)	(5.842)	(6.501)	(7.384)	(8.353)	(10.432)	
Number of countries	161	157	155	155	147	142	142
adj. R^2	0.349	0.483	0.472	0.524	0.549	0.558	0.558

Notes: The dependent variable is the size of shadow economy. Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1 percent level is denoted by ***; ** denotes significance at the 5 percent level; and * significance at the 10 percent level

Table 4
IQ and the size of shadow economy: robustness checks

	IV regression		OLS	LAD
	(1)	(2)	(3)	(4)
IQ	-0.309**	-0.266**	-0.249**	-0.287***
	(0.133)		(0.107)	(0.064)
GDP per capita	-0.179**	-0.229**	-0.300***	-0.179***
	(0.069)		(0.110)	(0.044)
Democracy	0.677	0.096	0.813	0.179
	(0.696)		(0.631)	(0.390)
Government Effectiveness	-5.434***	-0.409***	-5.377***	-5.144***
	(1.428)		(1.360)	(1.049)
Fiscal Burden	0.126**	0.157**	0.136***	0.078**
	(0.053)		(0.050)	(0.032)
Agriculture	-0.055	0.056	-0.026	-0.129**
	(0.068)		(0.069)	(0.053)
Constant	52.255***	-	46.386***	56.178***
	(12.284)		(10.162)	(6.389)
Number of countries	139	139	145	142
adj. R^2	0.531	0.531	0.533	

Notes: The dependent variable is the size of shadow economy. Column (2) reports standardized betas. Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1 percent level is denoted by ***; ** denotes significance at the 5 percent level; and * significance at the 10 percent level. See