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Summary

This paper replicates the Johnson et al.'s (1998) empirical analysis of the affects of regulatory discretion on the unofficial economy. The narrow replication uses the data set of the original study which comprises of 49 countries for the year 1997. The wide replication is performed in two ways. Firstly, I investigate the original authors' results using a larger data set of 162 countries and for a period from 1999 to 2007. Secondly, I use Arellano and Bond estimator to investigate the dynamics and causal effects. In both types of replications the results are similar to those in the original study. However, the estimates using Arellano and Bond estimator exhibit autocorrelation of order greater than 1 in the error term and are unable to pass the overidentifying restrictions test.

1. Introduction

Johnson, Kaufmann and Zoido-Lobatón (1998) (hereafter JKZ) tested three predictions of the theoretical model of Johnson, Kaufmann, and Andrei (1997). First, that greater regulation of economic activity leads to greater unofficial economy. Second, a higher tax burden, as perceived by economic agents, turned them away from the official sector. Third, that corruption complements the unofficial activity. Their findings, although supportive, were based on small sample (their full sample comprises of 49 countries which reduces to as low as 34 observations in some specifications). Moreover, it lacks coverage of East Asia and Africa, two biggest regions in terms of population and number of countries. This makes it difficult to tease out general conclusions from their analysis.

This paper replicates the analysis of JKZ both in narrow and wide sense. In wide replication, it employs a larger data set of 160 countries (country coverage varies from 119 to 160 countries in different estimations depending on the availability of right hand side variables). The wide replication not only tests the original relationship on a larger sample of countries (160 in total) but also for a different period (1999 to 2007). Unlike the original study, this study uses panel data set and also investigates the causal link between regulation and unofficial economy. The replication results are similar to the original analysis. However, the results from causality analysis are inconclusive.

The rest of the paper is divided as follows. The second section describes the data and methodology. Third and fourth sections detail the results of replication and causality analysis respectively, while the fifth section concludes.

2. Data and Methodology

Following the original study, I have estimated the following empirical relation:

$Unofficial_{it} = \alpha + \beta[Regulatory\ Discretion]_{it} + \gamma[Control]_{it} + \varepsilon_{it}$,

Where, $Unofficial_{it}$ denotes size of the unofficial sector as a percent of GDP for country i in the year t, α denotes the constant, and β is the coefficient, ε is the composite error term with usual

assumptions. The *Regulatory Discretion* is captured in three different ways: (a) through different measures of the business regulation; (b) by using different measures of tax burden; and (c) by the indices of the rule of law and corruption. Each of these variables is used in turn to estimate the above equation controlling for the per capita GDP.

The data for the unofficial economy is from Schneider *et al.* (2010). They provide the largest available panel data set on unofficial economic activities, covering 162 countries from 1999 to 2007. They estimate the size of the shadow economy relative to the official GDP using the DYMIMIC (dynamic multiple causes, multiple indicators) method[1]. For other explanatory variable, I have relied on various sources, attempting most of the time to come as close as possible to the measures considered in the original study[2].

3. Results[3]

Tables 1 (a and b) reproduce the results of JKZ using their data set[4]. The explanatory variables include Regulation1 (which is Heritage Foundation's business freedom index), Regulation2 (which is World Economic Forum's measure of regulatory discretion); Regulation3 (which is Political Risk Services Group's (PRSG) measure of bureaucratic quality); Regulation4 (which is Heritage Foundation's measure of overall economic freedom); Taxation1(which is World Economic Forum's (WEF) measure of tax burden); Taxation2 (which is Fraser institute's measure of marginal income tax rate); Leg Env1 (which is PRSG's measure of law and order); Leg Env2 (which is Heritage Foundation's measure of property rights); Leg Env3 (which is Fraser Institute's measure of equality of citizens before the law); Leg Env4 (which is World Governance Indicator's measure of the rule of law); Corruption1 (which is transparency international's index of corruption); Corruption2 (which is WEF's measure of bribes in the public sector); Corruption3 (which is Impulse's exporter bribery index); Corruption4 (which is

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[1] DYMIMIC method infers the size of the shadow economy from variables such as direct and indirect taxation, custom duties, government regulations, the rate of unemployment, growth rate of real GDP, and currency circulation. In order to calibrate absolute figures of the size of the shadow economies from the relative DYMIMIC estimation results, they used previous estimates derived using the currency demand method.
[2] Details of the data sources and definitions of the variables are given in Table A.
[3] All estimations use STATA version 11.
[4] The data set is available at
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:20701021~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

WGI's index of control of corruption); Corruption5 (which is PRSG's measure of public sector corruption).

The results tell us that more restrictive regulations from business point of view, increase the size of the shadow economy; greater tax burden is unsustainable with larger size of shadow economy; more effective law and order implementation helps attract economic activity in official sector; and public sector corruption has a negative affect on business decisions and positive on the size of the unofficial sector. These tables mimic the results of Tables 1 and 2 in JKZ study.

The results of wide replication, which uses panel data, are shown in tables 2 (a and b) and 3 (a and b). Following the recommendation of Beck and Katz (1995) we reported panel corrected standard errors which are robust against heteroskedasticity and autocorrelation[5]. In table 2a, I have used two measures of regulation (*Regulation3* and *Regulation5*). The Regulation3 is similar to JKZ whereas Regulation5 is a new measure. My results, like those of JKZ, indicate a negative relation between the quality of governance and the size of the unofficial economy (columns 2a.1 and 2a.2). In the next two columns (2a.3 and 2a.4) I have used two measures of taxation (*Taxation2* and *Taxation3*). The *Taxation2* is similar to JKZ whereas *Taxation3* is a new measure. The coefficients on these measures of taxation are positive and significant indicating, as in JKZ, that larger size of the shadow economy is not sustainable with lower tax rates.

In table 2b, I have presented the results of the affect of legal environment (*Leg Env1* and *Leg Env2*) on the unofficial economy using two measures of legal environment. The first measure (*Leg Env1*) is similar to JKZ measure of law and order. Results indicate negative and significant impact of good legal environment on the unofficial economy (columns 2b.1 and 2b.2).

In table 2b columns (2b.3 and 2b.4), I have employed two measures of corruption (*Corruption1* and *Corruption2*). Higher values of these indices are associated with lower corruption. Our results indicate that lower the corruption, lower the size of the unofficial economy.

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[5] We do not use individual specific fixed effects because there is not enough within variation in the variables of our sample, in particular the size of the shadow economy.

4. Causality Analysis

As an extension of the analysis of the JKZ, I try to identify the causal impact of the regulatory discretion on the shadow economy. Given the difficulties in finding the instruments for all the three sets of our variables, I use Arellano and Bond (1991) estimator which uses the own past values of the endogenous regressors as instruments.

Tables 3(a and b) show the results. The two crucial assumptions of Arellano and Bond estimator are the absence of serial correlation in the error term beyond order 1 and the validity of the overidentifying restrictions. The bottom panel of the table provides test hypothesis on these two assumptions. As is clear from the table, in most of the cases there exists serial correlation beyond order one. While Sargan test clearly indicates that overidentyfying restrictions are not valid. Although the coefficients of our regressions are in line with the earlier findings but failure to satisfy the assumptions of the Arellano and Bond estimator do not permit a valid inference[6].

Conclusions

I have replicated and reinvestigated the relationship between regulatory discretion and the size of the unofficial economy. In this respect, the paper endorses the findings of JKZ and adds two important dimensions to their results. First, it produces the same results using a much larger data set than original authors thus filling the important gap in terms of country coverage. Secondly, the paper attempts to establish a causal connection between the relationships proposed by original authors. The results of the causal analysis using Arellano and Bond estimator suffer from weak instrument and serial correlation problems. A more rigorous causal analysis could be an important motivation for future research in this area.

References

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[6] Inclusion of 2 or more lags of the dependent variable on the right hand side eliminates autocorrelation in some cases but it does not affect the outcome of the overidentifying restriction test.

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Table A. Data Description

Code	JKZ Data (for the year 1997)	Panel Data (for 1999-2007)
	Description	
Regulation1	**Business Freedom Heritage:** It is a measure of the ability to start, operate, and close a business that represents the overall burden of regulation as well as the efficiency of government in the regulatory process. High scores indicate freer business environment. Source. Heritage Foundation's Economic Freedom Index.	
Regulation2	**Regulatory discretion:** World Economic Forum's (WEF) measure of regulatory discretion. Higher values indicate lesser regulatory discretion. Source Johnson et al. (1998) data.	
Regulation5		**Regulation Quality:** It captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Source World Governance Indicators.
Regulation3	**Bureaucratic quality:** A measure of institutional strength and quality of the bureaucracy. High points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. Source International Country Risk Guide Services and The Political Risk Services Group	
Regulation4	**Economic Freedom:** It is a measure of the ability to start, operate, and close a business that represents the overall burden of regulation as well as the efficiency of government in the regulatory process. High scores indicate freer business environment. Source. Heritage Foundation's Economic Freedom Index.	
Taxation1	Tax burden: WEF's measure of tax burden. A higher value means lesser burden. Source. Johnson et al. (1998) data.	

Taxation2	**Marginal Income Tax Rate**: Fraser institute's measure of marginal income tax rate. It assigns lower ratings to countries with higher tax rates at lower income brackets.	
Taxation3		**Fiscal Freedom Heritage:** It measures tax burden imposed by the government. It includes both the direct tax burden in terms of top tax rates on individual and corporate incomes and the overall amount of tax revenue as a percentage of GDP. Source. Heritage Foundation, www.heritage.org/index/about
Leg Env1	**Law and Order:** It is a measure of two components 'law' and 'order'. The law subcomponent is an assessment of the strength and impartiality of the legal system, while the order subcomponent is an assessment of popular observance of the law. Higher values indicate greater law and order effectiveness. Source. International Counry Risk Guide Services and The Political Risk Services Group. www.prsgroup.com	
Leg Env2	**Property Rights:** It is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully forces by the state. Source. Heritage Foundation, www.heritage.org/index/about	
Leg Env3	**Equality of citizens before the law**: Fraser institute's measure of civil liberties and political rights. Higher scores indicate greater rights and liberties. Source. Johnson et al. (1998).	
Leg Env4		**Rule of Law:** It captures the perception of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Source World Governance Indicators, World Bank
Corruption1	Transparency international's index for corruption perceptions. Higher values indicate lesser corruption.	

	Source. Johnson et al. (1998).	
Corruption2	Bribery Index: World Economic Forum's survey based measure of bribes in public sector. Higher scores correspond lower corruption. Source. Johnson et al. (1998).	
Corruption3	Impulse's exporter bribery index: Incidence of bribery in public sector in foreign country as reported by German traders and investors abroad. Source. Johnson et al. (1998).	
Corruption4		Corruption Control: It captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of state by the elites and private interests. Source. World Governance Indicators, World Bank.
Corruption5		Corruption ICRG: It is an assessment of the corruption within the political system. Higher values indicate lower corruption. Source. International Country Risk Guide Services and The Political Risk Services Group. www.prsgroup.com

Table 1a. Unofficial economy, regulation, and taxation (JKZ data)

Independent Var.	1a.1	1a.2	1a.3	1a.4	1a.5	1a.6
Regulation1[b]	8.060***					
	(2.057)					
Regulation2[a]		-2.913				
		(2.941)				
Regulation3[a]			-7.728***			
			(2.459)			
Regulation4[a]				-0.363		
				(0.884)		
Taxation1[a]					-6.485***	
					(1.887)	
Taxation2[a]						1.901***
						(0.686)
GDP pc log	-7.273***	-7.425**	-1.040	-7.421***	-7.304***	-6.987***
	(1.162)	(3.137)	(2.942)	(2.737)	(1.537)	(1.320)
Observations	47	34	39	43	34	42
R-square	0.615	0.598	0.654	0.440	0.680	0.572

Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; [a] A higher value of this variable means better outcome for private business; [b] A higher value of this variable means worse outcome for private business. Constant is included but not reported

Table 1b. Unofficial economy, legal environment, and corruption (JKZ data)

Independent Var.	1b.1	1b.2	1b.3	1b.4	1b.5	1b.6
Leg Env1[a]	-9.307***					
	(2.385)					
Leg Env2[b]		8.023**				
		(3.527)				
Leg Env3[a]			-2.328***			
			(0.656)			
Corruption1[a]				-3.482***		
				(1.061)		
Corruption2[a]					-3.881*	
					(2.197)	
Corruption3[b]						0.828*
						(0.451)
GDP pc log	-1.850	-4.785*	-5.227***	-3.999*	-5.807*	-6.464***
	(2.031)	(2.378)	(1.583)	(1.997)	(3.262)	(2.122)
Observations	39	47	43	43	34	44
R-square	0.781	0.584	0.603	0.605	0.627	0.512

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; [a] A higher value of this variable means better outcome for private business; [b] A higher value of this variable means worse outcome for private business. Constant is included but not reported.

Table 2a. Unofficial economy, regulation, and taxation; (Panel data 1999-2007)

Independent Var.	2a.1	2a.2	2a.3	2a.4
Regulation3	-5.375***			
	(0.211)			
Regulation5		-4.046***		
		(0.258)		
Taxation2			0.967***	
			(0.040)	
Taxation3				0.172***
				(0.013)
GDP pc log	-2.831***	-3.695***	-7.228***	-6.232***
	(0.180)	(0.176)	(0.108)	(0.057)
Observations	1160	1083	862	1291
No. of countries	132	158	118	150
R-square	0.503	0.446	0.467	0.445
χ^2 (p-value)	0.000	0.000	0.000	0.000

Panel Corrected Standard Errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
Constant is included but not reported.

Table 2b. Unofficial economy, legal environment, and corruption;(Panel data 1999-2007)

Independent Var.	2b.5	2b.6	2b.7	2b.8
Legal Env1	-3.399***			
	(0.222)			
Legal Env4		-7.103***		
		(0.251)		
Corruption4			-6.051***	
			(0.262)	
Corruption5				-2.832***
				(0.359)
GDP pc log	-4.253***	-1.888***	-2.500***	-4.992***
	(0.162)	(0.167)	(0.163)	(0.211)
Observations	1160	1083	1083	1160
No. of countries	132	158	158	132
R-square	0.498	0.531	0.514	0.469
χ^2 (p-value)	0.000	0.000	0.000	0.000

Panel Corrected Standard Errors in parenthesis; *** p<0.01, ** p<0.05, * p<0.1;
Constant is included but not reported.

Table 3a. Unofficial Economy, regulation, and taxation.

Arellano and Bond Estimator (panel data 1999-2007)

Independent Var.	(3a.1)	(3a.2)	(3a.3)	(3a.4)
Lag unoff eco	0.804***	0.458***	0.655***	0.669***
	(0.088)	(0.102)	(0.090)	(0.104)
GDP pc log	-2.451***	-4.430***	-3.323***	-3.061***
	(0.514)	(0.560)	(0.539)	(0.601)
Regulation3	-0.508***			
	(0.137)			
Regulation5		-0.379***		
		(0.142)		
Taxation2			0.024	
			(0.017)	
Taxation3				0.007**
				(0.003)
Observations	901	768	743	994
No. of countries	132	158	117	149
Arellano-Bond Test of	0.001	0.290	0.002	0.001
AR(2) p-value	0.040	0.720	0.285	0.042
Sargan test (p-value)	0.000	0.012	0.000	0.000
No. of instruments	28	19	25	28

Robust standard errors in parentheses;*** $p<0.01$, ** $p<0.05$, * $p<0.1$;
Constant is included but not reported.

Table 3b. Unofficial Economy, legal environment, and corruption.

Arrelano and Bond Estimator (panel data 1999-2007)

Independent Var.	(3b.1)	(3b.2)	(3b.3)	(3b.4)
Lag Unofficial Eco.	0.871***	0.493***	0.783***	0.482***
	(0.093)	(0.104)	(0.108)	(0.102)
GDP pc log	-2.097***	-4.216***	-2.686***	-4.317***
	(0.546)	(0.583)	(0.664)	(0.576)
Legal Env1	-0.230**			
	(0.111)			
Legal Env4		-0.534***		
		(0.196)		
Corruption5			-0.128*	
			(0.066)	
Corruption4				-0.295***
				(0.105)
Observations	901	768	901	768
No. of countries	132	158	132	158
Arellano-Bond Test of	0.001	0.190	0.000	0.202
AR(2) p-value	0.028	0.605	0.042	0.589
Sargan test (p-value)	0.000	0.000	0.000	0.000
No. of instruments	28	19	28	19

Robust standard errors in parentheses;*** $p<0.01$, ** $p<0.05$, * $p<0.1$;
Constant is included but not reported.