

Social capital and the shadow economy: a Bayesian analysis of the BRICS

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Abstract

Purpose – The paper aims to examine the impact of social capital on the size of the shadow economy in the BRICS countries over the period 1995–2014.

Design/methodology/approach – The authors employ the Bayesian linear regression method to uncover the relationship between social capital and the shadow economy. The method applies a normal distribution for the prior probability distribution while the posterior distribution is determined using the Markov chain Monte Carlo technique.

Findings – The results indicate that the unemployment rate and tax burden positively affect the size of the shadow economy. By contrast, corruption control and trade openness are negatively associated with the development of this informal sector. Moreover, the paper's primary finding is that social capital represented by social trust and tax morale can hinder the size of the shadow economy.

Research limitations/implications – This study is limited to the case of the BRICS countries for the period 1995–2014. The determinants of the shadow economy in different groups of countries can be heterogeneous. Moreover, social capital is a multidimensional concept that may consist of various components. This difficulty of measuring the social capital calls for further research on the relationship between other dimensions of social capital and the shadow economy.

Originality/value – Many studies investigate the effect of economic factors on the size of the shadow economy. This paper applies a new approach to discover the issue. Notably, the authors use the Bayesian linear regression method to analyze the relationship between social capital and the shadow economy in the BRICS countries.

Keywords Bayesian approach, BRICS, Shadow economy, Social capital

Paper type Research paper

1. Introduction

The shadow economy happens in many countries and can cause significant impacts on the economic performance. Notably, findings by [Medina and Schneider \(2019\)](#) indicate that the average shadow economy size of 157 countries between 1991 and 2017 is 30.9% of gross domestic product (GDP). Overall, the size of the informality is significant in countries such as Bolivia and Georgia with 62.9 and 61.7% of GDP, respectively. By contrast, the shadow



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economy is much lower in countries such as Switzerland and the USA with an average value of 6.4 and 7.6% of GDP, respectively. Moreover, previous literature suggests that the informal sector is associated with the economic growth, although authors disagree whether the relationship is positive or negative (Asea, 1996; Goel *et al.*, 2019; Baklouti and Boujelbene, 2019; Nguyen and Duong, 2021). Other studies reveal that the shadow economy can harm the tax revenue collection (Kodila-Tedika and Mutascu, 2014; Mazhar and Méon, 2017; Ishak and Farzanegan, 2020).

Since the shadow economy plays a crucial role in various countries worldwide, it is essential to identify factors that affect the informal sector. Findings from studies on this issue can help provide recommendations for governments to adopt appropriate policies. Many authors indicate that economic factors such as the unemployment rate, corruption, tax burden and trade openness can be associated with the size of the shadow economy (Schneider, 2005; Fugazza and Fiess, 2010; Buehn and Schneider, 2012; Mauleón and Sardà, 2017).

Meanwhile, other authors suggest that it is vital to examine the impact of the psychological and social dimensions on economic phenomena (Arrow, 1970, 1973; Torgler, 2003; Feld and Frey, 2007). Notably, Arrow (1970, p. 20) argues that there exists “a whole set of customs and norms which might be similarly interpreted as agreements to improve the efficiency of the economic system (in the broad sense of satisfaction of individual values) by providing commodities to which the price system is inapplicable.” Indeed, some studies show that this dimension can significantly affect the size of the shadow economy in many countries, even after controlling different influences (Torgler and Schneider, 2009; D’Hernoncourt and Méon, 2012; Lee, 2013; Williams and Horodnic, 2015).

The study, therefore, aims to examine the effect of social capital on the shadow economy using a sample of the BRICS countries between 1995 and 2014. In addition to the primary explanatory variable, we also discover the impact of control variables, including the unemployment rate, corruption control, tax burden and trade openness. The Bayesian linear regression will be applied to investigate this relationship. The BRICS was formalized in 2006 and included five countries: Brazil, Russia, India, China and South Africa. Together, they make up more than 40% of the world’s population and are important drivers for global economic growth. According to Medina and Schneider (2019), the average shadow economy size of the BRICS is approximately 27.98% of GDP during this period.

The remainder of the paper is constructed as follow. Section 2 presents the literature review. Section 3 describes the models, data, methodology and correlation analysis. In Section 4, we perform a robust check for our findings and report the empirical results. The paper ends with some concluding remarks.

2. Related literature

2.1 Definition and theoretical considerations

Before analyzing the effect of social capital on the shadow economy, it is helpful to mention the definition of social capital and the shadow economy. Insightful thoughts about social capital are addressed in Arrow (1999), a collection of papers on the definitions and applications of social capital. Arrow (1999, p. 4) claims that “The term ‘capital’ implies three aspects: (1) extension in time; (2) deliberate sacrifice in the present for future benefit; and (3) alienability.” On the other hand, Leonardi *et al.* (2001) argue that social capital is the characteristics of social organization, including trust, norms and networks that can enhance social efficiency.

Meanwhile, although many studies have investigated this informal sector, there are disagreements about the definition of the shadow economy. According to Smith (1994, p. 18), the shadow economy can be defined as “market-based production of goods and services, whether legal or illegal, that escapes detection in the official estimates of GDP.” Meanwhile,

Dell'Anno (2007) suggests that the shadow economy is a nonobserved sector and contains underground production, informal production and illegal production. Medina and Schneider (2019) posit that the shadow or informal economy includes “all economic activities which are hidden from official authorities for monetary, regulatory, and institutional reasons” (Medina and Schneider, 2019, p. 4). This paper employs the definition suggested by Medina and Schneider (2019).

Moreover, to investigate the research objective, we follow a principal–agent framework based on Aidt (2003), Bjørnskov (2010) and Lee (2013). Specifically, Aidt (2003) constructs an agency model of corruption for collecting taxes. The author states that a tax collector can be willing to accept a bribe if the expected benefit is higher than the return to honest reporting. Meanwhile, Bjørnskov (2010) introduces the bureaucratic mechanism that examines the tradeoff among wages w , bribes B , an outside option, w_{out} , and a moral cost m under an assumption that decision-makers are risk-neutral. Accordingly, bribes are likely to occur if:

$$(1 - \lambda)(w + B) + \lambda w_{\text{out}} - m > w$$

Hence, the amount of bribe given a level of m is:

$$B > \frac{\lambda}{1 - \lambda}(w - w_{\text{out}}) + \frac{1}{1 - \lambda}m$$

Based on previous frameworks, Lee (2013) indicates that

$$\frac{\partial S}{\partial C} = \frac{\partial S}{\partial F} \frac{\partial F}{\partial C}$$

where:

S is the estimated size of the shadow economy

C is the intrinsic moral cost related to social capital

F is the probability that an economic activity, being corrupted, is in the shadow economy

The author shows that $\frac{\partial S}{\partial F}$ is positive and $\frac{\partial F}{\partial C}$ is negative, and thus $\frac{\partial S}{\partial C}$ is negative. This implies that if other things equal, an increase in social capital can reduce the size of the shadow economy in a country.

The above studies suggest that moral factors, including social capital, can be associated with the size of the shadow economy. We, therefore, explore this relationship for the BRICS countries in the following sections.

2.2 The determinants of the shadow economy

Various authors believe that the psychological and social dimension can have a significant impact on individual behavior as well as economic phenomena. Different empirical studies have also shown that agents care about positive/negative reciprocity, trust, fairness and distribution. For example, Fehr and Schmidt (1999) and Houser and McCabe (2014) indicate that many ultimatum agents offer between 40 and 50% of the endowment and the smaller the offer, the higher the likelihood that the proposers will reject. Likewise, Engel (2011) reports that the average offer in the dictator game experiment is approximately 28.35% of the total sum. Indeed, Thaler (2000, p. 140) claims that “As economists become more sophisticated, their ability to incorporate the findings of other disciplines such as psychology improves.”

The study of the determinants of the shadow economy should be no exception from the above arguments. Previous literature analyzes the effect of economic factors such as the unemployment rate, corruption, tax burden and trade openness. For example, Buehn and

Schneider (2012) analyze the effect of corruption on the size of the shadow economy using data from 51 countries over the 2000–2005 period. The authors report that corruption can increase the size of the shadow economy because bureaucrats may receive a bribe to ignore activities in the informal sector. Mauleón and Sardà (2017) investigate the relationship between the unemployment rates and the size of the shadow economy in different countries. The authors indicate that this relationship is significantly relevant in Greece and Spain, where the unemployment rates are high. For countries with moderate unemployment rates, such as Germany and Italy, they are less relevant.

Fugazza and Fiess (2010) reveal that while macrofounded data supports the conventional view, namely that trade liberalization can lead to an increase in the informality, microfounded data seems not to support such a view. Similarly, Birinci (2013) examines a sample of 12 advanced economies for the period from 1964:1 to 2010:4. The author indicates that the relationship between trade openness and the size of the informality is inconclusive. Schneider (2005) investigates a sample of 110 developing, transition and OECD countries. The author claims that the main drivers for the size and growth of the shadow economy are the tax burden, social security payments and the regulatory activities of the state. Likewise, Schneider *et al.* (2015) analyze data from the European Union countries between 2003 and 2014 and report that one major driving force of the shadow economy is the indirect taxes.

Regarding this issue, some studies have examined the motivation for citizens to comply or evade taxes. Notably, Torgler (2003) analyzes the effect of trust using data from the World Values Survey (WVS) and the Taxpayers Opinion Survey. The author indicates that trust in the officials and the legal system can enhance the tax compliance of citizens. Feld and Frey (2007, p. 104) state that individuals may consider the tax payments “as contributions to the bonum commune.” Hence, if they believe that the political process is fair and the policy outcomes are legitimate, they are more willing to comply with taxes, even if their benefits from the public good are not equivalent to their tax payments. In fact, Arrow (1973) posits that there exist situations where economic agents may forgo their own profit or other benefits to achieve certain social goals, especially to avoid detrimental to other people.

On the other side, Torgler and Schneider (2009) investigate the relationship between tax morale, institutional quality and the shadow economy. The authors reveal that tax morale and institutional quality are negatively associated with the shadow economy, even after controlling various potential factors. Meanwhile, D’Heroncourt and Méon (2012) examine the impact of social trust on the size of the shadow economy using a sample of 62 countries. They claim that social trust is adversely related to the shadow economy, and the results are robust even when controlling various influences such as economic, policy and institutional variables. The authors also show that this connection seems more significant for developing countries than for developed countries.

Likewise, Lee (2013) analyzes a sample of 65 countries between 1999 and 2007 to uncover the relationship between social capital and the shadow economy. The author posits that two important indicators of social capital are social trust and social norms (i.e. tax morale). Particularly, Lee (2013) reveals that both social trust and tax morale have a detrimental effect on the size of the shadow economy. Moreover, the study indicates that social networks are not significantly related to the size of the shadow economy. Williams and Horodnic (2015) discover the relationship between tax morale and the shadow economy in the Baltic states, namely Estonia, Lithuania and Latvia. They suggest that a decline in tax morale increases the likelihood that individuals participate in the shadow economy.

Based on the results of previous studies, we construct the following research hypotheses:

- H1. Social capital is negatively associated with the size of the shadow economy.
- H2. Unemployment is positively associated with the size of the shadow economy.

H3. Control of corruption is negatively associated with the size of the shadow economy.

H4. Tax burden is positively associated with the size of the shadow economy.

H5. Trade openness is positively associated with the size of the shadow economy.

3. Methodology and model specification

3.1 Model

To test the hypotheses, we propose the following model:

$$\text{Shadow economy} = \alpha + \beta_1 \text{Social capital} + \beta_2 \text{Unemployment} + \beta_3 \text{Control of corruption} \\ + \beta_4 \text{Tax burden} + \beta_5 \text{Trade openness} + \varepsilon \quad (1)$$

In this paper, social capital is the primary explanatory variable. As suggested by [Lee \(2013\)](#), we use two measures of social capital, which are social trust and tax morale.

Thus, model 1 is written into models 2 and 3 as follows:

$$\text{Shadow economy} = \alpha + \beta_1 \text{Social trust} + \beta_2 \text{Unemployment} + \beta_3 \text{Control of corruption} \\ + \beta_4 \text{Tax burden} + \beta_5 \text{Trade openness} + \varepsilon \quad (2)$$

$$\text{Shadow economy} = \alpha + \beta_1 \text{Tax morale} + \beta_2 \text{Unemployment} + \beta_3 \text{Control of corruption} \\ + \beta_4 \text{Tax burden} + \beta_5 \text{Trade openness} + \varepsilon \quad (3)$$

Social trust is the respondents' response rate who answered that "most people can be trusted". [D'Hernoncourt and Méon \(2012\)](#), [Lee \(2013\)](#) use social trust in their studies. Meanwhile, tax morale is measured by societal attitudes toward tax evasion, which is the proportion of respondents who answered that cheating on taxes could not be justifiable. [Torgler and Schneider \(2009\)](#), [Enste \(2010\)](#) and [Lee \(2013\)](#) use tax morale in their empirical analysis.

We collect social capital data from the WVS, which provides data on cultural, social and political changes worldwide. In these surveys, the survey question about social trust is "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" The possible answers are "Most people can be trusted", "Don't know" and "Can't be too careful." In this paper, we use the percentage of people who agree with the statement "Most people can be trusted" to measure the BRICS countries' social trust.

Meanwhile, the social attitudes toward cheating on taxes are measured from 1 to 10, where 1 indicates that cheating on taxes is never justifiable and 10 is always justifiable. A general question to assess tax morale is "Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between: . . . Cheating on tax if you have the chance." As [Torgler and Schneider \(2009\)](#) suggested, we will re-encode the scale for tax morale variables to facilitate discussion (i.e. the value of 10 becomes 1 and vice versa). Thus, the value of 1 means that cheating on tax is always justified, and 10 indicates that tax fraud is never justifiable (see [Table 1](#)).

The shadow economy represents a percentage of the official GDP. We collect data on the size of the shadow economy from [Medina and Schneider \(2019\)](#). In this study, [Medina and Schneider \(2019\)](#) use multiple indicator-multiple causes (MIMIC) to estimate the size of the shadow economy.

Moreover, we consider a broad set of control variables commonly used in the shadow economy literature, namely unemployment, control of corruption, tax burden and trade

openness (Schneider, 2005; Torgler and Schneider, 2009; Fugazza and Fiess, 2010; Buehn and Schneider, 2012; Lee, 2013; Mauleón and Sardà, 2017). Notably, unemployment is the unemployment rate, calculated as a percentage of the total labor force. We obtain this index from the World Bank’s World Development Indicators (WDI).

Control of corruption is measured by the Corruption Perceptions Index (CPI). The CPI defines corruption as “the abuse of public power for self-interest.” (Heywood, 2014). The CPI is collected from Transparency International’s annual report.

Meanwhile, the tax burden is a measure of the tax burden imposed by the governments and calculated as a percentage of GDP. We collect tax burden data from the Heritage Foundation. Finally, trade openness is the sum of imports and exports normalized by GDP. Data on trade openness is obtained from the WDI of the World Bank.

3.2 Methodology

This paper employs the Bayesian linear regression to estimate the effect of social capital on the size of the shadow economy in the BRICS countries. Unlike the frequentist approach, the Bayesian approach assumes that all parameters are random (Kruschke *et al.*, 2012; Thach, 2021). The Bayesian inference is performed based on the Bayes’ theorem.

$$p(\theta|D) = p(D|\theta) p(\theta) / p(D)$$

where D is the observed data and θ is a vector of parameters in the descriptive model. The posterior distribution, $p(\theta|D)$, specifies the relative credibility of every combination of parameters given the data. $p(D|\theta)$ is the marginal likelihood function, $p(\theta)$ is the prior distribution of the hypothesis and $p(D)$ is the probability of the data.

Because we are facing a small sample of data (the observations is 100), the use of uninformative *a priori* can cause a Type I error or a Type M error. Therefore, to obtain a balanced posterior regression model, Lemoine (2019) suggests using weak information *a priori*. Specifically, we perform simulations with a generic weakly informative prior: normal (0, 1). Normal prior distribution has been used in previous studies (Nguyen and Duong, 2021, 2022; Oanh *et al.*, 2022). Furthermore, the Markov chain Monte Carlo (MCMC) method using the Gibbs sampling algorithm will determine the posterior distribution. Finally, the Bayesian inference is robust if the MCMC converges (Cowles and Carlin, 1996) and the sampling is effective (Nguyen and Duong, 2021, 2022; Thach, 2021).

Variables	Proxy for	Sources
<i>Dependent variable</i>		
Shadow economy	The size of the shadow economy (% of “official” GDP)	Medina and Schneider (2019)
<i>Independent variables</i>		
Social trust	Share of people agreeing with the statement “most people can be trusted”	World value survey
Tax morale	Cheating on taxes (scale of 1–10, where 1 is always justifiable and 10 is never justifiable)	World value survey
<i>Control variables</i>		
Unemployment	Unemployment rate (% of total labor force)	World bank
Control of corruption	Corruption perceptions index (scale of 0–100, where 0 is highly corrupt and 100 is very clean)	Transparency international
Tax burden	Tax burden (% of GDP)	Heritage foundation
Trade openness	Trade (% of GDP)	World bank

Table 1.
Descriptions of
variables and sources
of data

3.3 Descriptive statistics

We collect panel data of five BRICS countries from 1995 to 2014. Table 2 presents the descriptive statistics of the shadow economy and the primary independent variables (social capital), that is, social trust and tax morale, for all countries in the sample. Among the BRICS countries, the size of the shadow economy in China is the lowest, that is, 13.94% of GDP, while Russia has the largest size of the shadow economy (39.59% of GDP). For social capital variables, China is a country with the highest social trust (53.13%) and the highest tax morale (8.17). By contrast, Brazil has the lowest social trust (6.37%) as well as the lowest tax morale (6.75).

3.4 Correlation analysis

Table 3 describes the Pearson Bayesian correlation matrix among the variables in the research models. Moreover, we present the 95% credible intervals of the correlation coefficient in parentheses. The results indicate that the size of the shadow economy and social capital are inversely correlated. The correlation coefficient between the shadow economy and social trust is -0.717 , while the correlation coefficient between the shadow economy and tax morale is -0.642 . Also, Table 3 shows a positive correlation between the size of the shadow economy and the unemployment rate and between the size of the shadow economy and tax burden. In contrast, the relationships between the size of the shadow economy and control of corruption and between the size of the shadow economy and trade openness are negative.

4. Empirical results

4.1 Convergence tests

In the Bayesian analysis, the main concern to consider with MCMC sampling is convergence (Gelman and Rubin, 1992; Kruschke et al., 2012; Thach, 2021). The convergence Markov chains have fully explored targeted posterior distribution. This paper employs the

Table 2. Shadow economy and social capital in the sample

Variables	Brazil	Russia	India	China	South Africa	BRICS
Shadow economy	36.51	39.59	23.66	13.94	26.23	27.98
Social trust	6.37	25.20	27.28	53.13	17.47	27.57
Tax morale	6.75	6.89	7.88	8.17	7.13	7.43

Table 3. Bayesian correlation matrix

	Shadow economy	Social trust	Tax morale	Unemployment	Control of corruption	Tax burden	Trade openness
Shadow economy	-						
Social trust	-0.717 (-0.803; -0.587)	-					
Tax morale	-0.642 (-0.744; -0.494)	0.591 (0.425; 0.709)	-				
Unemployment	0.123 (-0.075; 0.307)	-0.421 (-0.575; -0.223)	-0.290 (-0.463; -0.086)	-			
Control of corruption	-0.220 (-0.395; -0.023)	-0.285 (-0.464; -0.073)	-0.059 (-0.259; 0.149)	0.729 (0.613; 0.806)	-		
Tax burden	0.521 (0.356; 0.646)	-0.173 (-0.367; 0.042)	-0.358 (-0.520; -0.160)	-0.348 (-0.504; -0.160)	-0.393 (-0.542; -0.208)	-	
Trade openness	-0.190 (-0.368; 0.007)	0.243 (0.030; 0.427)	-0.051 (-0.251; 0.156)	0.359 (0.172; 0.513)	0.093 (-0.105; 0.281)	-0.092 (-0.279; 0.105)	-

Note(s): 95% credible intervals in parentheses

convergence diagnostic using Gelman–Rubin’s R_c statistics (Gelman and Rubin, 1992), a standard test that applies multiple chains. It compares variance between chains and variance within chains. Table 4 reports that Gelman–Rubin’s R_c statistics of all parameters in models 2 and 3 are lower than 1.2; therefore, the Markov chains converge to the target distribution.

4.2 Effective sample size

Along with convergence, we also consider stability when performing the Bayes regression analysis. The stability of the estimates is determined by the effective sample size (ESS). It reports the total number of independent MCMC samples from the total number of MCMC samples. As this value approaches the sum, the autocorrelation will become lower, which indicates the estimates’ stability and accuracy.

Table 5 shows the lowest ESS of 26,333 and the highest ESS of 30,000 for the posterior parameters. Simultaneously, all parameters’ efficiency indexes are above 0.01. Hence, the MCMC algorithm achieves sampling efficiency (Roberts and Rosenthal, 2001).

The above results on the convergence diagnostics and the ESS test reveal that the Bayesian inference is stable.

4.3 Parameter estimates

Table 6 presents the posterior simulation results of models 2 and 3 using the Bayesian linear regression method. Notably, we find a strong relationship between social capital, represented by social trust and tax morale, and the size of the shadow economy. Hence, the core hypothesis H1 is validated for the BRICS countries.

For model 2, the mean coefficient of social trust is -0.21657 , and the negative probability effect of social trust on the shadow economy is 100%. These figures suggest robust evidence

Models Variables	Model 2 R_c	Model 3 R_c
Social trust	1.000082	–
Tax morale	–	1.000005
Unemployment	1.000025	1.000113
Control of corruption	1.000052	1.000017
Tax burden	1.000103	0.999963
Trade openness	1.000024	1.000011
_Cons	1.000087	1.000009
Var	1.000154	1.000151

Table 4.
Convergence test
results

Models Variables	ESS	Model 2 Efficiency	ESS	Model 3 Efficiency
Social trust	30000.00	1.0000	–	–
Tax morale	–	–	29797.55	0.9933
Unemployment	30000.00	1.0000	30000.00	1.0000
Control of corruption	29360.98	0.9787	30000.00	1.0000
Tax burden	30000.00	1.0000	30000.00	1.0000
Trade openness	30000.00	1.0000	30000.00	1.0000
_Cons	30000.00	1.0000	29362.90	0.9788
Var	26333.82	0.8778	26780.62	0.8927

Table 5.
Sample size test results

Models Independent variables	Model 2		Model 3	
	Mean coefficient	Probability of coefficient	Mean coefficient	Probability of coefficient
Social trust	-0.21657 (-0.29676; -0.13781)	1.0000**	-	-
Tax morale	-	-	-0.71465 (-1.76011; 0.34902)	0.9087**
Unemployment	0.66870 (0.44667; 0.88578)	1.0000*	0.89245 (0.67417; 1.11001)	1.0000*
Control of corruption	-0.45054 (-0.61041; -0.28750)	1.0000**	-0.49607 (-0.70265; -0.28973)	1.0000**
Tax burden	0.65582 (0.58294; 0.72955)	1.0000*	0.71253 (0.61535; 0.80846)	1.0000*
Trade openness	-0.17005 (-0.26580; -0.07421)	0.9994**	-0.29451 (-0.38672; -0.20397)	1.0000**
_Cons	0.55234 (-1.36919; 2.50698)	-	0.26356 (-1.70434; 2.20828)	-
Var	25.23911 (18.42617; 34.57245)	-	33.01857 (24.36241; 44.61391)	-

Table 6.
Results from Bayesian
linear regression

Note(s): Dependent variable: Shadow economy; As priors for the effects of the independent variables, we use normal distributions with a mean of 0 and a standard deviation of 1; 95% credible intervals in parentheses; * Probability of coefficient > 0; ** Probability of coefficient < 0

of the negative relationship between social trust and the shadow economy. In other words, higher social trust will decrease the size of the shadow economy. This finding is in accordance with studies by [D'Hernoncourt and Méon \(2012\)](#) and [Lee \(2013\)](#).

For model 3, the posterior simulation results report that the mean coefficient of tax morale is -0.71465 , and the negative probability impact of tax morale on the shadow economy is 90.87%. These figures indicate a strong negative relationship between tax morale and the shadow economy. They imply that when the social norms (i.e. the tax morale) become higher, the size of the shadow economy will be smaller. This finding is consistent with the submissions of [Torgler and Schneider \(2009\)](#), [Lee \(2013\)](#), and [Williams and Horodnic \(2015\)](#).

In this regard, [Torgler \(2003\)](#) and [Feld and Frey \(2007\)](#) claim that increased trust can enhance tax compliance. Meanwhile, [Lee \(2013\)](#) posits that social trust and tax morale have a more significant impact on the shadow economy than taxes and regulations. Consequently, to reduce the shadow economy, there should be improvements in individuals' tax morale using education and enhancing consciousness about the benefits of paying taxes. Moreover, we suggest that governments should ensure that tax laws and the political process are implemented fairly and reliably. As citizens' confidence in the legal system improves, they are more likely to reduce tax avoidance.

Meanwhile, the mean coefficients of the unemployment rate in models 2 and 3 are 0.66870 and 0.89245, respectively. The positive effect probability of unemployment on the size of the shadow economy is 100%. The results uncover that the unemployment rate significantly affects the size of the shadow economy. This finding supports the hypothesis H2 suggested in [Section 2](#).

Likewise, the posterior simulation results in models 2 and 3 indicate a strong positive relationship between the tax burden and the size of the shadow economy. Notably, their mean coefficients are 0.65582 and 0.71253, respectively, while the posterior probability indicators in both models are 100%. The results posit that the higher tax burden will increase the size of the shadow economy in the BRICS countries. Thus, the hypothesis H4 is also valid for the countries examined.

By contrast, good corruption control reduces the size of the shadow economy in the BRICS. Specifically, the mean coefficients of control of corruption in models 2 and 3 are -0.45054 and -0.49607 , respectively. This negative impact is strong since the posterior probabilities in both models are 100%. Therefore, we document that for these countries, the hypothesis H3 is also validated. Moreover, we suggest that the governments should focus more on controlling corruption because good corruption control can increase citizens' trust and help decrease the size of the shadow economy.

Finally, the mean coefficients of trade openness in models 2 and 3 are negative (-0.17005 and -0.29451 , respectively). The posterior probability of this factor in model 2 and 3 is 99.94% and 100%, respectively. These numbers reveal that the negative relationship between trade openness and the size of the shadow economy is strong. In other words, an increase in trade openness will reduce the size of the shadow economy in the BRICS countries. Hence, the hypothesis H5 is rejected. As mentioned in the literature review, there is still controversy about this relationship. This implies that further research is needed to assess the impact of trade openness on the shadow economy.

5. Concluding remarks

The paper aims to examine the impact of social capital on the shadow economy in the BRICS countries over 1995–2014. The models also contain control variables: unemployment rate, corruption control, tax burden and trade openness. In particular, we use the Bayesian linear regression method with the prior distribution as the normal distribution and the posterior distribution through the MCMC technique.

The study measures social capital through social trust and tax morale, as Lee (2013) suggested. The results indicate that social trust and tax morale have a negative effect on the size of the shadow economy. These relationships are strong since their posterior probability indicators are 100% and 90.87%, respectively. Based on the findings, we suggest that governments concentrate more on these social dimensions when controlling the shadow economy.

Furthermore, we find that the unemployment rate and tax burden can promote the development of the shadow economy in the BRICS countries. Their positive effect probabilities of these factors are 100% in both research models. On the contrary, the control of corruption and trade openness adversely influence the size of the shadow economy. These negative relationships are strong in both research models.

Finally, the study is not free from limitation. This paper concentrates on the impact of social capital on the size of the shadow economy in the BRICS. Nevertheless, a comparison between groups of countries provides a more comprehensive picture of the shadow economy worldwide. Moreover, social capital is a multidimensional concept that may contain different components. This difficulty in measuring social capital calls for further research. Analyzing the impact of other dimensions of social capital on the shadow economy can be seen as a complement to shed light on this relationship.

References

- Aidt, T.S. (2003), "Economic analysis of corruption: a survey", *The Economic Journal*, Vol. 113 No. 491, pp. F632-F652.
- Arrow, K.J. (1970), "Political and economic evaluation of social effects and externalities", in Margolis, J. (Ed.), *The Analysis of Public Output*, National Bureau of Economic Research, Cambridge, MA, pp. 1-30.
- Arrow, K.J. (1973), "Social responsibility and economic efficiency", *Public Policy*, Vol. 21 No. 3, pp. 303-317.

- Arrow, K.J. (1999), "Observations on social capital", in Serageldin, I. and Dasgupta, P. (Eds), *Social Capital: A Multifaceted Perspective*, World Bank, Washington, DC, pp. 3-5.
- Asea, P.K. (1996), "The informal sector: baby or bath water? a comment", *Carnegie-Rochester Conference Series on Public Policy*, Vol. 45, pp. 163-171.
- Baklouti, N. and Boujelbene, Y. (2019), "Shadow economy, corruption, and economic growth: an empirical analysis", *The Review of Black Political Economy*, Vol. 47 No. 3, pp. 276-294.
- Birinci, S. (2013), "Trade openness, growth, and informality: panel VAR evidence from OECD economies", *Economics Bulletin*, Vol. 33 No. 1, pp. 694-705.
- Bjørnskov, C. (2010), "How does social trust lead to better governance? An attempt to separate electoral and bureaucratic mechanisms", *Public Choice*, Vol. 144 No. 1, pp. 323-346.
- Buehn, A. and Schneider, F. (2012), "Corruption and the shadow economy: like oil and vinegar, like water and fire?", *International Tax and Public Finance*, Vol. 19 No. 1, pp. 172-194.
- Cowles, M.K. and Carlin, B.P. (1996), "Markov chain Monte Carlo convergence diagnostics: a comparative review", *Journal of the American Statistical Association*, Vol. 91 No. 434, pp. 883-904.
- Dell'Anno, R. (2007), "The shadow economy in Portugal: an analysis with the MIMIC approach", *Journal of Applied Economics*, Vol. 10 No. 2, pp. 253-277.
- D'Hernoncourt, J. and Méon, P.G. (2012), "The not so dark side of trust: does trust increase the size of the shadow economy?", *Journal of Economic Behavior and Organization*, Vol. 81 No. 1, pp. 97-121.
- Engel, C. (2011), "Dictator games: a meta study", *Experimental Economics*, Vol. 14 No. 4, pp. 583-610.
- Enste, D.H. (2010), "Shadow economy – the impact of regulation in OECD-countries", *International Economic Journal*, Vol. 24 No. 4, pp. 555-571.
- Fehr, E. and Schmidt, K. (1999), "A theory of fairness, competition, and cooperation", *The Quarterly Journal of Economics*, Vol. 114 No. 3, pp. 817-868.
- Feld, L.P. and Frey, S.B. (2007), "Tax compliance as the result of a psychological tax contact: the role of in-centives and responsive regulation", *Law and Policy*, Vol. 29 No. 1, pp. 102-120.
- Fugazza, M. and Fiess, N. (2010), "Trade liberalization and informality: new stylized facts", Working Paper [No. 44], *United Nations Conference on Trade and Development*, United Nations, New York and Geneva, 1 March.
- Gelman, A. and Rubin, D.B. (1992), "Inference from iterative simulation using multiple sequences", *Statistical Science*, Vol. 7 No. 4, pp. 457-472.
- Goel, R.K., Saunoris, J.W. and Schneider, F. (2019), "Growth in the shadows: effect of the shadow economy on US economic growth over more than a century", *Contemporary Economic Policy*, Vol. 37 No. 1, pp. 50-67.
- Heywood, P.M. (2014), *Routledge Handbook of Political Corruption*, Routledge, Abingdon, Oxon.
- Houser, D. and McCabe, K. (2014), "Experimental economics and experimental game theory", in Glimcher, P.W. and Fehr, E. (Eds), *Neuroeconomics: Decision Making and the Brain*, 2nd ed., Academic Press, pp. 19-34.
- Ishak, P.W. and Farzanegan, M.R. (2020), "The impact of declining oil rents on tax revenues: does the shadow economy matter?", *Energy Economics*, Vol. 92, p. 104925.
- Kodila-Tedika, O. and Mutascu, M. (2014), "Shadow economy and tax revenue in Africa", *Economics Bulletin*, Vol. 34 No. 1, pp. 469-479.
- Kruschke, J.K., Aguinis, H. and Joo, H. (2012), "The time has come: Bayesian methods for data analysis in the organizational sciences", *Organizational Research Methods*, Vol. 15 No. 4, pp. 722-752.
- Lee, D. (2013), "How does social capital reduce the size of the shadow economy?", *Global Economic Review*, Vol. 42 No. 3, pp. 251-268.

-
- Lemoine, N.P. (2019), "Moving beyond noninformative priors: why and how to choose weakly informative priors in Bayesian analyses", *Oikos*, Vol. 128 No. 7, pp. 912-928.
- Leonardi, R., Nanetti, R.Y. and Putnam, R.D. (2001), *Making Democracy Work: Civic Traditions in Modern Italy*, Princeton University Press, New Jersey.
- Mauleón, I. and Sardà, J. (2017), "Unemployment and the shadow economy", *Applied Economics*, Vol. 49 No. 37, pp. 3729-3740.
- Mazhar, U. and Méon, P.G. (2017), "Taxing the unobservable: the impact of the shadow economy on inflation and taxation", *World Development*, Vol. 90, pp. 89-103.
- Medina, L. and Schneider, F.G. (2019), "Shedding light on the shadow economy: a global database and the interaction with the official one", Working Paper [No. 7981], Center for Economic Studies and ifo Institute, Munich.
- Nguyen, D.V. and Duong, M.T.H. (2021), "Shadow economy, corruption and economic growth: an analysis of BRICS countries", *Journal of Asian Finance, Economics and Business*, Vol. 8 No. 4, pp. 665-672.
- Nguyen, V.D. and Duong, T.H.M. (2022), "Corruption, shadow economy, FDI, and tax revenue in BRICS: a Bayesian approach", *Montenegrin Journal of Economics*, Vol. 18 No. 2, pp. 55-64.
- Oanh, T.T.K., Diep, N.V., Truyen, P.T. and Chau, N.X.B. (2022), "The impact of public expenditure on economic growth of provinces and cities in the Southern Key Economic Zone of Vietnam: Bayesian approach", in Ngoc Thach, N., Ha, D.T., Trung, N.D. and Kreinovich, V. (Eds), *Prediction and Causality in Econometrics and Related Topics*, Springer, Cham.
- Roberts, G.O. and Rosenthal, J.S. (2001), "Optimal scaling for various Metropolis-Hastings algorithms", *Statistical Science*, Vol. 16 No. 4, pp. 351-367.
- Schneider, F. (2005), "Shadow economies around the world: what do we really know?", *European Journal of Political Economy*, Vol. 21 No. 3, pp. 598-642.
- Schneider, F., Raczkowski, K. and Mróz, B. (2015), "Shadow economy and tax evasion in the EU", *Journal of Money Laundering Control*, Vol. 18 No. 1, pp. 34-51.
- Smith, P. (1994), "Assessing the size of the underground economy: the Canadian statistical perspectives", Working Paper [No. 28], Statistics Canada, Ottawa.
- Thach, N.N. (2021), "How values influence economic progress? Evidence from South and southeast asian countries", in Ngoc Thach, N., Kreinovich, V. and Trung, N.D. (Eds), *Data Science for Financial Econometrics*, Springer, Cham, pp. 207-221.
- Thaler, R.H. (2000), "From Homo economicus to Homo sapiens", *Journal of Economic Perspective*, Vol. 14 No. 1, pp. 133-141.
- Torgler, B. (2003), "Tax morale, rule-governed behaviour and trust", *Constitutional Political Economy*, Vol. 14 No. 2, pp. 119-140.
- Torgler, B. and Schneider, F. (2009), "The impact of tax morale and institutional quality on the shadow economy", *Journal of Economic Psychology*, Vol. 30 No. 2, pp. 228-245.
- Williams, C.C. and Horodnic, I.A. (2015), "Explaining and tackling the shadow economy in Estonia, Latvia and Lithuania: a tax morale approach", *Baltic Journal of Economics*, Vol. 15 No. 2, pp. 81-98.

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