Estimating the Shadow Economy in Uzbekistan

Estimating size of the shadow economy in Uzbekistan with MIMIC model

by

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Abstract

In this research I investigate the shadow economy in Uzbekistan and estimate the size of it for period 2007-2018. For estimation, I used MIMIC model which uses several variables as causes and several observable indicators as dependent variable. As this model requires an exogenous number for the size of the shadow economy in a given year, I used benchmark value of 50% stated in official sources in Uzbekistan. My estimates show that the size of the shadow economy in Uzbekistan is decreasing from almost 62% in 2007 to 50% over the observation period. However, comparing to other transition countries, this number still remains to be higher than in any other country.

Keywords – Shadow economy, unofficial economy, Uzbekistan, tax burden, currency demand

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1 Introduction

The shadow economy is one of the most widely discussed topics in economics as it is very difficult to measure and it affects different parts of our daily life. Many researchers studied different sides of the shadow economy. For example, Dreher and Schneider (2010) analyze the relationship between the shadow economy and level of corruption in a country. They conclude that in developing countries more corruption leads to more shadow activities, while the opposite is true for developed countries. Many researchers attempted to build models which estimate the size of the shadow economy relative to the official economy. Tanzi (1983) suggests the currency method, which only depends on monetary policy of the country, while the MIMIC method which is developed by several authors ((Jöreskog and Goldberger, 1975), (Frey and Weck-Hanneman, 1984)) depends on proxy variables which can have affect on activities of firms. Elgin et al. (2012) suggest a different model, using a simple deterministic dynamic general equilibrium model.

Though there are many researches on the size of the shadow economy in post-Soviet countries, Uzbekistan is out of the analysis in many cases. Even in the biggest analysis, Schneider and Enste (2002) give some restricted data on the size of the shadow economy in Uzbekistan. As these numbers are estimated using electricity consumption method, which in case of Uzbekistan does not change too much, the results of this analysis seem to be unreliable. Moreover, it includes quite short period, from 1991 to 2005.

In addition, there is no analysis on Uzbekistan for the period after 2005. In this research I estimate the size of the shadow economy in Uzbekistan for the period starting from 2007 to 2018 using MIMIC analysis. Why only this period and why only with MIMIC approach? One reason is that not all data is available before 2007. Moreover, another method that I tried to include in the beginning of my research, currency demand, is almost impossible for two reasons. Firstly, it mostly depends on Central Bank reports, which are unavailable before 2013, so quite limited observations are available. Secondly, this approach assumes zero percent of the shadow economy in the basis year. So it is quite far from reality.

Following the MIMIC approach, estimates are calculated using the 2018 shadow economy level as benchmark. Results show that the size of the shadow economy in Uzbekistan

varies between 48% to 62%, though in recent years it shows a decreasing trend.

The outline of the paper is as follows. Section 2 discusses previous researches and models on this topic. Section 3 describes the MIMIC approach which is used in this research in detail. The data that will be used for structural equations model calculations are given in section 4. In section 5, results of calculations are analysed and estimates for the size of the shadow economy are given. Section 6 presents policy recommendations.

2 Background

2.1 Definition of the shadow economy

For many developing countries, the shadow economy is still a big challenge. Empirical research on the size and development of shadow economy has grown rapidly in recent years. There are many researches that suggest different methods to predict the size of the shadow economy and different models that suggest predicting the development vector of the shadow economy. Firstly, how to define shadow economy?

There are different approaches on defining shadow economy. In accordance with System of National Accounts (SNA93), all activities that produce value added but are not registered in statistics of the economy are united under “non-observed economy” (NOE). In this paper, I rely on the classification and definitions used in the Measuring the Non-Observed Economy – OECD-ILO-IMF-CIS (2002).

According to Gyomai and Van de Ven (2014), non-observed economy covers five major areas:

1. "Underground production: activities that are productive and legal but concealed from taxation authorities to avoid payment of taxes or bureaucracy".
2. "Illegal production: productive activities that produce goods and services which are forbidden by law. These activities may include drug dealing or trafficking and so on".
3. "Informal sector production: productive activities conducted by unincorporated enterprises in the household sector or other units that are unregistered or less than a specified size in terms of employment. For example, these activities may include construction workers or other masters who have “gentlemen’s agreement” with the client and get paid in cash".
4. "Production of households for own-final use: productive activities that result in goods and serviced that are produced and consumed by households".
5. "Statistical underground: defined as all productive activities that should be

accounted for in basic data collection programs but are missed due to deficiencies in the statistical system".

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 this study, I take the approach used by Medina and Schneider (2018): the shadow economy reflects mostly legal economic and productive activities that, if recorded, would contribute to national GDP, therefore the definition of the shadow economy in our study tries to avoid illegal or criminal activities, do-it-yourself, or other household activities.

2.2 Literature review

As firms in the shadow economy try to stay undetectable, it is very difficult to measure exact size of the economy. Still there are many researches on measuring the size and development strategies of this market. Overall, all these studies can be divided into two groups: direct and indirect approaches.

Direct approaches include the following:

1. Measurement by the System of National Accounts statistics – Discrepancy method. According to Gyomai and Van de Ven (2014), the shadow economy is estimated by determining the difference between declared income for tax payments and actual income. This is done by selecting a group of companies (or people) who face unexpected audit in which their undeclared taxable income will be clarified. As this method uses sample of the population (possibly biased), its results cannot be fully accepted for whole economy.

2. Survey technique approach. This approach cannot capture all shadow economy activities. Moreover, respondents still may try to keep secret their business and underreport their shadow activities.

Indirect approaches try to measure using independent variables. According to Schneider

and Enste (2002), these include:

1. Discrepancy between national expenditure and income statistics. The key assumption in this method is that consumers can hide their incomes, but even unofficial income is also spent in official sector. Thus, the difference between these numbers can show us size of the shadow economy. A big disadvantage of this income is that not all expenditure is made in official market.

2. Discrepancy between official and actual labor force – this approach assumes that total labor force participation in the country is stable and salaries in both markets are quite close or equal. Thus, ratio between official labor force and total labor force should indicate official share of total production. The remaining part is the shadow economy. The main disadvantage of this method is that it does include high unemployment rate and labor effectiveness. The null hypothesis is that usually companies in the official sector can enjoy economies of scale and labor force in such companies are more effective than workers doing their job in unofficial sector.

3. Electricity approach. In this approach authors state that electricity consumption is the single best physical indicator of total production in the economy. So, by comparing growth in electricity consumption and growth in official GDP, Kaliberda and Kaufmann (1996) try to predict growth level of shadow economy. There are many researches that show the correlation between electricity consumption and GDP is equal to almost 1. So, electricity is a good instrumental variable. However, it is not the best single indicator for long term analysis of shadow economy as:

   (a) Machines and equipment in two sectors can vary in terms of efficiency;

   (b) Overall, as time goes on, there are more energy efficient technologies, thus electricity consumption in shadow economy now can vary a lot than that of 20 years ago.

4. Currency demand approach. This approach was first used by Cagan (1958) and was further developed by Tanzi (1983).

   Currency demand approach relies on the assumption that shadow transactions are done with cash payments, thus this part of the economy relies on more currency. Thus, when shadow economy increases in size, its demand on cash will also increases

and more cash will be flowing between firms (or consumers) without showing up in bank deposits. This approach reveals in which direction the shadow economy is moving. In regression model, main job is to identify excess demand for currency. As demand for holding money in cash rather than in bank deposits depends on several factors (tax rate, interest rate, government regulation and the complexity of tax system). So, all these variables are included in regression equation.

The basic equation, suggested by Tanzi (1983), is the following:

$$\ln(\frac{C}{M_2}) = \beta_0 + \beta_1 ln(1 + TW) + \beta_2 \ln(\frac{WS}{Y})_t + \beta_3 \ln R_t + \beta_4 \ln(\frac{Y}{N})_t + u_t \quad (2.1)$$

where

ln denotes natural logarithms;
$\frac{C}{M_2}$ is the ratio of cash holdings to current and deposit accounts;
TW is a weighted average tax rate (to proxy changes in the size of the shadow economy);
$\frac{WS}{Y}$ is the proportion of wages and salaries in national income (to capture changing payment and money holding patterns);
R is the interest rate paid on savings deposits (to capture opportunity cost of holding cash);
$\frac{Y}{N}$ is the per capita income.

This approach is widely criticized for various reasons. The most important two disadvantages are:

(i) The assumption that money velocity in both areas of the economy (official and unofficial) is the same. For now, there is no reliable research paper that proves equal velocity (or at least similar) of money transactions in two economies. Hill and Kabir (1996) shows contradicting results to that assumption. That means increasing demand on currency is not always result of increasing shadow economy.

(ii) Another weakness of this model is assumption of non-existing shadow economy in basis year. As all our estimates depend on 0 percent of shadow economy in year 0, we can be underestimating size of the shadow economy in specific

country.

5. Multiple Indicators, Multiple Causes (MIMIC) approach – this method uses several causes (taxation, state regulation, tax morale, etc.) and effects which can have an affect on the size of shadow economy.

As in this research I will be using the last method to predict the size of the shadow economy in Uzbekistan, I will discuss this method in the next section in detail.

3 Methodology

In this paper, shadow economy in Uzbekistan is analyzed with Multiple Indicators, Multiple Causes (MIMIC) model. In this part, I explain this model in detail.

3.1 Multiple Indicators, Multiple Causes (MIMIC)

MIMIC model is one of Structural Equation Models (SEM) which study relationship between latent (unobserved) and manifest (observed) variables. In this case, shadow economy is the unobserved variable and is defined with several other observed variables.

This model received its name from Jöreskog and Goldberger (1975). In their model, they showed how an unobserved variable can be explained by several other observed variables. The first economists to use this model to predict size of shadow economy (as it is unobserved), were Frey and Weck-Hanneman (1984). In their report, they study 17 OECD countries and find that size of the shadow economy in proportion to GDP varies from 4 percent for Japan to 13 percent for Sweden, with sample mean of 8.8 percent for all OECD countries (Frey and Weck-Hanneman (1984)). Later, researching shadow economy in OECD countries, Schneider (1996) found that on average the proportion of shadow economy increased up to 15 percent. Following these examples, other economists used this approach for their statistical analysis of the shadow economy: Loayza (1997) for Latin American countries, Giles (1999) for New Zealand, Giles et al. (2002) for Canada, Dell'Anno and Schneider (2003) for Italy, Bajada and Schneider (2005) for Asia-Pacific countries and Dell'Anno et al. (2007) for France, Greece and Spain.

In this paper, I will use MIMIC model with the most general specification (MIMIC 6-1-2), i.e. model with 6 observed variables, 1 unobserved variable and 2 indicators. As one can guess, one unobserved variable is the shadow economy. Two indicators that I will predict with our model are real GDP in constant prices and labor force participation ratio in official economy. The 6 observed variables are: share of public employment in labor force (x_1), tax burden (x_2), subsidies (x_3), social benefits paid by government (x_4), unemployment rate (x_5). Thus, the SE (η) is determined by a set of observable exogenous causes x_1, x_2, ..., x_5:

$$\eta = \alpha + \gamma_1 x_1 + \gamma_2 x_2 + \gamma_3 x_3 + \gamma_4 x_4 + \gamma_5 x_5 + \xi \tag{3.1}$$

The latent variable that can be determined by above equation will be used to determine, linearly, a set of observable endogenous indicators y_1 and y_2 (Dell'Anno et al., 2007):

$$y_1 = \lambda_1 \eta + \varepsilon_1 \tag{3.2}$$

$$y_2 = \lambda_2 \eta + \varepsilon_2 \tag{3.3}$$

The structural disturbance ξ and measurement errors ε all display normal distribution, mutually independent and all variables are transformed to deviation-from-means.

Considering the vectors:
$\boldsymbol{x}' = (x_1, x_2, ..., x_q)$ Observable exogenous causes
$\gamma' = (\gamma_1, \gamma_2, ..., \gamma_q)$ Structural parameters (structural model)
$\boldsymbol{y}' = (y_1, y_2, ..., y_q)$ Observable endogenous indicators
$\lambda' = (\lambda_1, \lambda_2, ..., \lambda_q)$ Structural parameters (measurement model)
$\varepsilon' = (\varepsilon_1, \varepsilon_2, ..., \varepsilon_q)$ Measurement errors
$v = (v_1, v_2, ..., v_q)$ Standard deviations of the ε's

The above equations, structural and measurement equations can be written as:

$$\eta = \gamma' x + \xi \tag{3.4}$$

$$y = \lambda \eta + \varepsilon \tag{3.5}$$

by assuming $E(\xi\varepsilon') = 0'$ and defining $E(\xi^2)$ and $E(\varepsilon\varepsilon') = \Theta^2$, where Θ is a diagonal matrix with v, displayed on its diagonal. The model can be united as the function of observable variables:

$$y = \lambda(\gamma' x + \xi) + \varepsilon = \Pi' x + v \tag{3.6}$$

The reduced form coefficient matrix and disturbance vector are respectively:

$$\Pi = \gamma\lambda' \qquad \text{and} \qquad v = \lambda\xi + \varepsilon.$$

A sufficient (but not necessary) condition of identification is that the number of indicators must be a minimum of two and the number of causes at least one, provided that a scale to η is assigned (following the MIMIC rule). In order to assign a scale to the latent variable it is necessary to fix one λ parameter to an exogenous value (Dell'Anno et al., 2007).

4 Data

In this section of the paper, necessary data for our models is analysed.

4.1 Data for MIMIC

Share of public employment in labor force. We will be using this variable as instrumental for index of economic freedom and burden of public sector in the economy. According to Index of Economic Freedom report, published by Schneider and Riley (2016) shadow economy can be defined as reaction of citizens against restrictions in the economy. According to Belev (2003), as share of government in the economy increases, bureaucratisation in the economy also will increase and more firms try to avoid this government control even for legal activities and thus turn black. Second factor is, as Schneider and Enste (2002) state, when bureaucrats have more power, level of corruption rises and trying to avoid paying bribes, firms turn to shadow economy.

Tax burden. This is another variable that is very important for shadow economy. As it is stated in the previous section, one of the main reasons for companies turning black is monetary which means avoiding tax payments. When a country sets too much tax on profit or income, firms can just do their activities unofficially and not pay taxes. The bigger the difference between total labor-cost in the official economy and after-tax earnings (from work), the greater the incentive for individuals to reduce the tax wedge and turn to black economy. In our database, this variable equals total tax payments in ratio to GDP. The source for absolute volume of taxes is Ministry of Finance of the Republic of Uzbekistan and the source for absolute amount of GDP of Uzbekistan in national currency is World Bank Data.

Subsidies. Theoretically, subsidies also have double effect on shadow economy. On the one hand, when subsidies are offered to one sector of business, it may give motivation for firms to turn white in search of subsidies. On the other hand, when system distributes subsidies inefficiently and not every firm has access to it, the remaining part of the firms, that were not given subsidies, may seek alternative sources of decreasing cost of products, which is usually paying less taxes (or even not paying). Thus, part of the firms can start

shadow activities.

In our database, we use data from state budget of Uzbekistan. As there is no explicit information about total amount of subsidies in the country, I take "Expenditures on the economy" line as proxy variable for subsidies.

Social benefits paid by government. This variable also has a dual effect. Workers with unofficial work experience do not have access to unemployment allowances and other types of financial help. On the other hand, this factor can reduce the willingness of the unemployed to work and get social benefits from official sources and still engage in shadow economy activities.

In our case I use line "Social expenditures" from state budget of Uzbekistan. Firstly, there is no detail information about sum of unemployment benefit in the country, secondly, social expenditures in Uzbekistan are quite varied and, I think, it is good idea if we take sum of all such expenditures.

Unemployment rate. The effect of unemployment rate on the shadow economy, as Tanzi (1983) states, is ambiguous. First effect, according to Giles et al. (2002) is that official GDP and shadow economy has positive correlation and GDP and unemployment rate has negative correlation. Thus, an increasing unemployment rate can be a result of shrinking shadow economy. On the other hand, sometimes "officially" unemployed workers can still be working underground. So it is difficult to state right effect of unemployment rate.

Table 4.1 describes the data that will be used for MIMIC estimation of the shadow economy in Uzbekistan.

As can be seen from the Table 4.1, numbers do not vary significantly during these years. The only significant changes are interest rate increase in the last 2 years. In order to reform the economy, the government targeted hard monetary policy which led to higher rates for loans. Currently, the interest rate in the country is 16%, i.e. in the last 2 years, the interest rate has almost doubled. Another notifiable change is gradual decrease in subsidies/GDP ratio. During currency board period, when the official rate was half of real rate, government was dependant on energy exporting companies for foreign currency. In return, government spent several billions of US dollars on subsidies for energy consumption,

	Unemp. rate	interest rate	tax/GDP	soc. ben./GDP	subsidies/GDP	Labor partic.
2007	8.3	14	19.45	1.36	2.31	67.2
2008	8.3	14	19.93	1.72	2.41	67.3
2009	8.2	14	21.95	2.19	2.55	67.4
2010	8.2	14	20.04	2.20	2.43	67.5
2011	8.1	12	20.10	1.95	2.43	67.7
2012	8.1	12	19.57	1.74	2.37	67.8
2013	8	12	19.56	1.42	2.28	68
2014	8	10	18.55	1.30	2.17	68.3
2015	8	9	19.10	1.31	2.22	68.5
2016	7.5	9	18.15	1.10	2.16	68.7
2017	7.2	11.5	18.09	1.05	2.08	68.9
2018	7	14.5	17.45	0.95	1.71	69.2

Table 4.1: Uzbekistan: Basic data for MIMIC estimation model, 2007-2018

on gasoline, above all. According to International Energy Agency, only in 2017, Uzbekistan spent on energy subsidies 5.25 bn USD, which makes up to 12% of its GDP. Even now, energy market is not liberal yet, however government took significant steps in cutting its fossil-fuel subsidies. I think, a decrease of 25% in between 2016-2018 can be explained mostly by price increase in all energy sources in the country.

Table 4.2 includes summary statistics for above observations.

Variable	Obs	Mean	Std. Dev.	Min.	Max.
unempl	11	7.99	0.34	7.2	8.3
interest	11	11.95	1.95	9	14
tax_gdp	11	19.49	1.08	18.09	21.95
sb_gdp	11	2.64	3.45	1.05	2.2
subs_gdp	11	2.31	0.14	2.08	2.55
labor	11	67.93	0.59	67.2	68.9
gdp	11	119.82	30.07	78.22	167.24

Table 4.2: Summary statistics for MIMIC model variables

Covariance matrix of independent variables is given in Table 4.3.

Variable	unempl	interest	tax	sb	subs
unempl	0.19				
interest	0.14	4.02			
tax	0.4	0.89	1.42		
sb	0.14	0.36	0.46	0.18	
subs	0.08	0.06	0.24	0.08	0.05

Table 4.3: Covariance matrix of independent variables

5 Analysis

5.1 Multiple indicators approach

In this model, I use 5 variables as determinants of shadow economy in Uzbekistan. These include unemployment rate, interest rate, tax/GDP ratio, social benefits/GDP ratio, subsidies/GDP ratio and labor force participation as indicator of shadow economy.

Once a measurement model is built, an index of shadow economy can be constructed using a bench-marking procedure. According to hypothesis, the index of latent variable measures not the size of the SE, but the changes in the size of SE relative to the size of GDP. With regard to the unit of measure, it is in percent rate because causes in our structural model are calculated as ratio. Thus, for calculating shadow economy size with respect to official GDP, I use the following equation:

$$\triangle \frac{\hat{\eta}_t}{GDP_t} = \hat{\gamma}_{11}\triangle X_{1t} + \hat{\gamma}_{12}\triangle X_{2t} + \hat{\gamma}_{13}\triangle X_{3t} + \hat{\gamma}_{14}\triangle X_{4t} + \hat{\gamma}_{15}\triangle X_{5t} \tag{5.1}$$

Models	unempl (s.e.) z-stat	interest (s.e.) z-stat	tax (s.e.) z-stat	sb (s.e.) z-stat	subs (s.e.) z-stat
MIMIC 5-1-2	-1.19 (0.11) -10.79	-0.21 (0.022) -9.84	0.2 (0.051) 3.91	0.44 (0.15) 2.84	-3.47 (0.38) -9.20
Global Goodness of Fit Statistics	Chi-square (p-value)	RMSEA (p-value)		Degrees of Freedom	
MIMIC 5-1-2	4.04 (0.40)	0.88 (0.22)		4	

Table 5.1: Output LISREL - coefficients for Uzbekistan

The maximum likelihood estimated coefficients are given in table 5.1. As most of other researchers used this estimation model for MIMIC method, I also chose this model for my structural equations model. Since cause variables are measured in the same unit of measurement, which percentage points, all these coefficients are easy to understand. As can be seen from the table, not all coefficients have expected signs. Standard errors

are given in brackets. As for p-values, LISREL statistical package does not calculate p-values in SIMPLIS projects for small sample data (less than 120 observations). Instead, Dell'Anno et al. (2007) suggests to use z-statistics. According to him, |z-stat|>1.96 means p-value<0.05 and |z-stat|>2.58 means p-value<0.01. Thus from the table, it can be concluded that all estimates are statistically significant at 1 percent level.

As for variables, unemployment rate has unexpected negative sign in this case, which means more unemployment rate leads to lower rate of shadow economy. All other 4 variables have their expected sign. Interest rate increase leads to higher opportunity cost between deposits and cash holdings, thus more interest rate directs cash money back into banking system and thus decreases the size of the shadow economy.

5.2 Benchmarking procedure and estimates of shadow economy in Uzbekistan

From results I have the following structural equation:

$$\bar{\eta}_t = -1.19 \cdot unempl - 0.21 \cdot interest + 0.2 \cdot tax + 0.44 \cdot sb - 3.47 \cdot subs \tag{5.2}$$

As our priory data for 2018 shadow economy is 50% of GDP, our shadow index is scaled to take up to value of 50% in 2018. These calculations are summarized in the following benchmark equation:

$$\frac{\bar{\eta}_t}{GDP_{2018}} \cdot \frac{\eta^*_{1995}}{GDP_{2018}} \cdot \frac{GDP_{2018}}{\bar{\eta}_1 995} \cdot \frac{GDP_{2018}}{GDP_t} = \frac{\bar{\eta}_t}{GDP_t} \tag{5.3}$$

$$\Longrightarrow \frac{\bar{\eta}_t}{\bar{\eta}_{2018}} \cdot \frac{\eta^*_{2018}}{GDP_t} = \frac{\bar{\eta}_t}{GDP_t} \tag{5.4}$$

In the table 5.2, numerical values for the size of shadow economy are presented for period between 2007 to 2018.

Years	Shadow Economy
2007	61.47
2008	60.97
2009	60.62
2010	60.51
2011	57.90
2012	57.79
2013	57.11
2014	55.22
2015	54.13
2016	50.12
2017	48.33
2018	50.00

Table 5.2: Shadow economy in Uzbekistan estimated by MIMIC model

As it is visible from the table 5.2, shadow economic activities make up a large part of the official economy in Uzbekistan. With burst of international financial crisis in 2008, government started to close economy by creating more artificial borders for capital and goods transfer. In the end, as can be seen from the numbers, the size of the shadow economy in Uzbekistan decreased during the observation period.

Below the size of the shadow economy can be observed in graph format.

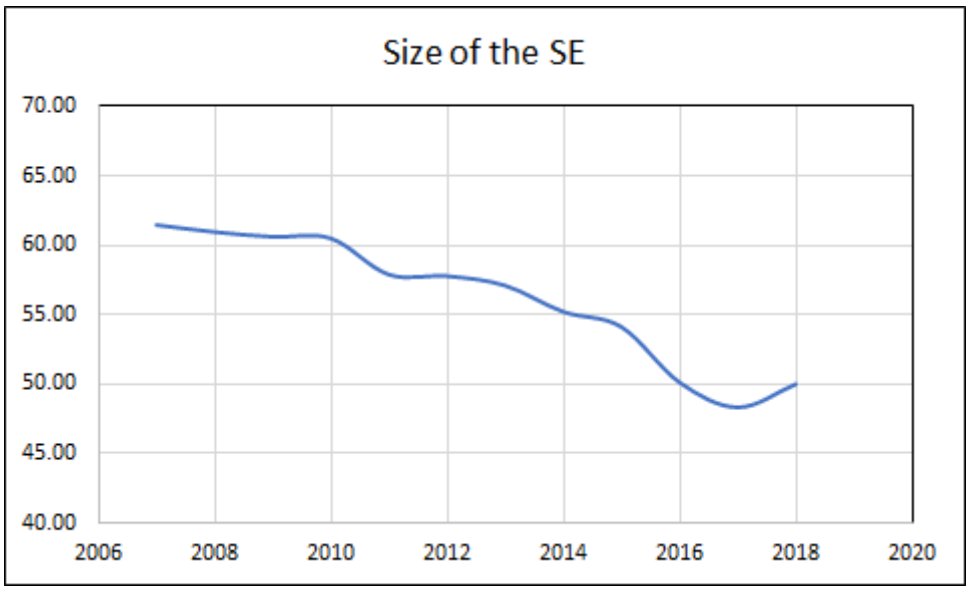

Figure 5.1: The size of the shadow economy in Uzbekistan relative to official GDP. Source: Author's calculations

Decreasing trend in the size of the shadow economy can be explained by several steps taken in 2000s in order to control flow of cash money and direct them back into banking

system. One of such decrees was signed by ex-president of Uzbekistan in 15.04.2005 with decree number PQ-57. In this decree, government imposes more restrictions and regulations for cash flow. This and other such decrees accepted in different levels of government was "intended to fight against shadow economy and corruption". Without creating independent banking system and strengthening trust in banks, all these steps led to higher costs of running shadow activities. The size of the shadow economy can decrease only in two directions: either it will turn white and run in official economy or it just stops running. As real GDP growth in Uzbekistan was quite low during this period (2007-2018), I think, most of the shadow companies ceased to exist.

From estimated coefficients it can be seen that the biggest drivers of change in the size of the shadow economy in Uzbekistan are interest rate and taxes, as only these variables change more dynamically than others and in our case these variables present more reliable data. However, one fact still must be considered. According to Dreher and Schneider (2010), shadow economy in developing countries is mostly positively correlated with corruption. Consequently, it can be expected that prime motives for turning shadow activities are not just monetary reasons, but also business climate in the country.

5.3 The size of the shadow economy in Uzbekistan and in neighbouring countries

There are several other research papers that discuss the size of the shadow economy in transition economies, including Central Asian countries. For example, using electricity consumption method, Schneider (2002) estimate the size of the shadow economy in Transition countries and present the following numbers:

Transition countries	Size of the shadow economy (in % of GDP)			
	Electricity method		Dynamic method	
	1990-1993	1994-1995	1990-1993	2000-2001
Kazakhstan	32.2	34.2	31.9	42.2
Kyrgyzstan	34.1	37.2	35.2	39.4
Uzbekistan	20.3	28.0	22.1	33.4
Russia	27	41	27.8	45.1
Georgia	43.6	63	45.1	66.1
Azerbaijan	43.8	59.3	45.1	60.1
Armenia	39.4	40.3	40.1	45.3

Table 5.3: The size of the shadow economy in Transition countries by Schneider (2002)

As can be seen from table 5.3, size of the shadow economy for many transition countries are quite high and make up 30-50 percent of GDP in those countries. These numbers are quite comparable with the results that I got for Uzbekistan using MIMIC estimation method for period 2007-2018, even though observation periods are different. It does not directly support above estimations, but it, at least, does not reject it.

The only available data for similar period in Transition countries are given by Abdih and Medina (2013). According to their estimations, the size of the shadow economy in 2008 varied from 26% in Kyrgyzstan to 35% in Armenia:

Country	Size of the shadow economy
Kyrgyzstan	26.3
Kazakhstan	33
Georgia	30.1
Azerbaijan	31.5
Tajikistan	32.8
Armenia	35

Table 5.4: The size of the shadow economy in Transition countries in 2008.

However, if our estimations are compared with estimations of Abdih and Medina (2013) for 2008, one can see a big difference between results. While in other neighbouring countries the size of the shadow economy varied between 26-33 %, the same indicator for Uzbekistan was about 60%.

Here, I can add two more comments. Firstly, one of MIMIC models disadvantage is that it only shows the trend of change in the size of the shadow economy and thus highly

depends on benchmark value. As in this case bench-marking value is a statement by minister of finance and it does not refer to any official paper, it is difficult to say whether our estimates are close to real. Secondly, as there is no data available for the size of the shadow economy in neighboring countries for the same period 2007-2008, again it is difficult to compare the trend of changes in the size of the shadow economy.

6 Conclusion

As in other post-soviet countries, Uzbekistan's economy is also suffering from the big size of shadow economy. Following the statement made by Deputy Minister of Finance, the size of SE in Uzbekistan is even bigger than average size of SE in post-soviet countries (Schneider and Enste, 2002), which is estimated to be between 30-35%. What steps can be made in order to direct shadow producers into the official economy?

Firstly, all steps must be targeting the same aim. Increasing the interest rate and thus creating higher opportunity cost for cash holders is a good step, but without structural reforms in other fields of the economy, this indicator will not play the role that is expected.

The biggest indicators that are creating motive to do shadow activities are, probably, the complex tax system and too much government intervention in the economy. In part of the subsidies to business in my data, the numbers include only those which are directly transferred from the government budget, but it does not include subsidies in the form of unpaid taxes. There are many companies in Uzbekistan where the government directly or indirectly has control over majority shares. All these government interventions in the economy create dual standard for business units in the economy. With the help of government officials, government companies can have big subsidies and in order to compete with such companies, private companies have to cut costs, often with paying less taxes. Consequently, the first message to create equal opportunity for firms is to sell government assets in open auctions and decrease its participation in the economy.

Another big reason is related to the tax system. Until recently, the country tax system was very complex. There were up to 27 different taxes depending on the size of the company: the bigger it gets in terms of workforce, the more taxes it has to pay. This in turn leads to companies trying not to exceed a certain limit and continuing to increase their shadow production. However, from January 1, 2019, the government adopted a new Tax code in which all business units are subject to pay the same tax regardless of their size of workforce. Moreover, from 2019, all companies with an annual turnover of over 120,000.00 USD, have to pay VAT. This, in turn, creates chain of VAT payers where everyone is interested to buy from the one who pays VAT. Consequently, many companies are expected to switch their activities to the official economy.

However, due to late implementation of the new tax code (it was announced on Dec 30, 2018 and implemented from Jan 1, 2019), many firms were not ready to such radical change and in the very beginning of the new year, average consumer prices increased by 20% (VAT amount).

Although the government implemented much better tax regime than before, there are still some necessary steps to be made. Firstly, VAT rate remains to be high. In neighbouring countries, Kazakhstan and Kyrgyzstan, the rate is at 12% and because of free movement between countries, most people prefer to buy consumer electronics products from these countries. Consequently, it again creates pressure on domestic firms. Thus, VAT needs to be lowered.

Besides monetary reasons of the shadow economy, one very important variable is not included in our model which corruption. When corruption is high, tax officials create a motive for firms to switch to shadow production and paying bribes instead of taxes. As Uzbekistan is one of the most corrupted countries (Rubio, 2018) in the world, this factor explains much of our shadow economy equation.

To conclude, I must admit that there are some questions as to the reliability of MIMIC estimates and data that I used for my calculations. Firstly, numbers used for calculations are sometimes far from reality or they are controlled not by market mechanisms, but by administrative sources. The unemployment rate and subsidies into the government enterprises do not vary much. Although the interest rate of the Central Bank was very low for many years (from 9 to 12%), and sometimes lower than the inflation rate, it did not reflect real opportunity cost between banknotes and bank deposits. Secondly, MIMIC is a good model to reproduce the dynamics of the shadow economy, but still for calculations I have to depend on exogenous data given by third source. As this is out of my control and cannot be predicted by the data, the correct size of the economy can be highly overestimated or even underestimated, depending on the benchmark value. In our case, this benchmark value is a statement from an official person and he does not refer to any scientific research or publication from international organization. However, if these estimates are compared to those of other papers (Schneider, 2002) or (Abdih and Medina, 2013), it can be concluded that these numbers can be not too far from reality.

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