ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

Volume 31(5), 2022

Stefan Petranov[1]
Dimitar Zlatinov[2]
Ilia Atanasov[3]

THE SHADOW ECONOMY IN BULGARIA DURING THE PERIOD 2006-2019[4]

The main objective of the article is to obtain an estimate for the size and the trend of the shadow economy in Bulgaria. Based on the monetary approach, we find that the shadow economy in Bulgaria for the period 2006-2019 tends to decline as a ratio to GDP: from 31.7%, it shrinks to 21.1%. This trend could be explained by the country's accession to the European Union, as this process is associated with the harmonisation of the domestic legislation, stricter procedures, and targeted measures to curb the shadow economy by several successive governments. Despite the declining trend, the share of the shadow economy in the country remains still relatively high. This is an obstacle to its economic and social development and there is a clear need for an in-depth analysis of this phenomenon and further measures to limit it and bring it to a much lower level.
Keywords: shadow economy; monetary approach; currency-demand approach; Bulgaria
JEL: E26; E41; F15; O17; O43

Introduction

It is an indisputable fact that the shadow economy[5] exists in all countries. Practices related to this phenomenon have various manifestations and its effects are spread in different areas.

[1] *Stefan Petranov, PhD, Professor at Sofia University "St. Kliment Ohridski", spetranov@feb.uni-sofia.bg.*
[2] *Dimitar Zlatinov, PhD, Associate Professor at Sofia University "St. Kliment Ohridski" and Economic Research Institute at Bulgarian Academy of Sciences, e-mail: dzlatinov@feb.uni-sofia.bg, d.zlatinov@iki.bas.bg.*
[3] *Ilia Atanasov, PhD, Assistant Professor, Sofia University "St. Kliment Ohridski", Faculty of Economics and Business Administration, e-mail: i.atanasov@feb.uni-sofia.bg.*
[4] *This research article is financed by the "Scientific Research" Fund at Sofia University St. Kliment Ohridski under project № 80-10-192/06.04.2021. Excellent research assistance was provided by Lidia Kabatliiska, Vladimira Limonova and Christina Uzunova.*
This paper should be cited as: *Petranov, S., Zlatinov, D., Atanasov, I. (2022). The Shadow Economy in Bulgaria During the Period 2006-2019. – Economic Studies (Ikonomicheski Izsledvania), 31(5), pp. 3-18.*
[5] In this article shadow economy refers to economic activities that are deliberately concealed from government authorities, because they are unlawful in nature, or because they don't comply with governmental reporting requirements.

Most of these effects are generally negative for economic development, which necessitates measures to limit and prevent the shadow economy. But in order for such measures to be designed and implemented in an efficient way, the shadow economy needs to be studied in depth, which includes, among other things, estimating its size and dynamics.

Obtaining estimates of the size of the shadow economy for a country is not a trivial task. The difficulties in this area are due both to the variety of forms and shadow practices that are implemented and, on the other hand, to the simple fact that economic operators engaged in shadow practices are actively seeking to keep these activities hidden from official authorities.

In general, different approaches to obtain such estimates can be found in the economic literature, and there is no single method that is considered to be superior and hence universally accepted. Basically, the methods for estimating the shadow economy may be distinguished into two main categories – direct and indirect methods. The direct methods are based on microeconomic approaches, and they employ surveys and samples designed in a specific way to "catch" the shadow economy activities. But as Schneider & Buehn (2018) stress, the results of such methods depend on respondents' willingness to share their views and experiences honestly as regards the shadow economy, which makes them unreliable and limited as a source of information.

The indirect methods rely on macroeconomic data, identities, and models. Using them, one may obtain information about the shadow economy by observing the discrepancies between various economic, social, and other indicators over time. Some of the most popular indirect methods are based on the discrepancy between national expenditure and income statistics, the discrepancy between the official and actual labour force[6], the physical input (electricity consumption) method and, of the monetary (currency demand) method. What is common in the indirect methods mentioned is that they are built on the relationship between observable economic variables and unobservable shadow economy indicators through which the evolution of the shadow economy over time is estimated. The main strength of indirect methods for estimating the size of the shadow economy is their complex nature as based on official empirical macroeconomic data, but their results largely depend on the assumptions made.

In the present article, an attempt is made to obtain an estimate of the size and dynamics of the shadow economy in Bulgaria for the period 2006-2019 based on the so-called monetary approach. This approach, like any other valuation procedure, is based on certain assumptions. This article proposes a version of the approach in which some of the traditionally used assumptions are relaxed and others are replaced by more realistic ones. In this way, estimates are obtained for the size and dynamics of the shadow economy in Bulgaria. By doing this, we believe that our study contributes to the expansion of knowledge in an area that has not been studied systematically and for which existing research in Bulgaria is scarce.

The rest of the article is structured as follows. In Section 1. we set out the logic on which the monetary approach is based on and review the literature. We comment on the differences between the different versions of the monetary approach and justify our choice of method. In Section 2 we discuss the specification of the selected general model, provide the sources of

[6] The factors and public policies for the limitation of informal employment are discussed in Yaskal et al. (2021).

the data used and the results of the econometric estimation of eight options for the general model. Based on these eight variants, in Section 3 we estimate the size of the shadow economy in Bulgaria for the period 2006-2019. The last section presents the main conclusions of our study.

1. The Monetary Approach for Estimating the Size of the Shadow Economy – Economic Logic and Methodological Issues. A Literature Review

The different methods have their strengths and weaknesses, but still, from the so-called indirect approaches that rely on econometric models, two approaches are the most used and widespread: the monetary (or currency-demand) approach and the MIMIC (Multiple Indicators Multiple Causes) approach.[7] In this article, we opt for the former because of the sound economic logic behind it, the ease of application, as well as the availability of data.

The logic of the monetary approach is based on the fact that cash is the preferred and dominant medium of exchange used to carry out shadow transactions. Agents in the shadow economy are generally reluctant to disclose the reasons and participants in monetary transactions that take part in their illegal or simply unreported activities. Therefore, these agents pay in cash; thus, seeking to eliminate the possibility of subsequent tracking of transactions, which otherwise exists if the payments are made by bank transfer.

Because of the above, when the volume of the shadow economy increases, other things being equal, the need for cash to serve the increased shadow payments will increase. Conversely, if the shadow economy shrinks, so will the need for cash. Based on this logic, the amount of money in circulation in an economy and the changes in this amount can be used to estimate the dynamics of the shadow economy. In practice, this is done in two steps. First is the calculation of the difference between the actual amount of money in circulation and a theoretical amount obtained under the assumption that there is no shadow economy, the latter being calculated based on a proper econometric model. In this way, an estimate is obtained for the amount of money that serves the shadow transactions. In the second step, based on this amount and certain assumptions about the velocity of money, the size of the shadow economy is estimated.

The monetary approach has been applied by economists in different versions, which can be classified into four groups. The first group includes studies based on the so-called transaction method, which was proposed by Feige (1979) and further extended in Feige (1996). The method uses the identity that the total stock of money multiplied by the velocity of circulation equals the total number of transactions multiplied by the average price of these transactions. In this case, the shadow component of the economy can be calculated under the assumptions

[7] The MIMIC models are built on a structural equation modeling approach (Dybka, Kowalczuk, et al., 2019; Naghdi, et al., 2015; Klarić, 2011). However, these models face some serious limitations such as the unstable coefficients with respect to the sample size (Dell'Anno, 2003). Also, they are often the subject of criticism because of specification and identification problems (Breusch, 2005; Feige, 2016; Kirchgässner, 2016).

that the ratio of the shadow economy to the official economy is known for a base year[8], there is a reliable estimation for the velocity of money, and the ratio of transactions to official GDP. The last assumption is a serious weakness of this method since some monetary transactions have nothing to do with income generation and the amount of cash held by the public depends on many factors that can change over time.

The second group of studies applies the monetary approach making use of econometric models of the demand for cash as an absolute amount. In this case, the analysis is based on models in which the amount of money in circulation is the dependent variable, while among the explanatory variables, there is an indicator which is supposed to be a proxy for the shadow economy. Usually, this indicator is the tax rate due to the logic that high tax rates provide incentives for more shadow practices and vice versa.

In our opinion, choosing to analyse only the amount of money in circulation is a weak point for this method, because the essence of the monetary approach is to analyse the behavioural patterns with respect to payments for goods and services. Since payments could be made by both cash and bank transfers, it is important for these two possibilities to be included in the analysis, while this version of the monetary approach considers cash as the only means of payment.

Despite the abovementioned limitation of the demand for cash method, it is used for estimating the size of the shadow economy in Bulgaria by Nenovsky & Hristov (2000) and Petrov (2004), as well as for other countries (see, for example, Bowsher (1980) for the USA). Nowadays, the method is mainly used when central banks study the relation between the currency in circulation and the shadow economy, as in the case of euro area countries (Seitz, Reimers & Schneider, 2018) and tax evasion in the Czech Republic (Nchor & Konderla, 2016). Ardizzi, Petraglia, Piacenza & Turati (2011) also introduce the cash payments as a dependent variable in the money demand equation, which allows them to estimate the size of the shadow economy for 91 Italian provinces for the period 2005-2008.

In order for transferable (giro) money to be included in the models as possible means of payment, many economists suggest analysing the ratio between the currency in circulation and some monetary aggregates (most often M1 or M2). This idea is the basis for the third and fourth versions of the monetary approach. The third version is suggested by Gutmann (1977), who assumes that the currency in circulation to M1 ratio is constant over time in the absence of relative changes in the shadow economy[9]. According to Gutmann, the only reason for changes in this ratio is because people want to hide certain activities to avoid taxation and restrictions. Also, adding the assumption that the shadow economy over the period 1937-1961 was zero or negligible, Gutmann estimates the relative size of the shadow economy in the U.S.[10]

[8]Actually Feige (1979) assumed zero shadow economy for the base year in his study. Also, the assumption that the velocity of money for the official and unofficial sector of the economy is constant could be valid only if the income elasticity is unity as shown by Ahumada et al. (2006).

[9] In his original work Gutmann calls the hidden activities not “shadow economy” but “underground economy”.

[10] This method is often referred to as “simple currency ratio method”.

The main advantage of Gutmann's approach is the simplicity for empirical application following the strong theoretical framework and the usual availability of high-quality monetary data. There is some criticism in the literature about the equality of velocity of money in the official and unofficial sectors of the economy, which is initially assumed and the lack of econometrically testing of the hypotheses under consideration. But, of course, the main weakness of the method remains the fact that the currency in circulation to M1 ratio is considered as being dependent only on the development of the shadow economy. This assumption could be valid in the short term – other things being equal. In the medium and long term, the ratio could be influenced by factors other than the dynamics of the shadow economy. The ratio may change, but this does not necessarily mean a change in the size of the shadow economy when the economic agents in the official economy significantly change their preferences for holding cash under the impact of some permanent factors.

Nevertheless, the Gutmann's approach has been applied recently for studying the shadow economy in Romania (Davidescu, Strat, Paul, 2015), Slovakia (Palascakova, 2016), Tanzania (Epaphra, Jilenga, 2017) and Azerbaijan (Guliyev, 2019). It is worth noting that in most studies, Gutmann's approach is used as a second method for estimating the size of the shadow economy, not so much as a basic one.

The fourth and last up to now version of the monetary approach is the most used one, as stressed by Ardizzi et al. (2011) and Davidescu (2013). It can be traced back to the work of Cagan (1958) on demand for currency, further developed by Tanzi (1982, 1983). This method relies on the econometric estimation of a demand-for-currency equation using as a dependent variable a ratio between money in circulation and a monetary aggregate. But while Cagan considers as a dependent variable the currency in circulation to M1 ratio, Tanzi considers the currency in circulation to M2 ratio.

The above method has been applied to many countries since firstly Tanzi (1983) showed its applicability for the USA for the period 1930-1980. Chen & Schneider (2018) estimate the size of the shadow economy in China over 1978-2016 based on the same method. Tan, Habibullah, Kaliappan & Radam (2017) employ an extended version of the Tanzi-type model to estimate the size of the shadow economy for 80 countries from 9 regions of the world for the period 1975-2012. Hassan and Scheider (2016) combine the method and the structural equation MIMIC model to estimate the size of the Egyptian shadow economy in the 1976-2013 period. Alexandru, Ion & Catalin (2009) estimate the size and evolution of the shadow economy in Romania in 1998-2008 period employing a vector error correction model based on the same idea.

The fourth version of the monetary approach, which employs cash as a proportion of a larger monetary aggregate, has a serious advantage over the other methods. It is the fact that variables which might have an impact on the currency to M1 ratio, besides the shadow economy, can be included in the econometric model and thus, it is possible for their influence to be isolated. Given this feature, the estimation of the relationship between the amount of currency in circulation and the shadow economy is much more reliable.

However, the monetary approach is not free of criticism, of course, and Schneider and Enste (2002) provide some crucial points. They stress the absence of transactions in the shadow economy in the base year – a common assumption for these models to have a point of reference. They also emphasise the equal velocity of money for the formal and the informal sector, as well as considering the tax burden as the only determinant (or at least the main one) of the shadow economy.

In the following analysis, we apply the last method. We reckon the solid economic background behind the currency demand approach combined with econometric analysis, as well as the wide applicability of this method for different income group countries. This gives us stable grounds to consider it as a sufficiently reliable tool for assessing the size of the shadow economy in Bulgaria. At the same time, we try to address the critical comments from the previous paragraph by relaxing some of the assumptions accepted by the cited researchers. More precisely, we don't suppose the absence of transactions in the shadow economy in a particular base year, which makes our version of the monetary method more relevant to economic reality. Moreover, we also do not consider the tax burden or any other individual indicator to be the only determinant of the shadow economy.

2. The Demand for Currency – An Econometric Model

2.1 Econometric specification

In this section, we estimate an econometric equation in order to explain the evolution over time of the currency in circulation/M1[11] ratio. This ratio is indicative for economic agents' preferences with respect to payment methods (cash or bank transfer) in a certain period. By definition, the ratio is always between zero and one and the larger it is, the more preferred is cash as means of payment. Like Cagan (1958), we choose the monetary aggregate M1 to be the denominator of the ratio instead of M2, which was the choice of Tanzi (1982 and 1983). The reason for this choice is that all financial assets which could be used as means of payment are included in M1, while in M2 some assets are included that cannot be used as means of payment given the present level of development of the Bulgarian financial system.

Under the assumption that cash is the preferred means of payment in the shadow sector, the above ratio is indicative of the relative dynamics of this sector. When shadow practices increase relative to the official activities, the demand for cash will increase relative to the payments via bank transfers and vice versa. Due to this relationship, we want to obtain a model which explains currency in circulation/M1 ratio evolution over time as a result of the influence of changes in the shadow economy. Since other factors might also have an impact on this ratio, clearly, the model should control for such possible influence, as well.

Given the above arguments, we use an econometric model based on time series data (each observation is indexed with t). The dependent variable in the model is the currency in circulation/M1 ratio, which is denoted by CY_t[12]. We believe that the evolution of this ratio is determined by the influence of four different forces. Therefore, the explanatory variables are

[11] M1 consists of currency in circulation plus overnight deposits.

[12] In some versions of the model, this dependent variable will be transformed by using the natural logarithm function.

divided into four groups, each group representing variables that have certain common aspects. As a benchmark, the econometric equation takes the following general form:

$$CY_t = a + \beta X_t + \gamma M_t + \delta L_t + \theta Z_t + u_t \quad (1)$$

The column vector $\boldsymbol{X}$ includes the first group of variables, which are macroeconomic in nature because clearly, the macroeconomic environment has an impact on the behaviour of economic agents with respect to cash balances. Possible explanatory variables from this group may include variables like inflation, unemployment, interest rates or real income per capita (see, for example, Tanzi, (1982&1983), Epaphra&Jilenga (2017)). The reasoning is straightforward. Other things being equal, higher interest rates encourage people to keep more of their money in the form of time deposits and a smaller share in cash or current accounts, in order to reduce the interest forgone when money is kept as means of payment. On the other hand, interest rates are related to inflation. Also, one might expect that a higher unemployment rate will lead to more participation of the unemployed in the shadow economy.

The second group of factors, represented by the column vector $\boldsymbol{M}$, are variables, related to the process of digitalisation and financial technology development. This process leads to the usage of credit and debit cards, POS terminal devices, ATMs, and e-wallets. As this process develops over time, economic agents will naturally hold less cash for transactional purposes (legal ones), and as a result, the CY_t ratio will respond – decreasing over time, other things being equal. In our study, we use the number of POS terminals per capita as a proxy for the development of financial technologies.

The third group of factors (column vector $\boldsymbol{L}$) includes structural variables. Here we consider indicators for the distribution of the population. In general, the older population tends to use more cash in their payments due to the lower level of trust and less knowledge of banking technologies. Also, in villages and small towns, the availability of ATMs and POS terminals is limited, which is why people there pay mainly in cash. Therefore, the population structure could have an impact on the overall demand for cash. To test for such a possible impact, we have used variables for the relative share of the population 65+ and for the relative share of the rural population.

The column vector $\boldsymbol{Z}$ includes variables that represent the incentives and disincentives of economic agents to participate in shadow practices. Here is the focus of our study based on the logic stated in Section 1 that more shadow practices will lead to larger cash holdings and vice versa. Indicators like tax rates (Cagan, 1958), share of taxes and social security contributions in GDP (Chen&Schneider 2018), government regulations (Hassan, Schneider, 2016), and tax morale (Feld, Frey, 2007) have been suggested to describe these incentives in the literature. But in our case, we use a composite indicator for economic freedom, because of several reasons.

First of all, conceptually, it is clear that shadow practices are actually a result of the lack of economic freedom in the broad sense. If a country has a higher degree of economic freedom (lower taxes, fewer social security contributions, fewer regulations, fewer trade restrictions, etc.), there will be fewer incentives to trade or produce goods and services outside of the legal market.

Secondly, there are many cases (such as the Nordic countries) where taxes are high, but the size of the shadow economy is low or where taxes are low, but the size of the shadow economy is high. This shows that tax rates or the relative share of taxes in the gross domestic product (GDP) do not represent well enough the motivation to implement shadow practices, although these variables are used in most of the studies published in the literature.

Finally, economic freedom, in general, is a broader concept than tax morality or the rule of law or commercial freedom, which have also been proposed and used in such models in economic literature. The latter are only individual aspects of economic freedom and therefore, a composite general indicator of economic freedom can capture more comprehensively the motivation to implement shadow practices.

For our purposes, we use the composite indicator "overall score of freedom", provided by the Heritage Foundation. It is composed of 12 individual indicators which estimate different aspects of economic freedom. These indicators are grouped into four categories which are considered the pillars of economic freedom.[13] The overall score of freedom gives us a broader coverage of different *"freedoms"* in an economy, thus lowering the probability of missing variables in our model. By using the overall score of freedom, we capture the effects of the shadow economy that may be included only in a specific freedom score variable.

With α we denote the intercept of the model and with u_t the error term. The vectors $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, $\boldsymbol{\delta}$, and $\boldsymbol{\phi}$ are row vectors with coefficients that are subject of estimation. Each of these row vectors is associated with the corresponding group of variables by vector multiplication. The model is estimated multiple times using the method of ordinary least squares (OLS) and the Newey-West heteroskedasticity and autocorrelation (HAC) consistent estimator.

According to the arguments described above, we are looking for a suitable model to explain the dynamics of the money in circulation /M1 ratio. By a suitable one, we mean a model that has good technical characteristics from an econometric point of view, as well as the signs of the estimated parameters to meet expectations, according to economic theory.

Combining different variables and different functional forms, we observed that the signs of the estimated regression coefficients remain the same, which corroborates our approach. By doing this, we arrive at eight models that are based on the same economic logic (described above). These models have approximately the same econometric features, and therefore we cannot choose one as superior. As a result, in Section 3 we evaluate the size of the shadow economy based on the estimates from these eight models, and then we take the average to arrive at our final estimate. By doing so even if some of the models overestimate or underestimate the regression coefficients, we believe that on average we derive a reasonable estimation of the true size of the shadow economy in Bulgaria. The data, the models that we use, and the estimation of the size of the shadow economy are presented in the following sections.

[13] Rule of Law, Regulatory Efficiency, Government Size, Open Markets.

2.2 Data sources and processing

This study tries to evaluate the dynamic behaviour of the shadow economy in Bulgaria and thus, the data for our variables have a time dimension. Most of the data which we were able to find is annual, but there are some variables which are reported on a monthly basis. For them, we need to obtain annual data, which refers to four variables.

The first variable is the ratio "currency in circulation/M1" (CY_t) which plays the role of the dependent variable in the estimation procedure. The source for the data is the Bulgarian National Bank's[14] (BNB) payment statistics, where these variables are reported monthly. Given this, we had two choices. First, to take the values for the end of the year (December) and use them as representatives for the whole year, which we believe would be incorrect, because of the strong seasonal effects, particularly for the month of December. The second possibility is to take the values for all twelve months, treat them as a distribution and calculate the averages. Then use these average values of the currency in circulation and M1 to calculate the ratio CY_t that we take as representative for the year t. We opt for the second approach because it is far more accurate and representative for the yearly behaviour of CY_t. Thus, the formula, used for the calculation of CY_t, is the following:

$$CY_t = \frac{Average\ currency\ in\ circulation\ during\ the\ year\ t}{Average\ M1\ during\ the\ year\ t}$$

Another two variables are calculated in the same way. $AVINFL_t$, part of the vector $\boldsymbol{X}$, is a measure of the inflation in Bulgaria during the period t. This variable was calculated by using the Harmonised Index of Consumer Prices (HICP), which is reported monthly by the National Statistics Institute in Bulgaria (NSI). To obtain yearly data, we take the average of the twelve HICP indexes for each year. Then we calculate the average yearly inflation by using the standard formula:

$$AVINFL_t = \frac{Average\ HICP_t}{Average\ HICP_{t-1}} * 100 - 100$$

With regard to interest rates, we apply a similar approach. We calculate the average annual interest rate on household deposits ($AVINTH_t$) and on deposits of non-financial institutions ($AVINTN_t$) using the interest rates by months for the respective year, which are published by the BNB:

$$AVINTN_t = \frac{1}{12}\sum_1^{12} interest\ rate\ on\ housholds'\ deposits, new\ business$$

$$AVINTN_t = \frac{1}{12}\sum_1^{12} interest\ rate\ on\ nonfinancial\ institutions' deposits, new\ business$$

Then we obtain the average interest rate on deposits of households and non-financial institutions ($AVINT_t$):

$$AVINT_t = \frac{AVINTN_t + AVINTN_t}{12}$$

[14] BNB is the Central bank of Bulgaria.

All other variables used in our model are reported annually. Data for the unemployment rate ($UNEM_t$) is provided by the NSI, the number of POS terminals per capita ($\frac{POS_t}{POP_t}$) is calculated as a ratio between the number of POS terminals, reported by BNB's payment statistics and the population available from the Demographic statics of NSI. From the Demographic statistics of NSI we also take the relative share to the total population of people 65+ ($RS65_t$) and the rural population ($RSRP_t$). As stated in Section 2.1, for the overall freedom score (OS_t), we use data, provided by the Heritage Foundation.

2.3. Estimation and results

Equation (1) is estimated eight times with different combinations of independent variables. In some of these estimations, we use different functional forms to try and evaluate how a change in the type of the equation affects the results. These are the *lin-log*, *log-log* and *log-lin* forms. Additionally, we've used the Newey-West HAC standard errors when estimating all models. The results are broadly robust to the choice of functional form. They are presented in Table 1, Appendix I, while the descriptive statistics of the used variables are presented in Table 2, Appendix I.[15]

In the top row of Table 1, numbered from 1 to 8, are the indexes of the models that we use when estimating the size of the shadow economy in Bulgaria. In the second row is the dependent variable – CY_t or its logarithmic transformation depending on the functional form. The independent variables are in the first column, denoted with their abbreviations, which were introduced in the previous section. Because the average yearly inflation can be negative during periods of deflation, we've added a constant equal to 10 to all observations when the natural logarithm function is used. This transformation won't change the variance of the data; however, it will change only the mean. We believe that this is not a problem, because, in this study, we are not interested in forecasting CY_t or evaluating the effects of the different variables on it. Our goal is to evaluate the shadow economy in Bulgaria, and therefore we are focused mainly on the impact of *O.S.* on CY_t.

The results from the econometric estimation are not surprising. The sign in front of the overall score for economic freedom (*O.S.*) remains negative in all eight equations. The negative sign indicates that as economic freedom increases, the shadow economy shrinks, and people will hold less currency in circulation relative to all means of payment because there will be less illegal transactions. The variable *O.S.* also remains statistically significant through all eight equations.

The logarithm of the variable that indicates the process of financial technology development, *POS/POP*, also remains statistically significant and with the expected negative sign. The negative sign here captures the overall effect of the process of digitalisation on the amount of currency in circulation. As this process evolves, other things being equal, people need less

[15] In Table 2 we also include results of the Jarque-Bera test for normality. The results show that the distributions of the used variables are normal.

cash, because they use more digital payment options, which decreases the ratio *C.Y.* throughout the period of our study.

The variables that capture the macroeconomic processes of inflation and unemployment are statistically significant at a 10% level for two of the eight models. In the cases when they are not significant at this level, their signs are still correct. The positive sign of the regression coefficient for the unemployment rate is expected, because the higher is unemployment the greater is the possibility that the unemployed will take shadow jobs. Also, periods of high unemployment create incentives for officially employed workers to participate in shadow practices because they may try to earn additional funds (no matter how) to protect themselves from possible future layoffs.

The negative sign for the inflation rate captures the effect of the opportunity cost of holding currency. When the inflation rate is relatively high, economic agents will try to keep as small currency holdings as possible: only up to the level of the planned transactions (legal and illegal) to minimise their opportunity costs.

We keep the macroeconomic variables in all equations, because even if they are not statistically significant, their removal can lead to a problem of missing variables, as they capture important processes in the Bulgarian economy which might influence the dependent variable *C.Y.* The F-statistics and the p-values, associated with them, indicate that the different versions of the model are better than a model with just an intercept. The variance inflation factors (VIFs) are less than five for all estimated equations. The adjusted coefficients of determination (adj. R^2) are all between 0.7 and 0.8, indicating that the different versions of the model explain between seventy and eighty percent of the total variation in the dependent variable.

It is also worth noting that interest rates and population-related structural variables were statistically insignificant for the period under study. In terms of interest rates, this is because the effect of the cost of holding cash is captured by inflation. Interest rates have a high degree of correlation with inflation and their inclusion in the model leads to multicollinearity. Also, formally speaking, the variables related to the population structure do not have a significant impact on the dependent variable. It is possible, however, for them to have some minimal influence, the effect of which was captured by one of the other more significant variables, which would be due to the relatively short time series.

3. Estimation of the Size of the Shadow Economy

In the present section, we use the regression coefficients of Section 2.3 to estimate the size of the shadow economy. We start from the understanding that cash and overnight deposits serve as payments in the official sector of the economy and shadow transactions are served only by cash.

For each of the eight models, we apply the following procedure. First, we calculate the fitted values for the money in circulation/M1 ratio ($\widehat{CY_t}$) for each year t based on the regression coefficients of the model. Next, we calculate notional values ($\widetilde{CY_t}$) which correspond to the demand for cash as it would be if the country had maximum economic freedom. This is done by substituting in the regression equation the actual value of $O.S._t$ with the number 90.[16]

With maximum economic freedom, economic agents would not be motivated to apply shadow practices. In that case, there would be no shadow transactions, or they would be negligible. According to the logic of the monetary approach, in such circumstances, economic agents would hold less cash because there would be no transactional demand for cash caused by shadow practices. Therefore, the difference between the two variables $\widehat{CY}_t - \widetilde{CY}_t$ represents the ratio between that part of the cash that serves the shadow practices (C_u) and the money supply M1, i.e.

$$\widehat{CY}_t - \widetilde{CY}_t = \frac{C_u}{M1} \tag{2}$$

Assuming equal velocity of money for the official and for the shadow sector, we can write that

$$\frac{GDP_u + GDP_o}{M1} = \frac{GDP_u}{C_u} \tag{3}$$

where:

GDP_o is official gross domestic product;

GDP_u – unofficial GDP generated by shadow economic activity.

After an elementary transformation of equation (3), we obtain that

$$\frac{C_u}{M1} = \frac{GDP_u}{GDP_o + GDP_u} \tag{4}$$

From the above equation, we derive

$$\frac{GDP_u}{GDP_o} = \frac{\frac{C_u}{M1}}{1 - \frac{C_u}{M1}} \tag{5}$$

Once we have an estimate for $\frac{C_u}{M1}$ from the econometric equations, it is possible based on (5) to estimate the ratio between the size of the GDP, created by the shadow economy and the size of the officially reported GDP. The results are shown in Table 3, where these ratios for each of the eight models discussed in Section 2.3 are shown. The last column shows the average for all models.

As can be seen from the table, the average estimate of the size of the shadow economy, as a ratio to the official GDP, has a declining trend over time. In 2006, which was the last year

[16] Most individual indicators of economic freedom are designed so that their maximum value is 100. However, this does not apply to all indicators, so we assume that there would be maximum economic freedom if the composite indicator has a value of 90. In the last year of the period under study “overall freedom score” for Bulgaria has a value of 69.0, the lowest values for the individual indicators being "judicial effectiveness" (43.6) and "government integrity" (46.8).

before the country became a member of the European Union, the size of the shadow economy was estimated at 31.7% of GDP. Each year thereafter, this number decreases compared to the previous year with only two exceptions – 2007 and 2010. In 2010 this was probably due to the global financial and economic crisis, whose effect was felt in Bulgaria in 2009.[17] At the end of the period, the size of the shadow economy shrinks to 21.1%.

Table 3

Shadow Economy to Official Economy Ratio

	1	2	3	4	5	6	7	8	Average
2006	0.305	0.247	0.251	0.278	0.358	0.299	0.300	0.496	0.317
2007	0.320	0.250	0.255	0.301	0.390	0.308	0.306	0.508	0.330
2008	0.297	0.225	0.230	0.284	0.367	0.272	0.267	0.505	0.306
2009	0.287	0.211	0.214	0.270	0.347	0.261	0.262	0.487	0.292
2010	0.343	0.257	0.261	0.308	0.400	0.312	0.313	0.546	0.343
2011	0.301	0.210	0.214	0.265	0.340	0.247	0.248	0.499	0.291
2012	0.309	0.213	0.217	0.268	0.345	0.249	0.250	0.512	0.295
2013	0.306	0.208	0.212	0.263	0.338	0.246	0.246	0.517	0.292
2014	0.288	0.193	0.196	0.252	0.323	0.233	0.233	0.496	0.277
2015	0.261	0.173	0.175	0.236	0.301	0.208	0.208	0.460	0.253
2016	0.269	0.180	0.182	0.249	0.319	0.222	0.222	0.485	0.266
2017	0.233	0.151	0.153	0.220	0.280	0.182	0.182	0.445	0.231
2018	0.223	0.144	0.146	0.215	0.273	0.173	0.173	0.446	0.224
2019	0.209	0.133	0.136	0.205	0.260	0.162	0.161	0.422	0.211

Source: Own calculations.

The applied monetary approach implicitly assumes that shadow transactions are paid only in cash. In this sense, the method is highly universal, because it covers all manifestations of the shadow economy virtually, regardless of their form, as long as the payments are in cash. Practical observations show that this is most often the case. But it is not impossible for some shadow transactions to be paid by bank transfers (when they are small) or by barter, or by cryptocurrencies, for example. If there is a significant number of such cases, this will lead to a larger size of the shadow economy, which is not reflected in larger cash holdings. In this sense, the proposed estimates might be considered as a lower limit.

The obtained results cannot be directly compared with the results of other studies for Bulgaria, based on the monetary approach, because they refer to different periods. But as a point of reference, the average annual estimate of Nenovsky & Hristov (2000) for the years 1997, 1998 and 1999 is 15.2%, 35.3% and 24.1%, respectively, while Petrov (2004) gives an average estimate for the period 1998-2002 of 10.9%[18]. Ahumada et al. (2009) derive that the size of the Bulgarian shadow economy is between 12.2% and 17.5% of its registered GDP as an average for the whole review period depending on the model specification and the definition of variables[19]. Against the benchmark of these studies, the estimates from our study present the shadow economy with a significantly higher share.

[17] In 2009, the GDP decreases by 5%.

[18] These authors apply the monetary approach based on the demand for cash method.

[19] The authors use four different models with quarterly data for the period 1998-2007.

Conclusions

In the present study, we find that the shadow economy in Bulgaria for the period 2006-2019 tends to decline as a ratio to GDP: from 31.7%, it shrinks to 21.1%. This trend might be explained by the country's accession to the European Union. The year 2006 was the last one before the country became a full member of the Union and after serious legislative and institutional changes happened. Domestic legislation is harmonised with that of the European Union, stricter procedures are required, and several successive governments make efforts and carry out targeted measures to curb the shadow economy.

Despite the declining trend, the share of the shadow economy in the country remains still relatively high. Several international studies place Bulgaria as the country with the highest share of the shadow economy of all countries in the European Union. This is an obstacle to its economic and social development and there is a clear need for an in-depth analysis of this phenomenon and further measures to limit it and bring it to a much lower level.

In the context of the model used in this article, the motivation to participate in shadow practices stems from various aspects of economic freedom. In this sense, reducing the interest of economic agents in shadow practices can be achieved through policies that have an impact on those factors that tend to reduce economic freedom. As discussed in Section 3, for the case of Bulgaria, these are primarily "judicial effectiveness" and "government integrity".

References

Ahumada, H., Alvaredo, F., Canavese, A. (2006). The Demand for Currency Approach and the Size of the Shadow Economy: A Critical Assessment. Berkeley Olin Program in Law & Economics, Working Article Series.

Ahumada, H., Alvaredo, F., Canavese, A., Grosman, N. (2009). The Size of the Shadow Economy in Bulgaria: A Measurement Using the Monetary Method. – Bulgarian National Bank, Discussion Papers, D.P./74/2009.

Alexandru, A., Ion, D., Catalin, G. (2009). Estimating the Size of Romanian Shadow Economy Using The Currency Demand Approach. – Annals of Faculty of Economics, University of Oradea, Faculty of Economics, Vol. 2(1), pp. 623-631.

Ardizzi, G., Petraglia, C., Piacenza, M., Turati, G. (2011). Measuring the Shadow Economy with the Currency Demand Approach – A Reinterpretation of the methodology, with an application to Italy. – Department of Economics and Public Finance "G. Prato", Working ArticleSeries No. 22.

Bowsher, N. (1980). The Demand for Currency: Is the Underground Economy Undermining Monetary Policy?. – Federal Reserve Bank of St. Louis, pp. 11-17.

Breusch, T. (2005b). Estimating the Underground Economy using MIMIC Models. – Working Paper. Available under: http://econwpa.wustl.edu/eps/em/papers/0507/0507003.

Cagan, P. (1958). The demand for Currency relative to the Total Money Supply. – Journal of Political Economy, 66, pp. 302-328.

Chen, H., Schneider, F. (2018), Size and Causes of Shadow Economy in China over 1978-2016: Based on the Currency Demand Method.

Davidescu, A., Strat, V., Paul, A. M. (2015). Revisiting the Size of Romanian Informal Economy using the Gutmann Approach. – Procedia Economics and Finance, Vol. 23, pp. 1037-1045.

Davidescu, A. (2013). Estimating the size of Romanian shadow economy using Gutmann's simple currency ratio approach. – Theoretical and Applied Economics, Volume XX (2013), No. 10(587), pp. 33-48.

Dell'Anno, R. (2003). Estimating the Shadow Economy in Italy: A structural Equation Approach. – Working Article2003-7, Department of Economics, University of Aarhus, Aarhus, Denmark.

Dybka, P., Kowalczuk, M., Olesinski, B., Torój, A., Rozkrut, M. (2019). Currency Demand and MIMIC Models: towards a Structured Hybrid Method of Measuring the Shadow Economy. – Tax Public Finance, 26, pp. 4-40.

– Economic Studies Journal (Ikonomicheski Izsledvania), 31(5), pp. 3-18.

Epaphra, M., Jilenga, M. T. (2017). Currency Demand, the Subterranean Economy and Tax Evasion: The Case of Tanzania. – Journal of Economic and Social Thought, Vol. 4, N 2, pp. 187-211.

Feige EL. (2016). Reactions on the meaning and measurement of unobserved economies: What do we really know about the shadow economy?. – Journal of Tax Administration 2(1).

Feige, E. (1996). Overseas Holdings of U.S. Currency and the Underground Economy. – In: Pozo, S. (ed.). Exploring the Underground Economy. W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, pp. 5-62.

Feige, E. (1979). How Big is the Irregular Economy?. – Challenge, 22/1.

Feld, L. P., Frey, B. S. (2007). Tax Compliance as the Result of a Psychological Tax Contract: The Role of Incentives and Responsive Regulation. – Law and Policy, 29/1, pp. 102-120.

Guliyev, F. (2019). Estimating the Size of the Shadow Economy in Azerbaijan. Voprosy upravleniya i ekonomiki: sovremennoye sostoyaniye aktual'nykh problem, Sbornik statey po materialam XXVIII mezhdunarodnoy nauchno-prakticheskoy konferentsii, N 10 (26), pp. 43-46.

Gutmann, P. (1977). The Subterranean Economy. – Financial Analysts Journal, 34/1, pp. 24-27.

Hassan, M., Schneider, F. (2016). Modelling the Egyptian Shadow Economy: A Currency Demand and A MIMIC Model Approach. – Munich Society for the Promotion of Economic Research – CESifo Working Papers No. 5725.

Kirchgässner, G. (2016). On estimating the size of the shadow economy. – German Economic Review 18(1):99111.

Klarić, V. (2011). Estimating the Size of Non-observed Economy in Croatia using the MIMIC Approach. – Financial Theory and Practice, 35(1), pp. 59-90.

Naghdi, Y., Kaghazian, S., Jojadeh, I. (2015). Underground Economy Estimation in Iran by MIMIC Method. – Economic Studies, N 1.

Nchor, D., Konderla, T. (2016). The Shadow Economy of Czech Republic and Tax Evasion: the Currency Demand Approach. – Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis, Vol. 64/225, pp. 2081-2086.

Nenovsky, N., Hristov, K. (2000). Currency Circulation after Currency Board Introduction in Bulgaria (Transactions Demand, Hoarding, Shadow Economy). – BNB Discussion Papers (D.P./13/2000).

Palascakova, D. (2016). Analysis of Shadow Economy in Slovakia: Comparison to other E.U. Countries. – Actual Problems in Economics, Kiev, N 178, pp. 63-68.

Petrov, B. (2004). Estimating the Shadow Economy through the Demand for Cash in Bulgaria, The Hidden Economy in Bulgaria, Center for the Study of Democracy, pp. 117-125 [Petrov, B. (2004), Ocenka na ikonomikata v syanka chrez tarseneto na nalichni pari v Bulgaria, Skritata ikonomika v Bulgaria, Center za izsledvane na demokraciata, str. 117-125].

Schneider, F., Buehn, A. (2018). Shadow Economy: Estimation Methods, Problems, Results and Open Questions. – Open Economics, 1, pp. 1-29.

Schneider, F., Enste D. (2002). The Shadow Economy: Theoretical Approaches, Empirical Studies, and Political Implications. – Cambridge University Press, U.K.

Seitz, F., Reimers, H. E., Schneider, F. (2018). Cash in Circulation and the Shadow Economy: An Empirical Investigation for Euro Area Countries and Beyond. – Munich Society for the Promotion of Economic Research – CESifo Working Papers.

Tan, Y-L., Habibullah, M., Kaliappan, S., Radam, A. (2017). Some New Estimates of Shadow Economy for 80 Countries using Pooled Mean Group Estimator. – International Journal of Business and Society, Vol. 18 N 1, pp. 133-156.

Tanzi, V. (ed.). (1982). The Underground Economy in the United States and Abroad. Lexington Books, Lexington, MA.

Tanzi, V. (1983). The Underground Economy in the United States: Annual Estimates, 1930-1980. – IMF Staff Papers, 30, pp. 283-305.

Yaskal, O., Yaskal, I., Kolosinska, M., Boyda, S. (2021). The Informal Employment – Factors and Public Policies for its Limitation. – Economic Studies, Vol. 30 (2).

Appendix I

Table 1

Results from the estimation of the regression model

Estimation method: OLS, Newey-West HAC standard errors, n=14, period: 2006-2019								
	Dependent variable							
	1 CY	2 CY	3 *ln(*CY*)*	4 *ln(*CY*)*	5 CY	6 CY	7 *ln(*CY*)*	8 *ln(*CY*)*
Intercept	284.93***	278.47***	10.39***	10.18***	334.11***	342.82***	11.89***	12.10***
	(83.74)	(84.28)	(1.82)	(1.82)	(62.78)	(72.09)	(1.48)	(1.69)
*ln(*POS/POP*)*	-5.10***	-5.02***	-0.13***	-0.13**	-6.38**	-5.91**	-0.16**	-0.15**
	(0.96)	(1.03)	(0.03)	(0.03)	(1.56)	(1.59)	(0.04)	(0.04)
*ln(*OS*)*	-65.14**	-64.05**	-1.77**	-1.74**	-77.65***	-77.94***	-2.15***	-2.15***
	(19.53)	(19.49)	(0.43)	(0.42)	(14.14)	(16.69)	(0.33)	(0.39)
UNEM	0.26	-	0.01	-	-	-	-	-
	(0.18)		(0.00)					
*ln(*UNEM*)*	-	2.16	-	0.06*	-	-	-	-
		(1.39)		(0.03)				
AVINFL	-	-	-	-	-0.23	-	-0.01*	-
					(0.13)		(0.00)	
*ln(*AVINFL+10*)*	-	-	-	-	-	-2.37	-	-0.07
						(2.25)		(0.05)
adj. R^2	0.77	0.77	0.79	0.79	0.76	0.75	0.79	0.78
F-statistic	15.12	15.14	17.52	17.61	15.08	14.12	17.01	15.94
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

*Notes: The numbers in the parentheses are the Newey-West HAC standard errors. Statistical significance indicators: *p-value < 0.10; **p-value <0.05; "***" p-value < 0.01.*

Table 2

Descriptive statistics of the used variables (2006-2019)

	CY	*AVINFL*	*UNEM*	*OS*	*PP*
Mean	38.70	2.92	8.49	65.40	0.0098
Median	39.25	2.46	8.30	64.95	0.0096
St. Deviation	4.26	3.80	2.82	2.02	0.0030
Observations	14	14	14	14	14
Jarque-Bera statistic	0.91	2.31	1.01	0.60	0.36
p-value	0.63	0.31	0.61	0.74	0.83

Source: Authors' calculations.