

ESTIMATION OF THE SIZE AND DYNAMICS OF THE SHADOW ECONOMY IN SERBIA

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The authors are solely responsible for the content presented in this study.

EXECUTIVE SUMMARY

The shadow economy includes economic activities allowed by law, such as consumption, that is, the sale of legal goods and services and the realization of income, which take place outside of registered flows, with the aim of avoiding taxes, achieving savings on regulatory costs and having other competitive advantages. Being unregistered, the shadow economy cannot be directly measured, but can rather be estimated using various empirical methods. In the previous two decades, the assessment of the level and dynamics of the shadow economy in Serbia was the subject of numerous studies, which mainly applied econometric methods (primarily MIMIC) or survey methods and assessed the shadow economy in a wide range from 11.7% of GDP to 41.4% of GDP, depending on the applied method and coverage.

In this study, the shadow economy is estimated using two innovative methods - one based on macroeconomic data and the other based on an improved monetary model of cash demand. The method based on macroeconomic data estimates the shadow economy as the sum of unreported income (shadow economy in the domain of income) and unregistered taxable supply of goods and services (shadow economy in the domain of consumption), which represents a coherent methodological procedure now applied in a novel manner. The shadow economy in the domain of income was estimated based on the data of the Statistical Office of Serbia (SOS) from national accounts and standard national survey data (Labor Force Survey; Survey on Income and Living Conditions), as the sum of unreported labour income and unreported income from capital. The shadow economy in the domain of consumption was estimated by a recursive methodological procedure, based on the previously estimated VAT gap (calculated using the modified C-efficiency method) and the average weighted VAT rate, using the SOS data from national accounts statistics and macrofiscal data from the Ministry of Finance.

Most transactions in the shadow economy are financed with cash, which is why the excess of cash in relation to the level determined by structural factors is directly related to the extent of the shadow economy in a country. Under monetary model shadow economy is estimated as the product of “excess demand” for cash and velocity of money. In that respect, under Cagan’s – as the one with the strongest theoretical basis, shadow economy is seen as a function of the structural determinants of the demand for money, such as the level of transactions and interest rates, but also taking into account an indicator of the tax burden. The “excess demand” for cash is calculated as the difference between the model-estimated volume of cash that exists with the actual tax burden in a country and the estimated volume of cash that would exist in the hypothetical case of zero or minimal tax burden. In this study, several modifications to the standard monetary model were implemented, in order to take into account the specificities of the Serbian economy and changes in payment technology, with the aim of bringing the model closer to reality. Due to the high degree of euroization, in addition to dinar cash, cash in euros is also used in Serbia, and therefore the shadow economy was estimated based on the sum of dinar and euro cash. Another extension of the standard monetary model refers to the inclusion of the indicator of the cashless transition, as Serbia posted significant proliferation of cashless payments, which represent an important structural factor affecting the reduction of the use of cash. Finally, when estimating the velocity of money, which is one of the two direct drivers of shadow economy under monetary model, we have empirically insulated the fraction of velocity that depends on shadow economy, rather than on macroeconomic factors. By means of these extensions and modifications, the monetary model is made more realistic, while the estimates of the shadow econo-

my being more accurate. The extended monetary model for evaluating the shadow economy was estimated using the ARDL method, which has an advantage over other econometric methods in the case of the presence of variables with different levels of integration.

The results of the assessment based on macroeconomic data show that the shadow economy in Serbia in the period from 2009 to 2023 amounted to 23.6% of GDP on average, ranging from a maximum of 29.1% of GDP in 2013 to a minimum of 17.9% of GDP in 2021. In 2023, the total level of the shadow economy in Serbia is estimated at 21.1% of GDP, which is approximately EUR 14.7 bn. Of the total amount of the shadow economy, about two-thirds is the shadow economy in the domain of consumption, and one-third is the shadow economy in the domain of income. Bearing in mind the theoretical limitations and assumptions on which the applied methodology is based, this is a rough estimate, which is probably close to the lower bound of the actual volume of the shadow economy. Observed over time, the shadow economy in Serbia was on the rise in the period up to 2013, while after that, until 2021, there was a continuous significant decline. Although during 2022, and especially in 2023, there was a certain surge in the estimated level of the shadow economy, in 2023 it was still significantly (by more than a quarter) lower than in 2013, when its maximum value was recorded in the observed period.

The results based on the monetary model suggest that from 2010 to 2013 the shadow economy in Serbia, estimated using the modified monetary model, was on average around 31.8% of GDP. Until 2018, the shadow economy was on the rise, and then - until 2022, it declined significantly. In 2023, the shadow economy in Serbia was estimated at around 23.6% of GDP. Estimates of the shadow economy in Serbia obtained by both macroeconomic and monetary method lead to relatively similar results, which signals the robustness of these results.

Rise of the shadow economy until mid-2010s can be explained by the government's increased tolerance for such activities during the period of the 2008 global economic crisis, and then during the period of political changes in the country, as well as by the insufficient efficiency of the tax enforcement and collection system. The noticeable decline in the shadow economy after that occurred due to the action of a number of factors, such as the improvement of organization and coordination, as well as the digitization of audit authorities, the reform of the penalty policy for non-compliance with tax regulations, the flexibilization of the labour market, a significant reduction in unemployment and the contingent of available labour force that have had a positive impact on the bargaining position of workers, reduction of the labour taxes, change in structure of retail in terms of an increase in the relative share of retail chains in total retail supply, increase in the share of cashless payments, etc.

In addition to the limitations associated with the application of the listed methods, it can be concluded that slightly more than a fifth of economic activity in Serbia takes place in unregistered flows, but that it has decreased in the previous decade. Nevertheless, the level of the shadow economy in Serbia is still relatively high, which has negative consequences for public finances, as well as the level playing field for doing business. For additional progress in curbing the shadow economy in Serbia to the level of the European average, it is crucial to further improve the capacity and efficiency of the work of the enforcement authorities, which requires an increase in their financial and human resources capacities. In addition, a moderate reduction in the labour taxes, further regulatory reform aimed at reducing regulatory costs, promoting a cashless transition, and raising the level of tax morale could also contribute to reduction in the shadow economy in Serbia.

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1. SHADOW ECONOMY – CONCEPTS, DETERMINANTS, AND METHODS OF MEASUREMENT

The shadow economy includes legally permitted economic transactions (earning of income, consumption, i.e. sale of legal goods and services) which, for reasons of avoiding tax and regulatory costs, as well as for other reasons, are done outside of registered flows. As a consequence of not recording those transactions and not reporting them, the government fails to collect tax revenues. Since the shadow economy is most often assessed with the aim of measuring the foregone tax revenues of the government, studies often use a narrower definition of the shadow economy, which includes *taxable* transactions permitted by law, which were realized outside of registered flows. Accordingly, the shadow economy does not include transactions prohibited by law (e.g. drug trafficking, prostitution, etc.), which fall under the so-called black economy.

Since the biggest direct consequence of the shadow economy is tax evasion, it can be said that the factors that influence tax evasion are relevant determinants of the size of the shadow economy. Thus, according to the neoclassical model (Allingham & Sandmo, 1972), the decision on tax evasion is a matter of rational choice under uncertainty, which is made on the basis of a comparison of the marginal benefits of evasion (tax savings, which depends on the level of income and the marginal tax rate) and marginal evasion costs (expected fines, which depend on the probability of detection and legal marginal penalties). However, by comparing the estimates by country, it is noted that about 2/3 of the variation in the level of tax evasion can be explained by the difference in the mentioned factors (tax rates, collection efficiency, penal policy), which means that the decision on this is also influenced by other factors, primarily psychological nature. Therefore, the issue of tax evasion (and shadow economy) can also be viewed through the prism of behavioural economics, i.e. tax morality, defined as people's willingness to pay taxes voluntarily, even if there were no state coercion (Arsić and Ranđelović, 2017). Numerous empirical studies show the importance of tax morale as a determinant of the decision on tax evasion and engaging in the shadow economy, indicating that the level of tax morale is influenced by numerous factors, such as socio-economic and demographic characteristics of the population (gender, age, educational structure), trust in government, the perception of the fairness of the tax system, the transparency of the public finance system, the degree of democracy and people's participation in collective decision-making (e.g. through elections and referenda), the degree of decentralization of the state, propaganda, etc. (see: Ranđelović, 2020). In addition to motives related to achieving tax savings, doing legal activities outside of registered streams can be motivated by other

reasons - savings on regulatory costs, increased flexibility of business (easier dismissal of workers, as well as starting and closing of businesses), and achieving a competitive advantage on the market. Accordingly, it can be concluded that the level of the shadow economy depends on a large number of factors, among which the dominant level of the tax burden, the penalty policy of the state, the efficiency of the state in controlling and collecting taxes, the level of regulatory costs, tax morale, etc.

The widespread shadow economy has numerous negative economic consequences - the loss of tax revenues of the state, which threatens the provision of goods and services by the state that significantly affect economic growth and general well-being, the violation of level playing field in doing business, the opening of opportunities for financing illegal activities (money laundering, terrorism and sl.), violating human rights (e.g. the right to access to health care of persons who work without an employment contract and poverty in old age due to no access to the pension system) and others. That is why the issue of continuous improvement of the institutional environment and policies in order to suppress the shadow economy is given great importance in modern public finance systems. In order to monitor the effects of those measures, it is necessary to measure the level of the shadow economy in a certain way, which is a challenging issue, since by definition it is about measuring a variable that is hidden (unregistered). Therefore, in practice, one can speak not about exact measurement, but rather about the assessment of the size of the shadow economy, which can be done using different methods, such as: surveys, assessments based on random tax controls, transactional method, method based on macroeconomic income data and consumption, a method based on the demand for cash, a method based on the consumption of physical inputs, a method based on econometric modelling, as well as various experimental and quasi-experimental methods (Schneider & Enste, 2000; Arsić & Randelović, 2017):

- *The survey* represents a direct method for assessing the shadow economy and the scale of tax evasion, the advantage of which is reflected in the possibility to formulate questions on purpose, and the data are often available for a larger number of periods and a larger number of countries, which enables temporal and international comparison. An important shortcoming in this context is reflected in the risk of respondents giving insincere or imprecise answers, which can be partially controlled by introducing indirect, or control questions.
- *Method based on macroeconomic data on income and consumption* (eng. *Household Tax Compliance Method - HTC*) is based on the comparison of data on the movement of income, consumption and savings at the national level in the context of estimating the size of the shadow economy. This method is based on the logical assumption that if the sum of consumption and savings growth is greater than the reported income, the difference could be considered unreported household income (Christie & Holzner 2004). The main drawback of this method is reflected in the fact that it covers only the part of the shadow economy that refers to undeclared household incomes.
- *Monetary method based on the demand for cash* starts from the assumption that transactions in the shadow economy are realized in cash, so that the

shadow economy can be evaluated based on the econometric estimation of the demand for cash. Thus, in the standard monetary model, the demand for money is evaluated as a function of the level of the tax burden, the share of wages in the national income and interest rates on savings and gross domestic product per capita, while the remaining (unexplained) part of the variation in the demand for money is attributed to the need for money motivated by transactions in the shadow economy (Feige 1979 ; Tanzi, 1980; Macillas and Cazzavillan , 2009; González -Fernández & González-Velasco , 2015). The basic limitation of this method is reflected in the assumption that the underground economy is realized exclusively by paying in cash, and that the speed of money circulation is the same in the underground economy and in legal flows. Difficulties with estimation of the relative share of the structural part of money demand relative to the excess demand stands for an additional limitation of this method.

- *The transaction method* is based on Fisher's equation and it is seen as special form of monetary model. Under this method the shadow economy is estimated as the difference between official and nominal gross national product, estimated on the basis of the assumption of a functional relationship between the number of transactions and the value of nominal gross national product (Feige 1979). The limitation of this method is reflected in the arbitrariness of assumptions about the relationship between the number of transactions and the nominal gross national product, and the fixed nature of that relationship over time.
- *The method based on random tax controls* compares the declared tax bases and the values of the tax base assessed in random controls of the tax administration. The random selection of control subjects in some way enables the extrapolation of the results, but on the other hand, the impartiality of the estimates obtained in this way is limited because the set does not include cases in which the bases were not reported at all.
- *The method based on the consumption of physical inputs* is based on the assumption of unit elasticity of electricity consumption and GDP. Therefore, accordingly the difference in the dynamics of electricity consumption and the dynamics of GDP is attributed to the transition of activities to the shadow economy (Kaufmann and Kaliberda, 1996; Lacko, 1996). The limitations of this method are reflected in the assumptions - that all forms of the shadow economy imply considerable consumption of electricity, not taking into account the possibility of substituting electricity for other energy sources, as well as technological progress.
- *The method based on econometric modelling using the system of equations*, treats the shadow economy as a phenomenon that has multiple indicators (on the goods market, the labour market and the financial market), and is influenced by a large number of factors (eng. *Multiple Indicators, Multiple Choices* method - MIMIC). Using factor analysis methods, the shadow economy is evaluated as a latent variable that changes over time, while the coefficients that describe the relationship between factors and indicators are evaluated through a system of structural equations (Schneider and Enste, 2000; Krstić et al. 2015). An important shortcoming of this model is reflected precisely in the fact that, by applying this method, they obtain relative estimates in an indirect way. The results of empirical studies based on the MIMIC method show e.g. that in the previous two decades in Cen-

tral and Eastern Europe, there was no significant change in the level of the shadow economy, although other methods indicate the opposite (Hassan & Schneider, 2016).

Due to the shortcomings inherent in each individual method, assessment and monitoring of the shadow economy is often done using a number of methods. Accordingly, in this study, the shadow economy was assessed using two groups of methods - based on macroeconomic and survey data on income and consumption and based on the monetary method of cash demand. The selection of these methods was made based on the availability of relevant data and the effort to elaborate methods that will be able to be used in practice later for periodic updating of estimates of the shadow economy in Serbia in order to monitor the effectiveness of the measures applied to suppress the shadow economy.



2. SHADOW ECONOMY IN SERBIA – REVIEW OF EMPIRICAL LITERATURE

Estimating the size and dynamics of the shadow economy in Serbia was the subject of empirical research in many domestic and international studies, based on the use of various methods. Considering the difference in the applied methodology, scope, and period to which the research refers, there is a relatively significant variation in the assessment of the size of the shadow economy in Serbia.

In the framework of two international studies for a large set of countries using the MIMIC method, *Schneider (2005; 2011)* estimated the level of the shadow economy in Serbia and Montenegro at the level of 39.1% of GDP in 2002/2003, i.e. 41.4% of GDP in 2006/2007. The obtained results, which indicated the rise in the shadow economy in Serbia in that period, were somewhat unexpected, because during the first half of the first decade of the 21st century in Serbia, a significant step forward was made in suppressing the smuggling of excise goods.

In the research by *Christie & Holzner (2004)*, an assessment of the shadow economy was made for a group of countries in Central, Eastern and South-eastern Europe, using the HTC method, i.e. by comparing the dynamics of income, consumption and savings in 2001. According to the results of that study, the shadow economy in Serbia in 2001 in terms of income (undeclared income) amounted to 19% of GDP, while the average for South-eastern European countries was about 30% of GDP, and the average for Central European countries was about 22% of GDP. In this paper, the relatively low level of the estimated shadow economy in Serbia is explained by the incomparability of data and possible errors in the measurement of macroeconomic aggregates in Serbia at that time.

In a study published in an international monograph by *Krstić et al. (2015)*, the shadow economy in Serbia was assessed using three methods - MIMIC, HTC and a survey of business entities. The results based on the application of MIMIC methods show that the shadow economy in Serbia in the period 2001-2010 was an average of 31.4% of GDP, while in that decade its slight decline was recorded from 33.2% of GDP to 30.1% of GDP). For the purpose of comparison, according to the same study, the average level of the shadow economy in the remaining 10 countries of Central and Eastern Europe for which the assessment was made at that time was about 26.9% of GDP. On the other hand, by applying the HTC method, the shadow economy in Serbia in 2010 was estimated at 23.6% of GDP – though it should be noted that the scope of the HTC method is narrower than the scope of the MIMIC method. Finally, the results of the company survey, conducted on a representative sample of companies at the end of 2012, showed that the shadow economy in Serbia was estimated by that method at 21.2% of GDP.

Dybka et al. (2019) in their research for 43 countries, including Serbia, on quarterly data for 2015, apply a hybrid method (a combination of MIMIC and the cash demand method) assessing the level of the shadow economy. Based on that method, in this research the level of the shadow economy was estimated at 15.2% of GDP, which is one of the highest levels of the shadow economy (along with Bosnia and Herzegovina, Albania and North Macedonia).

In a study for 157 countries, including Serbia, also based on the application of the MIMIC method, and covering the period from 1999 to 2013, the shadow economy in Serbia during this period was estimated at an average of 36.2% of GDP, with a downward trend starting in 2003, so that in the last year of the observed period, the shadow economy in Serbia was estimated at 29.8% of GDP (Hassan & Schneider, 2016).

The shadow economy in Serbia was assessed on two occasions (in 2017 and 2022) using the survey method, i.e. by collecting data through a tailored survey, run on a sample of over 1,000 business entities (Krstić and Radulović 2018; 2022). The results of the survey, which was said to be comparable to the survey conducted in 2012 (in the study by Krstić et al. 2015), show that the shadow economy in Serbia in 2017 was estimated at 15.4% of GDP, while the result is based on improved survey method, according to which the shadow economy is viewed as the sum of unreported employee benefits and unreported profits, estimated at 14.9% of GDP. The results of the survey conducted in 2022 and the assessment of the shadow economy based on that data and the application of an “improved” survey method (“Shadow economy Index”) show that the shadow economy in Serbia in 2022 is estimated at 11.7% of GDP (Krstić & Radulović, 2022). In the same study, an overview of the results of similar research in the countries of Central and Eastern Europe, based on the calculation of the Shadow economy Index based on the survey method, was given. According to these results, the shadow economy in 11 countries of Central and Eastern Europe and Central Asia amounted to 31.1% of GDP on average, ranging from 19% of GDP in Estonia to 44.7% of GDP in Russia.

The IMF study (Kelmanson et al. 2019) provided results on the shadow economy for the countries of Europe in the period 2000-2016, using the MIMIC method. According to those results, the shadow economy in Serbia ranged from 33% of GDP in 2000 to 34.5% of GDP in 2016. Observing only the year 2016, according to the estimated level of the shadow economy, Serbia was in the ninth place among the 39 observed European countries.

Finally, one of the last studies on the level of the shadow economy in Serbia - Atanasijević et al. (2022), is based on econometric estimation of monetary model of cash demand in the period from 2005 to 2021. According to the results of this research, during the observed period, the shadow economy in Serbia decreased from 28-30% of GDP in 2005 to around 20% of GDP in 2021, with a significant decrease recorded during 2005-2006 and 2012-2021 years.

Table 1. Overview of empirical results

Source	Method	Last year of assessment	Shadow economy (% of GDP)
Christie & Holzner (2004)	HTC	2001	19%
Schneider (2005; 2011)	MIMIC	2002/2003	39.1%
		2006/2007	41.4%
Krstić et al. (2015)	MIMIC	2010	30.1%
	HTC	2010	23.6%
	Business survey	2012	21.2%
Hassan & Schneider (2016)	MIMIC	2013	29.8%
Kelmanson et al. (2019)	MIMIC	2016	34.5%
Dybka et al. (2019)	Hybrid	2016	15.2%
Krstić & Radulović (2018)	Business survey	2017	15.4%
	Business survey	2017	14.9%
Atanasijević et al. (2022)	Demand for cash	2021	20%
Krstić & Radulović (2022)	Advanced survey	2022	11.7%

It should be noted that the literature in the domain of the informal economy and the tax gap in Serbia since recently includes a comprehensive and thorough methodological publication, in which the methodology for assessing the tax gap in Serbia is elaborated in detail on the basis of macroeconomic and fiscal data (Bisić & Tabaković, 2023).

The presented results of a large number of studies on the estimation of the shadow economy in Serbia point to several conclusions. *First*, most of the existing studies are based on the application of MIMIC methods or survey methods, each of which has certain drawbacks (see Chapter 1). *Second*, estimates of the shadow economy based on the MIMIC method, usually show a significantly higher level of the shadow economy than is the case with estimates based on other methods. That may be a consequence of the difference in coverage, but also in the design of the methodology, which is explained in (Schneider, 2011 and Hassan & Schneider, 2016). It is also noticeable that estimates based on the MIMIC method do not, usually indicate a significant change in the level of the shadow economy, neither in Serbia nor in European countries in the previous two decades, although significant institutional reforms and structural changes in economy (decline in unemployment and proliferation of cashless payments) took place during that period, some of which significantly affect the drivers of shadow economy and tax evasion. *Thirdly*, the results based on data from surveys designed to examine the shadow economy indicate a lower level of the shadow economy in Serbia than is the case with the MIMIC method, with a significant drop in the level of the shadow economy. These results from the recent studies point to a significantly lower level of shadow economy in Serbia compared to other countries of Central and Eastern Europe, which are on average at a substantially higher level of economic and institutional development. *Fourth*, research based on econometric estimation of monetary model of demand for cash only partially covers the relevant factors, failing to consider important peculiarities of the Serbian economy, such as high euroization, structural changes, such as rise in the relative share of cashless payments, as well as the fact that the dynamics of money velocity is not influenced only by shadow economy, but also by other macroeconomic factors.

3. EVALUATING THE SHADOW ECONOMY – METHODOLOGY AND DATA

Since there is already a significant number of empirical studies related to the assessment of the shadow economy in Serbia based on the MIMIC method and specially designed surveys of businesses, and bearing in mind the observed opportunities for improving the applied methodology in other available studies, in this study the shadow economy in Serbia estimated using two methods:

- Method based on macroeconomic data;
- Method based on econometric modelling of cash demand.

3.1 Methodology of shadow economy assessment based on macroeconomic data

The most important economic transactions/facts that can be recorded and taxed include income, consumption and property. In this study, the shadow economy is estimated by a combined two-stage method based on the use of macroeconomic data on income and consumption from national accounts, macro-fiscal databases of the Ministry of Finance and the data from available national survey databases that are regularly updated. This method implies a separate assessment of the shadow economy in the domain of income (SE_i) and consumption (SE_c), and then an assessment of the total volume of the shadow economy (SE) as their sum:

$$SE = SE_i + SE_c \quad (1)$$

The applied method of assessing the shadow economy based on macroeconomic data is an innovative procedure, since it consistently combines the use of official survey and other macroeconomic data from existing official databases - for the purposes of assessing the shadow economy in the domain of income, while the shadow economy in the domain of consumption is assessed recursively, on the basis of the assessment of the tax gap by means of the improved C-efficiency method used by the European Commission (European Commission, 2022).

Property and transactions with property will not be covered by this method, for the following reasons: *i*) property taxes in Serbia entail only tax real estate that is difficult to hide, which does not mean that part of the real estate are not outside the tax records (Arsić et al. 2012), *ii*) property taxes in Serbia include the sale of real estate, securities and investment units, as well as intellectual property rights - all of which, in order to be realized, must be recorded in the appropriate official records (notary, Real Estate Cadastre, Central Securities Register, the Agency for Economic Registers, etc.), which makes the possibility

of their concealment limited, *iii*) property taxes make up less than 2% of total tax revenues, which suggests that their potential share in the shadow economy and the tax gap would be relatively small, *iv*) finally, there is no systematic data source that would enable direct or indirect identification of relevant data series in the domain of undeclared taxable assets and transactions with assets. Since consumption - supply of goods and services is a source of income and the source of company profit, the assessment of unregistered consumption - indirectly partially identifies a part of unregistered income and profit of companies.

The advantage of applying this method is reflected in the fact that the shadow economy is evaluated in an economically and methodologically consistent manner, based on “hard” and official data from the SOS and the Ministry of Finance. In relation to other studies in which the shadow economy in Serbia was assessed based on macroeconomic data, this study applied an innovative methodological procedure - especially in the segment of shadow economy assessment in the domain of consumption in a recursive manner, which will be discussed further below. On the other hand, this, as well as other methods for assessing the shadow economy, has certain limitations, which should be taken into account when interpreting the obtained results - non-inclusion unregistered company profits in a direct way (but rather indirectly through turnover), and the use of survey data for the calculation of some macroeconomic variables, as well as the fact that there are transactions in the shadow economy that are not included in any macroeconomic aggregate. When interpreting the results, it should also be considered that the estimates obtained are based on certain methodological assumptions, explained below.

a) Estimation of the shadow economy in the domain of income

The shadow economy in the domain of income is estimated as the total amount of unreported income of individuals from labour and capital. In this study it is estimated using the data from the Labor Force Survey (LFS), which the SOS has been conducting for decades, on a representative (two-stage) stratified sample of (20,000-70,000) households. The LFS data on the number of formally and informally employed individuals, as well as the SOS data on the amount of their income are used in this study. Data on formally and informally employed individuals are taken from the LFS database for each year, with formal and informally employed persons and formally and informally self-employed persons being observed separately.

The total amount of undeclared income is calculated as the sum of the amount of undeclared income from employment (UIE), the amount of undeclared income from self-employment (UISE) and the amount of undeclared income from capital (UIC):

$$SE_i = UIE + UISE + UIC \quad (2)$$

The total amount of undeclared income from employment - includes the wages of informal employees, as well as that part of the wages of formal employees, which is paid “in hand” (unreported). Consequently, this indicator is calculated as the product of the total number of informally employed persons (*m*), i.e. persons working without an employment contract (according to data from the LFS database) and the average wage of employees (*AW*). Since, according

to empirical data, informally employed earn a lower salary on average than formally employed (because they often engage in lower-paid jobs that require lower qualifications), the average wage used in this procedure was corrected, i.e. reduced by 20% in relation to the official data of the SOS on the average wage of formally employed persons, which is the coefficient (α) estimated on the basis of data from the Survey on Income and Living Standards (SILC) conducted by the SOS. Considering that even employees who have an employment contract, and therefore belong to the category of formally employed persons, in some cases earn part of their earnings in an unreported form, the total amount of unreported income from employment was increased by the correction coefficient (β), which includes the assumption that a third of the formally employed persons, in addition to the reported wage, also earns part of the undeclared wage, in the amount of one quarter of their formal wage.

The total amount of unreported self-employment income - is calculated as the product of the total number of persons (k) who earn income from self-employment (according to LFS data) and the average monthly gross income from self-employment (AISE) of these persons, according to LFS data. It is assumed that the average monthly income from self-employment of persons who are informally engaged is lower than the income of those who are formally self-employed by the same relative amount as is the case with employed individuals.

The total amount of unreported income from capital in this model includes unreported income from renting real estate to individuals (RI), while for other income from capital (interest, returns on investment units, dividends, income from leasing real estate to legal entities) it is assumed that are fully taxed, since taxation is withheld at source. Data on rent flows are taken from the statistics of national accounts on the structure of household personal consumption, with the assumption that part of that amount (θ) is unreported. The assessment of the shadow economy in this study was performed with an assumed value of the parameter θ of 0.8.

Accordingly, the assessment of the shadow economy in the domain of income is empirically evaluated as follows:

$$SE_i = (1 - \alpha)(1 + \beta) \sum_{n=1}^m AW_n + \sum_{n=1}^k AISE_k + \theta RI \quad (3)$$

It should be noted that when interpreting the results obtained by this methodological procedure, several limitations should be considered - primarily in terms of the reliability of the data obtained through the survey, i.e. the bias of the answers given regarding the undeclared part of the income, as well as exogenous assumptions for the calculation of some variables, for which no official data are available. Consequently, estimates of the shadow economy obtained in this way can be considered indicative, possibly close to a lower bound of the actual extent of the shadow economy.

b) Estimating the shadow economy in the domain of consumption

The evaluation of the shadow economy in the domain of consumption is done in an indirect way based on the improved version of the C-efficiency method (European Commission, 2022). The C-efficiency coefficient represents the ratio between the actual amount of VAT revenue (a) and the potential amount of VAT revenue ($VATR_p$) that would have been collected if the entire taxable

consumption had been reported and taxed. For the purposes of assessing the shadow economy, instead of the ratio of the amount of actual and potential VAT revenue, their difference is calculated, which *de facto* represents the VAT gap (VAT_{gap}). After that, the shadow economy in the domain of consumption is derived indirectly from the VAT gap. Since the VAT gap is the amount of VAT that would have been collected, if the current tax rates had been applied to consumption that was not reported and taxed, the amount of undeclared and untaxed taxable consumption can be calculated recursively, by dividing the VAT gap and the average VAT tax rate (t):

$$VAT_{gap} = VATR_a - VATR_p \quad (4)$$

$$SE_c = \frac{VAT_{gap}}{t} \quad (5)$$

The key step in assessing the VAT gap, and then the shadow economy in the domain of consumption, is the assessment of the potential amount of VAT that would have been collected if the entire taxable consumption had been taxed, which can be calculated as the product of the potential value of taxable consumption and average VAT rate. The value of the entire potential taxable consumption can be estimated based on data from the national accounts, on the personal consumption of households (C), which is almost entirely taxable, as well as the part of government consumption (G) and investments in fixed capital (I), which are partially taxable, where the coefficients γ and δ represent respectively the part of government consumption and investment that is taxable by VAT. In addition, the amount of potential VAT is increased by the general correction factor η , which approximates other non-covered transactions.

Since the assessment of potential income from VAT is based on data from national accounts statistics, the weighted average rate of VAT was estimated for each year individually, based on SOE data on the structure of consumption and the statutory tax rates. Since the average VAT rate is calculated on the basis of disaggregated data on the structure of personal consumption of households, it takes into account the fact that some segments of personal consumption are not taxable (e.g. imputed rent). Accordingly, the potential amount of VAT revenue is calculated as follows:

$$VATR_p = (1 + \eta)(C + \gamma G + \delta I)t \quad (6)$$

For the purposes of assessing the shadow economy in the field of consumption, data on the actual amount of VAT collected is taken from the official databases of the Ministry of Finance, while other macroeconomic variables (C, G, I) are taken from the statistics of the national accounts of SOS or Eurostat. The accuracy of this method is also determined by the completeness of the coverage of personal consumption and investments in national accounts. Part of G and I, which should be included in the hypothetical value of VAT base, is obtained based on data from national accounts on the values of these variables, and the results of empirical analyses available for European countries (since such estimates are not available for Serbia), which show that on average, around 10.3% of government spending and 6.8% of investments are subject to VAT, while the general corrective factor for non-covered transactions usually amounts to 1% (European Commission, 2022).

3.2 Methodology of shadow economy assessment based on the econometric model of money demand

The starting point of monetary models of the shadow economy is the assumption that most transactions in the shadow economy are paid in cash. Consequently, due to the shadow economy, the total amount of cash and its ratio to deposits or the money supply, is higher than it would be if there was no shadow economy. The focus of the monetary model is to estimate what part of the demand for cash is a consequence of performing transactions in the shadow economy. The answer to this question is not simple, because apart from the shadow economy, the demand for cash depends on many other factors, such as the level of GDP, the level of interest rates, inflation, variability of the exchange rate, the proliferation of cashless payments, the density of the banking network, regulation, citizens' habits, etc.

The development of monetary models of the shadow economy began at the end of the 1970s (Gutmann, 1977; Feige, 1979) and continued during the following decades. Gutmann (1977) estimated the shadow economy in the US based on the assumption that the shadow economy did not exist in the past, and that its emergence was a consequence of high taxes and complicated regulation. Additional assumptions are that the ratio of cash and deposits grows, in order to finance transactions in the shadow economy, and that the speed of money circulation is equal in the regular and shadow economy. Based on the previous assumptions, he estimated the shadow economy as a product of the money velocity¹ and excess cash.

Feige (1979) evaluated the shadow economy starting from the quantitative theory of money according to which:

$$M^*v=PY \quad (7)$$

where M is transaction money, v is the velocity of money circulation, P is the price level, and Y is the volume of transactions in a country, which is usually approximated by real GDP. It then assumes that in a base period the volume of transactions, the money supply and the shadow economy are known, as well as that the velocity of money circulation over time is constant. Based on that the nominal income in each subsequent period is estimated. The shadow economy according to this approach is calculated as the difference between the estimated GDP and statistically measured GDP. This approach implies that the shadow economy is financed both with cash and non-cash. A common feature of early monetary models is that they assume that the extent of the shadow economy was known at some point in time. Without this assumption, by applying Guttman's and Feige's approach, it is possible to assess only the dynamics of the shadow economy, but it is not possible to assess its size.

At the beginning of the 1980s, Tanzi (Tanzi 1980a; Tanzi 1980b; Tanzi 1983) developed a monetary model of the shadow economy by expanding Cagan's money demand function (Cagan, 1958). A key extension of the model is the inclusion of tax burden as an explanatory variable:

¹ The velocity of money circulation is $v=Y/M1$, where Y is the GDP, and $M1$ is the money supply defined as the sum of cash and transaction deposits.

$$C_{ot} = A(1 + \lambda_t)^\rho Y_{ot}^\varphi e^{-\mu i_t} \quad (8)$$

where is C_{ot} is the observed cash, which is equal to the sum of cash used in the regular C_{rt} and shadow economy, C_{ht} , while is λ_t is a measure of tax burden (average tax rate, share of tax revenues in GDP, etc.). In this model Y_{ot} stands for the observed GDP, equal to the statistically registered GDP, which is assumed not to include the shadow economy.² The opportunity costs of holding cash are measured through interest rates i_t . In accordance with the theoretical expectation that an increase in the tax burden affects stimulates switch to shadow economy, and that an increase in the shadow economy raises the demand for cash, it is expected that the estimate of the parameter ρ has a positive sign. GDP growth increases the volume of transactions in a country, which affects rise in the demand for cash, which implies a positive sign of the estimate of the parameter φ . The rise in interest rates increases the opportunity cost of holding cash, which is why the sign in front of the parameter μ is expected to be negative.³

Cash demand can be decomposed into structural cash demand and excess cash demand (Ardizzi et al., 2014). In the standard model, the structural factors are the volume of transactions (GDP), interest rates and non-cash payments, while the excess demand for cash depends on the shadow economy, which rises with an increase in the tax burden. After logarithmic transformation, the model (8) takes a linear form:

$$c_{ot} = a + \rho \ln(1 + \varphi) + \beta y_{ot} - \mu i_t \quad (9)$$

where the logarithms of the variables are indicated by lowercase letters.

In the second step, based on the previous equation, the excess demand for cash is calculated c_{ht} as the difference between the estimated demand for cash (\hat{c}_t) that exists at the actual tax burden (λ_t) and the estimated demand for cash (c_t) that would exist in the hypothetical case when taxes were minimal ($\lambda_t = \min$) or equal to zero ($\lambda_t = 0$).

In the third step, the shadow economy is estimated for each period by multiplying the calculated excess cash c_{ht} and the velocity of money circulation $Y/M1$, using the assumption that the velocity of money circulation in the regular and shadow economies is equal.

The convenience of the theoretical framework proposed by Tanzi is that it is possible to expand the model by including other determinants of the demand for cash, such as cash in foreign currency, the development of non-cash payments, etc. (Dybka et al., 2019). The inclusion of cash in foreign currency is justified in countries where there is a substitution of the domestic currency by a foreign one, as is the case with Serbia and other countries of Central and Eastern Europe. Although the use of cash in foreign currency has decreased over the past two decades due to the suppression of inflation and regulations prohibiting cash transactions in foreign currency of more than 10 thousand euros, it is still present both in the regular and in the shadow economy. An ex-

² This assumption does not correspond to reality, because during the previous decades statistical offices included a part of the shadow economy in the GDP.

³ In Cagan's money demand function, the sign in front of μ is negative, which is why a positive sign of this parameter is expected, due to the negative impact of interest rates on the demand for cash.

ample of the shadow economy activities in which foreign currency is still used to performing transactions are: payments of rents, payments for services to craftsmen, payment of personal services, construction of private houses, sale of livestock, sale of durables, etc. Therefore, the inclusion of cash in foreign currencies enables a more complete coverage of the shadow economy, than is the case if only cash in dinars is used. Omitting this variable may lead to an underestimation of the extent of the shadow economy.

In accordance with the observation that transactions in the shadow economy are predominantly paid in cash, the development of cashless payments may also affect the reduction of the shadow economy (Randelović, et al., 2022). Of course, this does not mean that transactions in the shadow economy cannot be paid cashless, but the use of cashless payments in the shadow economy is less common, because these types of payments leave a trace that can be detected by tax authorities. Considering that in Serbia during the previous 15 years there has been a significant development of cashless payments (Randelović et al., 2022), the inclusion of variables that measure this enables a more precise assessment of the impact of other variables on the demand for cash, and thus a more precise assessment of the shadow economy. Accordingly, the extended model that includes cash in foreign currency as part of the demand for money and a variable approximating the form of payment (cash/non-cash) has the following form:

$$ch_{ot} = a + \rho \ln(1 + \lambda) + \varphi y_{ot} - \mu i_t + \kappa c_t \quad (10)$$

where is ch_{ot} stands for the sum of dinar and foreign currency cash, while c_t is the indicator of non-cash transactions. Given that non-cash transactions are a substitute for cash transactions, it is expected that the estimates of the parameter κ have a negative sign.

Although estimates based on excess demand for cash represent one of the most applied macro methods for evaluating the shadow economy, this method has several weaknesses. Though the majority of transactions in the shadow economy are paid in cash, according to some estimates, about 20% of the shadow economy is carried out by barter exchange or by means of cashless payments (Isachsen & Strøm, 1985), which means that monetary models underestimate the level of the shadow economy. However, it is estimated that this problem is currently not quantitatively significant, but that in the future, with the rise in cashless payments, we can expect to find new ways of cashless payments when performing transactions in the shadow economy. Given that the shadow economy within the monetary model is calculated as a product of excess demand for cash and the velocity of money, this model does not provide adequate estimates of the shadow economy, if there are other factors that affect the velocity of money, such inflation, interest rates or exchange rate variability. When evaluating monetary models, it is assumed that the velocity of money circulation in the regular and shadow economy is equal, which is justified only if the income elasticity of demand in both sectors is equal to one (Ahumada et al., 2009). Monetary models, as the only factor affecting the shadow economy, most often include the amount of the tax burden, although it is known that the shadow economy also depends on other factors such as: the efficiency of tax administration, the costs of tax administration, tax morale, etc. Omitting other relevant determinants of the shadow economy may result in biased esti-

mates of the size of the shadow economy. The absence of other determinants of the shadow economy in the monetary model is not a consequence of the assumptions or characteristics of this model, but rather the lack of data, which is a problem faced by other methods of estimating the shadow economy. In addition, the assumption of a zero level of shadow economy in the base year may be contested.



4. SHADOW ECONOMY IN SERBIA – EMPIRICAL RESULTS

4.1 Estimation of the shadow economy based on macroeconomic data

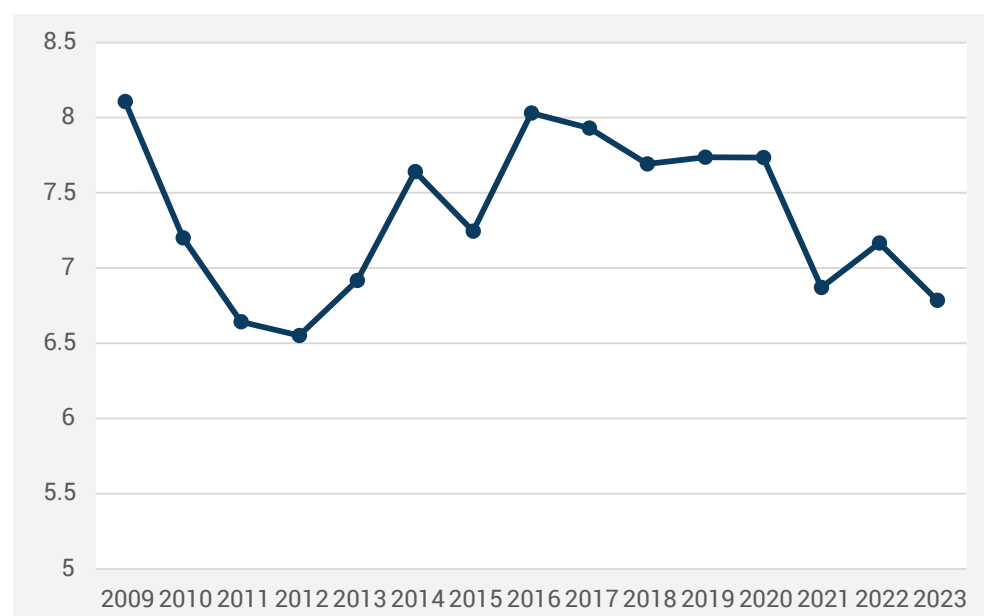
a) Shadow economy in the domain of income

The results of the estimation of the shadow economy in Serbia based on macroeconomic data on income show that unregistered taxable income ranged from about 8% of GDP in 2009 and 2016 to 6.6% of GDP in 2010 and 2011. In 2023, that is also the last year of the observed period, the shadow economy in terms of income is estimated at about 6.8% of GDP (about 4.7 billion euros), which is approximately the lowest values in the last fifteen years (Figure 1). It should be noted that this is probably the lower limit of the estimate, bearing in mind the limitations of the method applied to estimate the shadow economy in the income domain, explained in chapter 3.1 of this study.

Observed in relation to total (reported and unreported) taxable income, unreported taxable income in this period ranged from 19.1-19.9% of the total income in 2009 and 2016, up to 14.4% of total income in 2023 (Figure 2). The moderate decline in the relative share of unreported income is largely the result of a strong decline in this ratio in the case of income from self-employment, and a moderate decline in the domain of wages as well (Graph 3).

Observed over time, it can be seen that in the period from 2009 to 2012, the shadow economy in the domain of income declined, which was followed

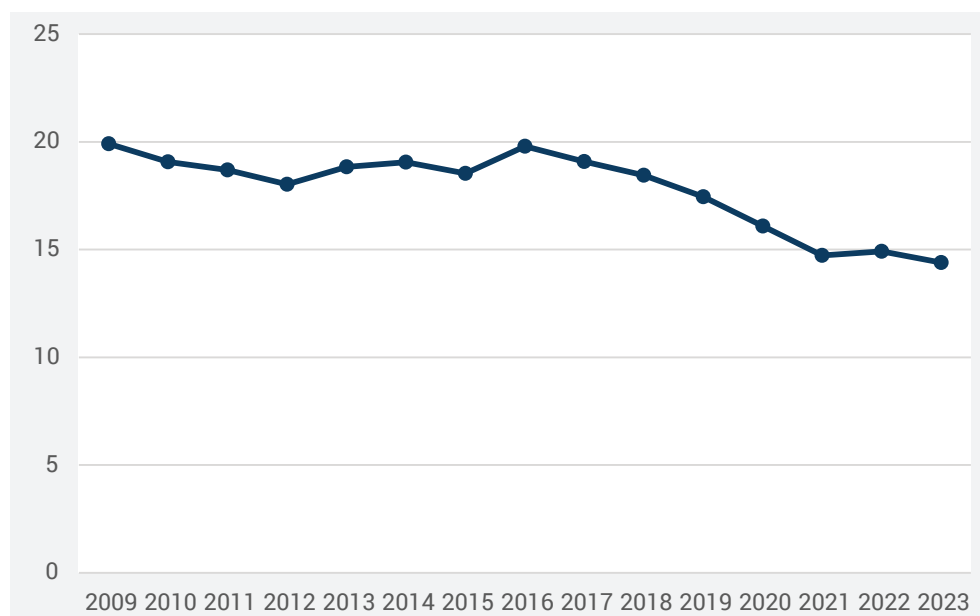
Figure 1. Shadow economy in the domain of income (% of GDP)



Source: Author's calculation

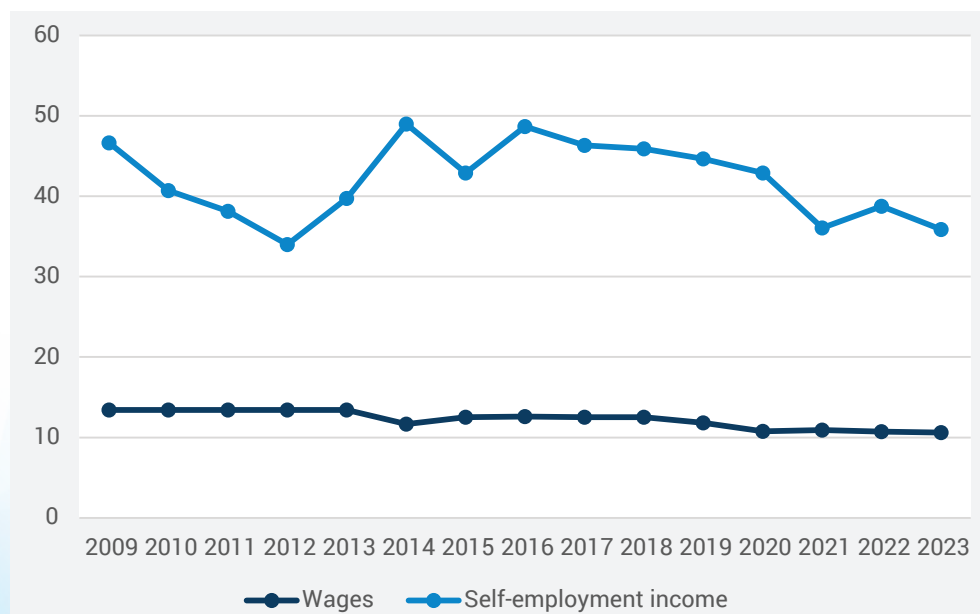
by a period of strong growth from 2013 to 2016, and then a period of gradual decline. The rise in the shadow economy in the period from 2012 to 2016 can be linked to the conditions at the labour market, as well as due to an increased tolerance for the shadow economy and reliance on unconventional tax collection measures and a softened punishment policy during 2013 and 2014. On the other hand, the noticeable decline of the shadow economy in terms of income in the last few years is largely a consequence of the change in the labour market, i.e. the decrease in the unemployment rate and the decline in the contingent of available labour force, due to demographic and migration trends, as well as the economic growth, which strengthened the bargaining position of workers, i.e. the supply side at the labour market. In addition, the decline of the shadow economy in the domain of incomes could also be influenced by some of the public policy measures - the flexibilization of the labour market, a slight reduction in the fiscal burden of work, etc.

Figure 2. Unreported income (as % of total income) - total



Source: Author's calculation

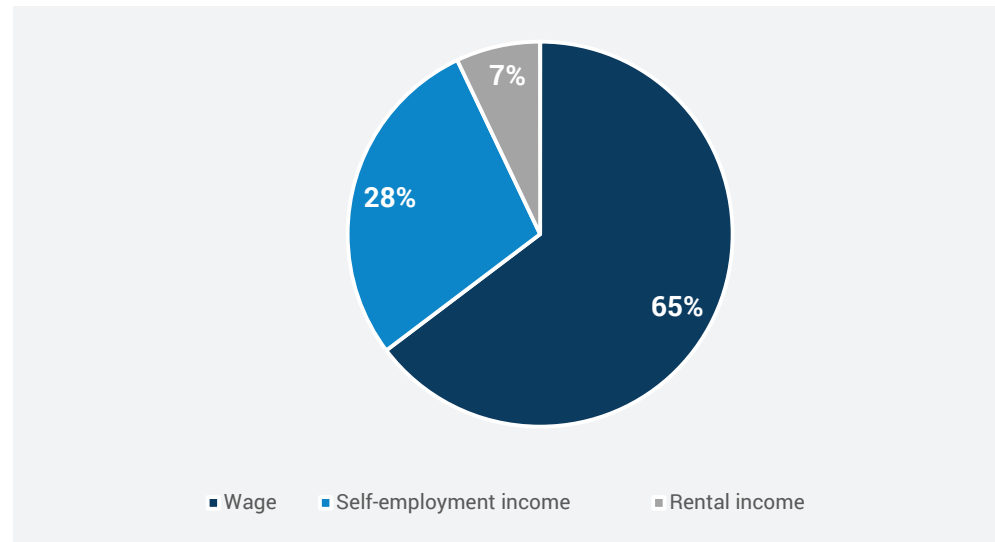
Figure 3. Unreported income (as % of total income) - by types of income



Source: Author's calculation

In terms of the structure of undeclared taxable income, almost two-thirds are undeclared income, which is expected since income from employment normally accounts for over 80% of taxable income in Serbia. The relative share of undeclared income from self-employment is also significant, while the share of unreported capital income is not negligible either (Figure 4).

Figure 4. Structure of unreported income in 2023 (%)

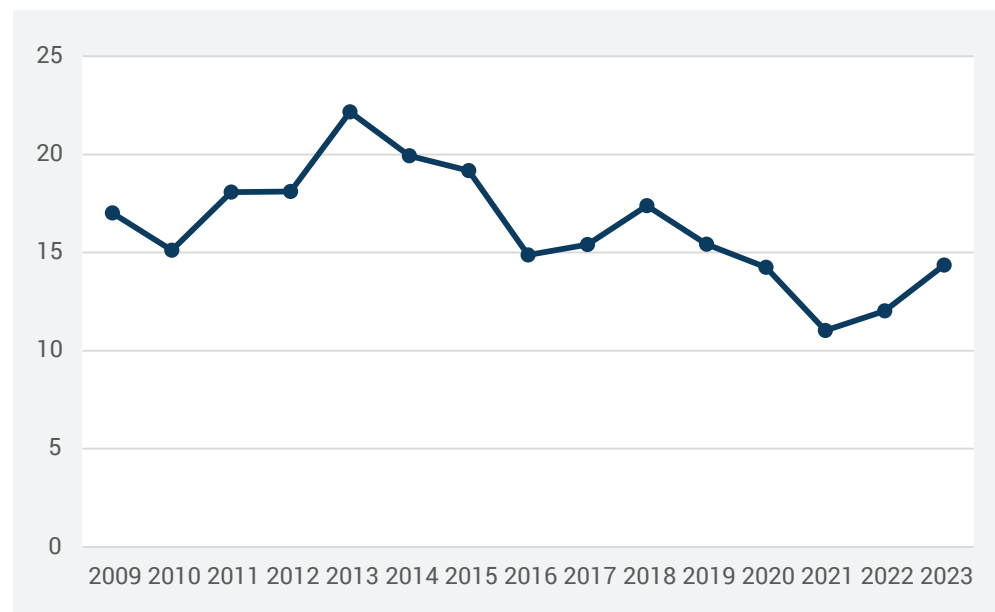


Source: Author's calculation

b) Shadow economy in the domain of consumption

Estimates derived from the VAT gap calculated based on the methodological concept of C-efficiency show that the shadow economy in the domain of consumption (undeclared taxable consumption) in Serbia in the period from 2009 to 2023 varied from 22.5% of GDP in 2013 to 13.5% of GDP in 2021 (Figure 5). In 2023, which is also the last year of the observed period, the shadow economy in the domain of consumption was estimated at 14.4% of GDP, which means that the total value of unregistered taxable consumption was about EUR 10 bn.

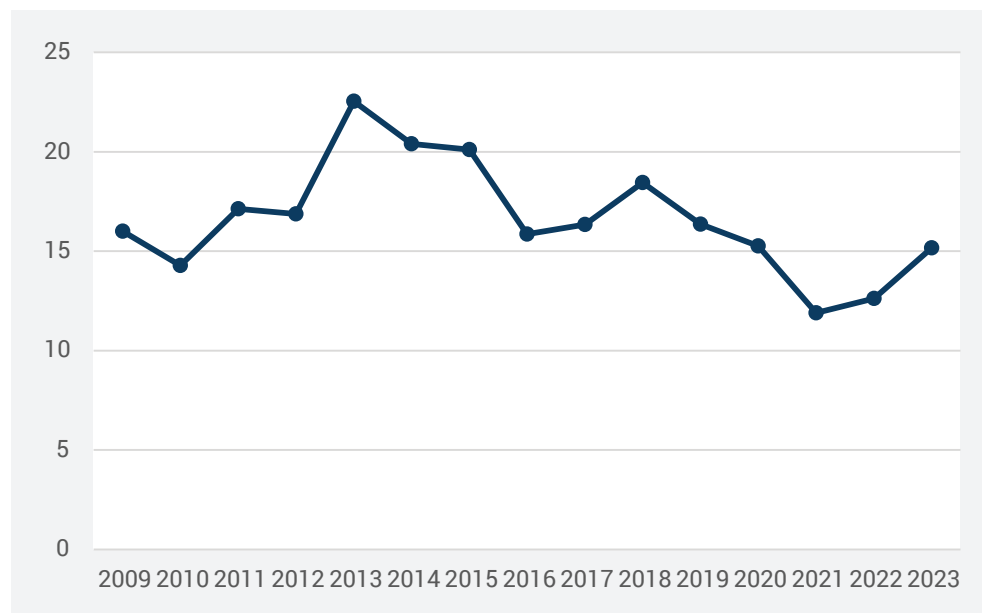
Graph 5. Shadow economy in the domain of consumption (% of GDP)



Source: Author's calculation

Observed in relative amounts, unregistered consumption in the period from 2009 to 2023 ranged from 22.5% of the total (registered and unregistered) consumption in 2013 to 11.9% in 2021. In the last year of the observed period - 2023, unregistered taxable consumption amounted to 15.2% of total consumption (Figure 6).

Figure 6. Unregistered consumption (% of total consumption)



Source: Author's calculation

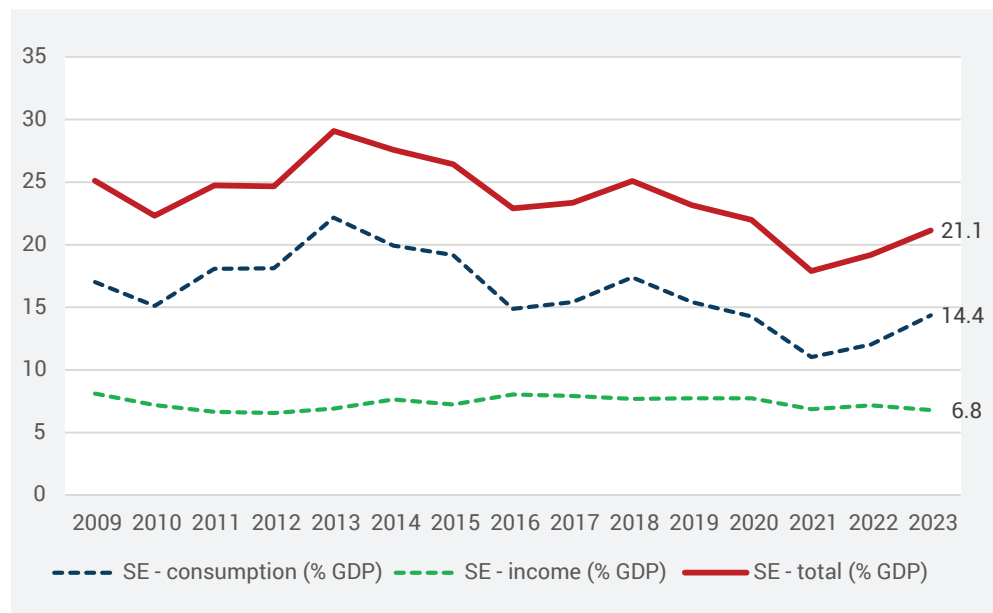
Regarding the dynamics of the shadow economy in the domain of consumption, the obtained results show that in the observed period there were two intervals - a period of strong rise in the shadow economy until 2013 and a period of its noticeable decline after that. Within the period, it is observed that the decline of the shadow economy ended in 2021, after which its slight increase is observed in 2022, and a more significant rise in 2023. Nevertheless, despite the rise in the previous two years, the shadow economy in terms of consumption in 2023 was lower by a third in comparison to 2013.

Such movements of the shadow economy in the field of consumption are largely the result of the government's approach to the collection of consumption taxes. The strong growth of unregistered turnover until 2013 is a consequence of high tolerance of the shadow economy and reliance on unconventional methods of tax collection (e.g. by appealing to taxpayers instead of strengthening the audit function of state authorities). On the other hand, the decline of the shadow economy in the domain of consumption since 2014 can be connected to institutional reforms - a more organized and systematic approach of the government to controlling the collection of consumption tax, a reform of the penalty policy that has been made more transparent and consistent, a reduction in the regulatory costs of tax collection due to digitization, and probably a stronger political will to suppress the shadow economy in the context of fiscal consolidation. In addition, the reduction of the shadow economy in the domain of consumption in this period was also influenced by some structural factors, such as the increase in the share of large trade chains in the total retail turnover, the increase in the share of fruit and vegetable supply in the supermarkets relative to green markets, as well as rise in the share of cashless payments.

c) Estimation of the overall level of the shadow economy based on macroeconomic data

Based on estimates of the shadow economy in the domain of income and consumption, the total size of the shadow economy in Serbia for the period 2009-2023 was estimated. According to these results, the shadow economy in Serbia in this period amounted to 23.6% of GDP on average, ranging from a maximum of 29.1% of GDP in 2013 to a minimum of 17.9% of GDP in 2021 (Figure 7). In 2023, the total volume of the shadow economy in Serbia is estimated at 21.1% of GDP, which is approximately EUR 14.7 bn. It should be noted that, according to the described assumptions and limitations, this is a rough estimate, which is probably close to the lower limit of the interval of the actual value of the shadow economy. Of the total amount of the estimated shadow economy in Serbia, about two-thirds refers to unregistered taxable consumption (i.e. turnover of goods and services), while one-third is made up of unreported taxable income.

Figure 7. Estimate of the shadow economy in Serbia based on macroeconomic data (% of GDP)



Source: Author's calculation

The overall level of the shadow economy in Serbia, estimated using this method, is comparable to the results obtained in some of the available empirical studies based on macroeconomic data (Krstić et al, 2015; Atanasijević, 2022), while it is lower compared to the estimates obtained using the MIMIC method (Krstić et al, 2015; Hassan & Schneider, 2016; Kelmanson et al, 2019). On the other hand, the size of the shadow economy in 2023 estimated in this study on the basis of macroeconomic data is significantly higher compared to the estimates obtained from tailored business surveys (Krstić et al, 2015; Krstić & Radulović, 2018; Krstić & Radulović, 2022).

Observed by sub-periods, the shadow economy in Serbia in the period up to 2013 posted considerable rise, while after that, until 2021, there was a continuous substantial decline. Although during 2022, and especially in 2023, there was an increase in the estimated size of the shadow economy, in 2023 it was still significantly smaller (by more than a quarter) than in 2013, when its maximum value was recorded in the observed period. Expansion of the shadow econo-

my until 2013 can be explained by the government's increased tolerance for undeclared activities during the period of the great economic crisis, and then during the period of political changes in the country. In addition, the application of heterodox tax collection methods, especially in the period of 2013 and 2014, i.e. reduced reliance on standard methods of control and coercion, also stimulated the growth of the shadow economy. In the period 2012-2014 there was also an increase in some tax rates (VAT rate and corporate income tax), which could also have an effect on shifting economic activity to informal flows. Nevertheless, some of the institutional reforms carried out after that, such as the improvement of work organization and coordination, and the digitization of the operations of inspection bodies, the reform of the penalty policy, the flexibilization of the labour market, the significant reduction of unemployment and the contingent of available labour force, the general reduction of political tolerance for the shadow economy due to the need to implement fiscal consolidation, and later a slight reduction in the labour tax wedge, had the impact of reducing the shadow economy. Also, the decline of the shadow economy in this period was influenced by numerous structural factors, including the rise of the relative share of large trade chains in the total retail turnover, an increase in the share of fruit and vegetable supply made in trade shops compared to the green markets, as well as the rise in the share of cashless payments.

4.2 Estimation of the shadow economy based on the monetary model of cash demand

According to the monetary model, the demand for cash depends on the volume of transactions, the level of interest rates or inflation, and the level of tax rates (see chapter 3.2). In the monetary model, the shadow economy calculated as the product of the "excess demand" for cash and the velocity of money. In the standard monetary model, the excess demand for cash is calculated as the difference between the demand for cash that exists at actual tax rates and the demand for cash that would exist at hypothetical minimum or zero tax rates, with volume of transactions (GDP) and interest rate or inflation as control variable.

In this study, the assessment of the shadow economy was made based on a modified monetary model of the demand for cash. The first modification refers to the assessment of the excess demand for cash in Serbia, while the second improvement relates to the assessment of the velocity of money. When assessing the excess demand for cash, high euroization was taken into account, i.e. the fact that in Serbia a significant part of transactions is done in foreign currency. Therefore, the dependent variable includes estimated foreign currency cash in addition to dinar cash.

An important characteristic of the Serbian economy is that for several decades there has been a partial substitution of the dinar by foreign currencies, primarily - euro. The substitution between dinars and foreign currency depends on economic factors, such as the level and variability of inflation, the variability of the exchange rate, the level of interest rates, etc. In periods when inflation is high and rising, as well as when the exchange rate is highly variable - the demand for dinars decreases, and the demand for foreign exchange increases. On the contrary, in periods when inflation decreases and when the variability of inflation and the exchange rate decreases, the demand for dinars

increases and the demand for foreign currencies decreases. The existence of substitution between dinars and foreign currency is included through the incorporation of the standard deviation of the exchange rate in the econometric equation. The decrease in the variability of the exchange rate affects the growth of confidence in the dinar and the growth of the demand for dinars, including dinar cash. Finally, the growth in demand for cash is also influenced by changes in payment technology, i.e. rise in the share of cashless payments. The ratio of the number of cashless payment terminals (POS) and the number of ATMs (ATM) was used as an indicator of the development of cashless payments, whereby the rise of this ratio indicates an increase in the share of cashless payments, thus affecting the reduction of the demand for dinar cash.

In standard monetary models, the velocity of money circulation is calculated as the ratio of GDP and money supply.⁴ This approach is based on the assumption that the velocity of money is relatively stable over time, which implies that the monetary drivers of velocity have not changed significantly in the analysed period. Given that the velocity of money depends on the rate of inflation and interest rates, it means that it is assumed that there were no significant changes in the rate of inflation and the level of interest rates in the sample period. The velocity of money in the countries where there is partial substitution of domestic currency by foreign currency also depends on the stability of the exchange rate, whereby a more unstable exchange rate reduces the demand for domestic currency, i.e. increases the velocity of money. In Serbia, in the observed period, there was a strong trend of increasing demand for money, i.e. decreasing velocity of money. In the sample period, the velocity of dinar and foreign currency transaction money decreased by 2 - to about 0.8, while the velocity of dinar transaction money decreased from over 3.5 to about 1.3 (Appendix 1, Graph 1A).

The determinants of the velocity of money in the sample period in Serbia have changed significantly, which is contrary to the assumption of the standard monetary model for evaluating the shadow economy. From the end of 2007 to the end of 2013, inflation averaged around 9% per year, while from the beginning of 2014 to the middle of 2021, it averaged around 2% per year. From mid-2021, inflation accelerated again to average over 10% per year from mid-2021 to the end of 2023. On the basis of economic theory, it is expected that the slowdown of inflation will encourage rise in the demand for dinar money, that is, the decline of money velocity. Correlation coefficient between the level of inflation and the velocity of dinar and foreign currency transaction money in Serbia (from 2007 to mid-2021) was 0.77, which can be seen in Figure 2A in Annex 1. This finding is consistent with economic theory according to which falling inflation affects the decline in velocity of money. Since the middle of 2021, when inflation began to rise, the velocity of money circulation has been rising, but this increase was relatively modest, which implies that citizens and the economy perceived the acceleration of inflation as temporary.

There is a strong positive relationship between the velocity of money circulation and the variability of the exchange rate, which means that lower variability of the exchange rate encourages the rise in demand for dinars, i.e. it leads to a decrease in the velocity of money (Figure 3A, Annex 1).

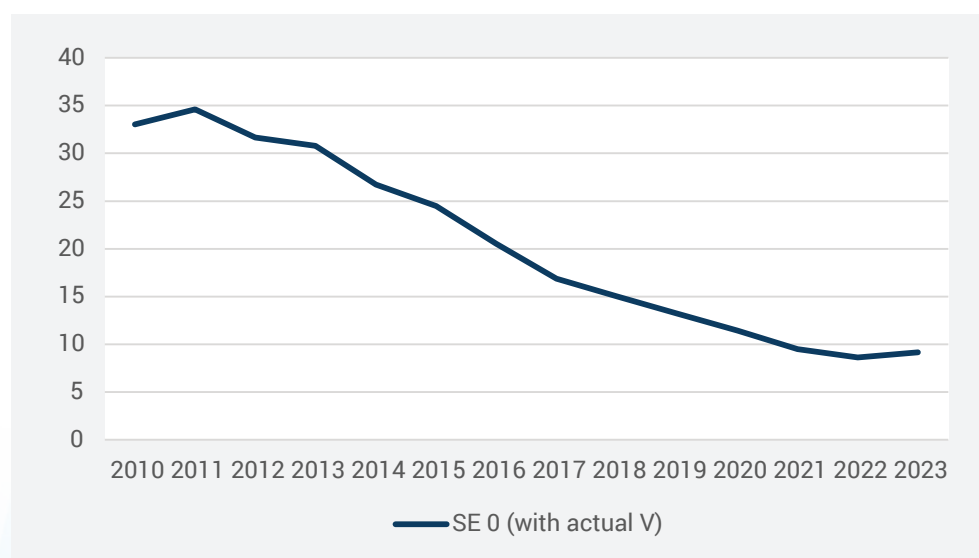
In the observed period, there were significant variations in real interest rates, which represent one of the determinants of the demand for money,

⁴ The reciprocal of the velocity of money represents the demand for money, which means that when the velocity of money decreases, the demand for money increases, and *vice versa*.

that is, the velocity of money. In the first few years, real interest rates were mostly negative, while their variability was high. After that, real interest rates declined, and their variability decreases, so that during the last inflationary episode that began in mid-2021, real interest rates temporarily declined again (Figure 4A, Annex 1).

The modified monetary model of the shadow economy was assessed using the ARDL method, in which the demand for the sum of dinar and foreign currency depends on actual tax rates, GDP, real interest rates and the ratio of the number of POS terminals and the number of ATM devices (econometric evaluations of the model are given in Annex 2, in Table 1A.). All variables in the ARDL model are statistically significant and have the expected sign, which means that rise in tax rates and volume of transactions increases the demand for cash, while an increase in interest rates, development of cashless payments infrastructure, and rise in exchange rate variability reduce demand for cash. Excess cash demand is calculated as the difference between the estimated cash demand at actual tax rates and the estimated cash demand at a 5% tax rate.⁵ The hypothetical tax rate of 5% is selected in accordance with the assumption that the shadow economy at very low tax rates is minimal or would not exist. By multiplying the excess demand for cash with the actual velocity of money, an estimate of the dynamics of the shadow economy is obtained, which is presented in Figure 8. On that Figure, the shadow economy measured as a percentage of GDP decreases throughout the observed period, so that at the end of the period it is less than 10 % GDP. Such a low level of the shadow economy was not registered even in the countries with the most efficient tax administration and high tax morale, which raises doubts about the adequacy of this model. More detailed analyses show that the main “driver” of this drop of the shadow economy is the decrease in the velocity of money that occurred during the previous two decades in Serbia. However, previous analyses indicate that the decrease in the velocity of money in Serbia is mostly a consequence of changed macroeconomic conditions, such as the decrease in the inflation rate

Figure 8. Estimate of the shadow economy in Serbia based on the velocity of money (% of GDP)



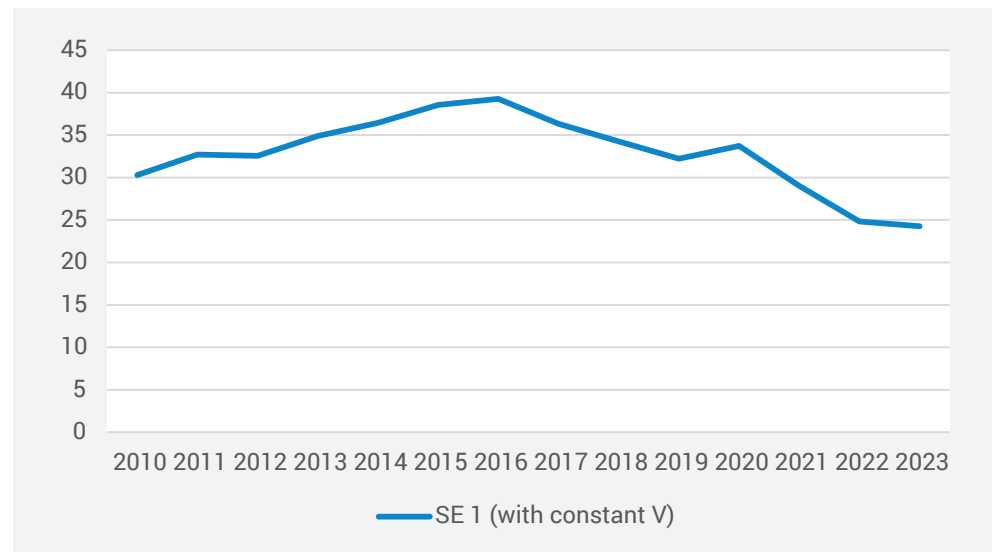
Source: Author's calculation

⁵ The estimation of cash demand at actual and hypothetical minimum tax rates is evaluated econometrically based on the long-run relationship between cash demand and the variables that determine cash demand within the ARDL model.

and its variability, the decrease in the variability of the exchange rate and the rise in real interest rates. In general, after 2000, Serbia went through a strong remonetisation, within which the demand for money increased significantly, and the velocity of money decreased. After Serbia went through hyperinflation and periods of strong macroeconomic instability during the 1990s, it was expected that remonetisation would occur after the inflation was brought down to a low and stable level. Therefore, the previous assessment of the shadow economy, shown in Figure 8, can be considered inadequate.

Therefore, as an alternative, the shadow economy is estimated as the product of the econometrically assessed excess demand for cash and the constant velocity of money, which is equal to the average velocity of money in the first two years of the sample period. On the basis of the constant velocity of money circulation assumption, it is estimated that the shadow economy was significantly higher than in the case when the actual velocity of money is used. In addition, the shadow economy estimated in this way has a significantly different dynamics than in the case of an assessment based on the actual velocity of money. According to this estimate, shown in Figure 9, the shadow economy at the beginning of the analysed period amounted to about 30% of GDP, and by 2016 it reached close to 40% of GDP, after which it decreased, so that at the end of the period it was below 25% of GDP (Figure 9).

Figure 9. Estimate of the shadow economy in Serbia based on the constant money velocity (% of GDP)



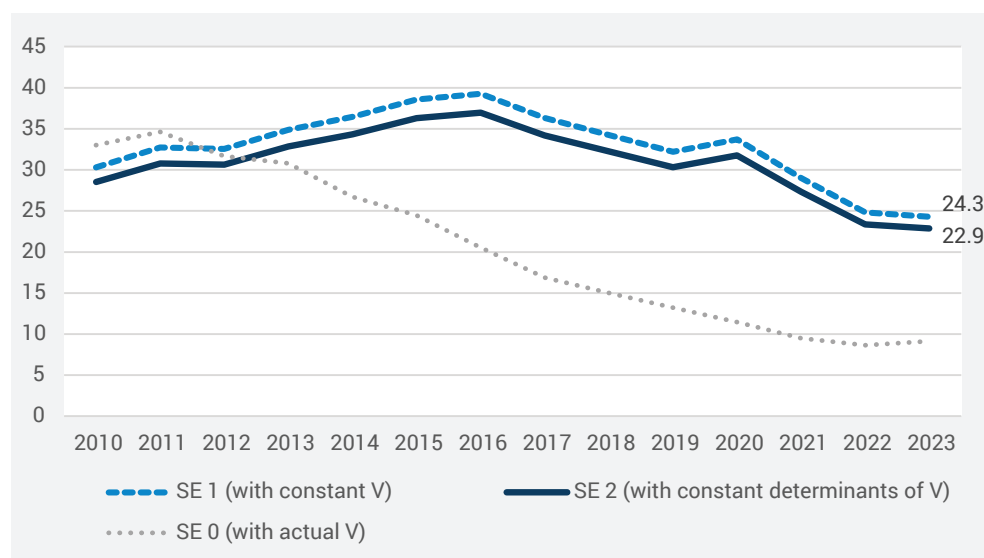
Source: Author's calculation

Instead of the assumption of a constant speed of money circulation, from the point of view of assessing the shadow economy, it is more appropriate to estimate the velocity of money based on the assumption of unchanged macroeconomic determinants of the velocity of money. Therefore, in order to obtain the most accurate estimates of the shadow economy, in the first step, the velocity of money was estimated based on an econometric equation in which the velocity of money circulation depends on the inflation rate, interest rates and exchange rate volatility.⁶ Then, based on the evaluated equation, it was estimated what the velocity of money circulation would be, assuming that the macroeconomic circumstances (inflation level, exchange rate volatility and

⁶ The equation for the velocity of money is given in Table 2A, in Appendix 2.

interest rate level) were unchanged in the entire period compared to the first two years of the analysed period. The velocity of money circulation estimated in this way excludes the influence of macroeconomic factors on the velocity of money, so the remaining variation of the velocity of money should reflect the connection with the shadow economy. The results of the assessment of the shadow economy in Serbia, calculated as the product of the previously estimated excess demand for cash and the econometrically estimated velocity of money, from which the impact of macroeconomic factors has been insulated, are shown in Figure 10.

Figure 10. Estimates of the shadow economy in Serbia based on different options in terms of the velocity of money (% of GDP)



Source: Author's calculation

The obtained results (Figure 10) show that during the observed period (2010-2023), the shadow economy in Serbia, estimated using the modified monetary model, was on average about 31.8% of GDP. Until 2018, the shadow economy was on the rise, and then, until 2022, it declined significantly. In 2023, the shadow economy in Serbia is estimated at around 23.6% of GDP.

5. CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

The widespread shadow economy has negative consequences for the sustainability of public finances, thus undermining provision of public goods and services, on which the dynamics of economic growth and social welfare directly depend. In addition, the shadow economy has a negative effect on the level playing field for doing business, which also undermines investments as an important factor of economic growth. Finally, performing transactions outside of registered flows increases the possibility of financing criminal activities, and undermines some of the basic human rights, such as, for example, the right of access to health care or pensions.

The shadow economy cannot be precisely and directly measured but can be approximated. In this study, the shadow economy in Serbia was assessed using two tailored complementary methods: *i*) a method based on macroeconomic data - with the use of an innovative procedure, *ii*) a monetary method based on an econometric assessment of the money demand - improved in terms of the specification of the econometric model, in order to better reflection of the specificities and characteristics of the economic system of Serbia. The results derived from the application of the method based on the macroeconomic data show that the shadow economy in Serbia in 2023 amounted to 21.1% of GDP - of which two-thirds is related to unreported consumption (supply of goods and services) outside of registered flows, and one-third is unregistered income. After strong growth from 2009 to 2013, the shadow economy in Serbia was declining strongly until 2022.

Another method for estimating the shadow economy, applied in this study, is based on the monetary model of demand for cash. The standard monetary model for evaluation of the shadow economy is not suitable for a country with a high rate of euroization, significant variability of macroeconomic indicators and a strong switch to cashless payments, which is the case in Serbia. Under these conditions, more reliable estimates of the shadow economy are obtained using a model in which, in addition to dinar cash, foreign currency cash is also taken into account when assessing the excess demand for cash, while also taking into account the cashless transition when estimating the demand and excess demand for cash. Finally, more reliable estimates of the shadow economy based on the monetary model are obtained if, instead of the actual velocity of money, only a fraction of the velocity that depends on shadow economy, rather than on variability of macroeconomic indicators, is taken into account. Assessments based on the modified monetary model show that the shadow economy in Serbia stood at about 23.6% of GDP in 2023, with strong rise until 2016, and then a significant decline until 2022. Estimates of the shadow economy in Serbia obtained by both macroeconomic and monetary method lead to relatively similar results, which signals the robustness of the obtained results.

The decision to carry out economic transactions outside of registered flows is a consequence of evaluating the benefits of such a way of business operations (savings on taxes and other regulatory costs, having a competitive advantage) and the costs of dealing with the shadow economy (expected costs in case of detection), as well as other factors that shape the society's tax moral, i.e. people's willingness to pay taxes. Accordingly, and bearing in mind the measures and policies of the previous decades, as well as the experiences of other countries where the level of the shadow economy is lower than in Serbia, the strategy for systematically suppressing the shadow economy should be set in such a way that it affects the reduction of benefits and the increase of costs from dealing with the shadow economy, as well as raising the general level of tax morale. This would specifically mean that the measures that could be considered in the context of the systemic reduction of the shadow economy in Serbia should be multidimensional and may include:

- Further improvement of the tax control and collection system, through investing more financial, human and organizational resources to the Tax Administration and other inspection services;
- Improving the capacity of the prosecution and courts to process cases that have elements of the shadow economy, i.e. tax evasion (e.g. through the specialization of certain organizational segments of the judicial authorities for these issues);
- Reduction of regulatory costs of legal business - through digitization of administrative procedures, improvement of state administration, fight against corruption, etc.;
- Reducing the tax burden on the businesses and citizens, while keeping the fiscal deficit and public debt within sustainable limits, and shifting part of the tax burden from the production factor to consumption, which is easier to control, especially in the conditions of the digital fiscal system;
- Encouraging the cashless transition, through the reduction of operating costs and the availability of cashless payments;
- Continuous systemic action on factors that affect the level of tax morale, including the fight against crime and corruption, increasing the transparency and fairness of the public finance system on both the revenue and expenditure side, building inclusive institutions, educating the population about the importance of the efficient functioning of the tax system, etc.

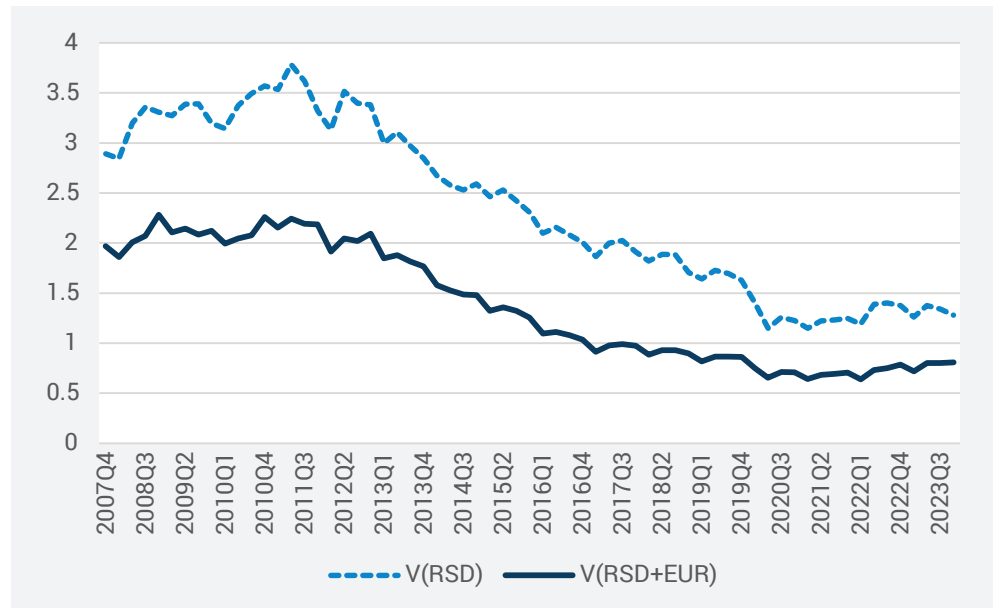
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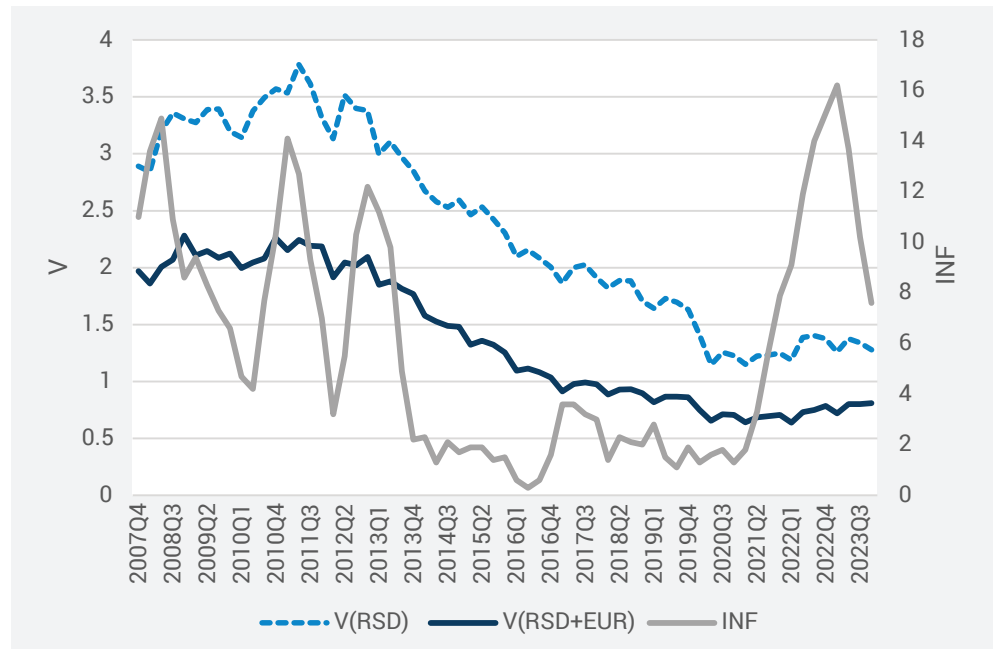
APPENDIX 1 – STYLIZED FACTS

Figure 1A. Money velocity in Serbia



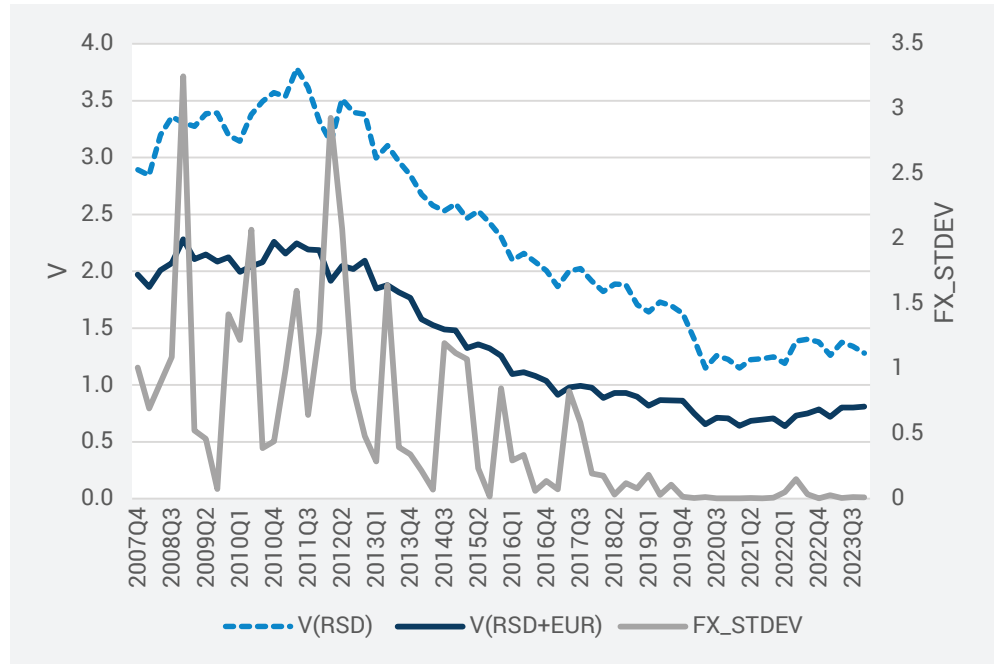
Source: Authors' calculations

Figure 2A. Money velocity and inflation in Serbia



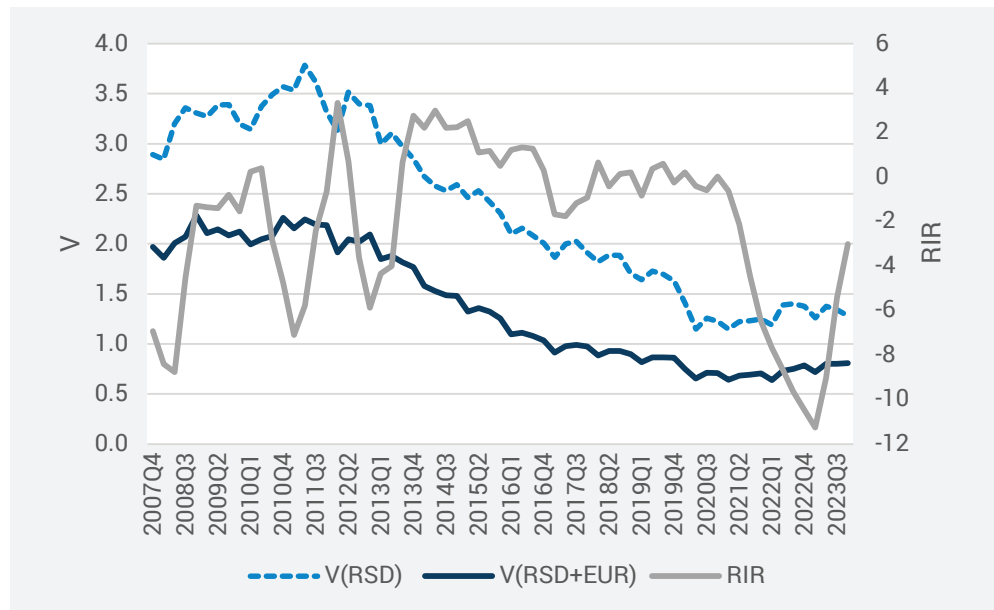
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Figure 3A. Money velocity and exchange rate volatility in Serbia



Source: Authors' calculations

Figure 4A. Money velocity and real interest rates in Serbia



Source: Authors' calculations

APPENDIX 2 – ECONOMETRIC ESTIMATIONS

Econometric estimation of the money demand model is done by using the Autoregressive Distributed Lag (ARDL) estimation method, since the unit root tests have indicated that relevant variables differ in terms of the integration. ARDL is widely used estimator used to analyze the dynamic relationship between variables over time. One of its primary strengths lies in its flexibility to be applied irrespective of whether the underlying variables are purely $I(0)$ (stationary), purely $I(1)$ (non-stationary), or a combination of both. This is a significant advantage over other models, such as the Vector Error Correction Model (VECM), which requires all variables to be non-stationary and cointegrated of the same order. The ARDL model is highly beneficial in capturing both the short-term dynamics and long-term equilibrium relationships between variables. It accomplishes this by incorporating lagged values of both the dependent and independent variables, thus allowing for a more nuanced understanding of how past values influence current outcomes. This feature makes the ARDL approach particularly useful in econometric estimations where the lag structure is important in understanding the temporal causality among variables. Another advantage of the ARDL model is its robustness to small sample sizes, a common issue in empirical research. While many other econometric techniques, including the VECM, require large samples to produce reliable results, the ARDL model can yield robust and consistent estimates even with relatively small datasets. Furthermore, the ARDL model provides a straightforward method for testing for the existence of a long-run relationship between variables using the bounds testing approach. This method is relatively simpler compared to the Johansen cointegration technique used in VECM, which can be complex and sensitive to model specification. The ARDL bounds test is also advantageous because it does not impose the restrictive assumption that the cointegrating vector must be unique, offering more flexibility in modelling.

Table 1A. Results of econometric estimation of the money demand model

Sample: 2010-Q4 - 2023-Q4			No. of obs.	=	53	
			R ²	=	0.8767	
			Adj R ²	=	0.6946	
Log likelihood = -508.00616			Root MSE	=	5591.306	
Dep. var: CASH	Coefficient	Std. Error	t	P>t	[95% confidence interval]	
L1.	-0.5084	0.1403	-3.62	0.0020	-0.800	-0.217
Long run						
GDP	0.2299	0.0777	2.96	0.0070	0.068	0.391
Tax	788.673	286.791	2.75	0.0120	192.259	1.385.088
IR	-36.483	11.904	-3.06	0.0060	-61.239	-11.728
POS_ATM	-1.104.522	414.498	-2.66	0.0140	-1.966.518	-242.526
FX_STDEV	-92.824	29.226	-3.18	0.0050	-153.603	-32.046
Cov-19	40.049	6.336	6.32	0.0000	26.872	53.226
Short run						
IR						
D1.	12.715	2.099	6.06	0.0000	8.349	17.080
LD.	12.324	2.099	5.87	0.0000	7.959	16.689
L2D.	16.346	2.605	6.28	0.0000	10.929	21.763
L3D.	16.189	2.528	6.4	0.0000	10.932	21.446
L4D.	9.359	1.850	5.06	0.0000	5.511	13.206
L5D.	5.491	1.415	3.88	0.0010	2.550	8.433
L6D.	9.006	1.743	5.17	0.0000	5.382	12.630
L7D.	10.387	1.656	6.27	0.0000	6.943	13.830
L8D.	3.357	1.011	3.32	0.0030	1.255	5.459
L9D.	1.466	858	1.71	0.1020	-317	3.250
L10D.	2.354	966	2.44	0.0240	345	4.363
L11D.	4.927	937	5.26	0.0000	2.977	6.876
POS_ATM						
D1.	480.623	88.610	5.42	0.0000	296.347	664.898
LD.	234.550	67.299	3.49	0.0020	94.593	374.506
FX_STDEV						
D1.	52.905	10.170	5.2	0.0000	31.755	74.055
LD.	48.021	9.712	4.94	0.0000	27.825	68.218
L2D.	43.051	7.914	5.44	0.0000	26.593	59.510
L3D.	32.175	6.407	5.02	0.0000	18.851	45.500
L4D.	32.387	6.204	5.22	0.0000	19.485	45.288
L5D.	30.674	5.569	5.51	0.0000	19.091	42.256
L6D.	22.712	4.844	4.69	0.0000	12.639	32.785
L7D.	18.689	4.360	4.29	0.0000	9.622	27.755
L8D.	16.368	3.544	4.62	0.0000	8.999	23.737
L9D.	9.261	2.446	3.79	0.0010	4.175	14.348
Const.	79.427	41.436	1.92	0.0690	-6.743	165.597

Table 2A.
Econometric
estimation of the
velocity of money

				No. of obs.	=	65
				F(40,60)		132.98
				Prob>F	=	0.0000
				R ²	=	0.9013
				Root MSE	=	5591.306
Dep. var: V (Velocity)	Coefficient	Std. Error	t	P>t	[95% confidence interval]	
IR	0.1376	0.0155	8.9	0.0000	0.107	0.168
FX_STDEV	0.0547	0.0117	4.67	0.0000	0.031	0.078
INF	0.1332	0.0108	12.36	0.0000	0.112	0.155
Cov-19	-0.3379	0.0762	-4.43	0.0000	-0.490	-0.185
_cons	-0.1211	0.0577	-2.1	0.0400	-0.236	-0.006

Table 2B. Description
of variables used in
econometric models

Variable	Definition	Source
CASH	Cash (dinar) in circulation in RSD million + Cash (Euro) in circulation in RSD million (2006 prices)	NBS, OeNB Euro Survey, SOS
V (Velocity)	ln (ratio of GDP in current prices and the sum of dinar cash and foreign currency transaction deposits)	NBS, SOS
GDP	GDP in RSD million, fixed prices	SOS
Tax	Weighted average tax rate	Authors' calculations
IR	Weighted average interest rate on deposits	NBS
POS_ATM	Value of POS turnover (RSD mil.)/Value of cash withdrawal from ATMs (RSD mil.)	NBS
FX_STDEV	Standard deviation of monthly nominal exchange rate	Authors' calculations using NBS data
INF	Inflation rate at the end of the period	NBS
Cov-19	COVID-19 dummy (Q2'20-Q2'22)	

