Foundation for the Advancement of Economics

THE IMPACT OF AN INCREASE IN CASHLESS PAYMENTS ON THE SHADOW ECONOMY AND PUBLIC FINANCE IN SERBIA

Saša Ranđelović
Milojko Arsić
Svetozar Tanasković

Belgrade, November 2022

Acknowledgement

This study is prepared as the part of the project "Macroeconomic research on cashless payment in Serbia", funded through the develoPPP program that Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH implements on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

The project is an integral part of the National Cashless Payment Initiative (Serbia) – "Better Way", a joint project between GIZ and Visa and Mastercard companies, in partnership with NALED and the Ministry of Finance of the Republic of Serbia.

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

EXECUTIVE SUMMARY

The shadow economy in Serbia is considerably larger than in most other European countries. According to internationally comparable studies, the shadow economy in Serbia in 2019 stood at around 33.5% of GDP, which was somewhat below the Western Balkans average, but considerably higher (by 15 %) than the average in Central and Eastern Europe (CEE) countries and substantially (by 84%) above the average size of the shadow economy in developed European countries – the "old EU member states". The shadow economy in Serbia is also larger than that in most other European countries when measured with the Value-Added Tax (VAT) gap, although there are some signs that the VAT gap in Serbia subsequently narrowed – especially in 2021. A large shadow economy undermines tax revenue mobilization and the provision of goods and services by the government, violates the level playing field, fosters the proliferation of illegal activities and harms human rights.

The size of the shadow economy depends on many tax-related factors, the level of regulatory costs and the methods of settlement of transactions. The shadow economy is determined by a set of tax-related factors, such as the level of tax burden, the system of fines and penalties, the efficiency of tax enforcement, the level of tax morale, as well as by non-tax factors, including the size of regulatory costs and opportunities to hide transactions – fundamentally shaped by the methods of transaction settlement. While cash-based transactions are easier to hide, cashless transactions are more traceable, which is why both theoretical and empirical studies suggest that de-cashing can reduce opportunities to hide transactions, thus boosting tax revenue collection.

Serbia faces a significant (negative) gap in terms of the development of a cashless economy with respect to financial inclusion, cashless payment infrastructure and the relative size of cashless transactions in the economy in comparison to other European countries. With around 62 payment cards per 100 inhabitants in 2019, the relative number of payment cards in Serbia in 2019 was lower than the CEE average and the developed Europe average by a half and by two-thirds, respectively, which indicates a low degree of financial inclusion. Similarly, with 1,313 POS terminals per 100,000 inhabitants, one-third lower than the CEE average and two-thirds lower than the developed Europe average, Serbia performs relatively modestly in terms of the proliferation and development of cashless payment infrastructure. Consequently, the total value of POS transactions in Serbia in the same year amounted to 8% of GDP, almost 50% less than the CEE average and 60% less than that of developed European countries. The data on 2020 and 2021 show that there was a relatively strong improvement in all three aspects of the cashless economy, which is probably linked to the pandemic, but the gap with other CEE and developed European countries probably remains pronounced.

Econometric results for Serbia and EU countries show that an increase in the size of the cashless economy has a statistically significant negative impact on the shadow economy. Using annual unbalanced panel data on Serbia and 25 EU countries for the period 2000-2019, the relationship between the shadow economy and the cashless economy is estimated econometrically, controlling for the impact of the set of control variables. The robustness of the results is checked by using two types of shadow economy variables (the

shadow economy relative to GDP and the VAT gap relative to GDP) and three types of cashless variables – the total value of POS transactions per capita, the total value of POS transactions relative to GDP and the relative value of POS-to-ATM transactions. The results show a strong negative link between the development of the cashless economy and the size of shadow economy. When the estimated parameters are translated into elasticities, our results indicate that an increase in the value of POS transactions of one percent is linked to a decrease in the shadow economy of 0.041 percent, while an increase in the ratio of the value of POS-to-ATM transactions of one percent is associated with a decrease in the shadow economy of 0.037 percent.

Expanding the cashless economy in Serbia close to the CEE average could curb the shadow economy by up to approximately 3.4 % of GDP, other things being constant, which may raise additional tax revenues of up to approximately EUR 700 million per year (1.35% of GDP). With proper policy actions, we estimate that this can be achieved within a six-to-seven-year timeline. It should, however, also be noted that promotion of cashless payments could provide a substantial contribution to the fight against the shadow economy and to the sustainability of public finances in Serbia. However, for more pronounced and lasting results, it should be accompanied by other structural measures, including an improvement in the efficiency of tax enforcement, a slight reduction in the tax burden, enhancement of tax morale, amongst others.

To achieve these results, coordinated policy action is needed, comprising of regulatory and fiscal stimuli as well as broad educational measures. Considering the significant benefits associated with the development of the cashless economy, there are strong arguments for the government to consider a comprehensive stimulus programme. This may entail not only regulatory measures (rules and restrictions on cash-based and cashless payments), fiscal measures (e.g. well-targeted subsidies and/or tax breaks), but also educational actions aimed at raising citizen awareness of the individual and social benefits linked to the development of the cashless economy and reduction of the shadow economy.

Table of Contents

INTRODUCTION

Technical progress in the field of information technology and telecommunications over the past few decades has encouraged the intensive development of cashless payments. Theoretical arguments, as well as empirical research, have confirmed that cashless payments have a positive effect on economic growth, suppressing the shadow economy, increasing the effectiveness of monetary policy and suppressing illegal activities (Rogoff, 2015; Schneider, 2019). Therefore, many countries have introduced regulatory and fiscal incentives to encourage the transition from cash to cashless payments.

The focus of this study is the impact of the transition from cash to non-cash payments on the shadow economy and tax collection. The size of the shadow economy depends on a large number of economic and social factors, such as the level of the tax burden, the probability of detection of tax evasion, the level of fines, the unemployment rate, the development and structure of the economy, the level of tax morale, the quality of government services, the level of corruption and the inflation rate. One of the factors that affects the size of the shadow economy is the way transactions are settled. Cash payment ensures the anonymity of the participants in the transactions and leaves few traces on the basis of which tax evasion could be detected and is therefore more suitable for the operation of the shadow economy. Cashless payment implies the identification of the participants in the transactions (no anonymity), which makes it difficult to conceal transactions, and thus tax evasion. Therefore, in order to suppress the shadow economy, it is desirable to increase the share of non-cash payments relative to cash payments.

In this study the country-level development of cashless payments was measured on the basis of the value of cashless payments per capita in euros and the total value of cashless payments relative to GDP. The relative importance of cashless payments compared to cash payments was measured on the basis of the ratio of the total value of transactions at POS terminals to the total value of cash withdrawn from ATMs. Cashless payments in the EU 27-member states in the period 2000-2019 amounted to about 12% of GDP on average – in the old EU member states this share was about 14% of GDP, while in the new states it was about 9% of GDP. During the past two decades, the value of cashless transactions in EU countries grew significantly faster than the GDP, with the growth of the cashless economy being particularly strong in the less developed, new EU member states, which indicates convergence in terms of development of the cashless economy. As a consequence of the strong growth, the share of cashless payments in GDP in 2019 in the EU countries reached close to 20% of GDP – with cashless payments amounting to 24% of GDP in the old member states and 16% of GDP in the new ones. Cashless payment in Serbia in the period 2005-2019 accounted for an average of 4.6% of GDP, while due to strong growth over the entire period it reached 8% of GDP in 2019. Despite significant progress over the past 15 years, cashless payments in Serbia are significantly less prevalent, not only in relation to the old, but also in relation to the new, EU member states.

In this study we use two alternative measures of the shadow economy, which differ in their scope and connection with payment methods. The first measure refers to the overall shadow economy and it includes both the shad-

ow economy in the sale of products (VAT, excise and customs evasion) and in the realization of labor income, capital and property, as well as the shadow economy in the payment of environmental taxes, etc. Another measure of the shadow economy is the VAT gap, which represents the difference between the hypothetical VAT and the actual VAT collected by the government. Using the overall shadow economy as a measure has an advantage over using the VAT gap because it includes all forms of the shadow economy, while the VAT gap covers only the part of the shadow economy related to the supply of goods and services. On the other hand, the advantage of the VAT gap is that it is more closely related to payment methods (cash and non-cash) and it includes that part of the shadow economy from which other forms of tax evasion are financed, such as informal work, profit evasion and the like.

The average size of the shadow economy in the EU countries in the period 2000-2019 was about 23% of GDP – in the old EU member states the shadow economy accounted for about 18% of GDP, while in the new member states it was about 29% of GDP. In the observed period, the shadow economy in Serbia was estimated at 33.6% of GDP on average, putting Serbia in fifth place in Europe. The share of the shadow economy in the GDP during the previous two decades in the EU and Serbia did not change significantly, which is why the shadow economy in 2019 was similar to that of the entire period (Kelmanson et al., 2019). The VAT gap in the EU countries during the period 2000-2019 averaged about 16% – amounting to 12% in the old EU member states, and about 20% in the new (Grzegorz et al., 2021). The VAT gap, unlike the overall shadow economy, decreased significantly in the EU countries during the last two decades (Grzegorz et al., 2021). We estimated that the VAT gap in Serbia throughout the observed period was slightly larger than that in the new EU member states. A reduction of the VAT gap was also posted in Serbia from 2014 onwards, the decline being especially sharp during the COVID-19 pandemic. Based on the above estimates, it follows that the shadow economy in Serbia is significantly larger than in the new EU member states, while the VAT gap in Serbia is somewhat larger than in the new EU member states, but significantly larger than in the old EU member states.

The econometric analysis of the impact of payment methods on the shadow economy is based on annual data on 26 countries (Serbia and 25 EU member states) for the period 2000-2019. The sample contains heterogeneous countries, both in terms of the size of the shadow economy and in terms of the development of cashless payments, but also in relation to other economic (level of development, structure of the economy, etc.) and social (tax morale, level of corruption, etc.) characteristics. Due to the existence of the endogeneity problem, i.e. the influence of the shadow economy on the development of cashless payments, panel models were estimated econometrically using the method of instrumental variables. In order to obtain unbiased assessments of the impact of payment methods on the shadow economy, we used a large number of control variables that represent the determinants of the shadow economy in theoretical models and empirical research, such as the unemployment rate, level of development, quality of institutions, inflation rate, share of foreign trade and agriculture in the GDP and VAT rate.

Our results show that the overall shadow economy is smaller if the value of cashless payments per inhabitant is higher, the value of cashless transactions in relation to GDP is higher and the ratio of cashless transactions to cash

transactions is higher. Similar results were obtained in the case of the models that explain variation in the VAT gap – the more developed cashless payments were, the smaller the VAT gap was. The obtained results are in accordance with the majority of previous empirical studies, according to which a higher prevalence of cashless payments, all other things being equal, affects the reduction of the shadow economy.

Based on the estimated panel econometric equations, the impact of a hypothetical increase in cashless payments on the overall shadow economy in Serbia was simulated. An increase in non-cash payments in relation to GDP to the CEE-average level would trigger a reduction in the size of the shadow economy in Serbia of about 3.4% of GDP. Reducing the shadow economy by increasing the use of cashless payments would provide additional tax revenues of around 1.3% of GDP, which is equivalent to EUR 700 million per year. The obtained results indicate that the substitution of cash payments with non-cash payments would have a solid positive impact on suppressing the shadow economy and increasing tax revenues in Serbia. The size of the positive effects justifies the application of various incentives to increase the use of cashless payments.

This report consists of a summary, an introduction and five main chapters. The first section analyzes the causes and consequences of the shadow economy and provides comparative assessments of the shadow economy in Serbia and the EU countries. The second section contains a comparative analysis of the institutional framework for cashless payments, an analysis of the development and current state of the infrastructure for cashless payments, as well as various indicators of the development and relative importance of cashless payments in Serbia and the EU. The third section analyzes the theoretical ideas and the results of empirical research on the impact of cashless payments on the shadow economy and tax collection. In the fourth section, using descriptive and panel econometric models, the connection between cashless payments and the shadow economy is analyzed, after which the effects of the increase in cashless payments on the shadow economy and tax collection are simulated. The final section summarizes the results of the research and provides recommendations for possible measures to encourage the use of non-cash payments.

1 THE SHADOW ECONOMY – CAUSES, CONSEQUENCES AND STYLIZED FACTS

The shadow economy entails legal economic activities which are conducted informally, beyond the official records. The decision to conduct an economic transaction in an informal sector can be driven by tax saving motives, and also by the motive to reduce regulatory and compliance costs (e.g. labor and environmental legislation) or to provide a greater degree of flexibility with regard to business operations.

1.1. DRIVERS OF THE SHADOW ECONOMY

Although conducting economic transactions in an informal (shadow) sector can be driven by different motives, empirical studies suggest that tax savings/evasion is usually the main motivation, which is why the determinants of the size of the shadow economy are normatively evaluated using a tax evasion framework. According to neoclassical economic models, the shadow economy/tax evasion decision is considered as a matter of rational choice under uncertainty, meaning that the tax evasion decision is made by balancing the expected benefits (savings in taxes) and the expected costs of evasion (expected penalty). In this sense, there are three main factors which determine the size of the shadow economy and the extent of tax evasion: i) the level of taxes (the higher the taxes, the larger the expected benefits from evasion), ii) statutory fines and penalties for non-compliance with tax legislation (the higher the penalties, the higher the expected costs of evasion), iii) the probability of detection of non-compliance, which is determined by the efficiency of the tax administration (the higher the probability of detection, the higher the costs of evasion).

Empirical studies show that up to two-thirds of the variation in the size of the shadow economy and the level of tax evasion across countries can be explained by the differences in the level of the tax burden, the level and design of the system of fines and penalties for non-compliance with tax legislation, and the efficiency of the tax administration in enforcing tax legislation. However, it still leaves up to one-third of the variation in the size of the shadow economy and the amount of tax evasion unexplained. Recent empirical literature shows that the fraction of variation in the shadow economy and tax evasion which is not explained by neoclassical factors can be attributed to tax morale, defined as the willingness of people to pay taxes beyond the tax enforcement requirements, i.e. the willingness of people to pay taxes voluntarily. Tax morale is shaped by numerous factors, such as people's satisfaction with the availability and quality of public goods and services provided by the government, social norms (adherence of other people and government to the social

contract), trust in government, the degree of fiscal decentralization, participation of people in public governance (e.g. through referenda), the perception of fairness of the tax system and tax administration operations, the complexity of the tax system, as well as socioeconomic characteristics of people (age, gender, education, marital status, employment, etc.).

In addition to the factors associated with the rational choice model and tax morale arguments, the size and dynamics of the shadow economy can be affected by the state of an economy (e.g. the unemployment rate, sectoral structure of the economy and the development of international trade) as well as by the opportunities to conduct economic transactions in an (in)formal sector. Making payments for transactions in cash leaves behind no trace, while making payments for transactions using (credit/debit) cards or other electronic payment instruments leaves records, which is why the shadow economy and tax evasion are usually associated with cash transactions. For this reason, an increase in the share of cashless transactions in the overall volume of transactions is expected to reduce space for the shadow economy, thus curbing tax evasion.

1.2. CONSEQUENCES OF THE SHADOW ECONOMY

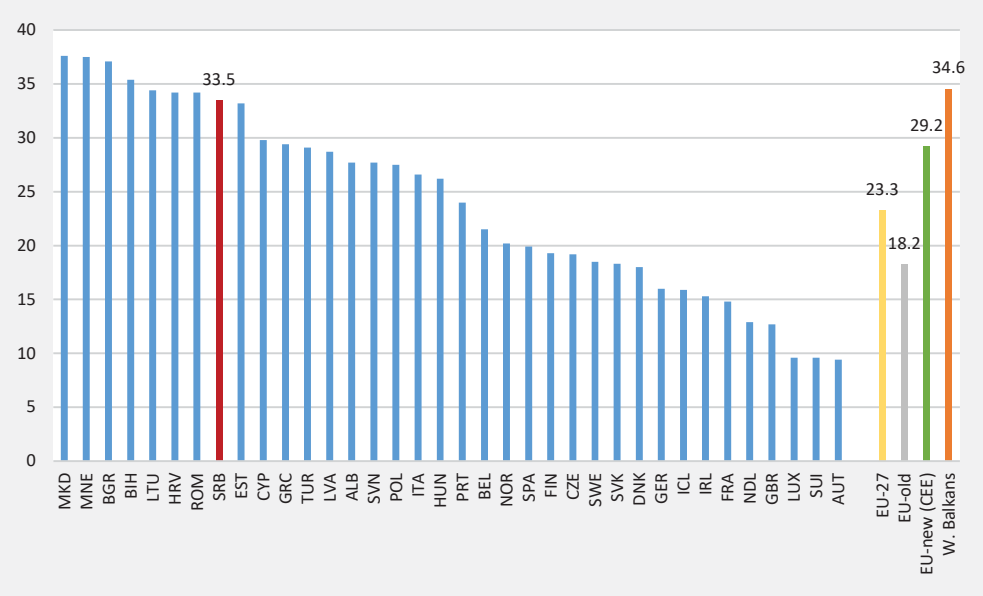
An extensive shadow economy triggers numerous negative economic and social effects – it undermines the provision of public goods and services (as it reduces tax revenues of the government), thus harming growth and welfare drivers, violates the level playing field, thereby putting compliant individuals and companies in a disadvantaged position, increases economic inequality, provides opportunities for financing illegal activities and also violates some human rights (e.g. access to healthcare).

1.3. COMPARATIVE FACTS ON THE SHADOW ECONOMY IN SERBIA AND THE EU

In order to be able to quantify the impact of the development of cashless payments on the shadow economy, it is necessary to find a way to quantify the volume of the shadow economy itself. Since the shadow economy is by definition hidden, it cannot be measured directly, but it can instead be estimated using various methods such as surveys; methods based on macroeconomic data on consumption, saving and income; random control methods; the transaction method; the money demand method; a method based on the demand for physical inputs (e.g. electricity); quasi-experimental methods; as well as econometric methods, such as MIMIC (see Schneider et al., 2015; Arsić and Ranđelović, 2017). Each of these methods has its limitations, which is why the evaluation of the size and dynamics of tax evasion is usually carried out using more than one method.

As estimation of the size of the shadow economy is beyond the scope of this study, to provide stylized facts on the shadow economy in Serbia, we shall use the available data on the estimation of the size of the shadow economy derived using the MIMIC method, as well as the VAT gap data provided by the European Commission using harmonized methodology (Elgin et al., 2021;

Figure 1: Shadow economy in Europe in 2019 (% GDP)



Source: Author's calculations based on Kelmanson et al. (2019)

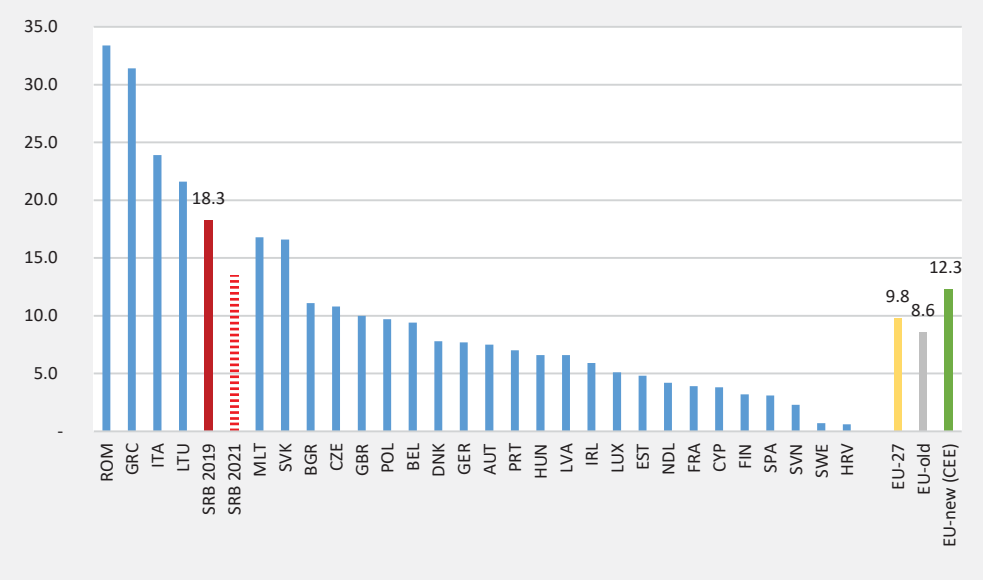
Kelmanson et al., 2019; Grzegorz et al., 2021) and the data on the authors' estimations of the VAT gap for Serbia.[1]

MIMIC is an econometric modelling method used to confirm the influence of a set of exogenous causal variables on the latent variable (such as the shadow economy). Results provided by Kelmanson et al. (2019), presented in Figure 1, show that the shadow economy in Europe ranges from around 10% of GDP to more than 35% of GDP. With a shadow economy that accounts for 33.5% of GDP in 2019, Serbia ranks eighth in Europe across 36 European countries, with only four EU member states having a larger shadow economy than Serbia. The Serbian shadow economy was slightly smaller than the Western Balkans average, but at the same time larger by more than a tenth in comparison to the Central and Eastern Europe (CEE) average, larger by more than a fifth in comparison to the EU-27 average, and larger by 84% in comparison to the developed European countries. These data indicate that there is considerable space for reducing the shadow economy in Serbia. The realistic medium-term target could be a reduction in the shadow economy to the CEE average, while in the long run the goal should be to further curb it to be in line with the European average or below, which has already been achieved by some CEE countries, such as Czechia and Slovakia.

VAT is one of the main pillars of tax systems in Europe, including in Serbia. Economic transactions conducted in an informal sector, which would otherwise be taxable (with VAT), result in foregone tax revenues, i.e. the tax gap. The tax gap is the difference between the hypothetical amount of tax revenues that would have been collected if all transactions had been reported, and the

[1] In addition to this, there are other *ad hoc* estimates of the shadow economy in Serbia, such as the estimate of NALED, using survey data from registered businesses, which suggests that the shadow economy in Serbia declined from 21.2% in 2012 to 15.4% in 2017. However, due to limitations of the surveys with regard to information on sensitive issues, the limited scope of the estimation and lack of comparable estimations for other countries, these results cannot be used for the statistical and econometric calculations in this study.

Figure 2: VAT gap in 2019 (% potential VAT revenues)



Source: Grzegorz et al. (2021) and authors' calculations

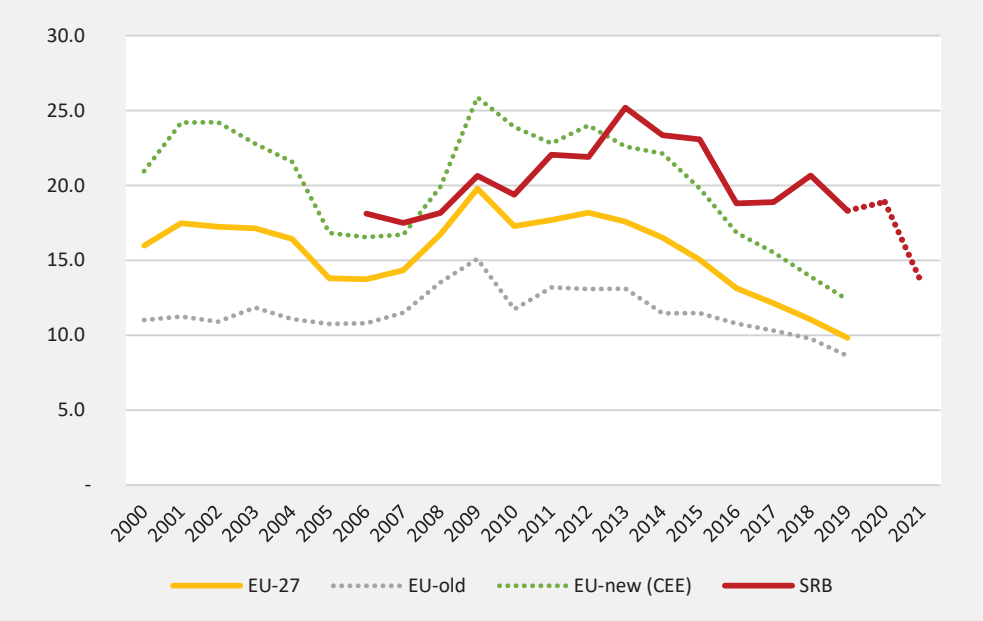
actual amount of VAT revenues collected by the government. The hypothetical amount of VAT revenues is calculated using the macroeconomic data on the final consumption of households, government and gross fixed capital formation and statutory VAT rates. By construction, the VAT gap reflects the efficiency of tax collection and therefore can be used as a proxy for the size and dynamics of the shadow economy because informal transactions contributing to the VAT gap are also a source of cash that can be used to finance other forms of the shadow economy, such as informal employment and payment of wages, underreporting of corporate profits, and similar.

The results of Grzegorz et al. (2021) indicate that the VAT gap in EU-27 is close to one tenth of the potential VAT revenues, while in new member states in CEE it is somewhat higher. Using the same methodology, the VAT gap in Serbia in 2019 is estimated to be approximately 18.3% of potential VAT revenue collection, with only four European countries having a larger VAT gap. The estimated VAT gap in Serbia is almost 50% greater than the VAT gap in CEE countries, while it is more than double that of the developed European countries.

The analysis of VAT gap dynamics since the introduction of VAT in Serbia (in 2005) suggests that the VAT gap grew, i.e. tax collection efficiency was in decline, from 2008 to 2013, when the VAT gap peaked at around one-quarter of potential VAT revenue collection. Since 2014 onwards, the VAT gap in Serbia has been declining, indicating a contraction of the shadow economy and an improvement in tax collection efficiency. Although the VAT gap in Serbia shrank by a more than a quarter from 2014 to 2019, it is still considerably larger than in the CEE and other EU countries, which is consistent with findings based on the MIMIC model. Preliminary estimates show that in 2021 the VAT gap narrowed substantially to about 13.5% of potential tax revenue, which is close to the CEE average in 2019, but still higher by a half in comparison to the developed European countries.[2] A potential explanation for this could be linked to the switch to cashless payments and e-commerce during the pandemic, the digitalization of tax compliance and tax enforcement, as well as to

[2] The estimates for Serbia are made using the methodology proposed by Grzegorz et al. (2021), with the imputation of some parameters (e.g. VAT on investment) using the data on comparable countries from the CEE region.

Figure 3: VAT gap in 2019 (% of potential VAT revenues)



Source: Grzegorz et al. (2021) and authors' calculations

the other factors, such as changes in the structure of the economy – a decline in the share of agriculture, an increase in the share of transactions that are conducted in large retail chains (relative to the transactions in small shops), etc.

2 THE CASHLESS ECONOMY – INSTITUTIONAL FRAMEWORK AND STYLIZED FACTS

2.1 INSTITUTIONAL FRAMEWORK

The cashless economy refers to an economy in which transactions are settled using digital payment methods instead of cash. Therefore, non-cash payment methods stand at the core of the cashless economy. The general framework for payment operations in Serbia is provided by the *Law on Payment Services*, which stipulates the terms of payment operations and provides general regulations on electronic money. In addition, cashless payment operations are regulated by the *Law on Multilateral Interchange Fees and Special Terms of Payment Operations Involving Payment Cards*, which was enacted in 2018. Among other issues, this law stipulates the maximum level of interchange fees that can be charged between the bank issuer and recipient for card payment intermediation. The fee for payment by debit card (held by individuals) is limited to 0.2% of the value of the transaction, while for credit card payment the fee is limited to 0.3% of the value of the transaction. These limits are equivalent to the ceilings provided by the EU Regulation (2015/751) on interchange fees for card-based payment transactions.

The total fee payable by a merchant for card payment transactions, however, is higher than the multilateral interchange fee, as the total merchant fee also includes the fees charged by the payment schemes and processors. The total fee payable by a merchant may deviate from the average, depending on the merchant's negotiating power and the volume and size of the transactions. According to an estimate of the National Bank of Serbia, the average total fee payable by a merchant in Serbia in 2021 was estimated to be approximately 1.06%, which is around one-half of the fees charged in 2018, when the new legislation was introduced. However, in many cases the total fee payable by merchants is substantially higher than the average as the terms and conditions that they negotiate with the banks are usually less favorable than those of large retailers, who account for a large share of the total volume of card payments in Serbia. It should be noted that in Serbia there are no other regulatory barriers for cashless payments, but until now Serbia has also offered no tax incentives or subsidies to promote cashless payment methods.

2.2 COMPARATIVE ANALYSIS OF CASHLESS PAYMENTS IN SERBIA AND THE EU

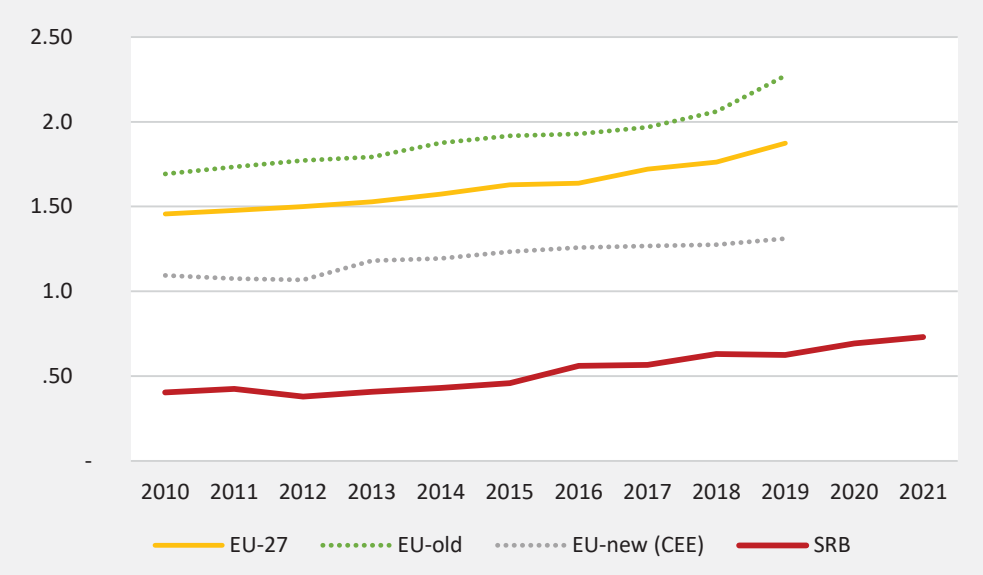
The level of development and proliferation of cashless payments in Serbia relative to other European countries is analyzed using the stylized facts on three groups of indicators:

i) *The number of payment cards (per capita) – which may illustrate the degree of financial inclusion and cashless payment potential;*
ii) *The number of POS terminals (per 100,000 people)* – which may indicate the proliferation and availability of cashless payment infrastructure;
iii) *The volume of POS terminals transactions (% of GDP) – which may indicate the actual proliferation of cashless payments in Serbian economy.*

The indicators are evaluated from the dynamic perspective over the last decade, as well as from the static-comparative perspective using the last available data (2019 or 2021 – in Serbia). The selection and form of the indicators, the selection of the sample countries and the timeline are shaped by data availability.

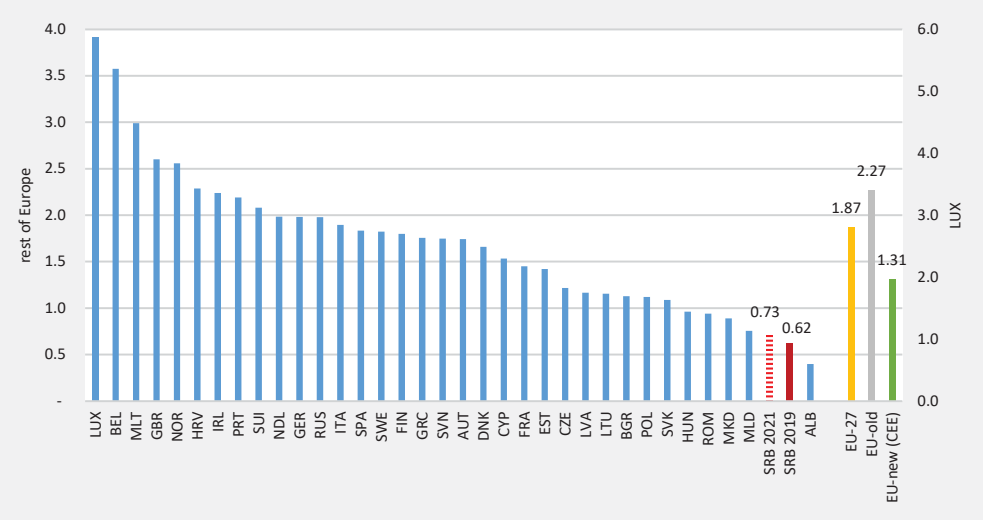
Over the past decade, from 2010 to 2019, the number of payment cards per capita in Serbia rose substantially by more than a half, which is a considerably faster increase than in both the old and the new EU member states (Figure 4). A strong improvement in financial inclusion in Serbia, proxied by the number of payment cards per capita, continued at an even faster pace in 2020 and 2021, which can be attributed to the shift in payment habits due to the pandemic and the proliferation of new payment methods (e.g. the integration of payment cards and mobile devices). The stronger increase in financial inclusion in Serbia than in other European countries over the past decade was to large extent a consequence of the lower baseline, since in 2010 the number of payment cards stood at around 0.4 per capita, which was 2.7 times less than in CEE countries and more than four times less than in the developed (old) EU member states. Due to faster growth in the relative number of payment cards, Serbia posted some convergence in this respect relative to the other European countries, although the gap remains pronounced.

Figure 4: Dynamics of the number of payment cards per capita



Source: Author's calculations based on ECB and individual central banks' data

Figure 5: Number of payment cards per capita in Europe by country in 2019

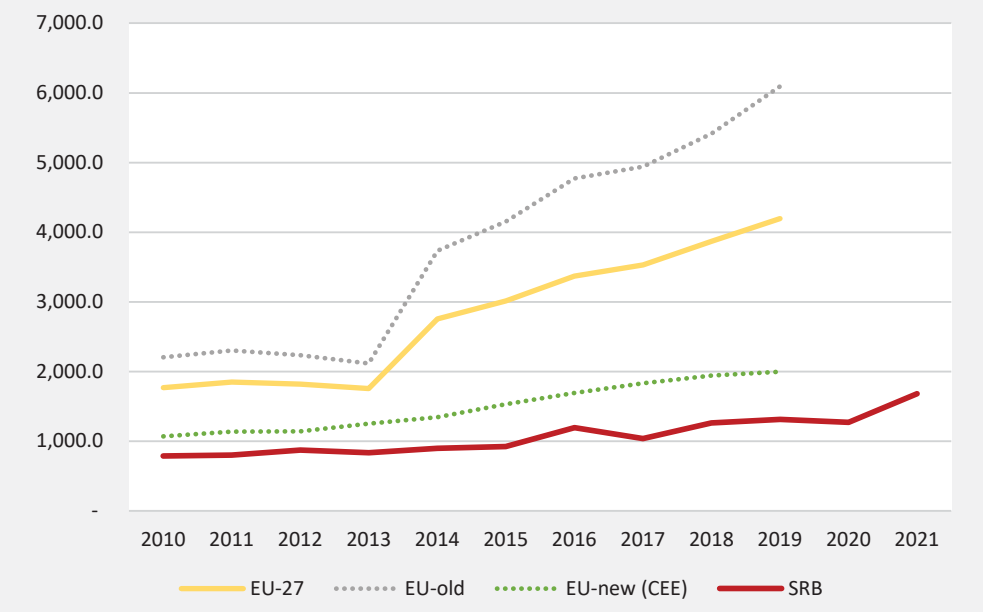


Source: Author's calculations based on ECB and individual central banks' data

In spite of the faster rise in the number of payment cards, with around 0.62 payment cards per capita overall financial inclusion in Serbia in 2019 was still lower than in most other European countries (except Albania). Even after a substantial rise in the number of payment cards in 2020 and 2021, with about 0.73 payment cards per capita overall financial inclusion in Serbia was still less than half of that in other CEE countries and less than a third of that in developed European countries (Figure 5).

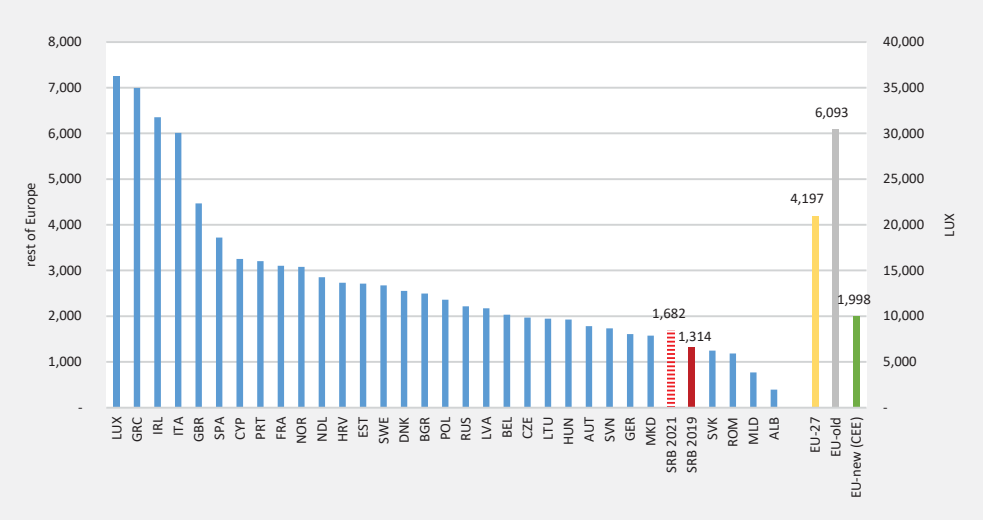
From 2010 on, the number of POS terminals (per 100,000 people) was on the rise – the total number of POS terminals was almost 67% higher in 2019 than in 2010, which is a solid rise, albeit slower than the increase in the number of POS terminals in the CEE and developed European countries (Figure 6). However, more recent data indicate that the number of POS terminals in 2021 soared by 32% in comparison to 2020, which makes the total number of POS terminals in 2021 2.1 times higher than in 2010. This strong surge in the number of POS terminals may reflect the increased demand for cashless payments associated with the pandemic.

Figure 6: Dynamics of the number of POS terminals (per 100,000 people)



Source: Author's calculations based on ECB and individual central banks' data

Figure 7: Number of POS terminals (per 100,000 people) by country in 2019

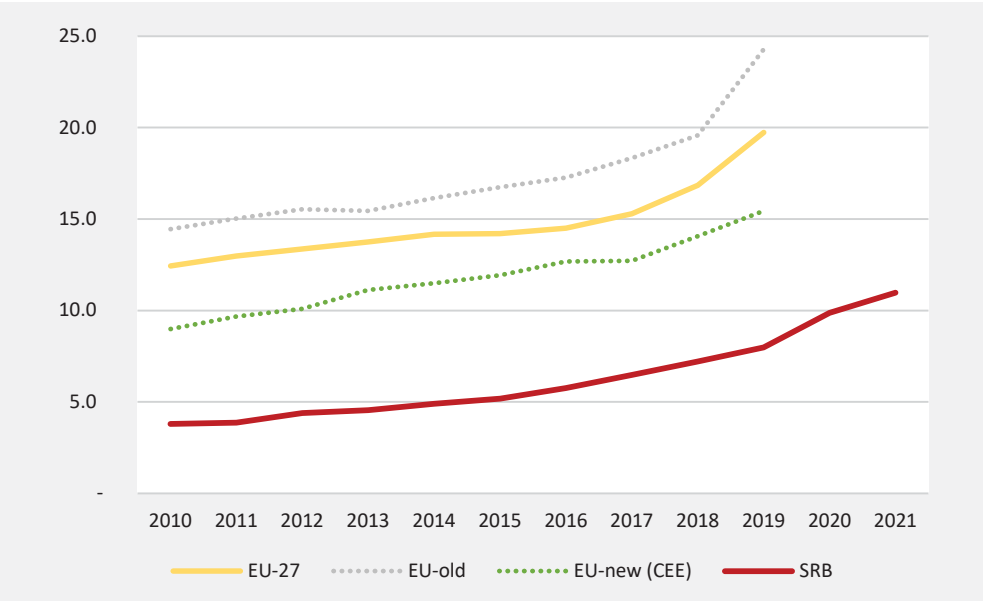


Source: Author's calculations based on ECB and individual central banks' data

However, in spite of the solid rise, the total number of POS terminals in Serbia in 2019 was a third lower than that in other CEE countries, and only slightly more than a quarter of that in developed European countries. Although the number of POS terminals surged in 2021, availability of the cashless payment infrastructure in Serbia is still modest in comparison to other European countries – with only Slovakia, Romania, Moldova and Albania having a weaker performance in this respect (Figure 7). This may reflect not only the relatively high costs of implementation, but also the reluctance of merchants to introduce cashless payment options, perhaps due to strong preferences for conducting transactions in an informal sector.

While the number of payment cards and POS terminals in Serbia rose significantly from 2010 to 2019, the value of payments effected using cards (relative to GDP) in this period more than doubled, meaning that the propensity to use payment cards also rose substantially. Data presented in Figure 8 suggest that the rise in the value of POS terminal transactions in Serbia outperformed growth in the CEE and other European countries, which can to a certain

Figure 8: Dynamics of the value of POS terminal transactions (% GDP)



Source: Author's calculations based on ECB and individual central banks' data

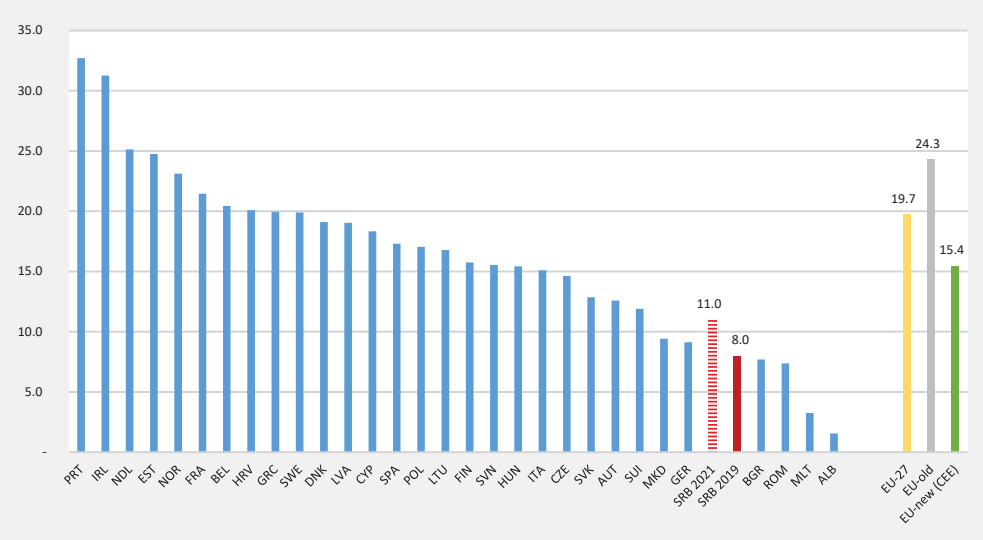


Figure 9: Value of POS terminal transactions in Europe by country in 2019 (% GDP)

Source: Author's calculations based on ECB and individual central banks' data

extent be attributed to the lower baseline, since in 2010 the volume of card payment transactions in Serbia accounted for less than 40% and 26% of the volume in the CEE and developed European countries, respectively. It should also be noted that the rise in the volume of POS terminal transactions accelerated in 2020 and 2021, probably reflecting the change in payment habits in the COVID-19 pandemic. Therefore, the total value of POS transactions in Serbia relative to GDP in 2021 was 2.8 times higher than in 2010.

In spite of the substantial rise over the last decade, the volume of POS terminal transactions in Serbia is still modest in comparative terms, with only Bulgaria, Romania, Malta and Albania having a lower ratio (Figure 9). The share of POS terminal transactions in GDP in Serbia in 2019 was 48% lower than the corresponding figure in the CEE countries and 67% lower than that in the developed European countries. Although the share of POS terminal transactions in Serbia is sharply increasing, there is still a significant gap to close in comparison to other European countries, and a set of policy actions would be required to do this. This pronounced gap in terms of the relative value of POS transactions in Serbia can be attributed not only to the difference in the level of economic development, but also to the lack of any progress in this respect during the 1990s.

The data presented in Figures 4-9 and summarized in Table 1 suggest that Serbia achieved significant progress in terms of financial inclusion, availability of cashless payment infrastructure and the value of cashless transactions in the past decade, with considerable convergence to other European countries. This process was accelerated during the COVID-19 pandemic, probably induced by the broader change in *modus operandi* and *modus vivendi*. However, the data suggest that the gap with the CEE countries and particularly with the developed European countries in terms of the development of the cashless economy in Serbia still remains significant.

Table 1: Summary statistics of cashless payments dynamics

		Number of payment cards (per capita)	Number of POS terminals (per 100,000)	Value of POS terminal transactions (% GDP)
2011	SRB	0.4	802	3.9
	EU-new (CEE)	1.1	1,138	9.7
	EU-old	1.7	2,303	15.0
	EU-27	1.5	1,848	13.0
2019	SRB	0.6	1,314	8.0
	EU-new (CEE)	1.3	1,998	15.5
	EU-old	2.3	6,093	24.3
	EU-27	1.9	4,197	19.7
	EU-new/SRB	2.1	1.5	1.9
	EU-old	3.6	4.6	3.0
	EU-27/SRB	3.0	3.2	2.5

Source: Author's calculations

3 THE RELATIONSHIP BETWEEN THE CASHLESS ECONOMY AND THE SHADOW ECONOMY – THEORETICAL CONSIDERATIONS AND EMPIRICAL EVIDENCE

De-cashing is defined as "the gradual phasing out of currency from circulation and its replacement with convertible deposits" (Kireyev, 2017). It can be done by means of "abolishing large denomination bills, imposing ceilings on cash transactions, introducing declaration requirements on the carriage of cash in and out of the country, reporting requirements for cash payments exceeding a specified amount, and even taxing cash transactions" (Kireyev, 2017). In spite of de-cashing initiatives, cash is still widely used, especially for small transactions, for both technical and symbolic reasons.

De-cashing may influence economic performance in many ways, which from the macroeconomic point of view can be grouped into four sets (Kireyev 2017; Rogoff 2015):

i) *Economic growth impact – On the positive side, de-cashing is expected to reduce the cost of transactions in the economy by about 2-2.5% of GDP (Bundesbank, 2014) and to curb the shadow economy, thus enhancing the level playing field, with a positive impact on economic growth. On the other hand, a substantial part of private investment is settled in cash, which means that with the elimination of high denomination banknotes, individuals will have to use a greater volume of smaller banknotes, which increases the transaction costs. In addition to this, it should be noted that due to the symbolic importance of cash, de-cashing may trigger social tensions, with harmful effects on the business environment.*

ii) *Monetary impact* – The existence of paper currency makes it difficult for central banks to charge negative interest rates, thus diminishing the effectiveness of monetary policy in tackling deflationary pressures, which is a well-known *zero lower bound* phenomenon. In the cash-driven economy, this can to some extent be tackled with higher inflation rate targets, creating more space to charge real negative interest rates. However, in a cashless economy, charging nominal negative interest rates would be simple from the technical point of view.

iii) *Fiscal impact* – The substitution of cash with electronic money in daily transactions reduces the space for the shadow economy and tax evasion as transactions conducted using cashless payment methods are traceable. In this respect, de-cashing is expected to contribute to a reduction in the relative size of the shadow economy, thus improving tax collection and the overall sustainability of public finances. On the other hand, the provision

of tax incentives or direct subsidies for cashless payment infrastructure and the associated costs would trigger additional fiscal expenditures.

iv) *Structural impact* – De-cashing may have a positive impact on financial inclusion as well as on tackling illegal transactions, such as money laundering, drug trafficking and financing terrorism. Reducing cash in circulation may also have a positive impact on the environment as a polymer bill leads to a 32 percent reduction in global warming potential and a 30 percent reduction in primary energy demand compared with paper (Wang, 2016).

In addition to the (mostly positive) macroeconomic impact of de-cashing, substitution of cash with electronic money may also be associated with economic and social challenges. Replacing anonymous paper currency with non-anonymous electronic money may discourage money demand, thus reducing seigniorage, resulting in a loss to be absorbed by the government. A cashless payment system is also less robust than the traditional one since a system of electronic payments is more vulnerable to cyberattacks and electromagnetic pulse blasts, and similar risks. Finally, complete de-cashing may be viewed as violation of fundamental human rights and a challenge to the freedom of contract and freedom of ownership, which may have a considerable impact on social stability (Rogoff 2015; Kireyev, 2017).

Considering the focus of our study on the impact of the development of cashless payment methods on the shadow economy and public finance sustainability, we will provide an overview of selected empirical studies in due course in order to frame our empirical modelling strategy and discuss the results. The theoretical explanation of the link between payment methods and the shadow economy is based on the line of reasoning which suggests that cash payment for transactions to a large extent facilitates tax evasion, as it is easier to hide the transaction history than in the case of electronic (non-cash) payments. Earlier studies (Rogoff 1998) showed that the cash circulating in OECD countries is far in excess of that required for normal operations of a formal economy. Similarly, Fisher et al. (2004) estimated that the (legal) transaction demand for euros was equal to roughly 30% of the total volume of euros in circulation.

Digitalization has profoundly transformed the *modus operandi* of contemporary economies, with a significant impact on the shadow economy and tax evasion opportunities. Digitalization of government services could mitigate tax evasion by improving tax procedures in general and the tax-filing system, thus raising tax compliance, as well as by reducing corruption. Uyar et al. (2021) used 1677 country-year observations over the period 2006-2017 to find that governments' long-term vision and the digitalization of government services may contribute significantly to alleviating tax evasion. They also found that the digitalization of government services has a stronger negative impact on tax evasion in countries where information and telecommunication technology adoption is higher.

Among other aspects of doing business, digitalization has also had a strong impact on the way transactions are settled. Although the first bank cards enabling cash withdrawals from ATMs were issued in the late 1960s and were extensively used for many years, their use has plunged in the last two decades. The ICT revolution has accelerated this process by facilitating and reducing the costs of cashless payments and creating new methods for the cashless

settlement of transactions beyond traditional payment cards (e.g. e-banking, mobile banking, mobile cards, and payment platforms, such as Pay Pal). Empirical studies show that retail electronic transactions, and especially retail card payments, are positively correlated with GDP per capita growth, consumption and trade (Hasan et al., 2012).

The empirical literature on tax evasion and tax compliance is mostly focused on the impact of rational choice factors – level of tax burden, fines/penalties and efficiency of tax enforcement, and to some extent also on tax morale (for an overview see Arsić and Ranđelović, 2017). For instance, the literature on drivers of the VAT gap thus far has primarily been focused on the effect of standard and reduced rates (Bogetić and Hassan, 1993; Agha and Haughton, 1996; Engel et al., 2001), the quality of tax administrations (de Mello, 2009), as well as the level of urbanization, trade openness and some political and institutional variables (Aizenman and Jinjarak, 2008). At the same time, the literature on the impact of payment methods on the shadow economy, tax evasion and tax collection efficiency is relatively scarce.

In one of the first studies on this topic, Madzharova (2014) used country-level panel data for 26 EU countries in the period 2000-2010 to find that the relationship between the share of cash transactions and VAT collection efficiency was consistently negative, except in countries with a high preference for cash transactions. She also found that the relationship between both cash and cards and the chosen VAT performance ratio is non-linear. Immordino and Russo (2018) used data for 25 European countries from 2000 to 2012 to show that payment with (debit and credit) cards is associated with lower VAT evasion, while the impact of cash withdrawals at ATMs is linked to higher VAT evasion. Jacolin et al. (2019) used parametric and non-parametric methods on panel data from 101 emerging and developing countries over the period 2000-2015 to find that mobile financial services negatively affect the size of the informal sector, suggesting that the adoption of mobile financial services leads to a decrease in the shadow economy by 2.4 – 4.3 % of GDP. These effects are explained with several arguments, such as an improvement in credit access, an increase in productivity and the induced growth of firms already operating in a formal sector due to an improvement in the level playing field. Finally, Reimers et al. (2020) used 2002-2019 data for the Eurozone countries to investigate the impact of payment innovations on the shadow economy. They found a significant and positive relationship between households' cash holdings, the volume of transactions and the size of the shadow economy irrespective of country. The same study also showed an inverse relationship between the accessibility and availability of cashless payment media and cash demand, which leads to the conclusion that a decreasing number of ATMs reduces cash holdings, with an impact on a reduction of the shadow economy.

Most of the empirical studies deal not only with the estimation of the determinants of the shadow economy and tax evasion, but also with the evaluation of the link between payment methods and the shadow economy. However, the number of studies dealing with the relationship between payment methods and the tax gap, i.e. with the quantification of the impact of a switch from cash to cashless payment methods on the tax gap, is limited. A recent study on this topic, dealing with Albania (Ernst and Young, 2018) shows that around 87% of the shadow economy in that country is directly linked to cash payments, while the remainder may be attributed to fraudulent operations in the formal sector.

The same study showed that the total tax gap associated with the cash-driven shadow economy stood at 2.85% of GDP, with 2.11% of GDP relating to the VAT gap and 0.74% of GDP being attributed to the corporate income tax gap, while the tax gap associated with labor taxes was not estimated.

Considering the findings from numerous empirical studies, it can be concluded that an increase in the relative value of cashless transactions can considerably reduce the shadow economy, although in order to have a large decrease in the shadow economy, promoting a cashless economy should also be accompanied by other structural policy measures and actions.

4 ECONOMETRIC ESTIMATION OF THE IMPACT OF THE DEVELOPMENT OF THE CASHLESS ECONOMY ON PUBLIC FINANCE

4.1 DATA AND DESCRIPITVE ANALYSIS

Due to the fact that the series of relevant macroeconomic data needed for the econometric evaluation of the relationship between the cashless economy and the shadow economy are relatively limited, the econometric estimation in this study was performed using panel data for 26 European countries (Serbia and 25 EU member states[3]) for the period from 2000 to 2019. The following control variables were used – GDP per capita, the total volume of international trade in percentage of GDP, unemployment rate, inflation rate, standard VAT rate, share of agriculture in gross value added and level of risk of corrup-

Table 2: Description of variables

Short name of variable	Definition/description of variable	Data source
SE	Shadow economy (% GDP)	Elgin, C., M. A. Kose, F. Ohnsorge, and S. Yu. (2021) Centre for Economic Policy Research, London Kelmanson et al. (2019)
VAT gap	Value added tax gap (% potential VAT revenues)	Study and Reports on the VAT Gap in the EU-28 Member States – European Commission Report 2020
POS value pc	Value of POS transactions per capita in EUR	ECB and data of individual central banks
POS%GDP	Value of POS transactions (% GDP)	ECB and data of individual central banks
POS/ATM	Logarithm of the ratio of value of POS transactions and value of ATM withdrawals	ECB and data of individual central banks
GDPpc	Logarithm of the gross domestic product per capita in market prices in USD	IMF World Economic Outlook
Trade	Value of export + import (% GDP)	The World Bank, World Development Indicators
Unemployment	Unemployment as a share of labour force	IMF World Economic Outlook
Inflation	End of period consumer prices percentual change	IMF World Economic Outlook
VAT rate	Value added tax standard rate in %	IMF Tax Policy Assessment Framework (TPAF) and Ernst & Young Tax Guides Library Archive (Worldwide VAT, GST and Sales Tax Guide 2005-2019)
Agriculture	Agriculture, forestry, and fishing, value added (% of GDP)	The World Bank, World Development Indicators
Corruption	Logarithm of the risk of corruption (0-6, high-low)	PRS Group historical database

[3] Due to limitations in the available data for Croatia and Cyprus for most of the observed time period, these two countries have been excluded from the sample of EU countries.

tion. Some countries in the sample did not collect data on cashless payments during the initial years of the observation period. This caused the number of observations per variable to vary from 433 to 494, meaning that we worked with an unbalanced panel. An overview of the variables used in the econometric modelling is given in Table 2.

The main descriptive statistics for these variables are presented in Table 3, while the correlation matrix is given in Table 4. Pearson correlation coefficients that are larger than 0.5 in absolute terms are marked in light blue, indicating stronger direct linear correlation between the variables. As can be seen in Table 4, both the VAT gap and the shadow economy have similar degrees of correlation to the rest of the variables used in the model and the same direction (sign). We can see that these two variables have negative correlation with all three indicators of the cashless economy, with the values of coefficients over -0.5, except in the case of the shadow economy and the value of POS transactions as percent of GDP, where the coefficient is -0.4. Although this negative correlation between share of the cashless payments and size of the shadow economy does not mean causation, it is in line with expectations that the countries with a larger share of cashless payments would have relatively lower levels of the shadow economy and *vice versa*.

Table 3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
VAT gap	489	0.152	0.097	-0.009	0.460
SE	475	21.741	7.194	9.387	36.900
POS value pc	455	7.367	1.488	0.421	10.711
POS (% GDP)	456	11.229	7.073	0.000	45.143
POS/ATM	433	-0.287	0.989	-2.907	6.047
GDPpc	494	9.976	0.873	7.122	11.738
Trade	494	108.733	55.235	22.492	360.132
Unemployment	494	9.232	4.662	2.217	27.475
Inflation	494	3.129	5.874	-1.684	80.744
VAT rate	489	20.528	2.562	15.000	27.000
Agriculture	494	2.698	2.145	0.214	17.070
Corruption	494	1.237	0.353	0.000	1.792

Table 4: Correlation matrix

	Vat gap	SE	POS-I	POS-II	POS/ ATM	GDPpc	Trade	Unemp	Infla-tion	VATrate	Agricul-ture	Corrup-tion
VAT gap	1											
SE	0.6243	1										
POS value pc	-0.6524	-0.6932	1									
POS%GDP	-0.5145	-0.4056	0.7764	1								
POS/ATM	-0.6423	-0.5604	0.8142	0.7495	1							
GDPpc	-0.5761	-0.7706	0.9095	0.5595	0.6947	1						
Trade	-0.2357	-0.4144	0.3339	0.2636	0.2752	0.3352	1					
Unemp	0.3384	0.4352	-0.2946	-0.1467	-0.2282	-0.3374	-0.2833	1				
Inflation	0.2251	0.319	-0.5821	-0.3324	-0.3642	-0.4861	-0.1144	-0.0271	1			
VATrate	0.0882	0.1527	0.0752	0.1702	0.0463	-0.046	-0.1915	0.0689	-0.1858	1		
Agriculture	0.5804	0.7453	-0.8419	-0.4893	-0.5806	-0.8374	-0.3395	0.3217	0.5754	0.0259	1	
Corruption	-0.6965	-0.7403	0.7058	0.5415	0.6397	0.7237	0.1821	-0.413	-0.2645	0.0419	-0.5917	1

4.2 ECONOMETRIC METHODOLOGY

The estimation of the impact of the development of the cashless economy on the level of the shadow economy, as well as on tax revenues, was carried out by combining the econometric methods and methods of simulation analysis in three steps:

i) *The relationship between the cashless economy and the shadow economy was estimated using econometric methods;*
ii) Based on the econometrically evaluated coefficients, an assessment of the expected change in the level of the shadow economy due to the increase in the cashless economy was simulated in three scenarios: scenario 1 – an increase in the level of the cashless economy in Serbia to the average level of the CEE countries; scenario 2 – an increase in the level of the cashless economy in Serbia to the average level of all member states of the European Union (EU-27); and scenario 3 – an increase in the level of cashless economy in Serbia to the average level in developed European countries, the so-called old EU member states.[4] In all three scenarios, the effects were estimated assuming that other factors affecting the shadow economy were unchanged;
iii) *Using estimates of the expected change in the size of the shadow economy in each of the scenarios described in the previous step, the effect on tax revenues in Serbia was estimated, starting from the official data of the Ministry of Finance on the share of tax revenues in the GDP of Serbia.*

Econometric modelling was performed on the basis of the following equation:

$$SE_{it} = c + \alpha_0 CE_{it} + \alpha_1 CV_{it} + \varepsilon$$

where SE_{it} represents the level of the shadow economy in country i in year t and CE_{it} stands for the test variable that describes the level of development of the cashless economy, while CV_{it} is a vector of control variables that may shape the shadow economy according to the theoretical and empirical literature.

The robustness of the results was checked using two alternative versions of the dependent variable that describes the level of shadow economy – the share of the shadow economy in GDP and the size of the VAT gap in relation to potential VAT revenues. The robustness was also tested using a number of alternative test variables that describe the level of development of the cashless economy, namely the total value of transactions at POS terminals per capita, the total value of transactions at POS terminals relative to GDP, and the ratio of the annual value of transactions at POS terminals and the value of transactions on ATMs. In the empirical literature on this topic, there are also other variables that can be used as an indicator of the development of the cashless economy, such as the number of payment cards and the number and value of transactions with payment cards. However, the selection of the three aforementioned test variables is conditioned on the availability of comparable data for Serbia and other European countries.

[4] Although we present the results for all three scenarios for illustrative purposes, the realistic goal for Serbia in the mid-run is to increase the level of cashless payments close to the CEE average, which is why only that result will be discussed.

Due to the potential endogeneity problem regarding the link between the shadow economy and the cashless economy, the instrumental variables method, based on the empirical strategy used by Immordino and Russo (2021), was used for the econometric estimations. The main idea behind the instrumental variables approach is that the choice of the payment method (POS instead of cash) is endogenous to the size of the shadow economy; for example, we expect a higher level of cash payments if the shadow economy is more extensive in a country. To deal with this, we introduced variables that influence cashless payments and thus the size of the shadow economy while at the same time not being causally affected by the size of shadow economy. In line with the approach used in other empirical studies, we proposed several instruments that could satisfy these conditions; for example, the quantity and quality of the internet network measured by the percentage of internet users and subscriptions to a fixed-broadband internet, the number of cards (debit and credit) per capita, the level of economic development and the number of ATM and POS terminals in the country per capita. We performed an underidentification test to check the relevance or irrelevance of the proposed instruments and weak instrument tests to examine whether the proposed instruments explain little variation in the endogenous regressor (cashless payment variable). In addition to this, an overidentification test was carried out to determine whether there is a correlation between the suggested instruments and the error term, making them inconsistent.

4.3 ECONOMETRIC RESULTS

The econometric models are specified on the basis of the theoretical framework and verified empirical strategies implemented in other similar studies (see Immordino and Russo, 2018). The first set of models (Table 5) provides the results on the impact of various forms of cashless economy indicators on the shadow economy (relative to GDP), while the second set of models (Table 6) provides the robustness check using the VAT gap as a proxy for shadow economy dynamics.

Our results (Table 5) suggest a strongly significant negative relationship between the total annual value of POS transactions per capita and the size of the shadow economy, which is also confirmed when the VAT gap is used as a proxy for the shadow economy (Table 6). Similar results are captured when the cashless economy is measured with the total value of POS transactions relative to GDP – strongly significant and negative coefficients are obtained in the three models with the shadow economy (% of GDP) as the dependent variable and the five models with VAT gap (% of GDP) as the dependent variable. An increase in the total value of POS transactions of 1 percent is associated with a decrease in the shadow economy of around 0.08 percent of GDP[5], while an increase in the number of POS terminals per capita of 1 percent is linked with a reduction in the shadow economy of 1.6 percent of GDP. The results also show that an increase in the value of POS transactions relative to the value of ATM transactions of 1 percent triggers a fall in the shadow economy of 0.027 percent of GDP.

[5] Average value of coefficients under different specifications.

Table 5: Shadow economy and cashless economy – econometric results

Dependent variable: SE	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
POS value PC	-0.4664***	-0.5804***	-0.4196***							
	(0.0837)	(0.0807)	(0.0842)							
POS value (% GDP)				-0.0686***	-0.0503***	-0.1182***				
				(0.0115)	(0.0109)	(0.0204)				
POS/ATM							-0.9572***	-1.0240***	-0.6334***	-0.6115***
							(0.2172)	(0.2341)	(0.1764)	(0.1694)
GDPpc	-0.4418	-0.5373*	-0.4026	-0.3745	-0.3115	-0.6660*	-0.4884	-0.4894	-0.3581	-0.4193
	(0.2913)	(0.2940)	(0.2814)	(0.3021)	(0.2930)	(0.3817)	(0.3389)	(0.3550)	(0.3115)	(0.3031)
Trade	-0.0039	-0.0028	-0.0036	-0.0039	-0.0048	-0.0030	-0.0021	-0.0030	-0.0050*	-0.0039
	(0.0033)	(0.0034)	(0.0033)	(0.0035)	(0.0034)	(0.0043)	(0.0031)	(0.0033)	(0.0029)	(0.0029)
Unemp	0.1431***	0.1371***	0.1453***	0.1644***	0.1652***	0.1626***	0.1324***	0.1314***	0.1407***	0.1409***
	(0.0101)	(0.0102)	(0.0100)	(0.0121)	(0.0093)	(0.0117)	(0.0133)	(0.0133)	(0.0114)	(0.0112)
Inflation	0.0032	-0.0030	0.0053	0.0252**	0.0260**	0.0244*	0.0059	0.0072	0.0213	0.0198
	(0.0122)	(0.0123)	(0.0121)	(0.01211)	(0.0119)	(0.0148)	(0.0223)	(0.0223)	(0.0187)	(0.0185)
VATrate	-0.0395*	-0.0212	-0.0505**	-0.0306	-0.0553**	0.0254	0.1278	0.0182	-0.0208	-0.0273
	(0.0232)	(0.0234)	(0.0244)	(0.0261)	(0.0251)	(0.0341)	(0.0252)	(0.0235)	(0.0221)	(0.0223)
Agriculture	0.1011**	0.0639	0.0987**	0.2175***	0.2235***	0.2128***	0.1842***	0.1795***	0.1932***	0.1883***
	(0.0477)	(0.0448)	(0.0480)	(0.0354)	(0.0377)	(0.0432)	(0.0487)	(0.0576)	(0.0477)	(0.0441)
Corruption	-0.5216**	-0.4955**	-0.2415	-0.0513	-0.1814	-0.0620	-0.1759	-0.3088	-0.5094	-0.3561
	(0.2365)	(0.2199)	(0.2559)	(0.2588)	(0.2743)	(0.3019)	(0.3191)	(0.3361)	(0.3114)	(0.3210)
Dummy	0.3188***	0.3107***	0.3062***	0.3134***	0.3195***	0.2991***	0.2891***	0.2948***	0.3128***	0.2990***
	(0.0830)	(0.0846)	(0.0807)	(0.0881)	(0.0850)	(0.1083)	(0.0757)	(0.0779)	(0.0697)	(0.0694)
Instruments	Broadband, ATM	Internet, ATM	Broadband, POS	Internet, POS	Broadbend, POS	ATM, GDPpc	Internet, POS	Internet, GDP	Broadband, Card	Broadband, POS
Underidentification test (Kleibergen-Paap rk LM statistic)	58.356	50.065	62.444	57.506	56.966	40.016	42.914	28.023	33.129	43.533
Chi-sq(2) P-val	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Weak identification test (Cragg-Donald Wald F statistic or Kleibergen-Paap kr Wald F statistic)	93.019	115.347	84.565	116.089	108.021	53.977	23.642	28.252	29.027	29.617
Stock-Yogo weak ID test critical values (max)	19.93	19.93	19.93	19.93	19.93	19.93	19.93	19.93	19.93	19.93
Hansen J statistic (overidentification test of all instruments):	0.949	0.014	1.146	0.892	0.172	3.915	0.029	2.432	3.195	2.079
Chi-sq(1) P-val	0.3299	0.9054	0.2844	0.3448	0.6779	0.0479	0.8646	0.1189	0.0739	0.1493
Number of observatrion	412	418	398	404	398	418	384	398	391	378
F statistics	77.28	88.39	76.9	80.1	71.46	72.97	61.64	50.08	58.98	60.32
Prob > F	0	0	0	0	0	0	0	0	0	0
Centered R2	0.6498	0.6598	0.6548	0.6032	0.6148	0.4442	0.3637	0.3418	0.5164	0.5184
Root MSE	0.4479	0.4583	0.4334	0.4755	0.4578	0.5858	0.5856	0.6232	0.5124	0.4961

Notes: All regressions include fixed country effects with robust standard errors presented in brackets, *** significant at the 1% level. ** significant at the 5% level, * significant at the 10% level.

Table 6: VAT gap and cashless economy – econometric results

Dependent variable: VAT gap	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
POS value PC	-0.0136*	-0.0139**	-0.02079***	-0.0134*								
	(0.0073)	(0.0063)	(0.0081)	(0.0073)								
POS value (% GDP)					-0.0023**	-0.0022**	-0.0028**	-0.0012*	-0.0025**			
					(0.0011)	(0.0010)	(0.0011)	(0.0007)	(0.0011)			
POS/ATM										-0.247**	-0.0278***	-0.0236**
										(0.0103)	(00096)	(0.0106)
GDPpc	-0.0655***	-0.0685***	-0.0739***	-0.0650***	-0.0667***	-0.0591**	-0.0710***	-0.0637***	-0.0685***	-0.0690***	-0.0709***	-0.0605**
	(0.0242)	(0.0247)	(0.0250)	(0.00240)	(0.0239)	(0.0244)	(0.0252)	(0.0243)	(0.0247)	(0.0243)	(0.0245)	(0.0243)
Trade	-0.0001	-0.0002	-0.0000	-0.0000	-0.0001	-0.0001	-0.0000	-0.0002	-0.0001	-0.0001	-0.0001	-0.0002
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Unemp	0.0037***	0.0038***	0.0033***	0.0038***	0.0042***	0.0047***	0.0041***	0.0045***	0.0042***	0.0038***	0.0036***	0.0043***
	(0.0009)	(0.0009)	(0.0009)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0009)	(0.0009)	(0.0009)
Inflation	-0.0030**	-0.0037**	-0.0033**	-0.0030**	-0.0024*	-0.0030**	-0.0024	-0.0031**	-0.0024*	-0.0028*	-0.0029*	-0.0035**
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0015)	(0.0015)	(0.0015)
VATrate	-0.0002	0.0004	0.0008	-0.0003	0.0006	0.0016	0.0013	-0.0003	0.0009	0.0002	0.0006	0.0012
	(0.0022)	(0.0025)	(0.0024)	(0.0022)	(0.0024)	(0.0025)	(0.0025)	(0.0024)	(0.0024)	(0.0024)	(0.0025)	(0.0025)
Agriculture	0.0047	0.0069	0.0021	0.0049	0.0086***	0.0135***	0.0082***	0.01159***	0.0084***	0.0069*	0.0065*	0.0119***
	(0.0048)	(0.0042)	(0.0048)	(0.00485)	(0.0033)	(0.0040)	(0.0032)	(0.0037)	(0.0032)	(0.0037)	(0.0036)	(0.0042)
Corruption	-0.0200	-0.0310	-0.0156	-0.025	-0.0119	-0.0226	-0.0074	-0.0310	-0.0098	-0.0091	-0.0066	-0.0209
	(0.0202)	(0.0218)	(0.0205)	(0.0202)	(0.0216)	(0.0224)	(0.0219)	(0.0214)	(0.0217)	(0.0202)	(0.0199)	(0.0222)
Dummy	0.0215***	0.0195***	0.0207***	0.0215***	0.0218***	0.0235***	0.0215***	0.0203***	0.0217***	0.0276***	0.0204***	0.0225***
	(0.0070)	(0.0072)	(0.0071)	(0.0070)	(0.0071)	(0.00716)	(0.0072)	(0.0071)	(0.0071)	(0.0072)	(0.0073)	(0.0073)
Instruments	Internet, Broadband, Cards	POS, Card	Broadband, Cards	Broadband, Internet	Broadband, Internet	Internet, Cards	Broadbend, Cards	POS, Cards	Internet, Broadband, Cards	Internet, Broadband	Broadband, Cards	Internet, Cards
Underidentification test (Kleibergen-Paap rk LM statistic)	51.351	59.171	51.065	51.006	50.182	50.963	48.417	24.578	50.358	37.839	38.057	34.61
Chi-sq(2) P-val	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Weak identification test (Cragg-Donald Wald F statistic or Kleibergen-Paap kr Wald F statistic)	50.796	44.906	49.501	72.068	67.331	73.36	52.932	49.386	47.424	33.887	35.151	32.357
Stock-Yogo weak ID test critical values (max)	22.3	19.93	19.93	19.93	19.93	19.93	19.93	19.93	22.3	19.93	19.93	19.93
Hansen J statistic (overidentification test of all instruments):	4.778	2.68	1.792	3.03	1.65	1.666	0.106	3.447	1.777	0.024	1.764	3.264
Chi-sq(1) P-val	0.0917	0.1016	0.1807	0.0818	0.199	0.1968	0.7449	0.0634	0.4113	0.8767	0.1841	0.0708
Number of observatrion	469	452	469	470	470	475	469	452	469	450	449	455
F statistics	10.32	10.39	10.38	10.33	10.6	11.41	10.59	10.39	10.57	11.56	11.89	12.39
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Centered R2	0.2104	0.2506	0.1823	0.2121	0.1989	0.2528	0.1775	0.268	0.1898	0.2345	0.2218	0.2824
Uncetered R2	0.2104	0.2506	0.1823	0.212	0.1989	0.2528	0.1775	0.268	0.1898	0.2345	0.2218	0.2824
Root MSE	0.0394	0.0397	0.0401	0.0393	0.0396	0.0409	0.0402	0.0392	0.0399	0.0393	0.0397	0.0407

Notes: All regressions include fixed country effects with robust standard errors presented in brackets, *** significant at the 1% level. ** significant at the 5% level, * significant at the 10% level.

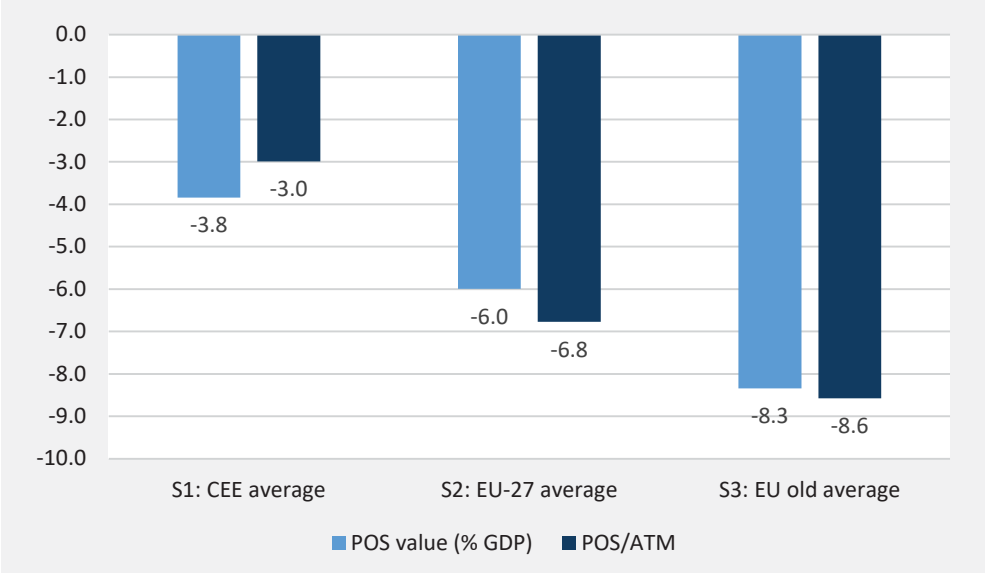
Taking the average value of the estimated coefficients in the first set of models (Table 5), we recalculated them into coefficients of elasticity of the shadow economy with respect to size of the cashless economy. Our results suggest that an increase in POS transactions in GDP of 1 percent triggers a reduction in the shadow economy of 0.041 percent. Similar findings are derived when the ratio of the total value of POS transactions and the total value of ATM transactions is used as an indicator of development of the cashless economy – an increase in the volume of POS transactions relative to ATM transactions of 1 percent is associated with a decrease in the shadow economy of 0.037 percent of GDP.

Concerning the impact of the control variables, solid and stable evidence on the positive impact of unemployment on the shadow economy (the higher the unemployment, the larger the shadow economy) and the positive impact of share of agriculture are found in both sets of models. This finding is intuitive and in line with the findings of other empirical studies (Uyar, 2021; Immordino and Russo, 2018) since higher unemployment makes people more willing to accept informal work, while a significant number of transactions in agriculture are conducted in the informal sector. Strong evidence of the negative association of the level of economic development (GDP per capita) and the shadow economy is found in the set of models in which the VAT gap is used as a proxy for the shadow economy, whereas only weak evidence of this link was captured in the first set of models. Similar results are obtained in terms of the impact of inflation on the shadow economy, whereas there is no robust evidence of a significant impact of the volume of international trade, the tax burden and corruption, which may be due to linear dependence between the explanatory variables (see the correlation matrix presented in Table 4).

The simulation analysis was carried out using the estimated elasticities between the shadow economy and two types of cashless economy indicators – the value of POS transactions relative to GDP and the ratio of the value of POS-to-ATM transactions. The final results were calculated as the average of the results obtained using each of the two elasticities.

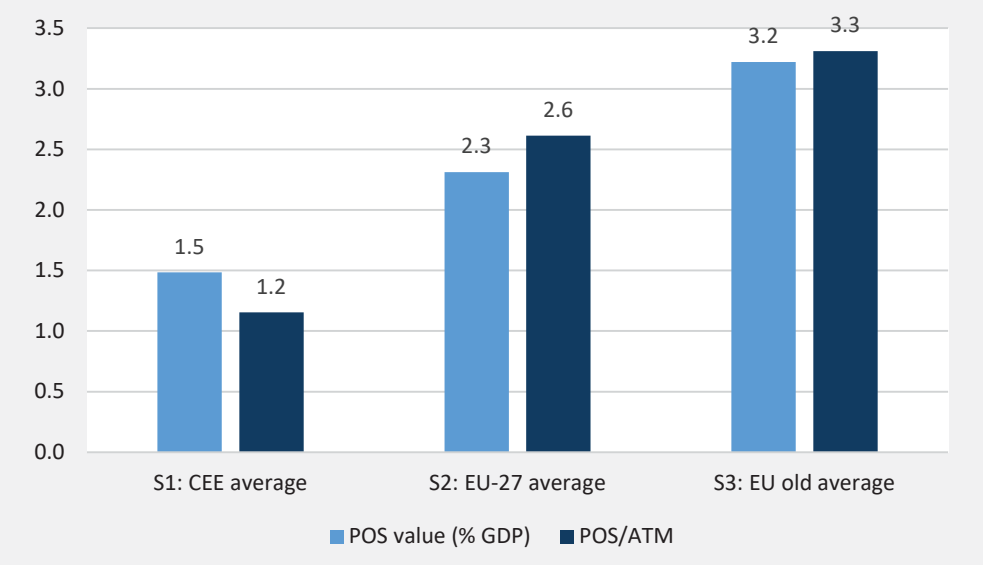
According to the simulation analyses, an expansion of the cashless economy in Serbia may have a considerable impact on reducing the shadow economy.

Figure 10: Impact of increase in cashless economy on change in shadow economy in Serbia (% GDP)



Source: Authors' calculations

Figure 11: Impact of increase in cashless economy on tax revenue in Serbia (% GDP)

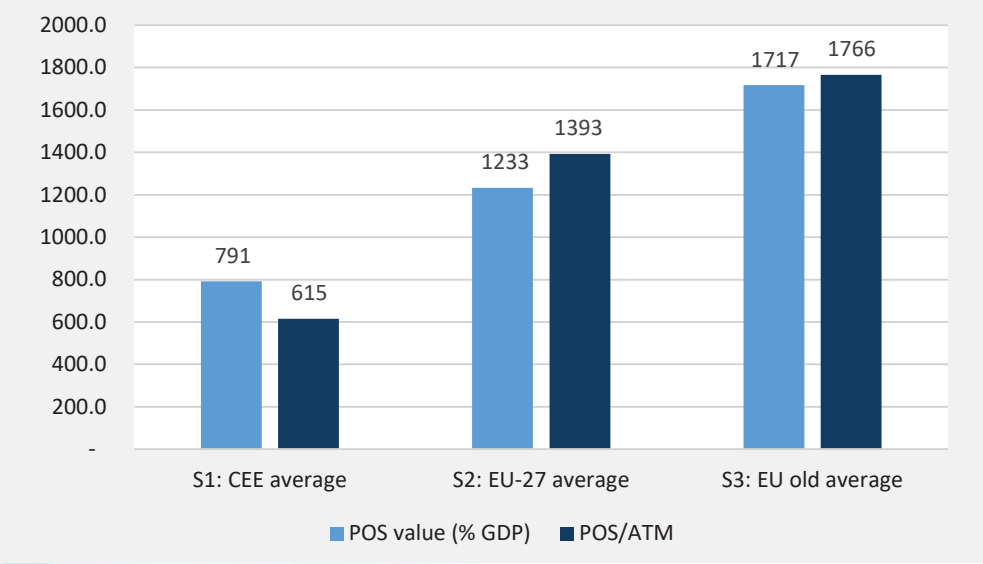


Source: Authors' calculations

In the case of an increase in the cashless economy in Serbia to the CEE-average, the shadow economy would decline by around 3.4% of GDP (Figure 10). This decline in the shadow economy as a consequence of a rise in cashless payments can be achieved in a relatively short period of time. Data on cashless payments in CEE countries for the last 10 years suggest that the three countries with the fastest growth in this respect (Lithuania, Poland and Slovakia) recorded an average annual growth rate of 9.8%, as measured by the value of POS payments as the share of GDP. If Serbia were to commit itself to fostering and strongly incentivizing the cashless economy, thus reaching this growth rate, it would take around 6-7 years to achieve the current level development of the cashless economy in the CEE countries.

In the case of formalization of economic transactions equivalent to 1% of GDP, tax revenues in Serbia could rise by approximately 0.38% of GDP. Considering this and the estimated impact of the cashless economy on the shadow economy, we estimated the tax revenue collection effects associated with the development of the cashless economy (Figure 11 and Figure 12). Our results show that an increase in the cashless economy in Serbia to the CEE average would be associated with an increase in tax revenues of around 1.35% of GDP, i.e. approximately EUR 700 million per year.

Figure 12: Impact of increase in cashless economy on tax revenue in Serbia (mil. EUR)



Source: Authors' calculations

5 CONCLUDING REMARKS AND POLICY CONSIDERATIONS

According to various estimates, the shadow economy in Serbia has been sizable for a long period of time. It is significantly larger not only in comparison to developed European countries, but also relative to the average of the CEE countries. The extensive size of the shadow economy is the consequence of a large number of economic and social factors, such as a relatively low level of economic development, high unemployment, the structure of the economy, low efficiency of the tax administration, low quality and availability of public services, a low level of tax morale, a high level of corruption, the dominance of cash payments, among others. The negative consequences of a large shadow economy include lower tax revenues, lower availability and quality of public services, violation of the level playing field and social insecurity. Therefore, suppression of the shadow economy is necessary in order to improve the quality and availability of public services, to improve social security and to enhance conditions for overall economic development.

The results of the econometric analysis for Serbia and EU countries in this study suggest that an increase in the share of cashless payments in GDP, as well the ratio of cashless and cash payments over the past two decades, has influenced the reduction of the shadow economy. If Serbia were to reach the current relative level of development of cashless payments in the CEE countries, under other unchanged conditions, the shadow economy in Serbia would decline by 3.4% of GDP, which would trigger an increase in tax revenues of up to 1.35% of GDP, i.e. of up to EUR 700 million per year. With effective policy actions and their efficient implementation, convergence of Serbia to the CEE countries in terms of the share of the value of cashless payments (relative to GDP) would probably take 6-7 years. To achieve this, it would be necessary to accelerate the increase in the cashless payments in Serbia relative to the dynamics that Serbia achieved during the previous decade. The fact that several EU member states have managed to double the share of cashless payments in GDP over 6-7 years suggests that this is achievable goal.

The acceleration of the growth of cashless payments can be expected as the part of a wider process of digitalization, which represented one of the main drivers of technological progress during the previous few decades. Moreover, the prevailing predictions at the moment suggest that digitalization, including the development of infrastructure for cashless payments (POS terminals, telecommunication systems, etc.) will accelerate in the future. The advantages of cashless payment from the point of view of security, reliability, availability, cost efficiency, etc. may also encourage a rise in demand for cashless payments in the future.

It is expected that the reduction of the shadow economy in Serbia in the coming years will be driven not only by the substitution of cash with cashless payments, but also by wider economic and social development; for example,

a gradual decrease as a result of economic growth and a long-term decline in unemployment is also anticipated. The decline in the shadow economy will also be affected by the change in the sectoral structure of the economy in such a way that the participation of sectors in which the shadow economy is substantial (e.g. agriculture) will decrease. Furthermore, the relative importance of medium and large companies in the Serbian economy (especially in wholesale and retail) is expected to increase, which may also contribute to suppression of the shadow economy.

Although the focus of this study is on the impact of the development of cashless payments on the shadow economy and public finances, when evaluating the benefits and costs of the development of the cashless economy it is also necessary to estimate and to take into account its positive effects on the reduction of overall economic costs with a positive impact on GDP growth, on the effectiveness of monetary policy, on the prevention of money laundering and financing of terrorism, on environmental protection, etc. At the same time, the respective risks and limitations, such as possible electromagnetic shocks, power shortages, hacking and similar, should be considered and proactively addressed with well-designed policy measures.

Increasing the relative share of cashless payments may well have a positive effect on reducing the shadow economy and a considerable impact on increasing tax revenue collection and economic development. Therefore, there are strong arguments for not leaving the development of the cashless economy solely to technological and market drivers, but rather to engage government in proactive action aimed at promoting the use of cashless payments by means of regulatory, fiscal and educational measures. In this respect, considering the current institutional framework in Serbia and insights into comparative international practice, the portfolio of regulatory measures that can been applied in order to encourage cashless payments is relatively rich and may include measures such as: *i)* imposing and/or reducing the maximum value of transactions that can be paid in cash, *ii)* imposing the obligation for legal entities to possess POS terminals and to provide an option for cashless payments to their customers, *iii)* imposing the obligation to conduct some transactions in a cashless form (payment of wages, pensions, social assistance, government subsidies, etc.), *iv)* further limiting the costs of cashless payments, *v)* imposing the obligation to report large cash transactions to state authorities, etc. On the fiscal side, incentives may include direct subsidies or tax breaks (e.g. accelerated depreciation) for investment in infrastructure for cashless payment, partial reduction of tax liabilities for cashless settlements and the recognition of some tax expenses only for cashless remittance of payments. In addition to regulatory and fiscal incentives, it is necessary to apply educational measures, i.e. to raise awareness of citizens of the benefits of cashless payments, through the regular education system as well as through media campaigns. Considering the multidisciplinary nature of these issues, the concrete set of measures that would encourage the development of cashless payments in Serbia should be designed and implemented in close collaboration with all the relevant stakeholders, including of the Ministry of Finance, the Tax Administration, the National Bank of Serbia, business associations, trade unions, etc.

The shadow economy is a complex phenomenon that exists in all countries. The gradual transition from cash-based to cashless payments will not eliminate the shadow economy, but it may well contribute to its reduction. In-

creasing the relative share of cashless payments is only one of the instruments for suppressing the shadow economy, with limited impact. This means that for a more significant reduction in the shadow economy, the implementation of many other measures is required (see Schneider, 2019): improving the efficiency of tax enforcement, strengthening tax morale, curbing corruption, improving the quality of public services, etc. Based on historical experience, it can be expected that hand-in-hand with the development of the cashless economy, other forms of tax evasion will emerge as taxpayers seek new tax evasion opportunities, even in the cashless environment. Therefore, continuous monitoring and analysis of cashless transactions is needed in order to discover new forms of tax evasion in a timely manner and to take appropriate measures to combat them.

REFERENCES

Agha, A., & Haughton, J. (1996). Designing VAT systems: Some efficiency considerations. *The Review of Economics and Statistics*, 303-308.

Aizenman, J., & Jinjarak, Y. (2008). The collection efficiency of the Value Added Tax: Theory and international evidence. *Journal of International Trade and Economic Development*, *17*(3), 391-410.

Arsić, M., & Ranđelović, S. (2017). Ekonomija oporezivanja–teorija i politika. *Beograd: Centar za izdavačku delatnost Ekonomskog fakulteta u Beogradu*.

Bogetic, Z., & Hassan, F. (1993). Determinants of Value-Added Tax revenues. *World Bank Policy Research Working Paper*, (1203).

de Mello, L. (2009). Avoiding the value added tax: Theory and cross-country evidence. *Public Finance Review*, *37*(1), 27-46.

Elgin, C, Kose, A, Ohnsorge, F and Yu, S. (2021). Understanding Informality. London, Centre for Economic Policy Research. https://cepr.org/active/publications/discussion_papers/dp.php?dpno=16497

Engel, E. M., Galetovic, A., & Raddatz, C. E. (2001). A note on enforcement spending and VAT revenues. *Review of Economics and Statistics*, *83*(2), 384-387.

Ernst & Young Report (2018) Reducing the shadow economy through electronic payments.

European Commission (2021). *Taxation Trends in the European Union*. Luxembourg

Fischer, B., P. Kohler, & Seitz, M. (2004). The demand for euro currencies, past, present and future. ECB Working Paper Series no. 330, European Central Bank, April.

Grzegorz, P., Durán-Cabré, J. M., Esteller-Moré, A., & Bonch-Osmolovskiy, M. (2021). Study and Reports on the VAT Gap in the EU-28 Member States.

Hasan, I., De Renzis, T., & Schmiedel, H. (2012). Retail payments and economic growth. *Bank of Finland research discussion paper*, (19).

Immordino, G., & Russo, F. F. (2018). Cashless payments and tax evasion. European Journal of Political Economy, 55, 36-43.

Jacolin, L., Massil Joseph, K., & Noah, A. (2019). Informal sector and mobile financial services in developing countries: Does financial innovation matter?

Kireyev, M. A. P. (2017). *The macroeconomics of de-cashing*. International Monetary Fund WP 17/71

Madzharova, B. (2014). The impact of cash and card transactions on VAT collection efficiency. *The usage, costs and benefits of cash–revisited*, 521-559.

Reimers, H. E., Schneider, F., & Seitz, F. (2020). Payment innovations, the shadow economy and cash demand of households in Euro Area countries. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3702126

Rogoff, K. (1998). Foreign and underground demand for Euro Notes: blessing or curse?. *Economic Policy* 26 (April), 263–303.

Rogoff, K. (2015). Costs and benefits to phasing out paper currency. *NBER Macroeconomics Annual*, *29*(1), 445-456.

Schneider, F., Krstić, G., Arsić, M., Arandarenko, M., Radulović, B., Ranđelović, S. & I. Janković (2015). *Formalizing the shadow economy in Serbia: Policy measures and growth effects* (p. 179). Springer Nature.

Schneider, F. (2019). Restricting or Abolishing Cash: An Effective Instrument for Eliminating the Shadow Economy, Corruption and Terrorism? Some Remarks. forthcoming in SUERF *Conference Proceedings*, (2019), Vienna.

Uyar, A., Nimer, K., Kuzey, C., Shahbaz, M., & Schneider, F. (2021). Can e-government initiatives alleviate tax evasion? The moderation effect of ICT. *Technological Forecasting and Social Change*, *166*, 120597.