SHADOW BANKING IN CENTRAL AND EASTERN EUROPE: SPECIFICITIES AND DRIVERS

András Bethlendi, Katalin Mérő, Zsanett Orlovits

Abstract

The paper analyses the specificities and drivers of the shadow banking (SB) system in eleven Central and Eastern European (CEE) EU member states for 2004-2019. It contributes to the understanding of the CEE SB in terms of how the structural features of the financial and banking system determine its development. The SB system of the region is much smaller, and its structure is less complex and significantly different from that of developed European countries: the role of capital market intermediaries is smaller, while the role of nonbank lenders is larger. Specific features of the CEE financial system include the dominance of banks, the relative underdevelopment of capital markets, the dominance of foreign ownership, and, until the mid-2010s, the reliance on foreign interbank funding in several countries. Indeed, as the results of our panel regression show, regional specificities in the structural characteristics of financial systems are key for the development of the SB.

Key words: *Central and Eastern Europe, shadow banking, market-based finance*

JEL Classification: *G20, G23, G28*

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1. Introduction

This paper analyses the specificities and drivers of the shadow banking system in the eleven Central and Eastern European EU member states (CEE11) that joined the EU in 2004 or later, namely Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

According to the widely used definition of the Financial Stability Board (FSB 2011), the shadow banking system refers to 'The system of

credit intermediation that involves entities and activities outside the regular banking system' (p. 2). Shadow banking (SB) emerged in the early 2000s in the United States (Pozsar et al. 2010, Adrian and Ascraft 2012, Gorton and Metric 2010). Similar to traditional banking, SB activity based on maturity transformation creates leverage and takes credit risk, though without strict prudential regulations and a government-backed safety net (Adrian and Ascraft 2012, Claessens and Ratnovski 2014, Thiemann 2018). Accordingly, prior to the global financial crisis (GFC), regulatory arbitrage played an important role among the reasons for increased SB activities (Adrian and Ascraft 2012, Lysandrou and Nesvetailova 2015). The business model of financial intermediation through the SB system also gained ground in the EU (Bakk-Simon et al. 2012, Malatesa et al. 2016) and contributed to systemic risk in the member states. The EU has made a serious effort to reduce SB risk and transform it into stable market-based finance, but it has had limited success so far. In its Spring 2023 Financial Stability Review, the ECB identified SB risk as a key factor of vulnerability in the European financial system (ECB 2023).

In line with the less developed and highly bank-based financial system of CEE11, shadow banking plays a less dominant role throughout the CEE region. Hodula (2022) highlights that the CEE SB sector is relatively simple compared to that of developed countries. Nevertheless, different types of SB activities have emerged in the region that could also contribute to systemic risk. However, relatively little research has focused on the characteristics and drivers of the CEE SB system.

Our contribution to the existing research is to analyze the SB of the CEE region from the perspective of how the structural characteristics of the financial and banking system determine its development. The previous literature also includes banking system variables in the analysis of SB, but these are general banking system variables, not CEE-specific. The specificities of the financial intermediation system in the CEE region include the dominance of banks, the relative underdevelopment of capital markets, the dominance of foreign ownership, and, in several countries until the mid-2010s, the reliance on foreign interbank finance. Since foreign banks typically passed on the market-based funds they had raised (i.e., the shadow banking funds of their own country), a so-called secondary shadow banking system could develop in these countries, as Bethlendi and Mérő (2024) demonstrate in the case of Hungary. Based on these specialties, the structure of the CEE SB is also different from the SB structure in developed EU countries: the role of capital market intermediaries and intermediation is

smaller, while the role of nonbank lenders and lending is larger. The empirical part of our analysis also follows this logic: we look at the impact of several explanatory variables that capture specific structural elements of the CEE region.

Indeed, as our econometric analysis shows, regional specificities in the structural characteristics of financial systems are key for the development of the SB system in CEE11.

The structure of the article is as follows. The next section presents a brief overview of the literature on the European and CEE SB systems. Section 3 describes the data and methodology we used. In Section 4, we present the main structural characteristics of CEE SB system. Section 5, based on a panel regression, analyses the determinants of CEE SB developments, with special emphasis on regional specificities of the banking sector. We close the article with conclusions and policy implications in Section 6.

2. Literature review

The general characteristics of SB are well-researched topics (Pozsar et al. 2010, Adrian and Ashcraft 2012, Classens and Ratnowski 2014, Thiemann 2018). With regard to the financial stability implications of shadow banking, it should be stressed that due to increased lending capacity, the emergence of SB has resulted in rapid credit expansion (Moreira and Savov 2017, Özgür 2021). However, as the excessive lending took place outside the regulated banking industry, the risks taken by the SB system and the risk transfer mechanism among the different organizations within the system were highly opaque (Acharya et al. 2013, Gennaioli et al. 2013, Culp and Neves 2018, Thiemann and Tröger 2021). The lack of bank-like regulations resulted in wide-scale regulatory arbitrage (Adrian and Ashcraft 2012, Thiemann 2018, Adrian and Jones 2018) and also in bad incentive structures (Lysandrou and Nesvetailova 2015; Ban and Gabor 2016).

Despite the basic bank-based characteristics of most EU countries' financial systems, market-based finance has been gaining ground over traditional bank lending for decades, first of all in the old member states of the EU, but there are significant differences among member states (Hartman et al. 2003). Besides, as Hardie et al. (2013) demonstrate, the nature of banking has become more market-based; that is, there is a convergence between banking, capital markets, and SB. The European SB started to grow rapidly before the 2008 crisis and growth continued into the 2010s. As a result, by 2016, the euro area SB system was somewhat larger than that of the US (FSB 2020, Graph

1-4, p.12). Pires (2019) has also demonstrated the rapid growth of EU SB after the GFC and its increasing role in European financial intermediation, especially in lending. She draws attention to the related structural vulnerabilities, especially to the increasing leverage of investment funds and the high interconnectedness of different segments of the financial sector. As a result, the level of SB assets in the euro area reached 40% of total financial assets by 2018 (Petkovski at al. 2023).

Hodula et al. (2020) identified the following growth factors for EU SB: real GDP growth, the demand of institutional investors, tightening capital requirements of banks and the financial development of EU member states. Hodula (2022) analyzes the SB of old and new EU member states separately. In his analysis, the new member states are defined as those that joined the EU in 2004 and in 2007, including the post-communist CEE member states, as well as Malta and Cyprus. The main conclusion of the analysis is that whereas SB fulfills more of a complementary role to traditional banking in old member states, it functions more as a substitute in new member states.

Petkovski et al. (2023) also investigate the drivers of SB, comparing the old and new EU member states for the 1999-2020 period. However, they excluded Luxembourg, as an international financial center, from the group of old member states and reclassified Cyprus and Malta from the new to the old group due to their financial sector characteristics. They analyzed a wide range of explanatory variables, including a number of financial systems and institutional indicators (see Table 1). In contrast to Hodula (2022) they found that the CEE SB was also rather complementary to traditional banking.

Grillet-Aubert et al. (2016) complement the entity-based approach to European SB analysis with an activity-based approach. They draw attention to the need for more granular data for proper risk assessment of SB. The interconnectedness of SB and other parts of the financial system for the euro area is analyzed by Giron and Matas (2017). Using the ECB's who-to-whom data, they analyze the flow of funds between different categories of financial institutions. The interconnectedness of EU banks and SB has been analyzed by Abad et al. (2017). They highlight the high interconnectedness of EU banks and the global SB, especially that of the US.

In addition to these comprehensive analyses, there are other papers that focus on different market segments of European SB. European money market funds are analyzed by Bengtsson (2013); the investment fund sector by Doyle et al. (2016); the repo market by Ban and Gabor (2016); the money market funds and asset-backed commercial papers by Endrejat and

Thiemann (2020); and the interaction between macro-prudential policies and SB by Hodula and Ngo (2024). The latter also examines the old and new EU member states separately but finds no meaningful difference between the two groups.

Apart from the studies mentioned above comparing the SB in old and the new EU Member States, only a few studies deal with the shadow banking system in the CEE region. Ghosh et al. (2012) on the SB of emerging markets include three CEE countries (Bulgaria, Romania, and Croatia) for the 2003-2011 period. They argue that despite the low level of SB in these countries, the significant increase in SB activities in recent years, and their interconnectedness with the traditional financial system, may pose systemic risks. Apostoaie and Bilan (2020) focused on the macro determinants of SB dynamics in CEE11 between 2004 and 2017. They conclude that from a low base in 2004, the SB of the CEE11 increased more than the euro area countries between 2004 and 2007. The main macroeconomic drivers they identified were the following: economic growth, global liquidity conditions, search for yield of investors, demand from institutional investors, and the complementarity with the rest of the financial system.

Kjosevski et al. (2021) analyzed the drivers of SB growth in CEE for the period of 1999-2019. They identified economic growth as the main driver of SB. In their analysis, they divided the 11 CEE countries into three more homogeneous groups: the Baltics, the Visegrad countries, and the Balkans. According to their results, the SB of the subgroups differs most in how they were affected by the global financial crisis. In contrast to Hodula (2022) their results indicate complementarity between the development of SB and the rest of the financial system.

The geographical coverage, the time horizon, and the explanatory variables used in the literature for determining the drivers of CEE SB growth are summarized in Table 1.

3. Data and methodology

3.1. Data

One of the difficulties of analyzing the CEE shadow banking system is the lack of reliable data. Throughout our analysis, we relied on the dataset of Bethlendi and Mérő (2022). Besides the CEE, this dataset includes comparable data for three West European countries, Austria, France, and Germany, which are the most important home countries of several major CEE financial institutions. In this article, we also use these three

Table 1. Drivers of SB development used in the literature covering the CEE region.

	Apostoaie and Bilan, 2020	Ghosh et al., 2012	Hodula, 2022	Kjosevski et al., 2021	Petkovski at al., 2023
SB variable	Broad: including all non-monetary financial institutions, excl. insurance corporations and pension funds. Narrow: broad without investment funds, other than money market funds	Nonbank financial intermediaries	Investment funds (IF) incl. money market funds and other financial intermediaries (OFI)	Other financial intermediaries (OFIs)	Other financial intermediaries (OFIs)
Geographical coverage	CEE11	Emerging markets, including three CEEs	New EU member states, including Cyprus and Malta, excluding Croatia	CEE11	CEE11 and other EU countries, excluding Luxembourg
Time horizon	2004-2017	2002-2011	2004-2019	1999-2019	1999-2020
Method	Econometric	Descriptive statistics	Econometric	Econometric	Econometric
Macroeconomic	Real GDP growth		Real GDP growth	Real GDP growth Inflation rate	Real GDP per capita Size of the economy Inflation rate
Financial sector	Growth rate of total assets of monetary and financial institutions. Growth rate of total financial assets of insurance corporations and pension funds;	Total assets of banks per GDP	Traditional banking growth; WB Financial Development index Growth rate of total financial assets of insurance corporations and pension funds;	Total assets of banks per GDP Insurance companies' assets per GDP; WB Financial Development index Institutional cash pools;	Total assets of banks per GDP; Asses of insurance companies per GDP WB Financial Development index
Market indicators	Growth rate of total reserves, excluding gold		Short-term interest rate	Interest spread of banks Credit margin	Financial market index
Maturity transformation	Term spread Money market rate				Interest rate spread
Crisis (2007-2008)			Crisis dummy	Crisis dummy	Crisis dummy
Institutions			Macroprudential policy dummy Capital regulation		Regulatory quality Rule of law

countries as benchmarks for CEE analysis. The structure of the dataset is based on the subsectors of the European System of Accounts (ESA). These subsectors are as follows: money market funds (MMFs), non-MMF investment funds (non-MMFs), other financial institutions (OFIs), financial auxiliaries, and captive financial institutions. The OFI subsector consists of financial

vehicle corporations engaged in securitization (FVCs), security and derivative dealers, financial corporations engaged in lending (FCLs), and specialized financial corporations. The authors corrected Eurostat data and complemented missing data with other national sources. All data sources are presented in Annex 1.

3.2. Variables

We use the following variables to capture the development and characteristics of the CEE financial sector:

1. Capital market depth, as measured by stock- and non-financial corporate bond market capitalization-to-GDP ratio (Market cap). Our expectation is that due to underdeveloped financial intermediation (Cojocaru et al. 2016, Mérő and Bethlendi 2022), capital market depth and the shadow banking system are in positive correlation with each other.

2. Depth of banking (Bank to GDP). The region has a heavily bank-based character of the CEE financial sector (Allen and Gale 2001, Demirgüç-Kunt and Levine 2004, Mérő 2004, Bethlendi and Mérő 2020). Our expectation is that the indicators for the depth of banking (Bank to GDP) and SB intermediation (SB to GDP) are in a positive correlation with each other (co-development / complementary hypothesis).

3. The share of domestic bank ownership (Domestic). We expected a positive correlation between domestic bank ownership and the size of the SB system. It is more typical for a domestic banking group to have nonbank subsidiaries and to enter into business relationships with domestic nonbank service providers (ones not belonging to the banking group) more actively. In a predominantly foreign-owned banking sector, the proportion of cross-border activities is higher for foreign banks. These are primarily in asset-management-related services, where the parent banks' home market is much deeper and, consequently, has cheaper investment fees.

4. The banking sector's credit-to-deposit ratio (Bank credit to deposit). Due to limited market-based finance in the region, the importance of parent banks' interbank lending to their CEE subsidiaries was decisive (Kurach 2010, Epstein 2014, Király 2020). From pre-GFC to the mid-2010s, several CEE banks relied heavily on the interbank funding of parent banks to allow them to operate with high credit-to-deposit ratios. Foreign interbank lending is a special type of market-based banking that transfers market funds from foreign banks to CEE banks (Bethlendi and Mérő 2024). This meant that the high credit-to-deposit ratio did not reflect to the development of CEE capital markets by raising market funds. We therefore expect a negative relationship between banks' credit-to-deposit ratio and the size of SB.

5. The banking sector's return on equity (ROE). Due to pre-GFC outstandingly high profitability of the CEE's banking sector and a more mixed profitability trend post-GFC (Raiffeisen Research 2013, 2016, 2020), one of the most important motives of securitization has been to increase banking sector profitability according to Pozsar et al. (2010). It follows that there are fewer incentives to expand the SB activities in a highly profitable banking sector. Accordingly, we expect a negative relationship between the ROE and SB.

Other variables:

6. The country risk premium (CountryRisk). Country risk can significantly impact the flow of investment within a country (Muzindutsi and Obalade 2020) and, subsequently, the development of market-based finance. The country risk reflects well the inflation and yield pattern of an emerging country. Higher country risk can set back shadow banking penetration through several channels, including the crowding-out effect of the government securities market, stronger competition of traditional bank deposit products (offering higher yields), and increasing reliance on foreign service providers in the field of savings. Therefore, we expect a negative relationship between country risk and SB.

7. The GDP per capita. The relatively lower level of economic development, which might be more important than the economic growth indicator (Demirgüç-Kunt 2006, Demetriades and Law 2006), is expected to have a positive effect on SB development.

3.3. Methodology

Our methodology consists of two approaches. First, we do a structural analysis that applies descriptive statistical methods. The time horizon of this analysis is 2004-2019, which means that it covers the period from EU accession of most of the countries of the region to the final year prior to the outbreak of the Covid pandemic. Second, we use panel econometric methods to look for determinants of CEE shadow banking development. Banking system indicators in Poland and the Czechia for the beginning of the period under review are lacking, so we run models for a shorter period from 2010 to 2019 to get a balanced panel. In this way, our panel analysis investigates the recovery period after the GFC.

4. Structural characteristics of shadow banking in CEE region

Both the banking and the SB assets of the CEE11 lag far behind those of the three core EU benchmark countries. However, there are significant differences between CEE countries (Figure 1).

Before the GFC, there was a slight convergence between the depth of financial intermediation of the CEE region and the core EU countries. During the 2010s, as a result of the post-GFC deleveraging of the banks' assets, there was a fall in the assets-to-GDP ratio in most European countries, while the SB-to-GDP ratio either stagnated or increased. In the CEE region, this was due to both the depressed lending landscape, and to the fact that banks sold huge amounts of non-performing loans to debt-collecting companies that belonged to SB institutions (Bethlendi and Mérő 2020). Nevertheless, there are significant country-specific differences. The SB-to-GDP increased most

significantly in Czechia, while the most significant decrease took place in Hungary, where traditional banking activities also shrunk.

Not only the size but also the structure of the CEE SB differs significantly from that of the benchmark countries. As a common characteristic, we can mention the weak and decreasing role of MMFs. The marginalization of MMFs is dominantly due to the efforts to make the regulation of MMFs much stricter in 2012 (Endrejat and Thiemann 2020) and re-regulating them in 2017. After the post-GFC re-regulation process, the role of MMFs remained non-negligible in France – though significantly decreased – but this was not the case in any CEE countries. (Figure 2).

We define the non-MMF investment funds segment of SB as non-MMFs minus their equity holding. These are less significant in the CEE region than in developed countries in general, and in the benchmark countries in particular. The capital markets and the asset management industry in CEE were highly
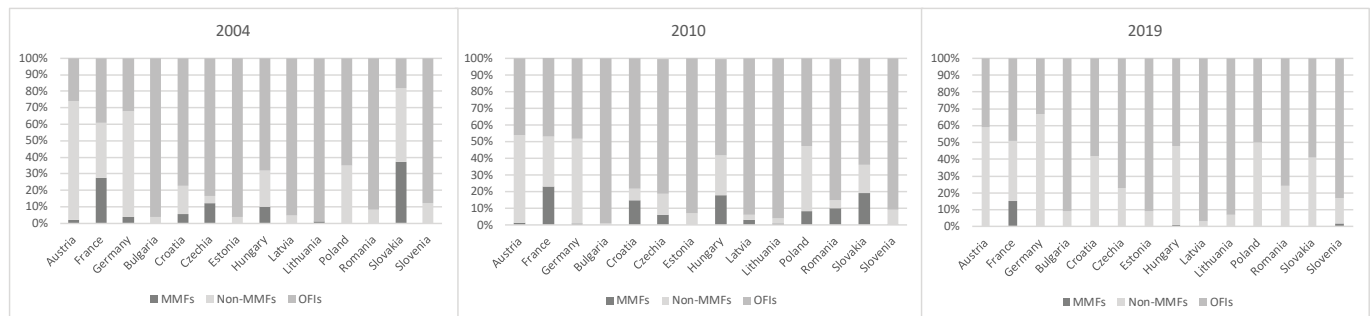
Figure 1. Comparing the size of banks and shadow banks per GDP
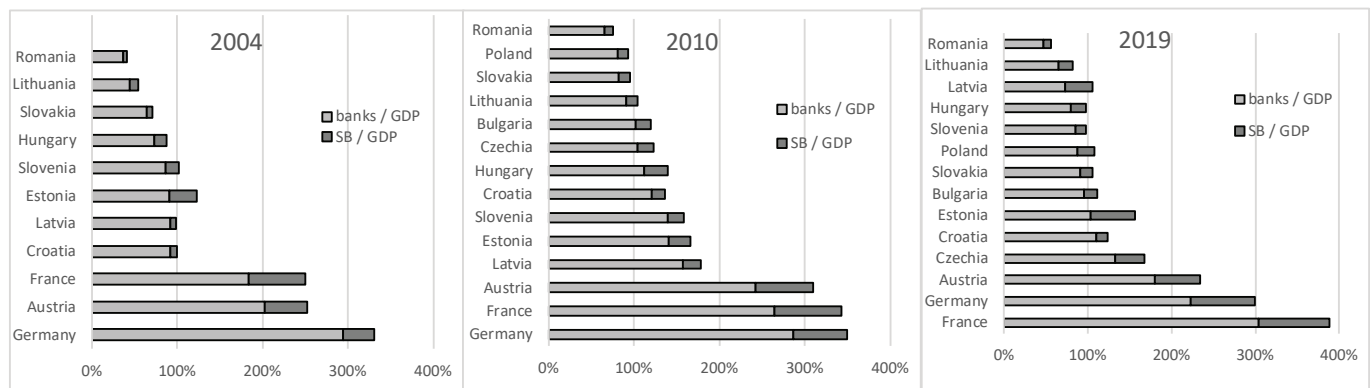
Source of data: Bethlendi and Mérő (2022)

Note: Data from 2004 are not available for some CEE countries.

Figure 2. The structure of SB in CEE and in benchmark countries (total SB=100%)

Source of data: Bethlendi and Mérő (2022)

Note: on a standalone basis, MMF data are not available for Bulgaria, Estonia, Poland, Romania, and Slovenia for 2004; nor for Bulgaria and Estonia for 2010; nor for Estonia for 2019.

underdeveloped both pre-and post-GFC. We see a degree of catching up only after the GFC. The non-MMFs are dominated by bonds and multi-asset funds (EFAMA 2022), while in some countries (especially in Hungary) real estate funds also play an important role. Among the non-MMFs' assets, the proportion of bonds created by securitization is negligible in the region. In other words, the most typical SB assets of developed countries are missing from the investment funds portfolio composition. According to a survey by the World Bank (2019), there was no residential real estate loan securitization in the region at all between 2011 and 2016. The SME loan securitization was also minimal in the region. According to the EIB (2017), there was some SME securitization in Bulgaria, Czechia, and Poland, but not in the other eight CEE countries. The first SME securitization deal was a joint issue of the Czech and Polish Raiffeisen banks in 2006 (David and Sebesta 2007). A special market segment of securitization emerged in Poland, where, instead of selling non-performing assets to debt-collecting companies, banks partly securitized their non-performing assets and sold them to specialized investment funds (Buszko and Krupa 2016).

Since the asset management industry is underdeveloped in the region, OFIs dominate the CEE SB. Specific to this region, OFIs are dominated by finance companies engaged in lending (FCLs), which includes lease-, factoring-, lending-, and debt-collecting companies. OFIs not only represent a more significant segment of SB in the region but are also much more engaged in lending. In the benchmark core-EU countries, the loans provided by FCLs were 5% of the loans provided by the banking sector in 2010 and 7% in 2019, while the relevant proportions for the average of 11 CEE countries was 11% for 2010 and 14% for 2019. In other words, the proportion of FCL loans to banking loans is twice as high in the region as in the benchmark countries (Bethlendi and Mérő 2022).

Out of the CEE11, only eight countries publish specific data on FCLs. Based on this sub-sample, FCLs play a dominant though decreasing role in the total SB sector of the region. (Figure 3).

5. Determinants of CEE shadow banking development[1]

We run panel regressions to analyze to what extent the development of the CEE SB system is determined by the regional specificities of financial structures (banking sector dominance, foreign ownership) and the level of economic development and riskiness of the countries under review.

Figure 3. Share of FCLs in the total assets of the SB sector.
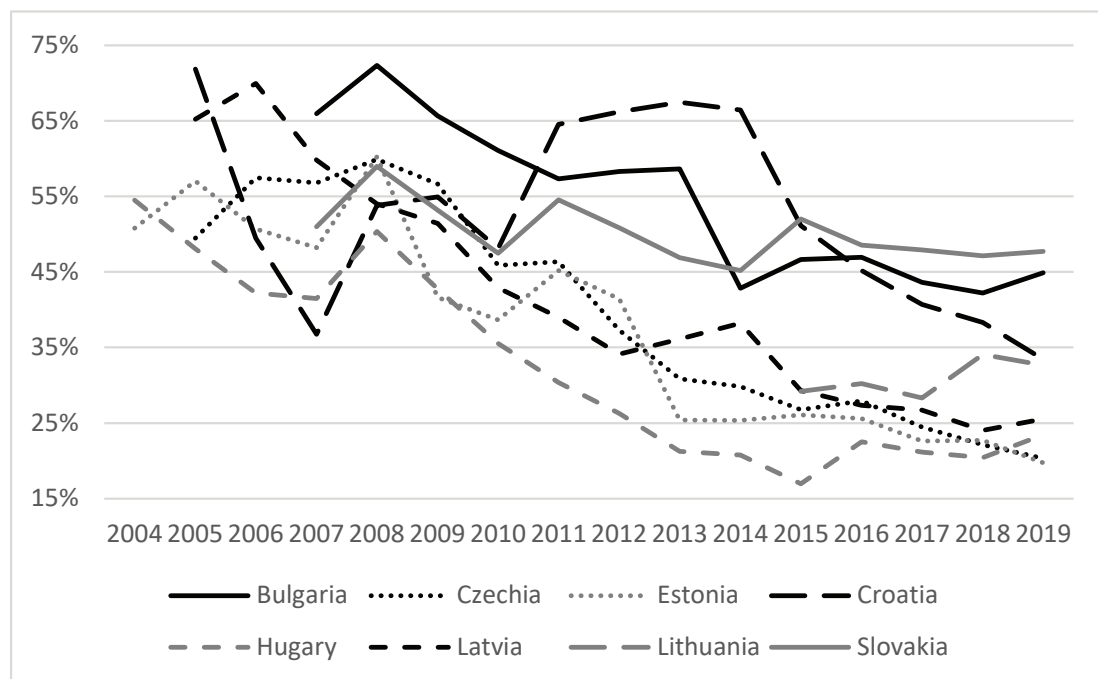
Source of data: Bethlendi and Mérő (2022)

Note: For Lithuania, FCL data are available only from 2015.

5.1. Basic statistics and tests

Throughout this section, we used only the CEE11 data from 2010 to 2019. The following table shows the basic statistics of our dataset.

The next table shows the pairwise correlation coefficients (Pearson) of the variables.

Heterogeneity across countries and times can be shown by a line plot (Figure 4). The blue line connects the mean values of SB to GDP, using all available years across countries (left figure). The same holds for the time dimension. Here, the blue line connects the mean values of SB to GDP, using all available countries across years (right figure).

Table 2. Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
SB to GDP	110	0.19	0.09	0.09	0.14	0.23	0.53
Bank to GDP	110	0.97	0.23	0.47	0.82	1.14	1.57
ROE	110	0.06	0.12	-0.90	0.05	0.11	0.23
Domestic	110	0.26	0.20	0.02	0.09	0.41	0.74
CountryRisk	110	0.02	0.01	0.01	0.01	0.03	0.05
Bank credit to	110	1.02	0.29	0.68	0.82	1.11	2.16
Market cap	110	0.18	0.12	0.03	0.10	0.22	0.47
GDP per capita	110	15.60	4.65	6.81	12.91	18.65	26.10

Source: own calculation

Table 3. Correlation coefficients

	Bank to GDP	ROE	Domestic	CountryRisk	Bank credit to deposit	Market cap	GDP per capita
SB to GDP	0.383***	0.091	0.091	-0.394***	-0.002	-0.056	0.239***
Bank to GDP	1	-0.137	0.08	-0.012	0.412***	0.295***	0.239**
ROE		1	-0.392***	-0.416***	-0.346***	-0.006	-0.036
Domestic			1	0.141	0.13	-0.017	0.206
CountryRisk				1	0.118	0.172	-0.476***
Bank credit to deposit					1	-0.235**	-0.019
Market cap						1	-0.106
GDP per capita							1

Note: Signif. codes: *** 0.001 ** 0.01 * 0.05 . 0.1

Source: own calculation

Figure 4. Visualization of heterogeneity
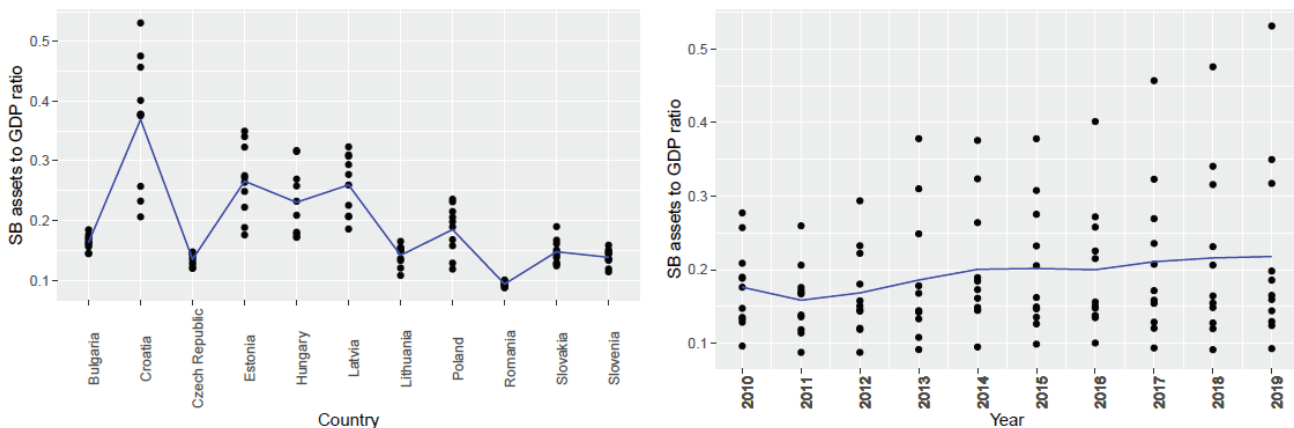
Source: own calculation

To analyze the relationship between SB to GDP and the potential determinants, we first tested whether a cross-sectional dependency existed. Then a panel cointegration test was carried out to see whether there was a long-term relationship among the variables. Finally, to test whether there was a causal relationship among the variables, a panel causality test was performed.

First, we used a diagnostic test for the cross-section dependence in the panels, specifically the Pesaran cross-dependence test (Pesaran, 2007). The null hypothesis of the test indicates the existence of cross-independence, while the alternative hypothesis assumes cross-dependence across the countries observed. Table 4 gives the results of the Pesaran test for cross-sectional dependence.

Table 4. Test for cross-sectional dependence

Variable	Pesaran CD test	p-value
SB to GDP	8.87	0.00
ROE	11.39	0.00
Domestic	-0.58	0.56
Country Risk	9.86	0.00
Bank credit to deposit	13.24	0.00
Market cap	12.46	0.00
GDP per capita	21.56	0.00

Source: own calculation

For all the considered variables (except for Domestic), we can reject the null hypothesis at a 1% level of significance, so the variables generally showed cross-dependence between the countries.

Second, we can also apply Pedroni (1999)'s cointegration test to reveal any underlying relationships between the variables. This test takes into account heterogeneity by using specific parameters that are allowed to vary across individual members of the sample and which consist of four statistics for testing panel data cointegration. Out of these seven statistics, four are based on the 'within' dimension (Table 5), and the remaining three deal with the 'between' dimension (Table 6). All the statistics are for testing the null hypothesis of no cointegration.

Table 6. Test for cointegration; Alternative hypothesis: common AR coefficients (between-dimension)

	Statistics	prob.
Group rho-statistic	4.458	1.000
Group PP-Statistic	-5.589	0.000
Group ADF-Statistic	-2.035	0.021

Source: own calculation

Since four out of seven statistics indicate that the null hypothesis of no cointegration can be rejected at a 1% significance level, we conclude that the variables are cointegrated.

Third, we examined the causal relationship between the shadow banking variable and the individual determinants using the panel Granger causality test performed by Dumitrescu and Hurlin (2012). The results are shown in Table 7.

Table 7. Test for causality

Variable	Granger causality test	p-value
SB to GDP causes Bank to GDP	2.358	*0.018*
Bank to GDP causes SB to GDP	1.503	0.133
SB to GDP causes ROE	7.056	*0.000*
ROE causes SB to GDP	24.024	*< 2.2e-16*
SB to GDP causes Domestic	0.893	0.372
Domestic causes SB to GDP	2.770	*0.006*
SB to GDP causes Country Risk	7.641	*0.000*
Country Risk causes SB to GDP	5.394	*0.000*
SB to GDP causes Bank credit to deposit	11.265	*< 2.2e-16*
Bank credit to deposit causes SB to GDP	4.782	*0.000*
SB to GDP causes Market cap	12.903	*< 2.2e-16*
Market cap causes SB to GDP	0.917	0.359
SB to GDP causes GDP per capita	1.885	*0.059*
GDP per capita causes SB to GDP	-0.619	0.536

Source: own calculation

Table 5. Test for cointegration; Alternative hypothesis: common AR coefficients (within-dimension)

	Statistics	prob.	weighted stat.	prob.
Panel v-statistic	-2.531	0.994	-3.179	0.999
Panel rho-statistic	2.881	0.998	2.722	0.997
Panel PP-Statistic	-0.894	0.186	-3.847	0.000
Panel ADF-Statistic	-0.764	0.223	-2.515	0.006

Source: own calculation

According to the results, a bidirectional causal relationship was found between shadow banking assets and ROE, Country risk, and Bank credit to deposit. In all other cases there is a unidirectional causal relationship. There is a causal effect of SB to GDP on Bank to GDP, Market capitalization, and GDP per capita. There is an opposite effect of Domestic ownership on shadow banking.

5.2. Estimation methods

As a first step, we estimated the data-generating process by a simple pooled OLS model using the individual determinants as explanatory variables. The results show that there is a causal relationship between shadow banking assets and some explanatory variables (Bank to GDP, Country risk, Bank credit to deposit, and MarketCap). A better choice would be to use the so-called least squares dummy variable (LSDV) approach or fixed effects (FE) model (also called within estimator), which allows the inclusion of dummy variables in the model for all countries. The F test for individual effects can test for fixed effects with the null hypothesis that pooled OLS is better than the fixed effects model. The test result (F = 4.338 with p = 0.03996) shows that the fixed effects model provides a better fit than OLS. Alternatively, this test can be carried out by jointly assessing the significance of the dummy variables in the LSDV approach. The results are identical.

The FE model can be applied with a time-fixed effect. The resulting model is not significant (almost all the coefficients are nonsignificant). There is also a possibility of testing whether time fixed effects are needed. The null hypothesis is that the coefficients are together zero for all years, and hence, no time-fixed effects need to be taken into account. The test results (F = 0.83229, df1 = 12, df2 = 84, p-value = 0.6172) show that there is no evidence that time-fixed effects should be taken into account.

We also examined that any variation between entities is random and not correlated with the regressors used in the estimation model. If there are reasons to believe that differences among countries influence the dependent variable, a random effect (RE) model should be preferred. A decision between a fixed and random effects model can be made with the Hausman test, which checks whether the individual error terms are correlated with the regressors. The null hypothesis states that there is no such correlation (RE). The alternative hypothesis is that a correlation exists (FE). The results ($\chi2$ = 126.58, df = 3, p-value < 2.2e – 16) show that a correlation exists, so the fixed effect model would be preferred.

We incorporated the past values of our dependent variable to capture the persistence of the time series. In economic terms, it means that a larger shadow-banking sector in the previous period is likely to affect its present size. The results of the FE model are presented in Table 8. Besides the lagged dependent variable, four explanatory variables remained significant (narrow model).

The GDP per capita and Bank to GDP variables were significant only at 10%. In their case, the Granger causality test showed the opposite direction than expected; namely, there was no causal relationship between these variables and the SB to GDP. Thus, we omitted these two variables from the final model. Table 9 presents the results of the final model. According to this model, Domestic and Bank credit to deposit variables are the most important determinants of shadow banking development in the CEE region.

The goodness-of-fit statistics tell us how well a particular model fits the data. The most common diagnostic tool is the residuals. Figure 6 shows some useful plots of the residuals. The first plot presents the normality assumption of the residuals using a QQ-plot. The second plot depicts residuals versus fitted values plotted by observation number. The third graph is the so-called scaled-location (or spread-location) graph used to check the homogeneity of variance of the residuals (homoscedasticity). Since there is no pattern in the residuals, we can conclude that the residuals are homoscedastic.

Table 8. The full and narrow model

	Full model				Narrow model			
	Estimate	Std. Error	t-value	p-value	Estimate	Std. Error	t-value	p-value
lag(SB to GDP, 1)	0.354	0.057	6.175	1.876e-08***	0.368	0.056	6.531	3.425e-09***
Bank to GDP	0.104	0.050	2.059	0.042*	0.091	0.049	1.880	0.063 .
ROE	-0.039	0.037	-1.052	0.296				
Domestic	0.104	0.054	1.951	0.054 .	0.113	0.053	2.140	0.035 ∗
Country Risk	0.267	0.840	0.318	0.751				
Bank credit to deposit	-0.081	0.028	-2.924	0.004∗	-0.067	0.025	-2.641	0.0097 ∗∗
Market cap	-0.109	0.114	-0.950	0.345				
GDP per capita	0.005	0.003	1.703	0.092 .	0.004	0.002	1.799	0.075 .

Note: Signif. codes: ∗∗∗ 0.001 ∗∗ 0.01 ∗ 0.05 . 0.1

Source: own calculation

Table 9. The full and final model

	Full model				Final model			
	Estimate	Std. Error	t-value	p-value	Estimate	Std. Error	t-value	p-value
lag(SBassetsGDP, 1)	0.354	0.057	6.175	1.876e-08***	0.392	0.056	6.948	4.62e-10***
Bank to GDP	0.104	0.050	2.059	0.042*				
ROE	-0.039	0.037	-1.052	0.296				
Domestic	0.104	0.054	1.951	0.054 .	0.167	0.049	3.444	0.0009 ***
Country Risk	0.267	0.840	0.318	0.751				
Bank credit to deposit	-0.081	0.028	-2.924	0.004*	-0.043	0.014	-2.986	0.0036 ***
Market cap	-0.109	0.114	-0.950	0.345				
GDP per capita	0.005	0.003	1.703	0.092 .				

Note: Signif. codes: ∗∗∗ 0.001 ∗∗ 0.01 ∗ 0.05 . 0.1

Source: own calculation

Table 10. Additional statistics to the estimated models (full and final)

	Full model	Final model
Total Sum of Squares:	0.214	0.214
Residual Sum of Squares:	0.096	0.105
R-Squared:	0.553	0.512
Adj. R-Squared:	0.463	0.445
F-statistics:	F (8, 90) = 13.8921 (p-value: 5.9153e-13)	F (3, 95) = 33.1588 (p-value: 9.4089e-15)

Source: own calculation

Figure 5. Model fitting by country
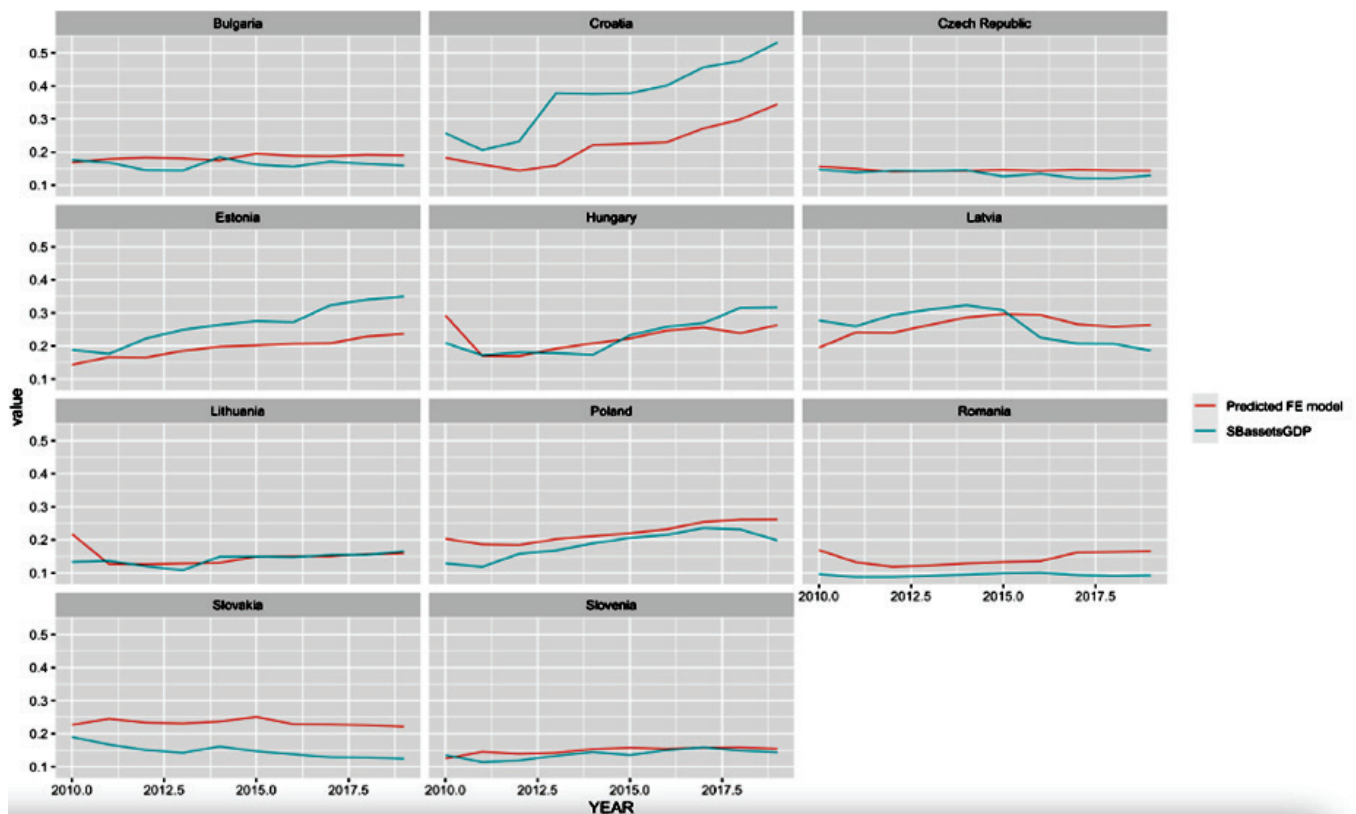
Source: own calculation

Figure 6. The goodness-of-fit
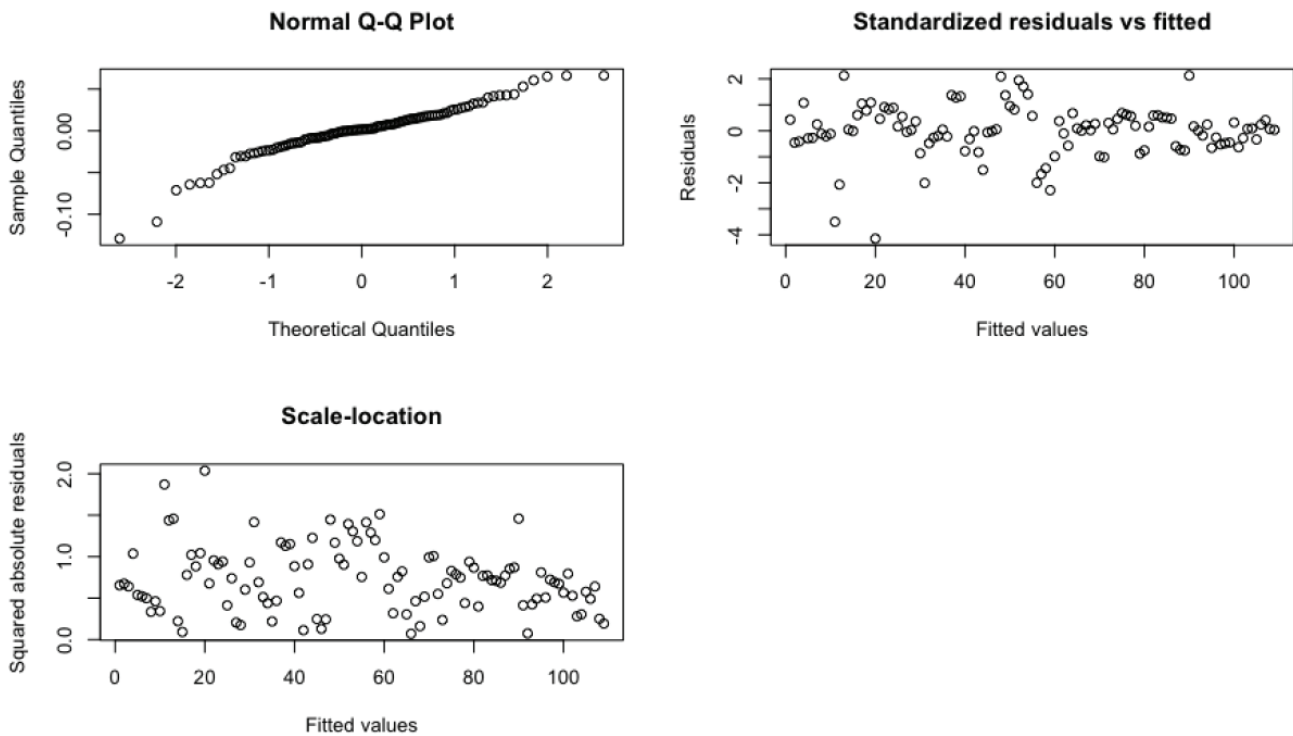
The normality of the residuals can be tested by the Shapiro-Wilk normality test. The results (W = 0.93107, p-value = 2.711e-05) show that the series of the residuals are consistent with the assumption of normality. We also tested the presence of autocorrelation in the residuals. According to the Durbin-Watson test (DW=1.75303 with p-value=0.180581), there is no serial correlation in idiosyncratic errors. The Woolridge test shows the same conclusion.

5.3. Results and discussion

Table 9 contains the results of the final model. In the following, we compare our expectations on the indicators with our results.

1. Contrary to our expectations, capital market depth did not play a significant role in SB intermediation after the GFC period.
2. We detect that the banking and SB systems developed in tandem, supporting the complementary hypothesis (Petkovski et al., 2023). Contrary to the results of Hodula (2022), who found that SB is more of a substitute for traditional banking in new member states.
3. In line with our expectations, we find that domestic ownership in banking has a positive effect on SB development. Thus, it is more general for a domestic banking group to have nonbank subsidiaries and to enter into business relationships with domestic nonbank service providers. At the same time, foreign-owned banks rely more on the service of home banking groups or other foreign service providers.
4. Also, in line with our expectations, we find a negative relationship between banks' credit-to-deposit ratio and the size of SB. This means that the high credit-to-deposit ratio did not contribute to the development of market-based finance in the CEE region. We suspect that the foreign interbank funds of parent banks allowed them to operate with high credit-to-deposit ratios. This and the previous results could be considered our main contributions to the literature and general understanding of the CEE financial / SB system.
5. Contrary to our expectations, the superior profitability of the CEE banking sector compared with that of developed countries does not explain the underdevelopment of CEE SB.
6. Also, contrary to our expectations, the country risk premium does not explain the differences in CEE SB developments.

7. The level of economic development has a positive effect on SB development according to the narrow model in keeping with our expectations and the literature (Apostoaie and Bilan, 2020; Hodula, 2022; Kjosevski et al., 2021).

6. Conclusions

In this paper, we have analyzed the specificities and drivers of the shadow banking evolution in eleven CEE countries. Based on the literature and our structural analysis, we used several explanatory variables in our panel regression, which reflects the special structural characteristics of CEE. In this respect, we get two main findings. Firstly, we detect a positive relationship between the rate of domestic ownership in the banking sector and the size of the SB system, which might be explained by the fact that domestic banks complement their activities to a lesser extent with cross-border (SB) activities, but instead have domestic service providers to do them. However, CEE countries' small domestic capital markets are not sufficiently size- and scope-efficient, which means that cross-border services are typically provided as part of the asset management activity of large international banks. Secondly, we discover a negative relationship between banks' credit-to-deposit ratio and the size of SB. Foreign-owned banks disbursed funds raised in their home markets in the form of interbank financing and not through local SB structure. This meant that the higher credit-to-deposit ratio did not develop the CEE capital markets by raising local market funds, which contributed to the underdevelopment of the SB and local capital markets.

The phenomenon of higher domestic bank ownership with wider SB activities also draws attention to the fact that, while the risks associated with the dependent nature of financialization are mitigated, at the same time, new risks might arise with the development of a larger-scale SB system.

We found that the banking and SB systems essentially developed in tandem, supporting the complementary hypothesis (Petkovski et al. 2023). According to the same model, the real GDP per capita, that is, the level of economic development – in keeping with our expectations and the literature – displayed a positive relation to the SB system.

Capital market capitalization, the banking sector's earnings (ROE), and country risk factor did not play a significant role in SB intermediation after the GFC period.

As regards the policy implications of the article, we stress that significant structural differences in the financial system of the CEE11 and the core EU member states, as well as the underdeveloped SB system might also constrain the region's participation in the advantages of Capital Markets Union (CMU). The growth of European SB is encouraged by the Action Plan for Building a CMU (EU Commission 2015, 2020), as almost all the tools of the Action Plan promote the growth of market-based finance and belong to the toolkit of SB (Pires 2019). However, due to their less developed financial system, CEE countries are less able to utilize these opportunities (Piroska and Mérő 2021, Piroska and Epstein 2022). This means that the underdeveloped CEE region also results in missed opportunities.

Endnotes

1 All of the calculations and graphs are made with RStudio 2022.

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Annex 1. Financial structure and macroeconomic data

Variable	Definition	Source
GDP	Gross domestic product	Eurostat
Shadow banking asset to GDP ratio	SB to GDP	numerator: see Bethlendi and Mérő (2022) denominator: Eurostat
Total banking asset to GDP ratio	Banking to GDP	numerator: see Bethlendi and Mérő (2022) denominator: Eurostat
Stock and bond market capitalisation to GDP	Stock and bond market capitalisation to GDP ratio = stock + bond market capitalisation	
	Stock market capitalisation	WB Financial Development and Structure Dataset: https://www.worldbank.org/en/publication/gfdr/data/financial-structure-database Own calculation based on Reuters
	Bond capitalisation	BIS Debt securities statistics: https://www.bis.org/statistics/sec-stats.htm For Czechia 2017: CNB
Share of domestic banks in the total banking assets	Ratio of domestic bank assets to total bank assets	WB Global Financial Development Database: 2004-2007/2010. https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database ECB: 2007/2010-2018
Bank credit to deposits	Private credit by deposit money banks as a share of demand, time and saving deposits in deposit money banks.	WB Financial Development and Structure Dataset: https://www.worldbank.org/en/publication/gfdr/data/financial-structure-database
Country risk	Calculated from the default spreads based on Moody's ratings	Damodaran: http://pages.stern.nyu.edu/~adamodar/
GDP per capita	GDP per capita (current US$)	WB Global Financial Development Database: https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database