

Does Public Debt Crowd Out Public Investment in Central and Eastern European economies? A Dynamic Approach Using CS-ARDL

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Abstract

This study estimates the impact of public debt on public investment in Central and Eastern European (CEE) economies. We implement Cross-sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) model, which effectively handles cross-sectional dependence and slope heterogeneity, while dealing with short- and long-run coefficients simultaneously. The results indicate the existence of both short- and long-term crowding out effects of public debt on public investment in the CEE region. These findings have significant fiscal policy repercussions, particularly in context marked by constrained financial resources and substantial debt loads, as has been the case in a number of CEE economies.

Keywords: public debt, public investment, CEE countries, CS-ARDL

JEL classification: C33, E22, E60, O52

Introduction

Concerns about debt sustainability and its potential to hinder long-term growth have received a great deal of attention over the last decades. One of the main transmission channels through which public debt could affect economic growth is public investment. However, the impact could

be twofold. On the one hand, high and increasing public debt raises risk of government default. Thus, in order to restore fiscal sustainability, governments often choose to reduce public investment as they are politically easier to cut compared to other types of government spending (de Haan et al., 1996). On the other hand, in the times of crisis and sluggish economic growth, increased public debt which is used to finance productive expenditures could potentially stimulate economic activity, acting as a significant infusion of financial resources (de Mendonca and Brito, 2021).

While many empirical studies have examined the debt-growth relationship (Fincke and Greiner, 2015; Guerini et al., 2020; Konatar et al., 2022; Woo and Kumar, 2015; Checherita-Westphal and Rother, 2012; Cecchetti et al., 2011; Reinhart and Rogoff, 2010), few of them have specifically investigated debt-investment nexus. One strand of literature, which is exploring main drivers of public investment, points to public debt as an important determinant of public investment dynamics in developed countries (Valila and Mehrotra, 2005; Heinemann, 2006; Turrini, 2004). Several studies show that the benefits of accumulating public debt are limited, particularly in highly indebted and poor developing economies (Calderon et al., 2003; Mahdavi, 2004; Patillo et al., 2004) where debt issues can undermine its effectiveness, indicating that a deteriorating fiscal situation diminishes the government's capacity for investment. The debt overhang effect is also relevant for developed countries, where public investment tends to decline with increase of public indebtedness (Bacchiocchi et al., 2011; Salotti and Trecroci, 2016; Picarelli et al., 2019; Kostarakos, 2021). However, even though debt-investment relationship is particularly important for developing countries of EU, which have been struggling with increased debt, especially after 2008, there is a notable gap in research focusing specifically on the impact of public debt on public investment in Central and Eastern European (CEE) economies.

Since the early 1990s, the economies of Central and Eastern Europe have undergone significant transformations, moving from centrally planned to market-oriented systems (Mourelle and Cuestas, 2023). This transition has required significant public investment in infrastructure and social services, which was frequently financed through increased public borrowing. However, in the aftermath of the Global Financial Crisis (GFC) and subsequent sovereign debt crises, many countries in CEE region have experienced rising public debt levels, raising concerns about possible crowding-out effect on public investment.

While the original EU member states managed to maintain higher levels of public investment, in contrast, public investment levels in CEE countries decreased, resulting in a widening infrastructure disparity between these regions. This suggests that CEE governments, like their EU counterparts, could not use public investment as a countercyclical measure. This trend was expected, given that many countries in the region were forced to implement strict fiscal consolidation measures in response to the financial crisis (European Investment Bank, 2018). Thus, policymakers have recognised the decade-long decline in public investment and the critical

need to close the investment gap in order to ensure long-term economic growth (Juncker, 2015). Despite these concerns, empirical research into the causal impact of high public debt on public investment in CEE countries remains scarce. Their specific economic structures, transition dynamics, and fiscal policies of CEE countries call for a special approach that should distinctly differ from studies focusing on developed OECD countries or large sets of developing nations.

The main aim of this study was to examine the potential crowding out effect of public debt on public investment in CEE countries. In order to estimate the relationship between public investment and public debt, we applied an advanced Autoregressive Distributed Lag (ARDL) type estimator, namely Cross-sectional Augmented Autoregressive Distributed Lag (CS-ARDL) model developed by Chudik and Pesaran (2015). This is second-generation panel data technique which takes into account common issues of cross-sectional dependence and slope heterogeneity common for panel data. Compared to first-generation panel techniques which were used in previous studies and which do not deal with the issues of cross-sectional dependence, thus leading to biased estimates (Ditzen, 2018), the CS-ARDL approach produces superior and more reliable empirical results for guiding future policy decisions.

This research offers two unique contributions. First, to our best knowledge, no similar study has been conducted using this specific sample of CEE countries. Second, the research is conducted in a dynamic panel framework, which takes into account non-stationarity, country heterogeneity and cross-sectional dependence to analyse short- and long-term effects of public debt on public investment. Therefore, the aim of this paper is to provide insights into the relationship between public investment and public debt in CEE countries using a comprehensive dataset spanning from 2000 to 2022 and employing advanced econometric techniques to distinguish between short-run and long-run effects. The purpose of this is to gain a better understanding of the financial changes in post-communist Central and Eastern Europe, which is a region that faces both the challenges of emerging markets and the characteristics of transitioning economies.

The study is organised in the following manner: after the introductory section, there is a comprehensive examination of the most pertinent research on the influence of public debt on public investment. The following section provides an overview of the data and the methodological framework. In the next section, we provide the empirical results and their discussion. The study concludes with a final section that summarises the main findings.

1. Literature review

The relationship between public debt and economic activity has been attracting attention for decades. Modern economic theory does not provide a clear understanding of the economic impact of public debt, and views on the subject have evolved over time. On the one hand,

there are studies that support the Keynesian viewpoint, rejecting the concept of a balanced government budget and viewing high public debt as an asset rather than a liability (Fincke and Greiner, 2015; Guerini et al., 2020). It is based on the idea that during economic downturns, increased public debt, if channelled into public investment, can promote long-term economic growth. In contrast, some studies show evidence that high public debt hinders economic growth (Konatar et al., 2022; Woo and Kumar, 2015; Checherita-Westphal and Rother, 2012; Cecchetti et al., 2011; Reinhart and Rogoff, 2010). High public spending financed through borrowing has been argued to harm economic growth by preventing savings from being invested productively. Thus, private investment is crowded out, limiting capital and wealth accumulation.

Ever since Keynes (1936) focused attention on the existence of an independent investment function in the economic system, many researchers have tried to investigate the nexus between economic growth, debt and investment. Keynesian economic theory posits that during periods of economic slowdown, increased public debt, if channelled into public investment, can have a counter-cyclical effect, stimulating economic recovery (Keynes, 1936). This theory has been particularly relevant in the context of post-2008 economic recovery strategies across various economies, where public debt was leveraged to fund significant infrastructural and developmental projects to spur economic growth (Blanchard and Leigh, 2013). Still, while the empirical literature on the debt-growth nexus has been growing over time, studies analysing public debt and public investment nexus are relatively limited. The seminal work by Elmendorf and Mankiw (1999) suggests that high public debt levels can crowd out public investment due to increased borrowing costs and budget constraints; this theory has been foundational in understanding fiscal behaviour in developed economies. This perspective is supported by subsequent research, which argues that governments facing high debt burden tend to reduce public sector spending to stabilize debt levels, particularly in long-term scenarios (Afonso and Jalles, 2013; Andrade and Duarte, 2016).

Several studies indicate that the benefits of accumulating public debt have limits, especially in highly indebted and poor developing economies, where debt challenges can hinder its effectiveness. Thus, Calderon et al. (2003) contend that the 1980s' debt crisis led to a significant decline in infrastructure investment in Latin America and the Caribbean. Pattillo et al. (2004) analysed 61 developing countries from 1969 to 1998 using a growth-accounting framework and finding that doubling the average external debt reduces growth in per capita physical capital and total factor productivity by nearly one percentage point. This suggests that large debt stocks hinder growth by curbing both capital accumulation and productivity. Mahdavi (2004) supports this adverse impact, showing that debt burden negatively affects capital expenditure in 47 developing countries between 1972 and 2001. Additionally, Deshpande (1997) found a significant

negative effect of debt on investment in 13 severely indebted countries from 1971 to 1991, with investment positively influenced by time until 1984, after which the impact turned negative. In a recent paper by De Mendonca and Brito (2021), panel data analysis was conducted for 24 emerging markets using GMM. Results show that public indebtedness has a more profound impact on public sector investment compared to other factors, indicating that a deteriorating fiscal situation diminishes the government's capacity for investment.

Relationship between public debt and public investment is relevant not only for developing but also for developed countries. Heinemann (2006) finds evidence of public debt being one of key drivers of declining public investment in 20 OECD countries, showing that mobilising government revenues for new investment projects becomes more challenging as debt service increases. Bacchiocchi et al. (2011) confirm previous results and show that public and private investment expenditures in OECD countries are adversely affected by high debt levels. Consistent with previous research, Salotti and Trecroci (2016) focus on a panel of 20 OECD countries using GMM estimations and conclude that high public debt adversely affects both aggregate investment spending and productivity growth through distortions related to the size of the public sector. Additionally, a few studies on the determinants of public investment focused on the impact of debt on public investment, clearly showing that capital expenditures are sensitive to fiscal adjustments, since this category of government spending is politically easier to cut than other spending categories (de Haan et al., 1996). Thus, Valila and Mehrotra (2005), using panel cointegration method in old EU member states for a period from 1970 to 2000, show that public investment tends to decline with an increase in public debt. Results of this research confirm findings of Turrini (2004), who tested almost the same group of old EU countries using fixed effects panel regression.

The implications of high government debt levels have been attracting a lot of attention in policy debates, especially following sovereign debt crisis in Europe. According to Checherita-Westphal and Rother (2012), public investment is one of the primary ways debt can harm economic growth. Picarelli et al. (2019) test the “debt overhang” hypothesis for a panel of 26 EU countries using an instrumental variable approach based on GMM estimation and show that 1% increase in public debt in the EU brings a reduction in public investment of 0.03%. In a panel of 28 EU countries based on common factor framework, Kostarakos (2021) confirms that public debt has, on average, an adverse effect that is more pronounced in the public investment than private investment case.

To sum up, the majority of the mentioned studies have focused on developed countries, with those investigating developing economies not specifically focusing on Central and Eastern European (CEE) countries. Furthermore, the dynamics of short-run versus long-run impacts

have not been explored in recent econometric studies, leaving a gap in the understanding of the distinct impacts across different time horizons. Testing the impact of public debt on public investment in CEE countries is critical because these economies have distinct economic structures, transition dynamics, and fiscal policies. Understanding these specific impacts can help to improve fiscal management and economic policy in CEE countries. This study intends to fill these gaps in the literature by specifically analysing the CEE countries and distinguishing between the short-term and long-term.

2. Data description

This study used balanced panel data with 242 observations, covering the period between 2000 and 2022 for 11 CEE countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia). The data was collected from three sources, namely the Eurostat, the AMECO database of the European Commission's Directorate General for Economic and Financial Affairs, and World Development Indicators (WDI) of the World Bank.

For public investment, as the dependent variable in the model, we used the most popular proxy that is the general government gross fixed capital formation (GFCF) expressed as percentage of GDP. The main variable of interest is public debt, proxied by general government consolidated gross debt as percentage of GDP. Data for both variables were extracted from Eurostat.

Regarding control variables, we draw from the relevant literature the usual drivers of public investment, for which the observations for all countries were available for the analysed period. Thus, we included government expenditure (govexp), private investment (privinv) and economic growth (growth). Data for government expenditure and private investment were from AMECO database, while data for economic growth were extracted from WDI. Government expenditure, proxied by general government final consumption expenditure as percentage of GDP, provides a comprehensive measure of government fiscal activity. Specifically, changes in government spending, due to increase of public debt and economic downturns, usually cause a reduction in public investment as it is more politically acceptable to reduce government investment compared to other forms of expenditure like those on social welfare. Additionally, in order to check if significant private sector investment produces crowding-in or crowding-out effect for public investment, we used private investment measured as gross fixed capital formation of private sector as percentage of GDP. This analysis aims to determine the relationship between private and public investment, specifically whether they function as substitutes or complements. Finally, due to the fact that public investment might be affected by broader economic conditions, we use real GDP growth as a measure of aggregate output

change. Its inclusion is based on the premise that higher economic growth enhances domestic tax revenues, crucial for funding public investment. To further clarify the role of each variable in the analysis, Table 1 provides an overview of their definitions, data sources, and expected effects on public investment. This summary helps to structure the theoretical expectations and aligns with findings from prior empirical research.

Table 1: Description, data sources and expected effects of the variables

Variable	Definition	Source	Expected Effect
<i>Pubinv</i>	Public investment, measured as general government gross fixed capital formation (% GDP)	Eurostat	Dependent variable
<i>Debt</i>	Public debt, measured as general government consolidated gross debt (% GDP)	Eurostat	(–)
<i>Exp</i>	Government expenditure, measured as general government final consumption expenditure (% GDP)	AMECO	(–)
<i>Growth</i>	Real GDP growth rate (%)	World Bank WDI	(+)
<i>Privinv</i>	Private investment, measured as gross fixed capital formation of private sector (% GDP)	AMECO	(+/-)

Source: authors' processing

Table 2 summarizes the collected data and describes the features of the data used in the study. The mean, median, maximum, minimum, standard deviation (SD), skewness and kurtosis estimations were calculated in the descriptive analysis.

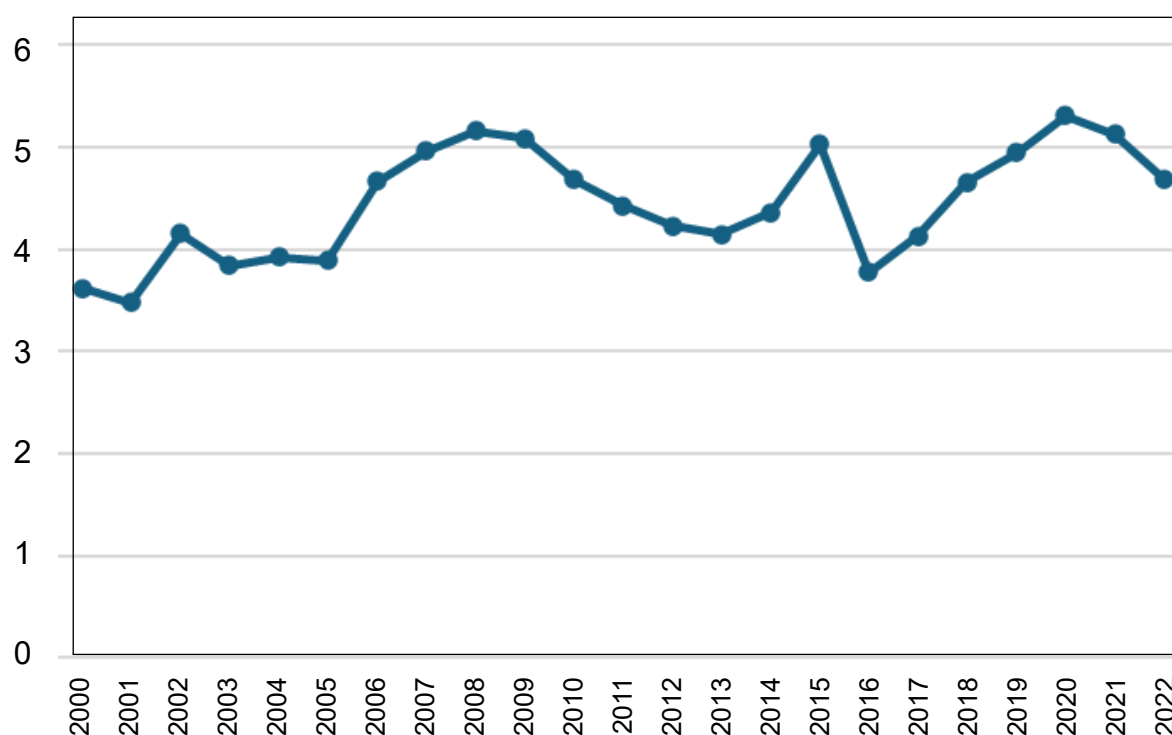
Table 2: Descriptive statistics

Variable	Mean	Median	SD	Min	Max	Skewness	Kurtosis
<i>Pubinv</i>	1.425	1.435	0.259	0.405	2.041	–0.580	3.832
<i>Debt</i>	3.491	3.640	0.681	1.335	4.464	–1.035	3.729
<i>Exp</i>	3.729	3.735	0.125	3.503	4.099	0.004	2.145
<i>Growth</i>	3.248	3.584	4.066	–14.839	13.784	–1.304	6.857
<i>Privinv</i>	2.936	2.933	0.193	2.473	3.447	0.252	2.560

Source: authors' calculations

The descriptive statistics showed that the mean and median values are within acceptable ranges, pointing to high accuracy of data. The data suggest that there is a moderate degree of variability in public investment and a slight tendency towards lower values. They also indicate that debt levels are considerably more variable and skewed towards lower values, implying that specific economies possess considerably lower levels of debt in comparison to others. The distribution of government expenditure is nearly symmetrical, indicating consistent spending patterns throughout the dataset. Economic growth exhibits considerable variability, with extreme values that suggest notable fluctuations. Private investment exhibits a relatively stable trend, with a slight bias towards higher values, indicating a consistent pattern of investment. Features of this dataset highlight the diverse economic conditions and underscore the importance of tailored financial strategies to effectively manage public debt and public investment in the analysed economies.

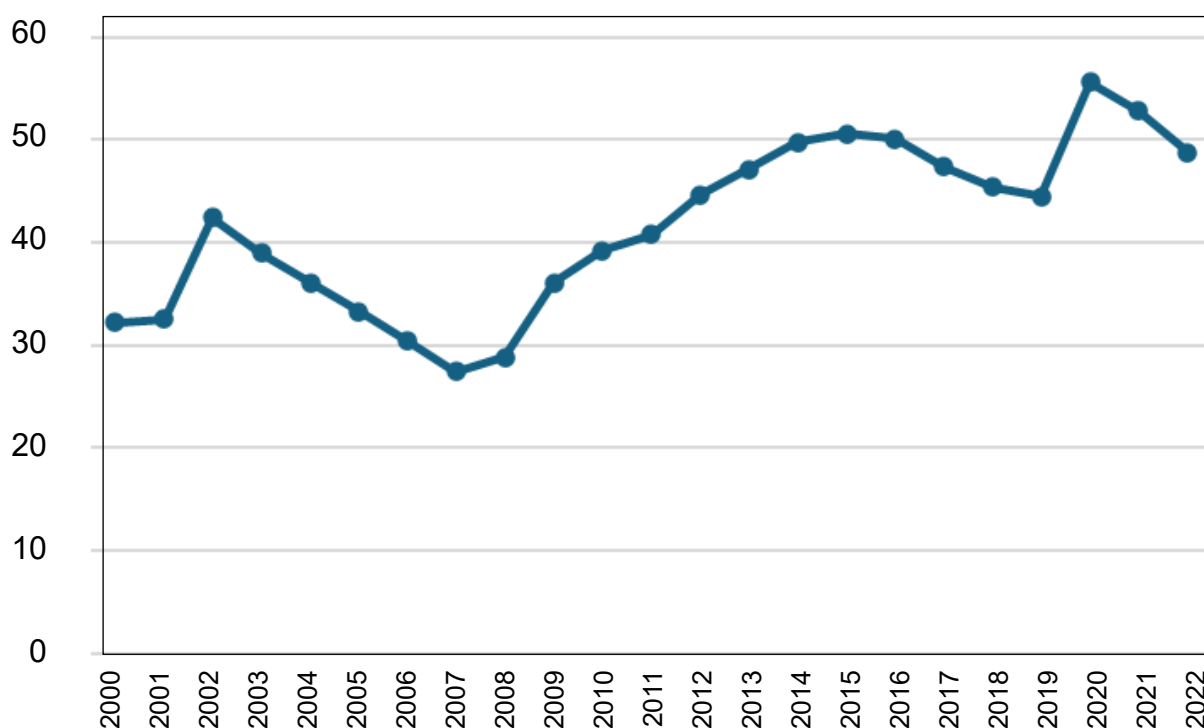
Figure 1: Public investment in CEE countries (% of GDP)



Source: authors' calculations

To provide a more comprehensive perspective, Figure 1 and Figure 2 illustrate the evolution of public investment and public debt in CEE countries over the period 2000–2022. The data indicate that public investment has fluctuated over time, with noticeable declines following major economic disruptions (Figure 1). A sharp contraction is evident after the Global Financial Crisis in 2008, followed by a gradual recovery and another drop around 2016, most likely reflecting fiscal consolidation measures. Despite the economic shock of the COVID-19 pandemic in 2020, public investment did not experience a severe decline, suggesting that countercyclical fiscal interventions may have mitigated its contraction. However, a slight decrease is observed in the final years of the sample.

Figure 2: Public debt in CEE countries (% of GDP)



Source: authors' calculations

In contrast, public debt follows a persistent upward trajectory, with significant surges in response to economic crises, most notably after 2009 and 2020 (Figure 2). While a modest decline is observed post-pandemic, debt levels remain high. The convergence of these trends over time suggests periods where rising debt coincides with declining investment, potentially indicating a crowding-out effect.

3. Methodology

In order to investigate the debt overhang hypothesis in CEE countries, this study used Cross-sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) model developed by Chudik and Pesaran (2015). It is an advanced Autoregressive Distributed Lag (ARDL) type estimator which effectively handles cross-sectional dependence, mixed integration orders of variables and endogeneity concerns, while producing short- and long-run coefficients simultaneously. This approach, therefore, extends the standard ARDL model by including cross-sectional averages of the dependent and independent variables that represent a proxy for the unobserved common factors. It is important to note that the CS-ARDL method does not incorporate fixed or random effects. Instead, it relies on cross-sectionally augmented components, which effectively address issues of cross-sectional dependence and slope heterogeneity in panel data. The model effectively tackles the issues related to weak exogeneity that arise if lagged dependent variables are included in the model. Lagged cross-sectional averages have been found to be particularly helpful in reducing endogeneity concerns in the model.

The CS-ARDL estimation is based on the following equation:

$$y_{i,t} = \sum_{l=1}^{k_y} \varphi_{i,l} y_{i,t-l} + \sum_{l=0}^{k_x} \beta'_{i,l} x_{i,t-l} + \sum_{l=0}^{k_z} \delta'_{i,l} \bar{z}_{t-l} + \alpha_i + \omega_i \tau + \varepsilon_{i,t}, \quad (1)$$

where $i = 1, 2, \dots, 11$ stands for the country; $t = 1, 2, \dots, 22$ for the time period; y for the public investment (*pubinv*) and x for the vector of explanatory variables including main variable of interest, which is public debt (*debt*); as well as control variables including economic growth (*growth*), government expenditures (*govexp*) and private investment (*privinv*). Similar to other studies (Kostarakos, 2021; de Mendonca and Brito, 2021), all variables except for economic growth are transformed into their logarithmic form.

In Equation 1, the vector $\bar{z} = (\bar{y}_t, \bar{x}_t)' = N^{-1} \sum_{i=1}^N y_{it}, N^{-1} \sum_{i=1}^N x_{it})'$ (proxies the common correlated factors, while the set of parameters δ refers to country-specific factor loadings, α_i to the country-specific intercept, τ to the linear time trend and $\varepsilon_{i,t}$ denotes the idiosyncratic error term. Additionally, the set of parameters φ, ω, β and δ are heterogenous coefficients randomly distributed around a common mean with unit-specific noise.

Following Ditzen (2021), Equation 1 can be reparametrized as an error-correction (EC) form:

$$\Delta y_{i,t} = \xi_i \left[y_{i,t-1} - \theta'_i x_{i,t-1} \right] + \sum_{l=1}^{k_y-1} \varphi_{i,l} \Delta y_{i,t-l} + \sum_{l=0}^{k_x-1} \beta'_{i,l} \Delta x_{i,t-l} + \sum_{l=0}^{k_z} \delta'_{i,l} \bar{z}_{t-l} + \omega_i \tau + \mu_{i,t}$$

The parameters φ and set of parameters β represent the short-run effects, while the long-run coefficients are provided as follows: $\hat{\theta}_i = \frac{\sum_{l=0}^{k_x} \hat{\beta}_{i,l}}{1 - \sum_{l=1}^{k_y} \hat{\phi}_{i,l}}$. The error-correction term, which is denoted by ξ_i , indicates an adjustment of short-term disequilibrium towards long-run equilibrium after an economic shock. In case of the existence of a long-term relationship, the value of parameter was significantly negative and can be regarded as evidence of cointegration between public investment and public debt (and other control variables).

The estimation procedure followed in this study consisted of five stages. Initially, we conducted a cross-sectional dependence test (CD) proposed by Pesaran (2015). Upon confirming the presence of cross-section dependence, in the following stage we used second-generation panel unit root test, namely cross-sectionally augmented Im-Pesaran-Shin (CIPS) panel unit root test (Pesaran, 2007). In the third stage, we checked the cointegrated relationship among variables using the Westerlund (2007) cointegration test. In the fourth stage, we provided the empirical findings through CS-ARDL model for the long- and short-run.

4. Empirical results and discussion

In the presence of cross-sectional dependence in panel variables, traditional panel cointegration methods and first-generation unit-root tests could provide misleading results. Thus, in the initial stage, we investigate the presence of cross-sectional dependence (CD) using test developed by Pesaran (2015) in order to determine the appropriate panel unit-root and estimation technique. The results of the CD test in Table 3 clearly show that all variables rejected the null hypothesis of cross-section independence, thus confirming the presence of cross-sectional dependence in variables.

Table 3: Pesaran test for cross-sectional dependence

Variable	CD test	p-value	corr	abs(corr)
<i>Pubinv</i>	7.7***	0.000	0.227	0.300
<i>Debt</i>	20.23***	0.000	0.595	0.686
<i>Exp</i>	12.03***	0.000	0.354	0.415
<i>Growth</i>	24.27***	0.000	0.714	0.714
<i>Privinv</i>	17.39***	0.000	0.489	0.493

Notes: *** indicates the rejection of the null hypothesis of cross-sectional independence (CD test) at 1% significance level.

Source: authors' calculations

It is important to note that slope heterogeneity across the panel can emerge when there is cross-sectional dependence. Consequently, the next step involves testing the null hypothesis of slope homogeneity using the method developed by Pesaran and Yamagata (2008). Results presented in Table 4 suggest that for a null hypothesis of presence of slope homogeneity could be rejected at a 1% level of significance, indicating the presence of slope heterogeneity across the panel.

Table 4: Results of slope heterogeneity analysis

Statistics	Test value	<i>p</i> -value
Delta tilde	5.611***	0.000
Delta tilde adjusted	6.342***	0.000

Notes: *** indicates that the test statistic is significant at 1% level.

Source: authors' calculations

After confirming cross-sectional dependence and slope heterogeneity, we conducted second-generation unit-root test, namely cross-sectionally augmented Im-Pesaran-Shin (CIPS) panel unit root test (Pesaran, 2007). As shown in Table 5, variables *pubinv*, *exp* and *growth* reject the null hypothesis of non-stationarity at 1% level, whereas *debt* and *privinv* do not reject the null hypothesis of non-stationarity at the same level. Finally, CIPS showed presence of stationarity at the first difference at the 1% level for all variables. Thus, the order of integration of variables included in the model is a mix of I(0) and I(1).

Table 5: CIPS unit root test results

	Level	<i>p</i> -value	Difference	<i>p</i> -value	Result
<i>Pubinv</i>	−3.355***	0.001	−8.143***	0.000	I(0)
<i>Debt</i>	0.257	0.602	−5.755***	0.000	I(1)
<i>Exp</i>	−4.123***	0.000	−8.108***	0.000	I(0)
<i>Growth</i>	−9.647***	0.000	−6.409***	0.000	I(0)
<i>Privinv</i>	−1.391	0.081	−6.437***	0.000	I(1)

Notes: *** indicates that the test statistic is significant at 1% level.

Source: authors' calculations

In the final step of preliminary analysis, we checked whether the variables are cointegrated. Results of the Westerlund (2007) test which are shown in Table 6 provide evidence of stable long-term relationship among variables by rejecting the null hypothesis (no cointegration) at the 5% level.

Table 6: Westerlund cointegration test

Statistics	Value	Z-value	p-value
G_t	-3.280***	-5.088	0.000
G_a	-11.553**	-1.987	0.014
P_t	-10.020**	-4.313	0.000
P_a	-10.869***	-3.466	0.000

Notes: *** and ** indicate statistical significance at the levels of 1% and 5%, respectively.

Source: authors' calculations

Finally, after verifying existence of a long-term cointegration relationship among the variables, we proceed with short- and long-run estimations via CS-ARDL model. Table 7 presents the model's findings, which reveal significant insights into the interplay between public investment and public debt.

The estimation results confirmed debt-overhang hypothesis in CEE countries both in the long- and short-term. One p.p. increase in public debt leads to a 0.273 and 0.247 p.p. drop in public investment in the long- and short-term, respectively. This implies that as public debt rises, there is a substantial drop in public investment, confirming the debt-overhang hypothesis in CEE countries. This outcome is consistent with prior research primarily focused on developed countries (Picarelli et al., 2019; Kostarakos, 2021) and aligns with findings from studies on developing nations as well (Patillo et al., 2004; de Mendonca and Brito, 2021). Obtained results point to the crowding-out effect, indicating that an increase in public debt results in rising interest rates and borrowing limitations, thereby constraining the government's ability to fund productive initiatives, especially those aimed at crucial sectors such as infrastructure, health and education. In addition, fiscal limits are frequently established by domestic economic policymakers or international financial institutions in order to prevent excessive indebtedness. These constraints place a greater emphasis on the reduction of debt rather than on public investment (de Haan et al., 1996).

Table 7: CS-ARDL estimation results

Variable	Coefficients	Standard Errors	p-value
Long- run results			
<i>Debt</i>	−0.273***	0.380	0.001
<i>Exp</i>	0.263***	0.839	0.000
<i>Growth</i>	0.024***	0.061	0.000
<i>Privinv</i>	−0.144**	0.515	0.023
Short-run results			
Δ <i>debt</i>	−0.247***	0.157	0.000
Δ <i>exp</i>	0.326***	0.465	0.000
Δ <i>growth</i>	0.021**	0.016	0.017
Δ <i>privinv</i>	−0.120	0.039	0.321
<i>ECT</i> (−1)	−0.721***	0.157	0.000
F statistics	4.57***		
Adjusted R^2	0.69		
CD p-value	0.295		

Notes: *** and ** indicate significance at the levels of 1% and 5 %, respectively.

Source: authors' calculations

Furthermore, government spending and economic growth demonstrated a positive relationship with public investment in both short and long run. The results suggest that proactive fiscal policies, such as increased government spending, can effectively mitigate some of the negative effects of high public debt on public investment (Mehrotra and Valila, 2006; Picarelli et al., 2019; Kostarakos, 2021). Public investment in CEE countries exhibits procyclicality in relation to output, consistent with previous studies (de Haan et al., 1996; Mehrotra and Valila, 2006; de Mendonca and Brito, 2021), supporting the notion that higher economic growth increases the government's ability to invest in public infrastructure. Additionally, private investment exhibited a negative relationship in the long run. This finding indicates that larger private investments possibly crowd-out public investments, especially if they are directed into

the production of similar goods (Turan et al., 2021). However, in the short-term, this variable was not found to be significant, suggesting that changes associated with private investment need more time to demonstrate a noticeable impact or possibly having an indirect effect on public investment.

The estimates of the error-correction coefficients were negative and statistically significant, indicating that the variables have a tendency to converge towards the long-term relationship. Convergence rate of 72.1% indicates a rapid adjustment rate, showing that short-term imbalances are efficiently corrected, preserving the equilibrium relationship established by long-run coefficients.

Finally, the model's robustness and explanatory power is supported by additional statistics. The model's significant F-statistics, adjusted R^2 , and non-significant CD test p-value indicate its reliability and effectiveness in capturing the relationships between public investment and its determinants in CEE countries. These results confirm the findings' validity and support the conclusions drawn about the impact of public debt on public investment.

Conclusion

This paper provides an empirical analysis of the nexus between public investment and public debt in CEE countries between the years 2000 and 2022. In order to test the debt overhang hypothesis, we employed the CS-ARDL approach, which is an advanced ARDL model. The analysis is conducted using a dynamic heterogeneous framework that takes into account important characteristics of the panel, including non-stationarity, slope heterogeneity, and cross-sectional dependence.

Our study provides strong evidence in favour of debt overhang hypothesis in CEE countries. Thus, as public debt rises, there is a substantial drop in public investment, pointing to the presence of crowding out effect in the analysed region. The findings in this study exhibit consistency in both short-term and long-term analyses, indicating a robust inverse correlation between public investment and public debt. This may have significant fiscal policy repercussions, especially in contexts characterised by limited financial resources and substantial debt levels, as was the case in numerous CEE nations in the wake of the 2008 financial crisis and COVID-19 crisis. CEE economies recorded a significant rise in average annual public investment (from 3.3% of GDP in the early 2000s to 5.2% in 2008). This substantial rise in public investment was driven by the need of CEE to converge with the developed countries in terms of the size of public capital stock. However, the emergence of sovereign debt crisis reverted this trend and led to decrease of public investment, amounting to 3.3% of GDP in 2013. Use of European

Structural and Investment Funds in the following couple of years rebounded public investment to 5 % in 2015 (European Investment Bank, 2018). Economic crisis induced by COVID in 2020 also had an impact on public investment and public debt. Economic uncertainty and urgent need to reallocate funds to social welfare and healthcare led to immediate decline in public investment. Simultaneously, as a result of extensive fiscal measures which were implemented to mitigate effects of pandemic, CEE countries experienced a rise in public debt, frequently surpassing 70% of GDP. This led to concerns regarding long-term fiscal sustainability and pointed to the need of prudent debt management to prevent compromising future public investment and economic stability.

The results obtained have important implications for fiscal policy. In order to protect the government's ability to invest in productive expenditure, fiscal discipline must be ensured to keep public debt at sustainable levels. This is of the utmost importance in periods of economic downturns, when expansionary fiscal policy is introduced to stimulate the economy (Carvelli, 2023). Expansionary fiscal policy contributes to the stabilization of economic cycle and preserves public investment at the desirable level, but side effects of this policy is an increase in public debt (de Brito and Mendonca, 2021). Thus, the implementation of measures aimed at strengthening of fiscal framework could result in higher level of accountability and long-term sustainability of public finance. On the other hand, increase in transparency as well as reduction of bureaucratic procedures might stimulate the efficiency of public investment, thus leading to better allocation of resources and improvement of the fiscal health of economy. Furthermore, negative impact of public debt on public investment might be reduced through diversification of funding sources, specially relying on the creation of public-private partnerships and the use of various financing options developed by international financial institutions.

This study can be extended using bipartition of public investment into investment in infrastructure, healthcare and education. Furthermore, examining the impact of institutional quality on mediating this relationship can offer valuable insights into the ways in which governance, corruption, and bureaucratic efficiency affect fiscal outcomes. Finally, using alternative econometric techniques, such as structural vector autoregressions (SVAR) or dynamic stochastic general equilibrium (DSGE) models, can enhance the strength and dependability of future findings.

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