Prague Economic Papers
2023, Volume 32, Issue 2
https://doi.org/10.18267/j.pep.825

VŠE / PRAGUE UNIVERSITY OF ECONOMICS AND BUSINESS

Non-linear Impacts of Public Debt on Growth, Investment and Credit: A Dynamic Panel Threshold Approach

Taner Turan [a], Pelin Varol Iyidogan [b]

a Gebze Technical University, Department of Economics, Kocaeli, Turkey

b Hacettepe University, Department of Public Finance, Ankara, Turkey

e-mail: tturan@gtu.edu.tr, pelinv@hacettepe.edu.tr

Abstract

This paper examines the effects of public debt on the growth rate, investment and domestic credit provided to private sector using the dynamic panel threshold regression method for a large number of developing countries, namely 53 (48) economies for growth and investment (credit) regressions. Our results suggest that public debt does not have a significant impact on the economic growth rate. Despite a strong negative effect of public debt on the total investment, our results do not support the existence of a (strong) threshold effect of public debt on total (private) investment. On the other hand, we present evidence for a threshold effect of public debt on public investment and credit. More precisely, public debt leads to a reduction in public investment and credit when the public debt exceeds the estimated threshold levels. Since public debt matters for investment and credit, it is important to ensure fiscal discipline and prudence in the long term.

Key words: Public debt, growth, investment, domestic credit, dynamic panel threshold

JEL Classification: E62, H60, O40

1. Introduction

To alleviate the effects of the last global financial crisis, many governments have implemented expansionary fiscal policies, including even the assumption of private sector liabilities in some cases. Moreover, a considerable contraction in output has automatically caused an increase in public debt to GDP ratio. These developments have naturally triggered an extensive research

agenda investigating the relationship between public debt and economic growth, especially after the publication of a very influential study by Reinhart and Rogoff (2010).

In principle, the relationship between public debt and economic growth is rather complex and multifaceted. On the one hand, public debt would have a negative effect through several channels such as debt overhang and crowding out. For example, an increase in public debt would be associated with a lower level of investment and domestic credit available for private sector (Cottarelli et al., 2005; Hauner, 2009; Checherita-Westphal and Rother, 2012; Woo and Kumar, 2015). On the other hand, public debt would positively affect economic growth through the liquidity supply channel or aggregate demand mechanism among others (Elmendorf and Mankiw, 1999; Panizza and Presbitero, 2013; Kobayashi, 2015). More interestingly, it is possible to observe a nonlinear or threshold relationship (Reinhart and Rogoff, 2010; Reinhart et al., 2012). As highlighted in Cecchetti et al. (2012), debt could be a source of economic growth and stability at low levels while at high levels it could increase the volatility and retard the growth.

There is no doubt that the effects of public debt matter, with very important policy implications ranging from the active role of governments in economic contractions and crises to implementation and timing of austerity measures. Therefore, the ramifications of shedding light on this relationship go much farther than mere academic curiosity. Additionally, study of effects of public debt could not be more timely than now due to the COVID-19 pandemic, which forced governments to increase budget deficits, eventually resulting in higher public debt levels. We think that it is crucial to examine the effects of public debt to design economic policies and predict their long-term consequences.

Investigating the effects of public debt on the growth rate, investment and credit in a large number of developing countries (53 economies for growth and investment, 48 for credit regressions), this study aims to contribute to the existing literature in four important dimensions. Firstly, we employ a dynamic panel threshold regression method developed by Kremer et al. (2013). Although this approach is utilized by Baum et al. (2013) to examine the effects of public debt for Euro area countries, to the best of our knowledge, it has not been used for developing countries so far in this context, except for Law et al. (2021). We think that this approach has some distinctive advantages, such as dealing with endogeneity and autocorrelation issues in a dynamic threshold framework. Secondly, we investigate the effects of public debt on investment and domestic credit provided to the private sector. Despite its relevance and importance, whether public debt has any impact on the amount of domestic credit provided to the private sector is a largely unexplored issue in this strand of the literature. This would be helpful to understand the transmission mechanism. Thirdly, we make a distinction between public and private investment, which can provide additional insights since public debt may have

different effects on public and private investment. Fourthly, given the considerable variation in public debt to GDP ratios in developing countries after the 1980s, it seems more interesting and relevant to examine the effects of public debt in developing countries. For example, in our sample countries, after a significant increase in the 1990s, the central government debt/GDP ratio reached 67%, then in the second half of the 2000s this ratio dropped to 46%, finally rising to 55% in the second half of the 2010s. To sum up, the novelty of our research question, which focuses on the impact of public debt on growth, investment and credit, arises from both the utilization of a sophisticated methodology, namely the dynamic panel threshold approach to enable estimation for different regimes, and the deep insight into the relationship by considering the private sector aspect and focusing solely on developing economies' experience. Therefore, our study significantly contributes to the existing literature.

Our findings do not support the existence of a threshold effect of public debt on growth. On the other hand, public debt exerts a negative and robust impact on total investment. We conclude that there is no threshold effect of public debt on total investment. More importantly, our results lend strong evidence for a threshold effect of public debt on public investment and credit. It seems that when the public debt is higher than the estimated threshold level, then it exerts a negative impact on both public investment and credit provided to the private sector. Although we find some negative effects of public debt on private investment, it seems that the evidence for a threshold effect is weak.

The remaining sections of this paper are structured as follows. We review the literature in Section 2, explain our model and methodology in Section 3, share and discuss the empirical results in Section 4, and conclude in Section 5.

2. Literature Review

Economic growth has important drivers and determinants, including but not limited to technological change, institutions, demographics, energy and economic policies with a wide range of implications (Romer, 1990; Acemoglu et al., 2001; Jones, 2015; Easterly, 2019; Bloom, 2020; Bansal, 2021; Xu et al., 2023; Zheng et al., 2022). Among those variables, we are mainly interested in the effects of public debt on economic growth, investment and credit. In an important study, Elmendorf and Mankiw (1999) discuss the effects of public debt by highlighting two different, even conflicting approaches: the conventional view and the Ricardian equivalence theorem. The conventional view distinguishes between the short and long-term impacts of public debt. In the short term, the aggregate demand plays a decisive role in the determination of the output. In this way, a deficit-financed government spending increase or tax cut leads to a rise in the output. However, the same policy puts an upward pressure on the interest rate, crowding

out private investment, implying a negative impact on the economic growth in the long term. On the other hand, based on the intertemporal government budget constraint and permanent income hypothesis, the Ricardian equivalence asserts that for a given level of government spending, the timing of taxes does not matter; hence, there is no difference between a tax and deficit-financed change in the budget (Barro, 1974). In other words, since a change in public saving is offset by an equal change in private saving, national saving, interest rates, consumption and output do not change. In this framework, public debt does not affect the growth rate.

Although the conventional view and the Ricardian equivalence are useful starting points in analysing the effects of public debt, they are by no means final words on the subject. Other than the well-known debt overhang effects (Krugman, 1988; Reinhart et al., 2012), the literature identifies some primary channels through which public debt would affect the economic growth. Public debt would negatively impact the economic growth creating higher tax distortions (Barro, 1979) and uncertainty about future policies and prospects (Woo and Kumar, 2015; Eberhardt and Presbitero, 2015), leading to higher inflation and financial repression (Cochrane, 2011), increasing the borrowing or funding costs of the private sector (Corsetti et al., 2013), lowering the public infrastructure or productive expenditures (Aizenman et al., 2007; Afonso and Jalles, 2013). Additionally, high public debt would constrain the government from performing its essential functions (Cecchetti et al., 2012), cause extra vulnerabilities via the "original sin" argument (Eichengreen et al., 2007), and finally trigger a banking, debt or currency crisis (Burnside et al., 2001; Hemming et al., 2003). Consistent with theoretical predictions, many studies such as Afonso and Jalles (2013), Eberhardt and Presbitero (2015), Woo and Kumar (2015), Brida et al. (2017), Chudik et al. (2017), Pegkas (2018), Ncanywa and Masoga (2018), Swamy (2020), Asteriou et al. (2020), Ghourchian and Yilmazkuday (2020) and Onofrei et al. (2022) report a negative effect of public debt on economic growth.

Despite some arguments for a negative growth effect of public debt, there is neither empirical nor theoretical consensus on the issue. For example, some researchers claim that public debt would have a positive rather than negative growth effect. Besides aggregate demand effects in the short run, Teles and Mussolini (2014) develop an endogenous growth model predicting that an increase in public debt would be associated with higher growth. Moreover, De Long and Summers (2012) suggest that an economic contraction would have a long-lasting impact on the output and unemployment, retarding the potential growth rate. To mitigate these negative effects, an increase in public debt would be optimal. Furthermore, some studies highlight the liquidity supply effects of public debt as a channel for economic growth (Cecchetti et al., 2012; Kobayashi, 2015). Finally, since public external debt would represent an additional source of funding for domestic economy, a positive short-run effect is expected. A limited number

of studies report a positive growth effect of public debt (Fincke and Greiner, 2014; Owusu-Nantwi and Erickson, 2016; Spilioti and Vamvoukas, 2015; Ahlborn and Schweickert, 2018). On the other hand, some studies, such as Teles and Mussolini (2014), Panizza and Presbitero (2014), Lof and Malinen (2014), Arcabic (2018), Jacobs et al. (2020) and Turan (2019) do not find a significant (negative) growth effect of public debt. However, in a recent study, de Soyres et al. (2022) find that the effects of an unanticipated increase in public debt to GDP ratio hurt or boost GDP, depending on some conditions such as the initial debt and income level.

There has been a growing interest in the nonlinear and threshold effects after the important contributions of Reinhart and Rogoff (2010) and Reinhart et al. (2012), who suggest that there is no relationship between public debt and economic growth when public debt (% of GDP) is lower than the threshold value of 90%. However, beyond this threshold value, public debt has a significant negative impact on the economic growth rate. Some studies confirm this nonlinear relationship even though different threshold values, i.e., public debt/GDP ratios, are reported. For example, Cecchetti et al. (2012) find a threshold level for government debt around 85% for OECD countries. Caner et al. (2010) report that the threshold value is 77% (64%) for 101 developed and developing countries (emerging markets). Similarly, Checherita-Westphal and Rother (2012) conclude that the threshold value for government debt is 90–100% for Euro area countries. They also note that negative effects of high debt on the growth may start from 70–80%. Baum et al. (2013) emphasize that when the public debt level reaches around 67%, the positive growth effect turns to be insignificant for European countries and also that additional debt has a negative impact on the growth in high debt levels (around 95%). Afonso and Jalles (2013) and Afonso and Alves (2015) indicate that the threshold debt ratio is 59 and 75% for a large panel of countries and European countries, respectively. In an influential study, Woo and Kumar (2015) find that when the initial level of public debt exceeds 90%, it has a stronger negative effect on the subsequent growth rate for a panel of advanced and emerging economies. Karadam (2018) reports that the debt threshold level is 106% (88%) for developed (developing) countries. Along similar lines, Mensah et al. (2020) report a threshold value of between 50 and 80% for 38 African countries. In a recent study, Law et al. (2021) show that if public debt is higher than 51%, then it has a negative effect on economic growth for a large number of developing countries.

However, not all studies support the existence of a nonlinear or threshold effect in the relationship between public debt and growth (Greiner, 2013). In this context, Herndon et al. (2014) suggest that there is no significant growth difference among countries depending on the level of public debt, thus rejecting the threshold identified by Reinhart and Rogoff (2010) and Reinhart et al. (2012). In a similar way, Pescatori et al. (2014) fail to find any particular debt

threshold level. Moreover, Egert (2015) concludes that finding a nonlinear relationship between public debt and economic growth is extremely difficult and not robust to modelling choices and data samples. Likewise, Eberhardt and Presbitero (2015), Chudik et al. (2017), Arcabic et al. (2018) and Bentour (2020) do not show any robust evidence for the threshold effect.

However, although there is a vast body of literature trying to explain the effects of public debt on economic growth, recently surveyed by Rahman et al. (2019) and Tamborini and Tomaselli (2020), possible channels have received relatively little empirical attention. In this context, we focus on two main channels: investment and credit provided to the private sector. It is clear that public debt would affect both public and private investment. Public debt would negatively affect public investment through the government budget constraint. It is a well-established argument that governments would be more willing to cut public investment compared to some other expenditure categories such as pension and wage payments (Alesina and Perotti, 1997). Public debt would lead to a decline in private investment via many channels such as crowding out and debt overhang mechanisms. We should note that some studies lend empirical evidence for the negative investment effects of public debt (Checherita-Westphal and Rother, 2012; Woo and Kumar, 2015; Benayed et al., 2015; Ncanywa and Masoga, 2018; Picarelli et al., 2019).

In spite of a possible relationship between public debt and domestic credit provided to the private sector, as suggested by the crowding-out effect, a limited number of studies investigate this critical issue in a different strand of the literature (Cottarelli et al., 2005; Kumhof and Tanner, 2005; Egert et al., 2006; Hauner, 2009; Anyanwu et al., 2017). In essence, an increase in public debt would lower the amount of credit available for the private sector. In other words, when public debt is high, banks allocate scarce funds to finance the public debt rather than the private sector since the former is regarded as a safe borrower (Kumhof and Tanner, 2005; Hauner, 2009). Although only a few studies have shown some interest, we should note that a nonlinear effect of public debt on investment and credit is possible (Checherita-Westphal and Rother, 2012; Benayed et al., 2015). For example, Checherita-Westphal and Rother (2012) detect a threshold effect of public debt on public, but not private, investment in European countries. Similarly, Benayed et al. (2015) report a negative government investment effect for some African countries.

To sum up, despite extensive research efforts and many publications, there is no consensus on the somewhat mysterious relationship between public debt and economic growth. Empirical findings are sensitive to time periods, sample countries and econometric methods. In a new study using meta-analysis, Heimberger (2021) strongly confirms this observation by pointing out the lack of evidence for a consistently negative growth effect of public debt.

3. Empirical Methodology and Data

The threshold models, which are widely employed in empirical macroeconomics, provide an opportunity to examine structural relationships varying across different regimes, defined in terms of threshold levels. More briefly, analysing a relationship above and below an estimated threshold level enables us to capture economic phenomena more accurately. In this context, within the scope of our study, we opt for employing the dynamic panel threshold model developed by Kremer et al. (2013) to question the impact of public debt on selected macroeconomic indicators, namely economic growth, investment (gross fixed capital formation) and domestic credit to the private sector (financial depth) within two different regimes specified with regard to different levels of debt. The intuition for the preference of this approach is that it provides a methodological priority in terms of capturing the nonlinear debt effect in different regimes, and considers endogeneity.

Caner and Hansen (2004) developed an approach enabling Generalized Method of Moments (GMM) estimation of a cross-sectional threshold model to eliminate the drawback of Hansen's (1999) panel threshold model, which ignores the dynamic structure, leading to an endogeneity problem. Following and developing those approaches, Kremer et al. (2013) proposed a dynamic panel threshold model, which embodies initial income as an endogenous regressor. The model structured in terms of our research questions is as follows:

$$y_{it} = \mu_i + \beta_1' debt_{it} I(debt_{it} \leq \gamma) + \delta_1 I(debt_{it} \leq \gamma) + \beta_2' debt_{it} I(debt_{it} > \gamma) + \emptyset z_{it} + \varepsilon_{it} \qquad (1)$$

where y_{it} indicates the country i's growth rate of real GDP per capita (GRW), investment (INV) or domestic credit provided to the private sector (CRD) in the period t, respectively, which are the dependent variables of our specified models. Besides, μ_i is the country-specific fixed effect that is removed with forward orthogonal transformation following Arellano and Bover (1995). Hereby, the serial correlation of the transformed errors is averted. In all the regressions, public debt (DBT) is the regime-dependent variable. $I(.)$ is the indicator function implying the regimes defined by the threshold variable, which is also debt. The threshold variable, DBT, divides the sample into two regimes, below and above the unknown level of the threshold parameter, γ. The vector of regressors is split into a subset of ***(i)*** exogenous variables z_{1it}, which is uncorrelated with the error term and defined in terms of each model examining the public debt effect for growth, investment and financial depth, and a subset of ***(ii)*** endogenous variables z_{2it} correlated with ε_{it}. The methodological procedure begins with the estimation of the reduced-form regression of the endogenous variables as a function of instruments which include z_{1it}.

Then the endogenous variables in (1) are substituted by the estimated values $\hat{z}_{2it}$. Afterwards, the threshold, γ, is determined by $\hat{\gamma} = argminS(\gamma)$ where $S(\gamma)$ is the sum of squared residuals for the regression, that is the estimation of (1) with $\hat{z}_{2it}$ repeatedly by least squares for each value of the threshold, γ. After the determination of the threshold which minimizes the sum of squared errors, the slope coefficients are estimated using the GMM approach for the previously determined instruments and estimated threshold. β_1 and β_2 are the regime-dependent slope coefficients. δ_1 presents the fixed-regime coefficient, which is common to all cross-sections. ε_{it} is the error term, which is independently and identically distributed.

Like many studies such as Checherita-Westphal and Rother (2012), Cecchetti et al. (2012) and Woo and Kumar (2015), besides initial GDP per capita (in log-INI) and public debt (DBT), we employ several variables as controls. In the growth regressions, we include fertility rates (FER) to capture the effects of demographic dynamics, while the trade shares (the sum of exports and imports, OPN) measure the effects of trade openness. Credit (CRD) is intended to grasp the impact of financial development, while total investment (TNV) reflects the change in capital stock. To better investigate the effects of public debt on investment (TNV), we separately use the public (PNV) and private (RNV) investment as the dependent variables as well. In the total and private investment regressions, we include INI, GRW, CRD, and OPN as controls. We think that voters would influence the allocation of budget resources among different uses. Therefore, rather than CRD, we include the polity score from Polity IV Project (Marshall et al., 2017) in the public investment regressions. As for the credit (CRD) regressions, INI, GRW, OPN, RNV, and broad money supply (MNY) are included as controls. Note that since the main focus of the present study is to reveal the effects of public debt on growth, investment and credit rather than to capture all determinants or dimensions of these variables, we use parsimonious models that are specified to provide consistency in our estimations regarding the threshold effect. Additionally, we have a limited number of observations and a dynamic model. Variable definitions and data sources are summarized in Table 1.

It would be important to explicitly state which independent variables are employed as endogenous and exogeneous in our regressions. Following Kremer et al. (2013), we include INI (FER), TNV (OPN) and CRD as endogenous (exogenous) variables in the growth regressions. On the other hand, we define OPN as exogenous and the remaining variables as endogenous in the investment regressions. Similarly, OPN and MNY are employed as exogenous while INI, GRW, and RNV are endogenous in the credit regressions. Moreover, consistent with previous studies such as Kremer et al. (2013) or Law (2021), we employ one lag of the dependent variable as the instrument in all the regressions.

Table 1: Variable definitions and sources

Variable	Definition	Source
INI	Initial GDP per capita (in log)	Penn World Tables (Feenstra et al., 2015)
DBT	Public debt (as % of GDP)	IMF (2020)
FER	Fertility rate	WDI (2020)
OPN	Trade openness (the sum of exports and imports, as % of GDP)	WDI (2020)
GRW	GDP per capita growth	WDI (2020)
POL	Polity score	Polity IV Project (Marshall et al., 2017)
CRD	Domestic credit to private sector (as % of GDP)	WDI (2020)
MNY	Broad money supply (as % of GDP)	WDI (2020)
TNV	Gross fixed capital formation (as % of GDP)	IMF (2020)
PNV	Public gross fixed capital formation (as % of GDP)	IMF (2020)
RNV	Private fixed capital formation (as % of GDP)	IMF (2020)

Our data set for the growth and investment (credit) regressions covers 53 (48) developing countries and spans from 1980 to 2019. The regional distribution of the sample countries indicates that most of them are in Africa (22 economies), the rest are in Asia (18), South and North America (9) and Europe (4). As a standard procedure to remove cyclical effects, we take five-year non-overlapping averages of all the variables, except for the initial GDP per capita, beginning from the initial period 1980–1984 and so on. Countries and time periods are determined by data availability.[1] All the variables, except for the growth rate, initial GDP per capita and fertility rate are employed as % of GDP. Descriptive statistics are presented in Table 2.

1 The list of countries is available from the authors.

Table 2: Descriptive statistics

Series	Mean	Standard deviation	Max	Min
Initial GDP per capita (log)	3.31	0.53	4.44	2.344
Debt	54.75	38.62	238.21	5.69
Fertility	4.16	1.88	8.39	1.15
Trade	64.28	31.69	210.15	12.76
GDP per capita growth	1.62	2.89	10.77	9.02
Polity	1.87	6.49	10	–10
Credit	33.34	31.59	140.15	9.84
Money supply	44.82	28.40	141.56	5.48
Total investment	17.25	7.04	42.74	4.38
Public investment	4.92	3.13	33.82	3.45
Private investment	12.23	5.97	34.16	3.37

Source: authors' calculations

4. Empirical Results and Discussion

We summarize the results of our growth regressions in Table 3. To ensure the robustness of our results, we include one control variable at a time. As expected, fertility rate has a negative impact. A decline in fertility leads to an increase in the growth rate. Additionally, there exists evidence for the convergence hypothesis in some specifications. Somewhat interestingly, other control variables do not exert any significant effect. Importantly, we do not find any evidence for the existence of a threshold effect of public debt on growth. More precisely, public debt is not associated with the economic growth rate either below or above the threshold level, estimated as 41% of GDP. Our results support some previous studies such as Herndon et al. (2014), Pescatori et al. (2014), Egert (2015) and Chudik et al. (2017). This is also consistent with findings of Heimberger (2021). Note that our estimated threshold value is below those reported in the literature, including Reinhart et al. (2012), Cecchetti et al. (2012), Woo and Kumar (2015). Advanced economies with more developed financial markets and favourable borrowing options could easily increase their public debt levels compared to developing ones. A higher debt level

then might be a source of uncertainty and negative effects in some cases even if advanced countries would tolerate or afford a higher debt level in general. On the one hand, this implies that negative threshold effects would emerge at lower debt levels in developing countries. On the other hand, borrowing constraints in developing countries might result in a lower public debt and hence a weak detrimental effect. Therefore, the insignificant growth effect of public debt might not be surprising in this sense. Besides, it might be caused by the relatively low debt threshold level determined endogenously in our study.

Table 3: The effects of public debt on the growth rate: dep. var. – GDP per capita growth rate

Threshold estimate (%) impact of debt	41.29	41.29	41.29	41.29	41.29
Regime 1: $\hat{\beta}_1$	0.0732 (0.995)	0.0903 (1.369)	0.0577 (0.714)	0.0333 (0.371)	0.0425 (0.466)
Regime 2: $\hat{\beta}_2$	0.0831 (0.408)	0.0140 (0.791)	−0.018 (−0.49)	−0.0264 (−0.664)	−0.0201 (−0.471)
Impact of Covariates					
L.GRW	0.182* (1.679)	0.0412 (0.413)	0.0623 (0.527)	0.0398 (0.315)	0.0709 (0.501)
FER		−1.836** (−2.121)	−2.03* (−1.91)	−2.45** (−1.998)	−2.31** (−2.169)
INI		−12.80** (−2.21)	−11.21* (−1.69)	−16.07* (−1.66)	−10.37* (−1.68)
TNV			−0.33 (−1.04)	−0.47 (−1.252)	−0.39 (−0.944)
OPN				0.0743 (0.767)	0.0516 (0.524)
CRD					−0.0433 (−0.298)
Constant	0.0129 (0.007)	50.13** (2.223)	53.11* (1.940)	69.80* (1.951)	51.50* (1.879)
Observations	371	371	371	371	371

Source: authors' calculations

Notes: i) *,** and *** indicate the significance at 10%, 5% and 1% level, respectively. ii) Either regime contains at least 5% of all observations in accordance with Hansen (1999). iii) Feasible inflation thresholds are valid for the estimations, thus between %95 confidence intervals. iv) t-statistics are given in parentheses. v) Time dummies are included but not reported here. For variable definitions, see the text.

It is more interesting to examine the effects of public debt on total, public and private investment. It seems that public debt has a strong negative effect on total investment (Table 4). Note that this negative investment effect is in line with many previous studies such as Woo and Kumar (2015), Benayed et al. (2015) and Picarelli et al. (2019). However, public debt exerts a negative impact whether public debt is lower or higher than the estimated threshold level, which is 72% of GDP. Therefore, our results do not lend any evidence for a threshold effect for total investment. It seems that credit boosts total investment in most specifications, while there is some evidence for the convergence among sample countries in terms of total investment as well.

Table 4: The effects of public debt on the total investment: dep. var. – Total investment (% of GDP)

Threshold estimate (%) impact of debt	72.16	72.16	72.16	72.16	72.16
Regime 1: $\hat{\beta}_1$	−0.21*** (–2.591)	−0.25*** (–2.920)	−0.24** (–2.188)	−0.22** (–2.186)	−0.21** (–2.06)
Regime 2: $\hat{\beta}_2$	−0.14*** (–3.036)	−0.11*** (–3.311)	−0.13*** (–3.020)	−0.12*** (–3.126)	−0.15*** (–3.008)
Impact of Covariates					
L.TNV	0.267 (1.470)	0.304 (1.443)	0.205 (1.013)	0.160 (0.807)	0.175 (0.835)
INI		−0.280 (−0.590)	−0.252** (–2.186)	−0.241** (–2.062)	−0.212 (–1.272)
CRD			0.205* (1.853)	0.195* (1.805)	0.186* –1.712
GRW				0.318 (0.756)	0.308 (0.720)
OPN					−0.0273 (−0.248)
Constant	0.252*** (3.487)	0.340* (1.703)	1.016*** (2.837)	0.965** (2.559)	0.945** (1.943)
Observations	318	318	318	318	318

Source: authors' calculations

Notes: See notes in Table 3.

We present the effects of public debt on private investment in Table 5. Despite a negative private investment effect of public debt in some specifications, this effect does not seem very strong. Additionally, there is weak evidence for a threshold effect on private investment in only our extended model and at the 10% level. This result suggests that if public debt exceeds the threshold level of 46%, then it has a negative effect. Our results are largely consistent with those of Checherita-Westphal and Rother (2012). Moreover, the estimated threshold values for investment regressions are close to those of Checherita-Westphal and Rother (2012) and Benayed et al. (2015). Note that credit exerts a robust and consistent effect on private investment.

Table 5: The effects of public debt on the private investment: dep. var. – Private investment (% of GDP)

Threshold estimate (%) impact of debt	46.05	46.05	46.05	46.05	46.05
Regime 1: $\hat{\beta}_1$	−0.140 (−1.558)	−0.235 (−1.628)	−0.380* (−1.947)	−0.366* (−1.656)	−0.416 (−1.531)
Regime 2: $\hat{\beta}_2$	−0.0409 (−1.132)	−0.0419 (−0.938)	−0.137* (−1.876)	−0.140** (−1.984)	−0.141* (−1.770)
Impact of Covariates					
L.RNV	0.584*** (2.880)	0.552** (2.302)	0.0465 (0.119)	0.0167 (0.0427)	0.0355 (0.0803)
INI		0.0112 (0.197)	−0.338* (−1.827)	−0.319* (−1.729)	−0.368* (−1.676)
CRD			0.357** (2.048)	0.361** (2.061)	0.383* (1.885)
GRW				0.111 (0.221)	−0.0121 (−0.0192)
OPN					0.0635 (0.461)
Constant	0.0956** (2.133)	0.0638 (0.359)	1.224** (2.010)	1.159* (1.927)	1.284* (1.758)
Observations	318	318	318	318	318

Source: authors' calculations

Notes: See notes in Table 3.

Table 6 clearly shows that public debt has a negative impact on public investment when the debt is above the threshold level in all the specifications. This means that public debt exerts a strong negative impact on public investment when public debt exceeds the estimated threshold level. This effect is not small given that the mean of public investment is around 4.9% of GDP in our sample countries. On the other hand, we do not find a negative impact in the low-debt regime, confirming the existence of a threshold effect of public debt on public investment. This lends evidence for the idea that governments cut public investment when public debt is high. It is clear that a higher debt would trigger or even force the implementation of austerity programmes. Under austerity, governments would be more willing to reduce public investment compared to some other spending categories such as transfers and pension payments (Alesina and Perotti, 1997; Aizenman et al., 2007).

Table 6: The effects of public debt on public investment: dep. var. – Public investment (% of GDP)

Threshold estimate (%) impact of debt	91.25	91.25	91.25	91.25	91.25
Regime 1: $\hat{\beta}_1$	−0.028 (−0.73)	−0.025 (−0.60)	−0.034 (−0.78)	−0.026 (−0.54)	−0.014 (−0.24)
Regime 2: $\hat{\beta}_2$	−0.05*** (−4.44)	−0.05*** (−3.90)	−0.04*** (−3.62)	−0.038** (−2.17)	−0.048** (−2.13)
Impact of covariates					
L.PNV	0.329*** (4.781)	0.332*** (4.564)	0.315*** (4.214)	0.380*** (3.565)	0.279* (1.841)
INI		0.266 (0.144)	−0.191 (−0.855)	−0.293 (−1.105)	−0.781* (−1.718)
OPN			0.0802* (1.758)	0.0784* (1.690)	0.0723 (1.226)
GRW				0.323 (0.932)	−0.214 (−0.351)
POL					0.489 (1.202)
Constant	0.0516** (2.539)	0.0413 (0.554)	0.0693 (1.012)	0.0860 (1.130)	0.257* (1.724)
Observations	318	318	318	318	318

Source: authors' calculations

Notes: See notes in Table 3.

Table 7: The effects of public debt on the credit: dep. var. – Credit (% of GDP)

Threshold estimate (%) impact of debt	64.07	64.07	64.07	64.07	64.07	64.07
Regime 1: $\hat{\beta}_1$	−0.266 (−0.95)	−0.100 (−0.64)	−0.0250 (−0.15)	−0.0449 (−0.24)	−0.030 (−0.12)	−0.07 (−0.3)
Regime 2: $\hat{\beta}_2$	−0.10* (−1.66)	−0.2*** (−3.57)	−0.16* (−1.95)	−0.168* (−1.93)	−0.30** (−2.33)	−0.22* (−1.7)
Impact of Covariates						
L.CRD	−0.0627 (−0.480)	−0.33** (−2.29)	−0.375** (−2.53)	−0.37** (−2.51)	−0.226 (−1.07)	−0.14 (−0.75)
MNY		0.72*** (5.72)	0.401* (1.705)	0.39* (1.701)	0.833** (2.26)	0.80** (2.43)
INI			45.04* (−1.67)	44.99* (1.68)	39.75 (1.06)	24.15 (0.667)
GRW				−0.191 (−0.237)	1.104 (0.89)	−0.586 (−0.41)
OPN					−0.76** (−2.35)	−0.65** (−2.20)
RNV						1.337* (1.916)
Constant	37.48*** (5.25)	20.9*** (2.78)	−11.54 (−1.38)	−11.37 (−1.362)	−75.25 (−0.655)	−44.44 (−0.41)
Observations	336	336	336	336	336	336

Source: authors' calculations

Notes: See notes in Table 3.

We also test whether public debt impacts on credit provided to the private sector, and we report the results in Table 7. Our results point to the existence of a significant negative impact on credit in high but not low-debt regimes.[2] There is no doubt that this effect is economically significant as well. Therefore, our results support some previous studies such as Cotarelli et al. (2005), Hauner (2009) and Anyanwu et al. (2017), which report a negative effect of public debt on credit as discussed above. On the other hand, we find a positive impact of money supply and private investment on credit. It seems that there is a two-way relationship between private investment and credit, consistent with expectations.

2 Our main results do not change when we include interest rates. However, we lose many observations.

Finally, we should note that our main results are not sensitive to the choice of endogenous variables. For instance; if we use INI as the only endogenous variable in all the regressions, we obtain similar results. Moreover, we think that adding one control at a time provides a natural and convincing sensitivity analysis. In this way, we track the changes in our estimations as we introduce a new variable in each step. What matters most is to observe whether there exists a significant change in our main variable of interest, i.e., public debt. Our estimations clearly demonstrate that effects of public debt on economic growth, total investment and public investment do not change across specifications. However, we detect some small change in the private investment regressions. Additionally, it is important to test whether our results change when we use a different lag of the dependent variable as the instrument. To do so, we employ one rather than two lags of the dependent variable as instruments in all the regressions. This change does not lead to a striking difference in our results with one exception.[3] With just one lag, we find some evidence for a threshold effect in the total investment regressions in the extended specification.

5. Conclusion

Using data for a large number of developing countries (53 economies for growth and investment, 48 for credit regressions) and the dynamic panel threshold regression method, we examined the effects of public debt on per capita GDP growth rate, investment and credit provided to the private sector. Our results suggest that public debt does not have a significant direct impact on the economic growth rate, suggesting the absence of a threshold growth effect. On the other hand, our results consistently indicate a strong investment effect of public debt. Public debt lowers the total investment in both low and high-debt regimes. More importantly, we present evidence for a threshold effect of public debt on public investment. When public debt is higher than the estimated threshold level, an increase in public debt is associated with a significant decline in public investment. This lends evidence for the argument that when public debt is higher, governments would be more willing to cut public investment. Unlike public investment, we do not find a persuasive evidence for a threshold effect of public debt on private investment. Furthermore, public debt leads to a reduction in credit provided to the private sector in high but not low-debt regimes, suggesting strong evidence for the threshold effect.

We would like to highlight some important points. Firstly, our results indicate that public debt has a significant impact on total investment, public investment and credit but not on economic growth. We think that this result is intuitive as public debt would have a more direct

3 These results are available from the authors.

effect on investment and credit rather than on growth. Moreover, this effect would be even more pronounced in the case of public investment due to the government budget constraint. It would be more helpful if future studies paid more attention to investigating the possible channels through which public debt could affect economic activity instead of solely focusing on the growth effects. In this way, we can learn more about the transmission channel or black box of public debt. Secondly, there is no doubt that imposing a linear relationship would be a serious mistake, likely causing misleading results. It seems that public debt has a threshold effect on public investment and credit. Thirdly, our results make it clear that public debt matters, highlighting the importance of conventional crowding-out mechanism. Even though it is tempting to pretend otherwise, this would be associated with some negative outcomes in terms of lower investment and credit. Given the more robust threshold effect of public debt on public investment, some fiscal rules or procedures aiming to protect public investment from detrimental effects of public debt should be seriously considered. Fourthly, a negative impact of public debt on investment and credit does not necessarily mean that governments should not implement fiscal policy to alleviate the destructive economic effects of catastrophic events such as the COVID-19 pandemic. Rather, we tend to think that governments can and even should use fiscal policy in a well-designed framework as long as they credibly commit to taking necessary steps to ensure fiscal discipline once these events disappear. Additionally, considering the effect of public debt on investment and credit, which are vital components of macroeconomic performance, policymakers should pay greater attention to debt management strategies for attaining debt sustainability. It is obvious that the policy implementations vary across the developing countries in terms of their macroeconomic, fiscal and financial structures. In this regard, future studies on the growth, investment and credit effects of public debt could focus on country-specific analysis by utilizing methods that enable examination of asymmetries. Moreover, the transmission mechanism could be studied by comprising the recent discussions on fiscal rules and institutional quality.

References

Acemoglu, D., Johnson, S., Robinson, J. A. (2001). The Colonial Origins of Comparative Development: An Empirical Investigation. *American Economic Review*, 91(5), 1369–1401. http://www.jstor.org/stable/41724682

Ahlborn, M., Schweickert, R. (2018). Public debt and economic growth—Economic systems matter. *International Economics & Economic Policy,* 15, 373–403 https://doi.org/10.1007/s10368-017-0396-0

Afonso, A., Jalles, J. T. (2013). Growth and productivity: The role of government debt. *International Review of Economics and Finance,* 25, 384–407. https://doi.org/10.1016/j.iref.2012.07.004

Afonso, A., Alves, J. (2015). The role of government debt in economic growth. *Review of Public Economics,* 215, 9–26. https://doi/org/10.7866/HPE-RPE.15.4.1

Alesina, A., Perotti, R. (1997). Fiscal adjustments in OECD countries: Composition and macroeconomic effects. *IMF Staff Papers,* 44(2): 210–248. https://doi.org/10.2307/3867543

Aizenman, J., Kletzer K., Pinto, B. (2007). *Economic growth with constrains on tax revenues and public debt: Implications for fiscal policy and cross-country differences*. NBER Working Paper No.12750. https://doi/10.3386/w12750

Anyanwu, A., Gan C., Hu, B. (2017). Government domestic debt, private sector credit, and crowding out effect in oil-dependent countries. *Journal of Economic Research,* 22, 127–151. https://dx.doi.org/10.2139/ssrn.3214288

Arcabic, V., Tica, J., Lee, J., Sonora, R. J. (2018). Public debt and economic growth conundrum: nonlinearity and inter-temporal relationship. *Studies in Nonlinear Dynamics & Econometrics*, 22(1), pp. 20160086. https://doi.org/10.1515/snde-2016-0086

Arellano, M., Bover, O. (1995). Another look at the instrumental variable estimation of errorcomponents models. *Journal of Econometrics*, 68(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Asteriou, D., Pilbeam, K., Pratiwi, C. E. (2021). Public debt and economic growth: panel data evidence for Asian countries. *Journal of Economics and Finance*, 45, 270–287. https://doi.org/10.1007/s12197-020-09515-7

Barro, R. J. (1974). Are government bonds net wealth? *Journal of Political Economy,* 82(6), 1095–1117. https://doi.org/10.1086/260266

Barro, R. J. (1979). On the determination of the public debt. *Journal of Political Economy,* 87(5), 940–971. https://doi.org/10.1086/260807

Bansal, B., Sharma, G. D., Rahman, M. M., Yadav, A., Garg, I. (2021). Nexus between environmental, social and economic development in South Asia: evidence from econometric models. *Heliyon*, 7(1), 1–10. https://doi.org/10.1016/j.heliyon.2021.e05965

Baum, A., Checherita-Westphal, C., Rother, P. (2013). Debt and growth: New evidence for the Euro Area. *Journal of Money and International Finance*, 32., 809–821 https://doi.org/10.1016/j.jimonfin.2012.07.004

Benayed, W., Gabsi, F. B., Belguith, S. O. (2015). Threshold effect of public debt on domestic investment: Evidence from selected African countries. *Theoretical and Applied Economics,* 22 (4), 189–198. http://store.ectap.ro/articole/1144.pdf

Bentour, E. M. (2021). On the public debt and growth threshold: one size does not necessarily fit all. *Applied Economics*, 53(11), 1280–1299. https://doi.org/10.1080/00036846.2020.1828806

Bloom, N. (2020). Population 2020. *Finance & Development*, 57(1), 5-9. https://www.imf.org/en/Publications/fandd/issues/2020/03/changing-demographics-and-economic-growth-bloom

Brida, J. G., Gomez, D. M, Seijas, M. N. (2017). Debt and growth: A non-parametric approach. *Physica A: Statistical Mechanics and Its Applications,* 486, 883–894 https://doi.org/10.1016/j.physa.2017.05.060

Burnside, C., Eichenbaum, M., Rebelo, S. (2001). *On the fiscal implications of twin crises*. NBER Working Paper No. 8277. https://doi/.org/10.3386/w8277.

Caner, M., Hansen, B. E. (2004). Instrumental variable estimation of a threshold model. *Econometric Theory,* 20, 813–843. https://doi:10.1017/S0266466604205011

Caner, M., Grennes, T., Koehler-Geib, F. (2010). *Finding the tipping point: When sovereign debt turns bad.* World Bank Policy Research Working Paper 5391. http://documents.worldbank.org/curated/en/509771468337915456/Finding-the-tipping-point-when-sovereign-debt-turns-bad

Cecchetti, S. C., Mohanty, M. S., Zampolli, F. (2011). *The real effects of debt*. BIS Working Papers 352. https://www.bis.org/publ/work352.pdf

Checherita-Westphal, C. D., Hallett, A. H., Rother, P. C. (2012). *Fiscal sustainability using growth maximising debt targets.* ECB Working Paper Series No.1472 https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1472.pdf

Checherita, C., Rother, P. (2012). *The impact of high and growing government debt on economic growth: An empirical investigation for the Euro Area*. European Economic Review, 56(7), 1392–1405. https://doi.org/10.1016/j.euroecorev.2012.06.007

Chudik, A., Mohaddes, K., Pesaran, M. H., Raissi, M. (2017). Is there a debt-threshold effect on output growth? *Review of Economics and Statistics,* 99(1), 135–150. https://doi.org/10.1162/REST_a_00593

Cochrane, J. (2011). Understanding policy in the great recession: Some unpleasant fiscal arithmetic. *European Economic Review*, 55(1), 2–30. https://doi.org/10.1016/j.euroecorev.2010.11.002

Corsetti, G., Kuester, K., Meier, A., Müller, G. (2013). Sovereign risk, fiscal policy, and macroeconomic stability. *The Economic Journal,* 123(566), F99–F132. https://doi.org/10.1111/ecoj.12013

Cottarelli, C., Dell'Arricia, G., Vladkova-Hollar, I. (2005). Early birds, late risers, and sleeping beauties: Bank credit growth to the private sector in Central and Eastern Europe and in the Balkans. *Journal of Banking & Finance*, 29(1), 83–104. https://doi.org/10.1016/j.jbankfin.2004.06.017

Hauner, D. (2009). Public debt and financial development. *Journal of Development Economics,* 88(1), 171–183. https://doi.org/10.1016/j.jdeveco.2008.02.004

DeLong, J. B., Summers, L. H. (2012). Fiscal policy in a depressed economy. *Brookings Papers on Economic Activity 233–274*, https://www.brookings.edu/wp-content/uploads/2012/03/2012a_delong.pdf

de Soyres, C., Kawai, R., Wang, M. (2022). *Public Debt and Real GDP: Revisiting the Impact*. IMF Working Paper WP/22/76, Washington DC: International Monetary Fund. https://www.imf.org/en/Publications/WP/Issues/2022/04/29/Public-Debt-and-Real-GDP-Revisiting-the-Impact-517449

Easterly, W. (2019). *In Search of Reforms for Growth: New Stylized Facts on Policy and Growth Outcomes.* NBER Working Papers, 26318. https://doi/10.3386/w26318

Eberhardt, M., Presbitero, A. F. (2015). Public debt and growth: Heterogeneity and non-linearity. *Journal of International Economics* 97(1), 45–58 https://doi.org/10.1016/j.jinteco.2015.04.005

Egert, B. (2015) Public debt, economic growth and nonlinear effects: Myth or reality? *Journal of Macroeconomics,* 43, 226-238. https://doi.org/10.1016/j.jmacro.2014.11.006

Egert, B., Backe, P., Zumer, T. (2006). *Credit growth in Central and Eastern Europe*. ECB Working Series No. 687. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp687.pdf

Eichengreen, B., Hausmann, R., Panizza, U. (2007). Currency mismatches, debt intolerance, and the original sin: Why they are not the same and why it matters, in Edwards, S., ed., *Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences*. University of Chicago Press, pp.121–164.

Elmendorf, D.W., Mankiw, N. G. (1999). Government debt, in Taylor, J. B., Woodford. M., ed., *Handbook of Macroeconomics,* Elsevier, 1615–1669.

Fincke, B., Greiner, A. (2014). *Public debt and economic growth in Emerging Market Economies*. Bielefeld University Working Papers in Economics and Management No. 08. https://dx.doi.org/10.2139/ssrn.2449222

Feenstra, R. C., Inklaar, R., Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review,* 105(10), 3150–82. https://doi/10.1257/aer.20130954

Gómez-Puig, M., Sosvilla-Rivero, S. (2015). *On the bi-directional causal relationship between public debt and economic growth in EMU Countries*. Research Institute of Applied Economics Working Paper, 12. https://www.ub.edu/irea/working_papers/2015/201512.pdf

Ghourchian, S., Yilmazkuday, H. (2020). Government consumption, government debt and economic growth. *Review of Development Economics,* 24(2), 589–605. https://doi.org/10.1111/rode.12661

Greiner, A. (2013). Debt and growth: Is there a non-monotonic relation? *Economics Bulletin*, 33(1), 340–347. http://www.accessecon.com/Pubs/EB/2013/Volume33/EB-13-V33-I1-P33.pdf

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: estimation, testing, and inference. *Journal of Econometrics*, 93(2), 345–368. https://doi.org/10.1016/S0304-4076(99)00025-1

Heimberger, P. (2021). *Do Higher Public Debt Levels Reduce Economic Growth?* The Vienna Institute for International Economic Studies Working Paper 211. https://wiiw.ac.at/do-higher-public-debt-levels-reduce-economic-growth-dlp-5976.pdf

Hemming, R., Kell, M., Schimmelpfennig, A. (2003). *Fiscal vulnerability and financial crises in Emerging Market Economies.* IMF Occasional Paper No. 216 https://www.imf.org/external/pubs/nft/op/218/index.htm

Herndon, T., Ash, M., Pollin, R. (2014). Does high public debt consistently stifle economic growth? A Critique of Reinhart and Rogoff. *Cambridge Journal of Economics,* 38(2), 257–279. https://doi:10.1093/cje/bet075

International Monetary Fund. (2020). Investment and capital stock dataset and historical public debt database. Washington: IMF. https://www.imf.org/external/datamapper/datasets/DEBT

Karadam, D. Y. (2018). An investigation of nonlinear effects of debt on growth. *The Journal of Economic Asymmetries,* 18, e00097. https://doi.org/10.1016/j.jeca.2018.e00097

Kobayashi, K. (2015). Public debt overhang and economic growth. *Public Policy Review,* 11(2), 247–275. https://warp.da.ndl.go.jp/info:ndljp/pid/11217434/www.mof.go.jp/english/pri/publication/pp_review/ppr028/ppr028b.pdf

Kremer, S., Bick, A., Nautz, D. (2013). Inflation and growth: New evidence from a dynamic panel threshold analysis. *Empirical Economics,* 44, 861–878. https://doi.org/10.1007/s00181-012-0553-9

Krugman, P. (1988). *Financing vs. forgiving a debt overhang*. NBER Working Paper No. 2486. https://www.nber.org/system/files/working_papers/w2486/w2486.pdf

Kumhof, M., Tanner, E. (2005). *Government debt: A key role in financial intermediation*. IMF Working Paper Series WP/05/57. https://www.imf.org/-/media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2005/_wp0557.ashx

Law, S. H., Ng, H., Kutan, A., Law, Z. (2021). Public debt and economic growth in developing countries: Nonlinearity and threshold analysis. *Economic Modelling,* 98, 26–40. https://doi.org/10.1016/j.econmod.2021.02.004

Lof, M., Malinen, T. (2014). Does sovereign debt weaken economic growth? A panel VAR analysis. *Economics Letters*, 122(3), 403–407. https://doi.org/10.1016/j.econlet.2013.12.037

Marshall, M. G., Gurr, T. R., Jaggers, K. (2017). Polity IV project: Political regime characteristics and transitions, 1800-2016. Center for Systemic Peace. https://www.systemicpeace.org/polity/polity4.htm

Mensah, L., Allotey, D., Sarpong-Kumankoma, E., Coffie, W. (2020). What debt threshold hampers economic growth in Africa? *International Journal of Development Issues,* 19(1), 25–42. https://doi.org/10.1108/IJDI-03-2019-0056

Ncanywa, T., Masoga, M. M. (2018). Can public debt stimulate public investment and economic growth in South Africa? *Cogent Economics & Finance,* 6(1), 1516483 https://doi.org/10.1080/23322039.2018.1516483

Jacobs J, Ogawa K, Sterken E, Tokutsu I (2020) Public debt, economic growth and the real interest rate: A panel VAR approach to EU and OECD countries. *Applied Economics,* 52(12), 1377–1394. https://doi.org/10.1080/00036846.2019.1673301

Jones, C. (2015). *The Facts of Economic Growth*. NBER Working Papers No., 21142. https://doi.org/10.3386/w21142

Onofrei, M., Bostan, I., Firtescu, B. N., Roman, A., Rusu, V. D. (2022). Public Debt and Economic Growth in EU Countries. *Economies* 10(10), 254. https://doi.org/10.3390/economies10100254

Owusu-Nantwi, V., Erickson, C. (2016). Public debt and economic growth in Ghana. *African Development Review,* 28(1), 116-126. https://doi.org/10.1111/1467-8268.12174

Panizza, U., Presbitero, A. F. (2013). Public debt and economic growth in advanced economies: A survey. *Swiss J Economics Statistics*, 149, 175–204 https://doi.org/10.1007/BF03399388

Panizza, U., Presbitero, A. F. (2014). Public debt and economic growth: Is there a causal effect? *Journal of Macroeconomics,* 41, 21–41. https://doi.org/10.1016/j.jmacro.2014.03.009

Pegkas, P. (2018). The effect of government debt and other determinants on economic growth:

The Greek experience. *Economies,* 6(1), 10. https://doi.org/10.3390/economies6010010

Pescatori, A., Sandri, D., Simon, J. (2014). *Debt and growth: Is there a magic threshold?* IMF Working Paper WP/14/34. https://www.imf.org/-/media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2014/_wp1434.ashx

Picarelli, M.O., Vanlaer, W., Marneffe, W. (2019). *Does public debt produce a crowding out effect for public investment in the EU?* European Stability Mechanism Working Paper No. 36. https://www.esm.europa.eu/system/files/document/wp36final.pdf

Rahman, N. H. A., Ismail, S., Ridzuan, A. R. (2019). How does public debt affect economic growth? A systematic review. *Cogent Business & Management,* 6, 1701339. https://doi.org/10.1080/23311975.2019.1701339

Reinhart, C. M., Reinhart, V., Rogoff, K. S. (2012). Public debt overhangs: Advanced economy episodes since 1800. *Journal of Economic Perspectives*, 26(3), 69–86. https://doi.org/10.1257/jep.26.3.69

Reinhart, C. M., Rogoff, K. S. (2010). *Growth in a time of debt*. NBER Working Paper no. 15639 https://www.nber.org/system/files/working_papers/w15639/w15639.pdf

Romer, P. (1990). Endogenous Technological Change. *Journal of Political Economy*, 98(5), 71–102. https://www.jstor.org/stable/2937632

Saint-Paul, G. (1992). Fiscal policy in an endogenous growth model. *The Quarterly Journal of Economics*,107(4), 1243–1259. https://doi.org/10.2307/2118387.

Spilioti, S., Vamvoukas, G. (2015). The impact of government debt on economic growth: An empirical investigation of the Greek market. *The Journal of Economic Asymmetries,* 12, 34–40 https://doi.org/10.1016/j.jeca.2014.10.001

Swamy, V. (2020). Debt and growth: Decomposing the cause and effect relationship. *International Journal of Finance and Economics,* 25(2), 141–156 https://doi.org/10.1002/ijfe.1729

Tamborini, R., Tomaselli, M. (2020). *When does public debt impair economic growth? A literature review in search of a theory*. DEM Working Papers No. 2020/7 https://www.economia.unitn.it/alfresco/download/workspace/SpacesStore/266e0a84-1dfc-44ba-8807-fe7e584c924b/DEM2020_07.pdf

Teles, V. K., Musollini, C. C. (2014). Public debt and the limits of fiscal policy to increase economic growth. *European Economic Review,* 66, 1–15 https://doi.org/10.1016/j.euroecorev.2013.11.003

Turan, T. (2019). The Effects of Public Debt on Economic Growth: A Cointegration Analysis for Turkey. Maliye Dergisi, 177, 1-27. https://ms.hmb.gov.tr/uploads/2020/03/001-Kamu-Borcunun-Ekonomik-B%C3%BCy%C3%BCme.pdf

Woo, J., Kumar, M. S. (2015). Public debt and growth. *Economica*, 82, 705–739 https://doi.org/10.1111/ecca.12138

World Bank (2020). World Development Indicators. Washington: World Bank. https://datacatalog.worldbank.org/dataset/world-development-indicators

Xu, D., Abbasi, K. R., Hussain, K., Albaker, A., Almulhim, A. I., Alvarado, R. (2023). Analyzing the factors contribute to achieving sustainable development goals in Pakistan: A novel policy framework. *Energy Strategy Reviews,* 45, 101050. https://doi.org/10.1016/j.esr.2022.101050

Zheng, L., Abbasi, K. R., Salem, S., Irfan, M., Alvarado, R., Lv, K. (2022). How technological innovation and institutional quality affect sectoral energy consumption in Pakistan? Fresh policy insights from novel econometric approach. *Technological Forecasting and Social Change 183,* 121900. https://doi.org/10.1016/j.techfore.2022.121900