

## Examining the Non-Linear Impact of External Debt on Economic Convergence

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**Abstract** This article investigates the impact of external debt on economic convergence in 201 economies from 1990 to 2020. Panel data collected from the fiscal space database of the World Bank are analyzed using the conditional beta convergence framework. Results show that external debt negatively affects growth and there is no evidence to support the non-linear association. However, external debt influences the convergence speed in an inverted-U-shaped fashion. The economic convergence speeds up as the level of indebtedness increases to a threshold above which the convergence slows down as the level of foreign debts continues to increase. We also disaggregate external debt into its six sub-components and discover the non-linear effects of private debts and debts denominated in domestic currency on the convergence process.

**Keywords:** beta convergence, economic growth, external debt, fixed effects, non-linear

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### I. Introduction

Since the seminal work of Barrow and Sala-i-Martin (1992), several research efforts have been made to investigate the convergence in national incomes. Convergence in the most general sense refers to the process of a gradual reduction of the differences among observed countries within a specified period. For economists, growth convergence implies that less developed countries exhibit faster rates of economic growth than more developed countries.

Broadly speaking, there are two main convergence theories in convergence literature: sigma and beta convergence. *Sigma convergence* refers to the reduction in cross-sectional dispersion of income over time (Quah, 1993) whereas *beta convergence* occurs when economies with initially lower levels of income tend to grow faster than and "catch up" with those with initially higher levels of income (Baumol, 1986; Barro and Sala-i-Martin, 1992). The concept of beta

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convergence is supported by the neoclassical growth model (Solow, 1956) which argues that the source of convergence is the diminishing return of capital. As such, national incomes converge in the long run regardless of the initial conditions—a hypothesis known as *unconditional beta convergence*. This hypothesis is usually tested by regressing the average growth rates on the initial income levels without including other explanatory variables. If national incomes converge in the long-term only providing that their structural conditions (such as technologies, human capital, population growth rates, and legal institutions) are identical, it implies *conditional beta convergence* (Mankiw et al., 1992). The equilibrium differs according to the economy, and each country approaches its unique equilibrium. Regarding conditional convergence, the negative relationship between initial incomes and the average growth rates holds only after controlling for the structural characteristics.

Despite the numerous factors that have been proposed to affect the convergence process, the literature has remained rather silent about the role of debt. When government expenditures exceed revenues, governments borrow to fund public spending. Reasonable borrowing for public and infrastructural development can help to enhance economic growth (Diamond and He, 2014; Fischer, 2018). However, excessive borrowing without planning for investment may cause a heavy debt burden and interest payment, which would be unfavorable for the economy (Munir and Mehmood, 2018). Theoretically, government borrowing is rooted in the neoclassical growth model, which maintains that economies with low productivity and income lack savings and depend on borrowing (especially from abroad) as their means of financing (Yusuf and Mohd, 2021). Developing countries with limited financing options often seek foreign capital such as remittance, financial aid, and external borrowing as a significant source for economic growth and acceleration. Following this reasoning, it would be beneficial to investigate how much of the economic convergence has been debt-led.

Moreover, the literature on the debt-growth nexus has revealed a non-linear relationship between government borrowing and economic growth. In the short run, borrowing has a positive impact on economic growth by stimulating aggregate demand and output (Fischer, 2018). However, too much of a good thing can be harmful as government debt can crowd out private investment and threaten growth through higher long-term interest rates, higher inflation, and higher future distortionary taxation (Rey and Tareque, 2020). Empirical studies have shown that heavy dependence on debt is detrimental to the economy in the long run (Mohsin et al., 2021). Therefore, excessive debts could have repercussions on growth convergence (Rant et al., 2021).

This research combines the two strands of literature on economic growth and the debt-growth nexus by examining the non-linear impacts of external debt in the convergence process among 201 countries from 1990 to 2020. Specifically, we decompose external debt into its sub-components: non-private versus private, short-term versus long-term, and those denominated in domestic versus foreign currency. Debt indicators and their squared terms are included in the conditional

beta convergence specifications to capture the non-linear effects of external debt on economic convergence. Further, to investigate the influence of external debt on the rate of countries' convergence, debt interaction terms are introduced in the conditional beta convergence model. If the coefficients of these interaction terms are significant, there is evidence that external debt influences the convergence speed.

Results from the fixed effects models indicate an inverse relationship between external debt indicators and economic growth. When debt interaction terms are considered, only the coefficient for total debt service is statistically significant and the negative sign implies a positive association between debt service and the convergence rate. The higher the level of debt service, the faster the convergence.

This article makes two contributions. First, it is one of the few studies exploring the influence of external debt on economic convergence. Closely related studies include Wamboye and Tochkov (2015), Munir and Mehmood (2018), and Rant et al. (2021); however, the former study investigates the effects of external debt on the growth of labor productivity while the latter two studies examine total debt. Even though Munir and Mehmood (2018) disaggregate the total debt figure into public and private debt, the role of external debt has been largely ignored. Second, this article disentangles total external debt into its sub-components in our analysis and unlike previous authors (for example, Munir and Mehmood, 2018), we include debt indicators at their lagged values.

The rest of the article is organized as follows. Section 2 discusses related literature, and Section 3 outlines the methodology and describes the data. Section 4 presents the empirical findings and Section 5 concludes the article.

## II. Literature Review

While a government might borrow for several reasons including low government revenue, low levels of domestic investment, budget deficits, or paying off maturing government debt, the underlying reason is the lack of savings and investments (Chenery and Strout, 1966). Governments can borrow in the local or international debt market, often by issuing Treasury bills, Treasury notes, or Treasury bonds. External debt hence represents the amount of debt owed to holders of such government securities. Although the relationship between external debt and economic growth has been investigated in different contexts, the findings are inconsistent.

The first stream in the literature advocates a positive association between economic growth and foreign debt (Demikha et al, 2021; Oberholzer, 2021; Mohamed, 2018; Spilioti and Vamvoukas, 2015). The theoretical framework supporting this view is based on the Keynesian paradigm which suggests that governments' intervention in economic activity may stimulate economic growth. Unfavorable structural conditions especially in developing economies underline the

importance of foreign loans in facilitating infrastructural developments which may contribute to better economic growth if the borrowed funds are used effectively (Agenor and Montiel, 2015). In addition, external financing encourages investment projects and accelerates the dynamic of capital accumulation and thereby economic growth (Gaies and Nabi, 2021).

That said, most studies have uncovered a negative relationship between external debt and economic growth (see, *among others*, Barik and Sahu, 2022; Yasar, 2021; Wang et al., 2021; Makun, 2021; Qureshi and Liaqat, 2020; Abdelhafidh, 2020; Guei, 2019; Hakimi et al., 2019; Onafowora and Owoye, 2019; Al Kharusi and Ada, 2018; Azam, 2016; Dogan and Bilgili, 2014). Such an adverse association can be explained by the "debt overhang" theory which was introduced by Krugman (1988). According to Krugman, "debt overhang" occurs when expected repayments on debt decrease as the amount of debt rises. Once a country's external borrowing is so heavy that the country cannot afford to pay it, incentives for domestic investment will be constrained since returns are expected to be "taxed away" by foreign creditors (Villieu et al, 2014). The reduction in domestic investment will exert a negative impact on growth prospects. In addition, accumulation in foreign debt burden is indicative of a higher default risk, which might become a concern for creditors. Consequently, creditors might require a higher borrowing cost premium and discourage capital flows, impeding future growth potentials (Gaies and Nabi, 2021). Mensah et al. (2017) identify another reason why more debt leads to slower growth. They report that external debt is "consumed" rather than invested in highly indebted poor countries in Africa. This is confirmed by Dey and Tareque (2020), Burnside and Dollar (2004), and Fisher (1993). However, the negative impact of external debt on Gross Domestic Product (GDP) growth is mediated by other factors. For instance, Dey and Tareque (2020) show that high inflation, high budget deficit, and restricted trade may cause macroeconomic instability, which discourages investment. The authors also mention that in the presence of macroeconomic policy, the long-term negative impact of external debt becomes insignificant. According to Ramzan and Ahmad (2014), the negative relationship between external debt and economic growth suggests that the transfer of resources from developed countries to developing countries could be oriented towards their own economic and strategic interests instead of the needs of the recipients.

Finally, a growing body of literature argues that the impact of external debt on economic growth is not linear but follows an inverted-U shape (see, *for example*, Reinhart and Rogoff, 2010; Tanna et al., 2018; Le et al., 2019; Beyene and Kotosz, 2021; Presbitero, 2012) due to the combined effects of the previous two models. Such a non-linear impact is rooted in the principles of the Laffer curve (Krugman, 1988), according to which the larger the total debt, the lower the repaying capability. On one side of the curve, as the number of borrowing increases, so does the economic growth and debt repaying capability. However, after the total debt reaches a certain point (i.e., the optimum debt where the growth potential is maximal), a marginal increase in external debt will lead to slower growth and smaller debt repaying capability.

Thus, the central point of this concept is the assumption of the existence of a critical level of external debt. Thus, several studies have made efforts to find such an optimal debt threshold level. The empirical literature however shows that the turning point is not universal but depends on country-specific characteristics. Beyene and Kotosz (2021) argue that external debt can affect growth through the total factor productivity channel, which is determined by countries' level of external debt stock. The optimal thresholds are considered as the reasons affecting the turning point. Based on the evidence from Sub-Saharan African countries, Hassan and Meyer (2020) suggest that the thresholds beyond which external debt depresses economic growth stand at 47.7% of GDP and 231.5% of exports. Examining a sample of middle- and low-income countries, Zaghdoudi (2020) concludes that when external debt exceeds the level of 15.28%, the impact of external debt on economic growth switches from positive to negative. Moreover, trade openness and foreign direct investment are other determining factors. Furthermore, Yolcu Karadam (2018) argues that the turning point depends on the debt structure. Specifically, the direction of the effect of public debt on growth changes smoothly from positive to negative depending on the level of indebtedness.

### III. Methodology

#### A. Model specification

To examine the impact of external debts on economic growth, we employ the following beta convergence model:

$$GDPGrowth_{i,t} = \alpha + \beta \ln(GDP_{i,t-1}) + \gamma DEBT_{i,t-1} + \psi CONTROLS_{i,t-1} + \rho_t + \sigma_j + \mu_{i,t} \quad (1)$$

where  $GDPGrowth_{i,t}$  represents the growth rate of GDP per capita of country  $i$  in year  $t$ ,  $\ln(GDP_{i,t-1})$  is the natural logarithm of GDP per capita of country  $i$  at the previous period,  $DEBT_{i,t-1}$  represents external debt indicator, which, depending on the specification, is either the total external debt stocks or its sub-components (*Non-private* versus *Private*, *Short-term* versus *Long-term*, and *Foreign* versus *Domestic*),  $CONTROLS_{i,t-1}$  denotes a set of control variables, and  $\mu_{i,t}$  is the robust standard error. We follow the previous literature and incorporate in our model several factors that could affect economic growth (Huffman and Huffman, 2021; Marelli et al., 2019; Wamboye and Tochkov, 2015; Villaverde and Maza, 2011). Specifically, we include population growth (*Population*), the ratio of total government expenditure to GDP (*Government*

Expenditure), the ratio of gross fixed capital formation to GDP (*Domestic Investment*), trade openness (*Openness*), annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*).

Equation (1) shows that a significantly negative  $\beta$  is indicative of beta convergence, meaning that countries with initially lower levels of income exhibit higher growth rates. The estimated  $\beta$  also indicates the rate (i.e., convergence speed) at which countries approach their steady-state levels. If  $\gamma$  and  $\psi$  are restricted to zero, *absolute convergence* is assumed. Providing that  $\gamma$  and  $\psi$  are freely estimated, *conditional convergence* is assumed.

Equation (1) also shows lagged values of the external debt indicator and all control variables in the model specification. This has been the common practice in the empirical literature (Li et al., 2021; Leszczensky and Wolbring, 2019; Bellemare et al., 2017; Wamboye and Tochkov, 2015). It addresses the endogeneity concern resulting from reverse causality bias. In this research, we incorporate year and country-fixed effects in the model. While country fixed effects ( $\sigma_i$ ) control for the unobservable time-invariant heterogeneities among different countries, year fixed effects ( $\rho_t$ ) enable us to control for potential business cycles.

Next, we include a debt interaction term between the external debt indicator and the natural logarithm of the GDP per capita as in the following beta convergence specification:

$$\begin{aligned}
 GDPGrowth_{i,t} = & \alpha + \beta \ln(GDP_{i,t-1}) + \gamma DEBT_{i,t-1} + \delta DEBT_{i,t-1} \\
 & \times \ln(GDP_{i,t-1}) + \psi CONTROLS_{i,t-1} + \rho_t + \sigma_i + \mu_{i,t}
 \end{aligned} \quad (2)$$

The inclusion of a debt interaction variable in Equation (2) helps to investigate whether debt affects the rate of convergence (which is deduced from  $\beta$  coefficient) among the countries in our sample. If  $\delta$  is statistically different from zero, external debt is said to influence the speed at which the convergence process occurs.

In this paper, we extend the linear relationship between external debt and economic growth of Equations (1) and (2) and allow for a quadratic relationship, given a potential U-shaped or inverted-U-shaped association. The quadratic model takes the following forms:

$$\begin{aligned}
 GDPGrowth_{i,t} = & \alpha + \beta \ln(GDP_{i,t-1}) + \gamma DEBT_{i,t-1} + \gamma' DEBT_{i,t-1}^2 \\
 & + \psi CONTROLS_{i,t-1} + \rho_t + \sigma_i + \mu_{i,t}
 \end{aligned} \quad (3)$$

And the quadratic model with interaction effects can then be defined as follows:

$$\begin{aligned}
GDPGrowth_{i,t} = & \alpha + \beta \ln(GDP_{i,t-1}) + \gamma DEBT_{i,t-1} + \gamma' DEBT_{i,t-1}^2 \\
& + \delta DEBT_{i,t-1} \times \ln(GDP_{i,t-1}) + \delta' DEBT_{i,t-1}^2 \\
& \times \ln(GDP_{i,t-1}) + \psi CONTROLS_{i,t-1} + \rho_t + \sigma_i + \mu_{i,t}
\end{aligned} \tag{4}$$

## B. Data

In this research, we employ data from two sources. First, information on external debt stocks as well as the sub-components of external debt is collected from a cross-country database of fiscal space by the World Bank's Prospects Group<sup>1)</sup>. Second, data on GDP per capita and other macroeconomic variables are gathered from the World Development Indicators (WDI) by the World Bank. Overall, our analysis covers 201 countries between 1990 and 2020. The definitions and data sources of these variables are reported in Table 1.

**Table 1.** Variable Definitions

Variable	Definition	Source
<i>GDPGrowth</i>	The annual growth rate of real GDP per capita	WDI
<i>GDP</i>	The natural logarithm of real GDP per capita	WDI
<i>Debt</i>	Total external debt stocks (% of GDP)	Fiscal Space
<i>Non-private</i>	Non-private external debt stocks (% of GDP)	Fiscal Space
<i>Private</i>	Private external debt stocks (% of GDP)	Fiscal Space
<i>Short-term</i>	Short-term external debt stocks (% of total)	Fiscal Space
<i>Long-term</i>	Long-term external debt stocks (% of total)	Fiscal Space
<i>Domestic</i>	External debt stocks in domestic currency (% of total)	Fiscal Space
<i>Foreign</i>	External debt stocks in foreign currency (% of total)	Fiscal Space
<i>Population</i>	Annual growth rate of total population	WDI
<i>Government Expenditure</i>	The ratio of total government expenditure to GDP	WDI
<i>Domestic Investment</i>	The ratio of gross capital formation to GDP	WDI
<i>Openness</i>	The sum of total imports plus export divided by GDP	WDI
<i>Inflation</i>	The annual inflation rate	WDI
<i>Telephone</i>	The natural logarithm of fixed telephone subscriptions	WDI

## IV. Empirical Findings

### A. Descriptive statistics

Table 2 provides some descriptive statistics of our variables. On average, external debt

1) Fiscal space data can be retrieved from the following link: <https://www.worldbank.org/en/research/brief/fiscal-space>

accounts for over 98% of a country's GDP. However, the level of foreign borrowing varies greatly across countries. Some countries seem to not depend on foreign borrowings at all whereas others borrow amounts that are more than 60 times the GDP level. Table 1 also reveals different features of the sub-components of external debt. Overall, almost three-quarters of external debt are from the private sector while public debts account for less than 40%. Long-term debts form an overwhelming majority of the total external debt stocks (84%), 79% of which are denominated in foreign currency. Among the sub-components of external debt, private debts exhibit the greatest disparity across countries given their large standard deviation. Regarding the macroeconomic variables, countries in our sample have grown at an annual speed of 5.3%. Government expenditures and domestic investment on average account for 16% and 22% of the total GDP respectively. Finally, inflation is the most volatile variable based on the standard deviation as well as its maximum and minimum values.

**Table 2.** Descriptive Statistics of the Variables under Examination. The Sample Period Runs From 1990 to 2020

Variable	Obs.	Mean	Standard deviation	Min	Max
<i>GDPGrowth</i>	5723	5.285	15.927	-99.78	294.955
<i>GDP</i>	5932	8.223	1.611	3.127	12.103
<i>Debt</i>	4442	98.885	330.709	.603	6753.44
<i>Non-private</i>	3251	39.745	31.645	.013	255.831
<i>Private</i>	3251	73.589	378.168	0	6537.671
<i>Short-term</i>	4484	16.325	16.162	0	88.983
<i>Long-term</i>	4484	83.675	16.162	11.017	100
<i>Domestic</i>	554	21.189	26.364	0	98.995
<i>Foreign</i>	554	78.811	26.364	1.005	100
<i>Population</i>	6017	1.494	1.560	-10.376	19.139
<i>Government Expenditure</i>	4947	16.463	8.519	.911	147.719
<i>Domestic Investment</i>	4874	22.408	7.857	-2.424	93.547
<i>Openness</i>	5169	85.609	52.518	.021	442.62
<i>Inflation</i>	5843	33.901	460.159	-31.566	26765.858
<i>Telephone</i>	5865	12.734	2.521	3.497	19.723

Table 3 reports the pairwise correlations among the variables under examination. Interestingly, the marginal negative correlation between *GDPGrowth* and *Debt* indicates that countries that experience economic growth tend to borrow less from external sources. Further, this association holds for most categories of debt, except for short-term debts and those denominated in foreign currency. Another interesting observation from Table 3 is that the degree of trade openness of a country is positively correlated with the level of external borrowing as well as most of its sub-components. Overall, the pairwise correlations reported in Table 3 suggest that there is no correlation among the variables (the highest value is observed for external debts and

their private component). Therefore, multicollinearity does not affect our empirical analysis<sup>2)</sup>.

**Table 3.** Correlation Matrix of the Variables under Examination. The sample Period Runs From 1990 to 2020

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) <i>GDPGrowth</i>	1.000														
(2) <i>GDP</i>	-0.029	1.000													
(3) <i>Debt</i>	-0.030	0.254	1.000												
(4) <i>Non-private</i>	-0.125	-0.232	0.208	1.000											
(5) <i>Private</i>	-0.024	0.299	0.997	0.127	1.000										
(6) <i>Short-term</i>	0.032	0.563	0.190	-0.167	0.201	1.000									
(7) <i>Long-term</i>	-0.032	-0.563	-0.190	0.167	-0.201	-1.000	1.000								
(8) <i>Domestic</i>	-0.095	0.573	0.332	0.158	0.300	0.433	-0.433	1.000							
(9) <i>Foreign</i>	0.095	-0.573	-0.332	-0.158	-0.300	-0.433	0.433	-1.000	1.000						
(10) <i>Population</i>	0.005	-0.255	-0.004	0.113	0.003	-0.237	0.237	-0.154	0.154	1.000					
(11) <i>Government Expenditure</i>	-0.091	0.161	0.054	0.028	0.074	0.161	-0.161	0.316	-0.316	-0.139	1.000				
(12) <i>Domestic Investment</i>	0.048	0.114	-0.052	-0.209	-0.048	0.093	-0.093	-0.129	0.129	0.003	0.077	1.000			
(13) <i>Openness</i>	0.016	0.325	0.441	0.025	0.487	0.322	-0.322	0.227	-0.227	-0.063	0.115	0.176	1.000		
(14) <i>Inflation</i>	0.001	-0.079	-0.007	0.029	-0.012	-0.006	0.006	-0.328	0.328	0.009	-0.026	-0.057	-0.012	1.000	
(15) <i>Telephone</i>	0.011	0.408	0.015	-0.306	-0.001	0.455	-0.455	0.208	-0.208	-0.292	-0.068	0.074	-0.111	-0.007	1.000

## B. Results from the fixed effects panel regression

Table 4 reports the results of the baseline models to explore the linear and non-linear impacts of external debts on economic growth. Columns (1) and (2) show the estimation results where *Debt* is included (Equation 1), while columns (3) and (4) present the results of quadratic models when an additional squared term ( $Debt^2$ ) is included (Equation 3). We incorporate country-fixed effects in all models and year fixed effects in half of the models.

From Table 4, the conditional beta coefficient for *GDP* is significantly negative in all models and the estimated value ranges between  $-8.7$  and  $-11.6$ . Therefore, there is a conditional convergence among national incomes, i.e., countries with initially low levels of GDP per capita exhibit higher economic growth rates. The main independent variable of interest (*Debt*) is statistically significant and negative in all models. This points to an adverse association between external debt and economic growth. Thus, foreign borrowing plays a role in economic convergence. However, is the nexus between debt and growth non-linear, meaning that there is a threshold of debt above which debt positively affects growth? As the coefficient for  $Debt^2$  is very close to zero and insignificant at any statistical significance level, we do not find evidence of an inverted-U-shaped relationship between external borrowing and economic growth.

2) We also calculated the Variance Inflation Factors (VIF) and the results indicate that our models do not suffer from multicollinearity. These results are available upon request.

**Table 4.** Impact of External Debt on Economic Convergence: Linear and Quadratic Models. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>GDP</i>	-8.687*** (0.761)	-11.583*** (1.772)	-8.694*** (0.761)	-11.653*** (1.781)
<i>Debt</i>	-0.006*** (0.002)	-0.004*** (0.001)	-0.011* (0.006)	-0.012** (0.006)
<i>Debt</i> <sup>2</sup>			6.64×10 <sup>-7</sup> (6.64×10 <sup>-7</sup> )	9.5×10 <sup>-7</sup> (5.85×10 <sup>-7</sup> )
<i>Population</i>	-0.265 (0.688)	-0.022 (0.620)	-0.267 (0.689)	-0.023 (0.620)
<i>Government Expenditure</i>	-0.430*** (0.152)	-0.327** (0.150)	-0.432*** (0.151)	-0.332** (0.149)
<i>Domestic Investment</i>	0.110* (0.061)	0.070 (0.055)	0.103* (0.062)	0.060 (0.056)
<i>Openness</i>	0.114*** (0.020)	0.105*** (0.019)	0.115*** (0.020)	0.107*** (0.019)
<i>Inflation</i>	-0.002** (0.001)	-0.002** (0.001)	-0.002** (0.001)	-0.002** (0.001)
<i>Telephone</i>	4.735*** (0.558)	0.566 (0.551)	4.691*** (0.557)	0.518 (0.552)
Constant	7.497 (7.783)	85.249*** (14.358)	8.715 (7.862)	87.336*** (14.652)
Country FEs	YES	YES	YES	YES
Year FEs	NO	YES	NO	YES
Observations	3,488	3,488	3,488	3,488
R-squared	0.140	0.342	0.140	0.343

*Note.* All models are estimated with country-fixed effects and robust standard errors. Year fixed effects are included in models (2) and (4). The dependent variable is the annual growth rate (log difference) of the real GDP per capita (*GDPGrowth*). Independent variables are the beginning of the period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), total external debt stocks (*Debt*), squared term of total external debt stocks (*Debt*<sup>2</sup>), annual growth rate (log difference) of the total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by the ratio of exports and imports to GDP, the annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

Considering the control variables, the impacts of *Government Expenditure*, *Openness*, and *Inflation* are highly significant in all models. While the intensity of trade has a positive influence, the level of government expenditure and inflation exert negative effects. These results imply that outward-oriented economies grow faster than inward-oriented countries, whereas expenditures and inflation appear to reduce growth. These impacts align with previous studies (Demikha et al., 2021; Rant et al., 2021; Hakimi et al., 2019).

So far, we have found evidence suggesting that external debt influences the process of convergence of national incomes. Next, we examine whether external debt influences the convergence rate by estimating a beta convergence specification with interaction effects as shown in Equations (2) and (4). The estimation results are displayed in Table 5. Columns (1) and (2) report the results of the models with an interaction term between the debt indicator and the natural logarithm of GDP per capita. Columns (3) and (4) report the results of the models with an additional interaction term between the squared debt indicator and the natural logarithm of GDP per capita. The conditional beta coefficient is still significantly negative, suggesting the conditional beta convergence process at place. In addition, Table 5 shows that the debt indicator and debt interaction terms are only significant in Column (4). The negative sign of  $GDP \times Debt$  and the positive sign of  $GDP \times Debt^2$  suggest that external debt does affect the convergence speed and such an influence follows an inverted-U shape. That is, the convergence rate rises as the level of indebtedness increases to a threshold above which the convergence process slows down as the level of debts continue to go up. We further calculate the turning point and it is revealed that when the amount of foreign borrowing exceeds the GDP figure 22.5 times, the association between external debts and the convergence speed switches from being positive to negative.

**Table 5.** Impact of External Debt on Economic Convergence: Interaction Effects. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>GDP</i>	-8.560*** (0.804)	-11.510*** (1.786)	-8.322*** (0.853)	-11.400*** (1.787)
<i>Debt</i>	0.011 (0.027)	0.012 (0.025)	0.028 (0.038)	0.068* (0.037)
<i>GDP</i> × <i>Debt</i>	-0.002 (0.002)	-0.001 (0.002)	-0.004 (0.004)	-0.009** (0.004)
<i>Debt</i> <sup>2</sup>			0.000009 (0.00001)	-0.00002* (0.00001)
<i>GDP</i> × <i>Debt</i> <sup>2</sup>			-5.95×10 <sup>-7</sup> (0.000001)	0.000002** (0.000001)
<i>Population</i>	-0.279 (0.686)	-0.033 (0.619)	-0.305 (0.692)	-0.117 (0.620)
<i>Government Expenditure</i>	-0.423*** (0.150)	-0.320** (0.147)	-0.417*** (0.149)	-0.304** (0.146)
<i>Domestic Investment</i>	0.117* (0.062)	0.077 (0.056)	0.110* (0.063)	0.074 (0.056)
<i>Openness</i>	0.114*** (0.020)	0.105*** (0.019)	0.117*** (0.020)	0.108*** (0.019)

Table 5. Continued

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>Inflation</i>	-0.002** (0.001)	-0.002** (0.001)	-0.002** (0.001)	-0.002** (0.001)
<i>Telephone</i>	4.768*** (0.554)	0.583 (0.552)	4.705*** (0.556)	0.503 (0.552)
Constant	5.455 (8.233)	83.923*** (14.666)	4.966 (8.410)	84.731*** (14.747)
Country FEs	YES	YES	YES	YES
Year FEs	NO	YES	NO	YES
Observations	3,488	3,488	3,488	3,488
R-squared	0.140	0.342	0.141	0.345

Note. All models are estimated with country-fixed effects and robust standard errors. Year fixed effects are included in models (2) and (4). The dependent variable is the annual growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are the beginning of the period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), total external debt stocks (*Debt*), squared term of total external debt stocks ( $Debt^2$ ), the interaction of total external debt stocks with the natural logarithm of real GDP per capita ( $GDP \times Debt$ ), the interaction of squared term of total external debt stocks with the natural logarithm of real GDP per capita ( $GDP \times Debt^2$ ), annual growth rate (log difference) of the total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by the ratio of exports and imports to GDP, the annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

As there is empirical evidence for the influence of external debts on economic convergence, we thoroughly investigate the impacts of sub-components of debts. Specifically, we decompose total external debt stocks into private versus non-private debts, short-term versus long-term debts, and debts in domestic currency versus those in foreign currency using these categorizations, we then estimate six models based on Equation (1) by varying the debt variables. The estimation results of linear and quadratic models are displayed in Table 6. Both country and year fixed effects are included in all models.

Table 6 shows that five out of six sub-components of external debts significantly impact the process of convergence of national incomes. Furthermore, the effects are not homogenous across the sub-components. While short-term debts and those denominated in domestic currency exhibit positive impacts, private, long-term debts and those denominated in foreign currency exhibit negative impacts. As short-term debt financing has been shown to positively influence firm profitability (Diamond and He, 2014), the positive sign reported in Column (3) is not unexpected. Conversely, the opposite signs of the coefficients of long-term and short-term debts may imply the lower cost of short-term liabilities than long-term sources of funds. While the coefficients of non-private debts are not statistically significant, the negative sign of the coefficient of private debts is consistent with what was documented by Silva (2020) in the Portuguese context. This result could point to the detrimental effect of private external debt on private

investment. Finally, we find that external debts denominated in domestic currency and positively impact growth whilst the reverse holds for external debts denominated in foreign currency.

**Table 6.** *Impact of Sub-Components of External Debt on Economic Convergence: Linear Models. The Sample Period Runs From 1990 to 2020*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-10.367*** (2.200)	-10.244*** (2.157)	-12.042*** (1.800)	-12.042*** (1.800)	-14.335*** (3.209)	-14.335*** (3.209)
<i>Non-private</i>	-0.010 (0.015)					
<i>Private</i>		-0.005*** (0.001)				
<i>Short-term</i>			0.123*** (0.041)			
<i>Long-term</i>				-0.123*** (0.041)		
<i>Domestic</i>					0.153** (0.073)	
<i>Foreign</i>						-0.153** (0.073)
<i>Population</i>	-0.479 (0.590)	-0.437 (0.586)	0.094 (0.612)	0.094 (0.612)	-2.715** (1.184)	-2.715** (1.184)
<i>Government Expenditure</i>	-0.548*** (0.209)	-0.539** (0.210)	-0.329** (0.149)	-0.329** (0.149)	0.068 (0.336)	0.068 (0.336)
<i>Domestic Investment</i>	0.129* (0.073)	0.130* (0.071)	0.072 (0.055)	0.072 (0.055)	0.113 (0.185)	0.113 (0.185)
<i>Openness</i>	0.111*** (0.019)	0.117*** (0.020)	0.100*** (0.019)	0.100*** (0.019)	0.091* (0.051)	0.091* (0.051)
<i>Inflation</i>	-0.002 (0.002)	-0.002 (0.002)	-0.002*** (0.0005)	-0.002*** (0.0005)	0.059 (0.120)	0.059 (0.120)
<i>Telephone</i>	0.202 (0.870)	0.269 (0.860)	0.542 (0.554)	0.542 (0.554)	-3.700 (3.254)	-3.700 (3.254)
Constant	85.704*** (21.334)	83.041*** (20.308)	86.705*** (14.485)	98.988*** (16.808)	178.122*** (58.162)	193.462*** (59.221)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	2,723	2,723	3,477	3,477	506	506
R-squared	0.372	0.373	0.347	0.347	0.650	0.650

*Note.* All models are estimated with country and year fixed effects. The dependent variable is the annual growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are the beginning of the period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debt stocks as % of GDP (*Non-private*), private external debt stocks as % of GDP (*Private*), short-term external debts as % of total external debt stocks (*Short-term*), long-term external debts as % of total external debt stocks (*Long-term*), % of external debt stocks in domestic currency (*Domestic*), % of external debt stocks in foreign currency (*Foreign*), annual growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by the ratio of exports and imports to GDP, the annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table 7.** Impact of Sub-Components of External Debts on Economic Convergence: Quadratic Models. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-10.403*** (2.204)	-10.258*** (2.156)	-12.184*** (1.805)	-12.184*** (1.805)	-14.540*** (3.186)	-14.540*** (3.186)
<i>Non-private</i>	-0.038 (0.032)					
<i>Non-private</i> <sup>2</sup>	0.0002 (0.0002)					
<i>Private</i>		-0.018*** (0.005)				
<i>Private</i> <sup>2</sup>		0.000002*** (5.09×10 <sup>-7</sup> )				
<i>Short-term</i>			0.204** (0.087)			
<i>Short-term</i> <sup>2</sup>			-0.001 (0.001)			
<i>Long-term</i>				0.077 (0.200)		
<i>Long-term</i> <sup>2</sup>				-0.001 (0.001)		
<i>Domestic</i>					0.304*** (0.115)	
<i>Domestic</i> <sup>2</sup>					-0.003* (0.002)	
<i>Foreign</i>						0.258 (0.224)
<i>Foreign</i> <sup>2</sup>						-0.003* (0.002)
<i>Population</i>	-0.493 (0.586)	-0.500 (0.588)	0.121 (0.610)	0.121 (0.610)	-2.689** (1.171)	-2.689** (1.171)
<i>Government Expenditure</i>	-0.554*** (0.208)	-0.533** (0.210)	-0.318** (0.148)	-0.318** (0.148)	0.067 (0.337)	0.067 (0.337)
<i>Domestic Investment</i>	0.129* (0.073)	0.123* (0.072)	0.072 (0.055)	0.072 (0.055)	0.114 (0.185)	0.114 (0.185)
<i>Openness</i>	0.112*** (0.019)	0.119*** (0.020)	0.100*** (0.019)	0.100*** (0.019)	0.089* (0.051)	0.089* (0.051)
<i>Inflation</i>	-0.002 (0.002)	-0.002 (0.002)	-0.002*** (0.0005)	-0.002*** (0.0005)	0.069 (0.121)	0.069 (0.121)
<i>Telephone</i>	0.079 (0.868)	0.177 (0.861)	0.543 (0.555)	0.543 (0.555)	-4.201 (3.302)	-4.201 (3.302)
Constant	88.361*** (21.335)	85.274*** (20.417)	87.003*** (14.511)	93.337*** (17.299)	187.688*** (58.823)	189.986*** (58.752)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES

Table 7. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
Observations	2,723	2,723	3,477	3,477	506	506
R-squared	0.372	0.374	0.347	0.347	0.652	0.652

*Note.* All models are estimated with country and year fixed effects. The dependent variable is the annual growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debts as % of GDP (*Non-private*), squared term of non-private external debts (*Non-private*<sup>2</sup>), private external debts as % of GDP (*Private*), squared term of private external debts (*Private*<sup>2</sup>), short-term external debts as % of total external debt stocks (*Short-term*), squared term of short-term external debts (*Short-term*<sup>2</sup>), long-term external debts as % of total external debt stocks (*Long-term*), squared term of long-term external debts (*Long-term*<sup>2</sup>), % of external debt stocks in domestic currency (*Domestic*), squared term of external debts in domestic currency (*Domestic*<sup>2</sup>), % of external debt stocks in foreign currency (*Foreign*), squared term of external debts in foreign currency (*Foreign*<sup>2</sup>), annual growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

To examine the non-linear effects of different sub-components of external debt, we examine a quadratic model with the inclusion of squared term of debt indicator and an interaction model incorporating the interaction of different debt sub-component and the natural logarithm of GDP per capita as shown in Equations (3) and (2). The estimation results are displayed in Tables 7 and 8. The coefficients reported in Table 7 show evidence of the non-linear influence of private debts and those denominated in domestic currency. The positive sign of the debt component but a negative sign of the squared term of debt imply that the influence of these two sub-components follows a U-shaped curve. That is, as external debt rises, economic growth first decreases and then increases. At first glance, this seems inconsistent with the Laffer curve theory which advocates an inverted U-shaped curve depicting the debt-growth nexus. However, our results are supported by Ly (2021) who also documents a U-shaped curve explaining the pattern of economic growth based on a sample of 145 advanced and developing countries. The author further argues that at first, higher levels of debt reduce the debt rating, which in turn, hinders economic growth. For a sufficient supply of debts, more debts raise the debt rating, which helps to improve the economic growth rate.

**Table 8.** Impact of Sub-Components of External Debt on Economic Convergence: Linear Models with Interaction Effects. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-9.933*** (2.176)	-10.264*** (2.159)	-10.934*** (1.753)	-18.200*** (3.874)	-14.212*** (3.205)	-18.707*** (5.894)
<i>Non-private</i>	0.122** (0.059)					
<i>GDP×Non-private</i>	-0.016*** (0.006)					
<i>Private</i>		0.014 (0.023)				
<i>GDP×Private</i>		-0.002 (0.002)				
<i>Short-term</i>			0.712** (0.326)			
<i>GDP×Short-term</i>			-0.073** (0.036)			
<i>Long-term</i>				-0.712** (0.326)		
<i>GDP×Long-term</i>				0.073** (0.036)		
<i>Domestic</i>					0.590 (0.510)	
<i>GDP×Domestic</i>					-0.045 (0.050)	
<i>Foreign</i>						-0.590 (0.510)
<i>GDP×Foreign</i>						0.045 (0.050)
<i>Population</i>	-0.583 (0.580)	-0.417 (0.587)	0.038 (0.621)	0.038 (0.621)	-2.711** (1.166)	-2.711** (1.166)
<i>Government Expenditure</i>	-0.550*** (0.208)	-0.539** (0.210)	-0.324** (0.149)	-0.324** (0.149)	0.069 (0.336)	0.069 (0.336)
<i>Domestic Investment</i>	0.131* (0.073)	0.131* (0.072)	0.078 (0.054)	0.078 (0.054)	0.108 (0.185)	0.108 (0.185)
<i>Openness</i>	0.117*** (0.019)	0.116*** (0.020)	0.095*** (0.019)	0.095*** (0.019)	0.096* (0.052)	0.096* (0.052)
<i>Inflation</i>	-0.002 (0.002)	-0.002 (0.002)	-0.002*** (0.0005)	-0.002*** (0.0005)	0.067 (0.122)	0.067 (0.122)
<i>Telephone</i>	0.365 (0.882)	0.275 (0.860)	0.421 (0.573)	0.421 (0.573)	-3.678 (3.249)	-3.678 (3.249)

Table 8. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Constant</i>	79.348*** (21.311)	82.970*** (20.317)	80.771*** (13.506)	151.965*** (38.017)	176.379*** (57.874)	235.344*** (82.274)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	2,723	2,723	3,477	3,477	506	506
R-squared	0.373	0.373	0.351	0.351	0.651	0.651

*Note.* All models are estimated with country and year fixed effects. The dependent variable is the annual growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debts as % of GDP (*Non-private*), interaction of non-private external debts with natural logarithm of real GDP per capita (*GDP×Non-private*), private external debts as % of GDP (*Private*), interaction of private external debts with natural logarithm of real GDP per capita (*GDP×Private*), short-term external debts as % of total external debt stocks (*Short-term*), interaction of short-term external debts with natural logarithm of real GDP per capita (*GDP×Short-term*), long-term external debts as % of total external debt stocks (*Long-term*), interaction of long-term external debts with natural logarithm of real GDP per capita (*GDP×Long-term*), % of external debt stocks in domestic currency (*Domestic*), interaction of external debts in domestic currency with natural logarithm of real GDP per capita (*GDP×Domestic*), % of external debt stocks in foreign currency (*Foreign*), interaction of external debts in foreign currency with natural logarithm of real GDP per capita (*GDP×Foreign*), annual growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

In Table 8, the coefficients for the interaction terms between either non-private debts or short-term debts and the natural logarithm of GDP per capita are negative, implying larger convergence rates. Conversely, the coefficient for the interaction term of long-term debts is positive, meaning that long-term debts negatively influence the speed of convergence. But are these effects non-linear?

In exploring non-linearity in the influence of sub-components of debts on the convergence rate, we further incorporate the interaction of the squared term of debts in the conditional beta convergence model. Specifically, we estimate Equation (4) including one sub-component of external debt at a time, and the estimation results using country and year fixed effects are reported in Table 9. Among the six sub-components, private debts, and those denominated in domestic as well as foreign currencies are found to exert non-linear impacts on the rate of convergence. Moreover, the signs of the coefficients suggest that these impacts follow a U-shaped curve. In other words, the rate of convergence among economies slows down as the level of private debts increases to a threshold, after which a higher supply of private debts leads to an acceleration of economic convergence. As a final step, the tipping point is calculated and it is revealed at the level of 2125, 30.88, and 71.25 percent for private debts, debts in domestic currency, and debts in foreign currency respectively.

**Table 9.** Impact of Sub-Components of External Debt on Economic Convergence: Quadratic Models with Interaction Effects. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-9.939***	-10.479***	-10.462***	-12.382*	-13.637***	2.529
	(2.098)	(2.171)	(1.773)	(6.489)	(3.187)	(9.774)
<i>Non-private</i>	0.102					
	(0.217)					
<i>GDP</i> × <i>Non-private</i>	-0.018					
	(0.025)					
<i>Non-private</i> <sup>2</sup>	0.0002					
	(0.001)					
<i>GDP</i> × <i>Non-private</i> <sup>2</sup>	0.000007					
	(0.0001)					
<i>Private</i>		0.161**				
		(0.067)				
<i>GDP</i> × <i>Private</i>		-0.017***				
		(0.006)				
<i>Private</i> <sup>2</sup>		-0.00005**				
		(0.00002)				
<i>GDP</i> × <i>Private</i> <sup>2</sup>		0.000004**				
		(0.000002)				
<i>Short-term</i>			1.422*			
			(0.780)			
<i>GDP</i> × <i>Short-term</i>			-0.159*			
			(0.091)			
<i>Short-term</i> <sup>2</sup>			-0.012			
			(0.012)			
<i>GDP</i> × <i>Short-term</i> <sup>2</sup>			0.001			
			(0.001)			
<i>Long-term</i>				0.927		
				(1.685)		
<i>GDP</i> × <i>Long-term</i>				-0.120		
				(0.185)		
<i>Long-term</i> <sup>2</sup>				-0.012		
				(0.012)		
<i>GDP</i> × <i>Long-term</i> <sup>2</sup>				0.001		
				(0.001)		
<i>Domestic</i>					2.744**	
					(1.112)	
<i>GDP</i> × <i>Domestic</i>					-0.247**	
					(0.110)	
<i>Domestic</i> <sup>2</sup>					-0.043**	
					(0.017)	

Table 9. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i> × <i>Domestic</i> <sup>2</sup>					0.004** (0.002)	
<i>Foreign</i>						5.877** (2.532)
<i>GDP</i> × <i>Foreign</i>						−0.570** (0.246)
<i>Foreign</i> <sup>2</sup>						−0.043** (0.017)
<i>GDP</i> × <i>Foreign</i> <sup>2</sup>						0.004** (0.002)
<i>Population</i>	−0.605 (0.575)	−0.515 (0.595)	0.072 (0.621)	0.072 (0.621)	−2.479** (1.174)	−2.479** (1.174)
<i>Government Expenditure</i>	−0.557*** (0.208)	−0.526** (0.210)	−0.297** (0.145)	−0.297** (0.145)	0.156 (0.340)	0.156 (0.340)
<i>Domestic Investment</i>	0.131* (0.073)	0.126* (0.072)	0.076 (0.054)	0.076 (0.054)	0.056 (0.187)	0.056 (0.187)
<i>Openness</i>	0.119*** (0.019)	0.117*** (0.020)	0.094*** (0.019)	0.094*** (0.019)	0.101** (0.051)	0.101** (0.051)
<i>Inflation</i>	−0.002 (0.002)	−0.002 (0.002)	−0.002*** (0.0005)	−0.002*** (0.0005)	0.085 (0.123)	0.085 (0.123)
<i>Telephone</i>	0.221 (0.870)	0.092 (0.860)	0.338 (0.588)	0.338 (0.588)	−4.038 (3.308)	−4.038 (3.308)
<i>Constant</i>	82.225*** (19.870)	88.074*** (20.523)	77.913*** (13.138)	102.674* (61.358)	174.497*** (59.355)	17.885 (118.366)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	2,723	2,723	3,477	3,477	506	506
R-squared	0.374	0.375	0.352	0.352	0.655	0.655

Note. All models are estimated with country and year fixed effects. The dependent variable is the annual growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debts as % of GDP (*Non-private*), private external debts as % of GDP (*Private*), short-term external debts as % of total external debt stocks (*Short-term*), long-term external debts as % of total external debt stocks (*Long-term*), % of external debt stocks in domestic currency (*Domestic*), % of external debt stocks in foreign currency (*Foreign*), squared terms of sub-components of external debts (*Non-private*<sup>2</sup>, *Private*<sup>2</sup>, *Short-term*<sup>2</sup>, *Long-term*<sup>2</sup>, *Domestic*<sup>2</sup>, *Foreign*<sup>2</sup>), interaction of sub-components of external debts with natural logarithm of real GDP per capita (*GDP*×*Non-private*, *GDP*×*Private*, *GDP*×*Short-term*, *GDP*×*Long-term*, *GDP*×*Domestic*, *GDP*×*Foreign*), interaction of squared term of sub-components of external debts with natural logarithm of real GDP per capita (*GDP*×*Non-private*<sup>2</sup>, *GDP*×*Private*<sup>2</sup>, *GDP*×*Short-term*<sup>2</sup>, *GDP*×*Long-term*<sup>2</sup>, *GDP*×*Domestic*<sup>2</sup>, *GDP*×*Foreign*<sup>2</sup>), annual growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the annual inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

### C. Robustness check

In the previous section, we regressed the one-year growth rate of income on the GDP per capita at the beginning period (1-year lagged value) using country-fixed effects. We also incorporated year fixed effects to control for the long-run relationship in the data instead of following the multi-year averaging approach often seen in previous studies. As a robustness test, we check whether our main results are valid if multi-year averages are utilized. Therefore, we employ three-year growth averages as a typical five-year averaging method that would lead to an excessive loss of observations, causing difficulties in obtaining meaningful inference (Wamboye and Tochkov, 2015; Rant et al., 2021). These results are reported in Appendix Tables A1-A6. Overall, robustness checks using a three-year average largely support our main findings in the previous section when a one-year growth rate was employed.

We also conduct another robustness test to further address the endogeneity issue. This stems from the fact that the previous year's GDP growth rate could affect the current year's GDP growth rate. Therefore, we re-check our main findings by using the two-step system Generalized Method of Moments (GMM) estimator to estimate the dynamic specification of models (1-4). The two-step system GMM estimator (Blundell and Bond, 1998) is suitable for dynamic panel data sets characterized by many individuals (countries) relative to the time (years) (Roodman, 2006) and where variables exhibit some persistence over time. In addition, the two-step system GMM estimator is preferred over Arellano and Bond's (1991) first difference GMM estimator when the panel data set is unbalanced (Roodman, 2009). To determine the suitability of the two-step system GMM estimator, we employ three diagnostics tests: (i) the Arellano-Bond test of the first-order serial correlation in the first-differenced error term-AR(1); (ii) the Arellano-Bond test of the second-order autocorrelation in the first-differenced error term-AR(2); and (iii) the Sargan/Hansen test of over-identifying restrictions (OID). The estimation results are displayed in Table B1-5. Overall, robustness checks using the GMM method largely corroborate our main findings.

As the final robustness test, we examine if there are heterogeneities in our results due to the long sample period (1990-2020). One could argue that over the past three decades, the relationship between the dependent variable and independent variables in our regression models could be prone to specific global events. Specifically, the major important ones include the Asian crises (1997-1998), the Dot-com bubble (2000-2002), the global financial crisis (2007-2008), and the EU sovereign debt crisis (2009-2011). To verify our results in light of these specific events, we attempt several specifications of the regression equations in which we exclude observations from the years of crisis and as can be seen from Tables C1-5, our results remain consistent. This suggests that the above global specific events do not significantly impact our regression results, therefore, the interpretations of our findings remain rigorous.

## V. Conclusion

In this paper, we investigate the non-linear impact of external debt on economic convergence based on a sample of 201 countries from 1990 to 2020. Results from fixed effects models show that external debts are an important determinant of economic growth in the long run. Broadly speaking, external debt and economic growth are adversely related; yet, we do not find evidence for an inverted-U-shaped relationship between them. This finding suggests that on average, countries in our sample have entered the zone of external "debt overhang."

We further explore the effects of external debt on the convergence speed and the results reveal a non-linear impact. The economic convergence speeds up as the level of indebtedness increases to a threshold above which the convergence process slows down as the level of debts continues to go up. On the one hand, this pattern provides important evidence that much of the economic convergence in the past has been debt-led. On the other hand, the non-linear impacts of rising external debt represent a cause of economic fragility.

One major contribution of this research is the disentanglement of the impacts of external debts by examining different sub-components. Results from the conditional beta convergence specifications show that short-term debts and those denominated in domestic currency exhibit positive impacts on the growth potential whereas private, long-term debts and those denominated in foreign currency exhibit negative impacts. When the quadratic models are employed, the estimation results point to the non-linear influence of private debts and those denominated in domestic currency. Finally, when the interaction terms are incorporated into the regression models, we find that private debts and debts denominated in domestic as well as foreign currencies influence the rate of convergence in a U-shaped fashion.

Overall, the findings of this study have significant policy implications. First, countries especially developing and emerging economies should consider external debt carefully as it exerts an important impact on economic growth. Even though external debt can help boost the economic convergence process in which lower-income countries are "catching up" with higher-income countries, its effect is detrimental in the long term and over-reliance on foreign borrowing can hamper the growth prospect. Second, not all external debts are alike. Using short-term debts is less troublesome for economic growth; yet, countries should pay more attention when debts come from the private sector or are denominated in foreign currency.

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## Appendix

**Table A1.** *Impact of External Debt on Economic Convergence: Linear and Quadratic Models using 3-Year Growth Rate Averages. The Sample Period Runs From 1990 to 2020*

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>GDP</i>	-7.038*** (0.908)	-5.806*** (1.438)	-7.041*** (0.908)	-5.761*** (1.434)
<i>Debt</i>	-0.003** (0.002)	0.002 (0.001)	-0.009 (0.010)	0.006 (0.009)
<i>Debt</i> <sup>2</sup>			6.12×10 <sup>-7</sup> (0.000001)	-4.61×10 <sup>-7</sup> (8.94×10 <sup>-7</sup> )
<i>Population</i>	0.071 (0.188)	0.010 (0.145)	0.073 (0.188)	0.008 (0.145)
<i>Government Expenditure</i>	-0.357** (0.175)	-0.193 (0.146)	-0.362** (0.174)	-0.188 (0.144)
<i>Domestic Investment</i>	0.157* (0.086)	0.093 (0.072)	0.150* (0.088)	0.099 (0.073)
<i>Openness</i>	0.093*** (0.028)	0.056** (0.024)	0.094*** (0.028)	0.055** (0.024)
<i>Inflation</i>	-0.009** (0.004)	-0.007** (0.003)	-0.009** (0.004)	-0.006** (0.003)
<i>Telephone</i>	4.240*** (0.749)	-1.120 (0.782)	4.192*** (0.756)	-1.094 (0.787)
<i>Constant</i>	0.129 (9.257)	63.077*** (13.895)	1.375 (9.448)	61.891*** (14.031)
Country FEs	YES	YES	YES	YES
Year FEs	NO	YES	NO	YES
Observations	1,092	1,092	1,092	1,092
R-squared	0.212	0.485	0.212	0.486

*Note.* All models are estimated with country-fixed effects and robust standard errors. Year fixed effects are included in models (2) and (4). The dependent variable is the three-year average growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (3-year lagged): natural logarithm of real GDP per capita (*GDP*), total external debt stocks (*Debt*), squared term of total external debt stocks (*Debt*<sup>2</sup>), growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table A2.** Impact of External Debt on Economic Convergence: Interaction Effects using 3-Year Growth Rate Averages. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>GDP</i>	-7.196*** (0.960)	-5.786*** (1.434)	-7.207*** (1.056)	-5.830*** (1.434)
<i>Debt</i>	-0.025 (0.039)	0.006 (0.038)	-0.029 (0.064)	-0.020 (0.064)
<i>GDP</i> × <i>Debt</i>	0.002 (0.003)	-0.0003 (0.003)	0.002 (0.006)	0.003 (0.006)
<i>Debt</i> <sup>2</sup>			0.000005 (0.00002)	0.00001 (0.00002)
<i>GDP</i> × <i>Debt</i> <sup>2</sup>			-4.51×10 <sup>-7</sup> (0.000002)	-0.000001 (0.000002)
<i>Population</i>	0.074 (0.187)	0.010 (0.144)	0.077 (0.185)	0.015 (0.144)
<i>Government Expenditure</i>	-0.370** (0.175)	-0.190 (0.143)	-0.372** (0.177)	-0.200 (0.144)
<i>Domestic Investment</i>	0.148* (0.088)	0.095 (0.073)	0.145 (0.089)	0.094 (0.074)
<i>Openness</i>	0.092*** (0.028)	0.056** (0.024)	0.092*** (0.029)	0.055** (0.024)
<i>Inflation</i>	-0.010** (0.004)	-0.006** (0.003)	-0.010** (0.004)	-0.007** (0.003)
<i>Telephone</i>	4.201*** (0.747)	-1.116 (0.784)	4.184*** (0.755)	-1.094 (0.786)
<i>Constant</i>	2.757 (10.283)	62.716*** (14.001)	3.256 (11.290)	62.830*** (14.204)
Country FEs	YES	YES	YES	YES
Year FEs	NO	YES	NO	YES
Observations	1,092	1,092	1,092	1,092
R-squared	0.212	0.485	0.212	0.486

*Note.* All models are estimated with country-fixed effects and robust standard errors. Year fixed effects are included in models (2) and (4). The dependent variable is the three-year average growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (3-year lagged): natural logarithm of real GDP per capita (*GDP*), total external debt stocks (*Debt*), squared term of total external debt stocks (*Debt*<sup>2</sup>), interaction of total external debt stocks with natural logarithm of real GDP per capita (*GDP*×*Debt*), interaction of squared term of total external debt stocks with natural logarithm of real GDP per capita (*GDP*×*Debt*<sup>2</sup>), growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table A3.** Impact of Sub-Components of External Debt on Economic Convergence: Linear Models using 3-Year Growth Rate Averages. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-6.455*** (1.473)	-6.909*** (1.485)	-7.199*** (1.809)	-7.199*** (1.809)	-16.210** (6.547)	-16.210** (6.547)
<i>Non-private</i>	0.045** (0.019)					
<i>Private</i>		0.002 (0.001)				
<i>Short-term</i>			0.074* (0.038)			
<i>Long-term</i>				-0.074* (0.038)		
<i>Domestic</i>					0.149 (0.146)	
<i>Foreign</i>						-0.149 (0.146)
<i>Population</i>	0.205 (0.263)	0.192 (0.267)	-0.287 (0.263)	-0.287 (0.263)	0.398 (0.844)	0.398 (0.844)
<i>Government Expenditure</i>	-0.217 (0.200)	-0.269 (0.203)	-0.199 (0.147)	-0.199 (0.147)	-0.570 (0.515)	-0.570 (0.515)
<i>Domestic Investment</i>	0.154* (0.093)	0.117 (0.091)	0.090 (0.075)	0.090 (0.075)	-0.260 (0.260)	-0.260 (0.260)
<i>Openness</i>	0.062** (0.026)	0.070*** (0.027)	0.047* (0.025)	0.047* (0.025)	0.031 (0.087)	0.031 (0.087)
<i>Inflation</i>	-0.003 (0.002)	-0.004* (0.002)	-0.00004 (0.001)	-0.00004 (0.001)	0.343 (0.212)	0.343 (0.212)
<i>Telephone</i>	-0.800 (1.025)	-1.013 (1.036)	-1.320* (0.778)	-1.320* (0.778)	-6.255 (6.169)	-6.255 (6.169)
<i>Constant</i>	63.055*** (18.151)	72.389*** (17.730)	77.820*** (16.315)	85.222*** (17.292)	254.938** (116.508)	269.873** (118.973)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	845	845	1,089	1,089	152	152
R-squared	0.536	0.533	0.468	0.468	0.695	0.695

*Note.* All models are estimated with country and year fixed effects. The dependent variable is the three-year average growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (3-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debt stocks as % of GDP (*Non-private*), private external debt stocks as % of GDP (*Private*), short-term external debts as % of total external debt stocks (*Short-term*), long-term external debts as % of total external debt stocks (*Long-term*), % of external debt stocks in domestic currency (*Domestic*), % of external debt stocks in foreign currency (*Foreign*), growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table A4.** Impact of Sub-Components of External Debts on Economic Convergence: Quadratic Models using 3-Year Growth Rate Averages. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-6.457*** (1.478)	-6.888*** (1.486)	-7.331*** (1.819)	-7.331*** (1.819)	-15.660** (6.354)	-15.660** (6.354)
<i>Non-private</i>	0.044 (0.045)					
<i>Non-private</i> <sup>2</sup>	0.000007 (0.0003)					
<i>Private</i>		0.006 (0.008)				
<i>Private</i> <sup>2</sup>		-5.27×10 <sup>-7</sup> (8.32×10 <sup>-7</sup> )				
<i>Short-term</i>			0.159* (0.091)			
<i>Short-term</i> <sup>2</sup>			-0.002 (0.001)			
<i>Long-term</i>				0.141 (0.190)		
<i>Long-term</i> <sup>2</sup>				-0.002 (0.001)		
<i>Domestic</i>					-0.154 (0.246)	
<i>Domestic</i> <sup>2</sup>					0.006* (0.003)	
<i>Foreign</i>						-1.098** (0.518)
<i>Foreign</i> <sup>2</sup>						0.006* (0.003)
<i>Population</i>	0.205 (0.264)	0.190 (0.267)	-0.279 (0.262)	-0.279 (0.262)	0.344 (0.851)	0.344 (0.851)
<i>Government Expenditure</i>	-0.218 (0.200)	-0.268 (0.203)	-0.188 (0.147)	-0.188 (0.147)	-0.577 (0.508)	-0.577 (0.508)
<i>Domestic Investment</i>	0.154* (0.094)	0.119 (0.091)	0.088 (0.075)	0.088 (0.075)	-0.259 (0.258)	-0.259 (0.258)
<i>Openness</i>	0.062** (0.026)	0.069** (0.027)	0.047* (0.025)	0.047* (0.025)	0.028 (0.087)	0.028 (0.087)
<i>Inflation</i>	-0.003 (0.002)	-0.004* (0.002)	-0.00001 (0.001)	-0.00001 (0.001)	0.332 (0.211)	0.332 (0.211)
<i>Telephone</i>	-0.805 (1.050)	-0.981 (1.036)	-1.328* (0.778)	-1.328* (0.778)	-5.391 (6.146)	-5.391 (6.146)

**Table A4.** *Continued*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	63.175*** (18.969)	71.500*** (17.800)	78.182*** (16.366)	79.067*** (17.984)	237.059** (115.426)	284.258** (117.994)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	845	845	1,089	1,089	152	152
R-squared	0.536	0.533	0.468	0.468	0.700	0.700

*Note.* All models are estimated with country and year fixed effects. The dependent variable is the three-year average growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (3-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debts as % of GDP (*Non-private*), squared term of non-private external debts (*Non-private*<sup>2</sup>), private external debts as % of GDP (*Private*), squared term of private external debts (*Private*<sup>2</sup>), short-term external debts as % of total external debt stocks (*Short-term*), squared term of short-term external debts (*Short-term*<sup>2</sup>), long-term external debts as % of total external debt stocks (*Long-term*), squared term of long-term external debts (*Long-term*<sup>2</sup>), % of external debt stocks in domestic currency (*Domestic*), squared term of external debts in domestic currency (*Domestic*<sup>2</sup>), % of external debt stocks in foreign currency (*Foreign*), squared term of external debts in foreign currency (*Foreign*<sup>2</sup>), growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table A5.** *Impact of Sub-Components of External Debt on Economic Convergence: Linear Models with Interaction Effects using 3-Year Growth Rate Averages. The Sample Period Runs From 1990 to 2020*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-6.304*** (1.481)	-6.922*** (1.486)	-6.614*** (1.831)	-10.824*** (2.559)	-16.529** (6.426)	4.702 (13.399)
<i>Non-private</i>	0.089 (0.068)					
<i>GDP</i> × <i>Non-private</i>	-0.005 (0.007)					
<i>Private</i>		0.021 (0.026)				
<i>GDP</i> × <i>Private</i>		-0.002 (0.002)				
<i>Short-term</i>			0.417** (0.196)			
<i>GDP</i> × <i>Short-term</i>			-0.042* (0.022)			
<i>Long-term</i>				-0.417** (0.196)		
<i>GDP</i> × <i>Long-term</i>				0.042* (0.022)		

Table A5. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Domestic</i>					-1.843 (1.200)	
<i>GDP×Domestic</i>					0.212* (0.127)	
<i>Foreign</i>						1.843 (1.200)
<i>GDP×Foreign</i>						-0.212* (0.127)
<i>Population</i>	0.200 (0.262)	0.195 (0.268)	-0.293 (0.263)	-0.293 (0.263)	0.309 (0.848)	0.309 (0.848)
<i>Government Expenditure</i>	-0.214 (0.200)	-0.267 (0.203)	-0.179 (0.146)	-0.179 (0.146)	-0.670 (0.505)	-0.670 (0.505)
<i>Domestic Investment</i>	0.158* (0.094)	0.118 (0.091)	0.090 (0.076)	0.090 (0.076)	-0.238 (0.252)	-0.238 (0.252)
<i>Openness</i>	0.064** (0.026)	0.069** (0.027)	0.044* (0.025)	0.044* (0.025)	0.010 (0.086)	0.010 (0.086)
<i>Inflation</i>	-0.003 (0.002)	-0.004* (0.002)	0.00004 (0.001)	0.00004 (0.001)	0.307 (0.212)	0.307 (0.212)
<i>Telephone</i>	-0.750 (1.031)	-1.010 (1.036)	-1.391* (0.779)	-1.391* (0.779)	-6.975 (6.090)	-6.975 (6.090)
Constant	60.755*** (18.611)	72.269*** (17.744)	74.561*** (16.344)	116.223*** (23.970)	270.273** (114.918)	86.016 (165.182)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	845	845	1,089	1,089	152	152
R-squared	0.537	0.533	0.469	0.469	0.702	0.702

Note. All models are estimated with country and year fixed effects. The dependent variable is the three-year average growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (3-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debts as % of GDP (*Non-private*), interaction of non-private external debts with natural logarithm of real GDP per capita (*GDP×Non-private*), private external debts as % of GDP (*Private*), interaction of private external debts with natural logarithm of real GDP per capita (*GDP×Private*), short-term external debts as % of total external debt stocks (*Short-term*), interaction of short-term external debts with natural logarithm of real GDP per capita (*GDP×Short-term*), long-term external debts as % of total external debt stocks (*Long-term*), interaction of long-term external debts with natural logarithm of real GDP per capita (*GDP×Long-term*), % of external debt stocks in domestic currency (*Domestic*), interaction of external debts in domestic currency with natural logarithm of real GDP per capita (*GDP×Domestic*), % of external debt stocks in foreign currency (*Foreign*), interaction of external debts in foreign currency with natural logarithm of real GDP per capita (*GDP×Foreign*), growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table A6.** Impact of Sub-Components of External Debt on Economic Convergence: Quadratic Models with Interaction Effects using 3-Year Growth Rate Averages. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-6.808*** (1.483)	-6.803*** (1.492)	-7.186*** (1.812)	-15.930*** (3.242)	-19.541*** (6.675)	-44.833* (22.845)
<i>Non-private</i>	-0.160 (0.204)					
<i>GDP</i> × <i>Non-private</i>	0.024 (0.023)					
<i>Non-private</i> <sup>2</sup>	0.001 (0.001)					
<i>GDP</i> × <i>Non-private</i> <sup>2</sup>	-0.000 (0.000)					
<i>Private</i>		-0.051 (0.104)				
<i>GDP</i> × <i>Private</i>		0.005 (0.010)				
<i>Private</i> <sup>2</sup>		0.000 (0.000)				
<i>GDP</i> × <i>Private</i> <sup>2</sup>		-0.000 (0.000)				
<i>Short-term</i>			-0.164 (0.489)			
<i>GDP</i> × <i>Short-term</i>			0.037 (0.059)			
<i>Short-term</i> <sup>2</sup>			0.009 (0.007)			
<i>GDP</i> × <i>Short-term</i> <sup>2</sup>			-0.001 (0.001)			
<i>Long-term</i>				-1.685* (0.914)		
<i>GDP</i> × <i>Long-term</i>				0.212** (0.106)		
<i>Long-term</i> <sup>2</sup>				0.009 (0.007)		
<i>GDP</i> × <i>Long-term</i> <sup>2</sup>				-0.001 (0.001)		
<i>Domestic</i>					-6.870** (2.960)	
<i>GDP</i> × <i>Domestic</i>					0.708** (0.314)	
<i>Domestic</i> <sup>2</sup>					0.098** (0.043)	

Table A6. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i> × <i>Domestic</i> <sup>2</sup>					-0.010** (0.004)	
<i>Foreign</i>						-12.647** (6.002)
<i>GDP</i> × <i>Foreign</i>						1.214** (0.609)
<i>Foreign</i> <sup>2</sup>						0.098** (0.043)
<i>GDP</i> × <i>Foreign</i> <sup>2</sup>						-0.010** (0.004)
<i>Population</i>	0.205 (0.263)	0.204 (0.266)	-0.304 (0.263)	-0.304 (0.263)	0.166 (0.890)	0.166 (0.890)
<i>Government Expenditure</i>	-0.220 (0.198)	-0.278 (0.203)	-0.195 (0.147)	-0.195 (0.147)	-0.912* (0.530)	-0.912* (0.530)
<i>Domestic Investment</i>	0.159* (0.094)	0.118 (0.092)	0.092 (0.075)	0.092 (0.075)	-0.071 (0.268)	-0.071 (0.268)
<i>Openness</i>	0.067** (0.026)	0.070** (0.027)	0.046* (0.025)	0.046* (0.025)	-0.021 (0.088)	-0.021 (0.088)
<i>Inflation</i>	-0.003 (0.002)	-0.004* (0.002)	0.000 (0.001)	0.000 (0.001)	0.252 (0.211)	0.252 (0.211)
<i>Telephone</i>	-0.938 (1.076)	-0.953 (1.041)	-1.284* (0.771)	-1.284* (0.771)	-7.033 (5.991)	-7.033 (5.991)
<i>Constant</i>	67.648*** (19.834)	70.459*** (17.985)	77.105*** (16.223)	153.141*** (30.097)	304.066** (116.889)	592.927** (247.513)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	845	845	1,089	1,089	152	152
R-squared	0.538	0.534	0.471	0.471	0.715	0.715

Note. All models are estimated with country and year fixed effects. The dependent variable is the three-year average growth rate (log difference) of real GDP per capita (*GDPGrowth*). Independent variables are beginning of period (3-year lagged): natural logarithm of real GDP per capita (*GDP*), non-private external debts as % of GDP (*Non-private*), private external debts as % of GDP (*Private*), short-term external debts as % of total external debt stocks (*Short-term*), long-term external debts as % of total external debt stocks (*Long-term*), % of external debt stocks in domestic currency (*Domestic*), % of external debt stocks in foreign currency (*Foreign*), squared terms of sub-components of external debts (*Non-private*<sup>2</sup>, *Private*<sup>2</sup>, *Short-term*<sup>2</sup>, *Long-term*<sup>2</sup>, *Domestic*<sup>2</sup>, *Foreign*<sup>2</sup>), interaction of sub-components of external debts with natural logarithm of real GDP per capita (*GDP*×*Non-private*, *GDP*×*Private*, *GDP*×*Short-term*, *GDP*×*Long-term*, *GDP*×*Domestic*, *GDP*×*Foreign*), interaction of squared term of sub-components of external debts with natural logarithm of real GDP per capita (*GDP*×*Non-private*<sup>2</sup>, *GDP*×*Private*<sup>2</sup>, *GDP*×*Short-term*<sup>2</sup>, *GDP*×*Long-term*<sup>2</sup>, *GDP*×*Domestic*<sup>2</sup>, *GDP*×*Foreign*<sup>2</sup>), growth rate (log difference) of total population (*Population*), the ratio of total government expenditure to GDP (*Government Expenditure*), the ratio of gross capital formation to GDP (*Domestic Investment*), the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP, the inflation rate (*Inflation*), and the natural logarithm of fixed telephone subscriptions (*Telephone*). Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* are statistically significant at the 1%, 5%, and 10% levels respectively.

**Table B1.** Impact of External Debt on Economic Convergence: Linear, Quadratic, and Interaction Models using Two-Step System GMM Estimator. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>GDPGrowth<sub>t-1</sub></i>	0.452** (0.227)	0.434** (0.218)	0.074 (0.060)	0.497*** (0.109)
<i>GDP</i>	-1.511 (1.141)	-1.322 (0.936)	-2.950** (1.189)	-0.541 (0.901)
<i>Debt</i>	-0.004 (0.005)	-0.007 (0.007)	-0.077 (0.054)	0.069** (0.032)
<i>Debt</i> <sup>2</sup>		0.000 (0.000)		-0.000 (0.000)
<i>GDP</i> × <i>Debt</i>			0.007 (0.005)	-0.007** (0.003)
<i>GDP</i> × <i>Debt</i> <sup>2</sup>				0.000 (0.000)
<i>Population</i>	-0.799*** (0.208)	-0.846*** (0.259)	-1.055*** (0.360)	-0.694*** (0.220)
<i>Government Expenditure</i>	-0.163*** (0.058)	-0.162*** (0.059)	-0.065 (0.086)	-0.191*** (0.056)
<i>Domestic Investment</i>	0.067 (0.060)	0.071 (0.058)	0.165** (0.070)	0.102** (0.048)
<i>Openness</i>	0.019 (0.012)	0.017* (0.010)	0.027** (0.012)	0.005 (0.009)
<i>Inflation</i>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001** (0.000)	-0.001*** (0.000)
<i>Telephone</i>	0.399 (0.380)	0.315 (0.296)	0.707 (0.455)	0.242 (0.262)
Constant	14.463*** (3.642)	14.433*** (3.897)	15.260*** (4.777)	6.146 (4.305)
Years included	YES	YES	YES	YES
AR1 (p-value)	0.019	0.013	0.004	0.005
AR2 (p-value)	0.393	0.383	0.275	0.290
OID (p-value)	0.543	0.840	0.431	0.264
Observations	3,519	3,519	3,519	3,519
Number of countries	159	159	159	159

Note. Robust standard errors are in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. In the two-step system GMM estimations, the variables *GDP*, *Debt*, *Debt*<sup>2</sup>, and the interaction variables are considered endogenous.

**Table B2.** Impact of Sub-Components of External Debt on Economic Convergence: Linear Models using Two-Step System GMM Estimator. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDPGrowth<sub>t-1</sub></i>	0.133* (0.069)	0.725*** (0.149)	0.128*** (0.043)	0.530*** (0.148)	0.140 (0.115)	0.156 (0.129)
<i>GDP</i>	-15.344*** (4.191)	-0.027 (1.035)	-2.429*** (0.754)	-1.196 (1.131)	-59.218*** (19.762)	-57.094*** (19.839)
<i>Non-private</i>	-0.116 (0.086)					
<i>Private</i>		-0.000 (0.001)				
<i>Short-term</i>			0.071 (0.061)			
<i>Long-term</i>				-0.007 (0.092)		
<i>Domestic</i>					0.224 (0.471)	
<i>Foreign</i>						-0.255 (0.449)
<i>Population</i>	-2.215* (1.246)	-0.718*** (0.252)	-0.904*** (0.304)	-0.722*** (0.156)	-7.023 (8.107)	-7.348 (7.794)
<i>Government Expenditure</i>	1.007** (0.462)	-0.225** (0.099)	-0.211*** (0.063)	-0.179** (0.086)	2.166 (2.792)	1.457 (2.611)
<i>Domestic Investment</i>	0.056 (0.205)	0.027 (0.056)	0.141*** (0.051)	0.068 (0.043)	-1.295 (1.728)	-0.797 (1.679)
<i>Openness</i>	0.119*** (0.045)	0.005 (0.008)	0.010 (0.010)	0.011 (0.008)	0.078 (0.360)	0.064 (0.359)
<i>Inflation</i>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-2.114 (1.256)	-2.330* (1.360)
<i>Telephone</i>	4.209** (1.758)	-0.006 (0.357)	0.460 (0.296)	0.260 (0.286)	17.196** (8.329)	15.748* (8.074)
Constant	58.439** (25.283)	9.427*** (3.149)	14.995*** (4.318)	12.797 (14.727)	272.709* (140.883)	303.502* (166.692)
Years included	YES	YES	YES	YES	YES	YES
AR1 (p-value)	0.013	0.000	0.001	0.003	0.084	0.052
AR2 (p-value)	0.020	0.975	0.798	0.230	0.235	0.244
OID (p-value)	0.000	0.148	0.168	0.662	0.685	0.412
Observations	2,770	2,770	3,508	3,508	542	542
Number of countries	141	141	158	158	42	42

Note. Robust standard errors are in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. In the two-step system GMM estimations, the variables *GDP*, *Non-private*, *Private*, *Short-term*, *Long-term*, *Domestic*, and *Foreign* are considered endogenous.

**Table B3.** *Impact of Sub-Components of External Debts on Economic Convergence: Quadratic Models using Two-Step System GMM Estimator. The Sample Period Runs From 1990 to 2020*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDPGrowth</i> <sub>t-1</sub>	0.662*** (0.158)	0.733*** (0.117)	0.080* (0.046)	0.084* (0.051)	0.122 (0.202)	0.063 (0.170)
<i>GDP</i>	-2.008** (0.807)	-0.621 (1.220)	-1.411 (0.992)	-1.035 (1.179)	1.204 (3.323)	8.577 (6.335)
<i>Non-private</i>	-0.045 (0.054)					
<i>Non-private</i> <sup>2</sup>	0.000 (0.000)					
<i>Private</i>		-0.008* (0.004)				
<i>Private</i> <sup>2</sup>		0.000* (0.000)				
<i>Short-term</i>			0.129 (0.125)			
<i>Short-term</i> <sup>2</sup>			-0.002 (0.002)			
<i>Long-term</i>				0.898 (0.602)		
<i>Long-term</i> <sup>2</sup>				-0.006 (0.004)		
<i>Domestic</i>					0.199 (0.378)	
<i>Domestic</i> <sup>2</sup>					-0.002 (0.004)	
<i>Foreign</i>						0.051 (0.387)
<i>Foreign</i> <sup>2</sup>						0.000 (0.004)
<i>Population</i>	-0.850*** (0.230)	-0.657*** (0.188)	-0.689** (0.282)	-0.510* (0.298)	-1.736* (1.024)	-1.082 (1.890)
<i>Government Expenditure</i>	-0.010 (0.078)	-0.104 (0.106)	-0.223*** (0.072)	-0.245** (0.108)	-0.344 (0.238)	-0.644 (0.622)
<i>Domestic Investment</i>	-0.015 (0.052)	-0.009 (0.043)	0.162*** (0.048)	0.156*** (0.057)	0.191 (0.197)	0.493** (0.243)
<i>Openness</i>	0.022*** (0.008)	0.020** (0.010)	0.009 (0.010)	0.016 (0.016)	-0.014 (0.038)	-0.004 (0.074)
<i>Inflation</i>	-0.001 (0.001)	-0.001** (0.001)	-0.001*** (0.000)	-0.001*** (0.000)	0.308 (0.304)	0.522 (0.454)

**Table B3.** *Continued*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Telephone</i>	0.577** (0.245)	0.285 (0.410)	0.267 (0.367)	0.167 (0.448)	-1.588* (0.869)	-2.625 (1.604)
Constant	16.203*** (4.832)	8.591** (3.719)	8.070* (4.570)	-22.314 (24.051)	2.482 (31.910)	-56.686 (53.676)
Years included	YES	YES	YES	YES	YES	YES
AR1 (p-value)	0.003	0.002	0.002	0.001	0.108	0.107
AR2 (p-value)	0.970	0.971	0.916	0.922	0.467	0.390
OID (p-value)	0.073	0.338	0.066	0.736	0.141	0.109
Observations	2,770	2,770	3,508	3,508	542	542
Number of countries	141	141	158	158	42	42

*Note.* Robust standard errors are in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. In the two-step system GMM estimations, the variables *GDP*, *Non-private*, *Non-private*<sup>2</sup>, *Private*, *Private*<sup>2</sup>, *Short-term*, *Short-term*<sup>2</sup>, *Long-term*, *Long-term*<sup>2</sup>, *Domestic*, *Domestic*<sup>2</sup>, *Foreign*, and *Foreign*<sup>2</sup> are considered endogenous.

**Table B4.** *Impact of Sub-Components of External Debt on Economic Convergence: Linear Models with Interaction Effects using Two-Step System GMM Estimator. The Sample Period Runs From 1990-2020*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDPGrowth</i> <sub><i>t-1</i></sub>	0.860*** (0.122)	0.366* (0.190)	0.846*** (0.082)	0.742*** (0.207)	0.139 (0.246)	0.968*** (0.271)
<i>GDP</i>	-0.231 (1.420)	-2.570** (1.080)	0.516 (1.093)	-5.067 (4.072)	2.693 (3.210)	-4.564 (3.377)
<i>Non-private</i>	0.150 (0.159)					
<i>GDP</i> × <i>Non-private</i>	-0.013 (0.019)					
<i>Private</i>		0.013 (0.051)				
<i>GDP</i> × <i>Private</i>		-0.001 (0.004)				
<i>Short-term</i>			0.494 (0.339)			
<i>GDP</i> × <i>Short-term</i>			-0.068* (0.038)			
<i>Long-term</i>				-0.421 (0.430)		
<i>GDP</i> × <i>Long-term</i>				0.057 (0.051)		

Table B4. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Domestic</i>					0.013 (0.973)	
<i>GDP×Domestic</i>					-0.003 (0.097)	
<i>Foreign</i>						-0.072 (0.204)
<i>GDP×Foreign</i>						0.015 (0.028)
<i>Population</i>	-0.586*** (0.198)	-1.314*** (0.307)	-0.604*** (0.153)	-0.613*** (0.227)	-1.246 (0.772)	-0.733 (0.765)
<i>Government Expenditure</i>	-0.099 (0.092)	-0.083 (0.088)	-0.087 (0.058)	-0.109 (0.072)	-0.350 (0.233)	-0.040 (0.300)
<i>Domestic Investment</i>	0.011 (0.057)	0.135** (0.057)	-0.039 (0.030)	0.004 (0.068)	0.184 (0.202)	-0.220 (0.267)
<i>Openness</i>	0.013 (0.008)	0.012 (0.009)	0.028*** (0.008)	0.018* (0.010)	-0.003 (0.036)	0.051 (0.035)
<i>Inflation</i>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	0.306 (0.339)	-0.037 (0.295)
<i>Telephone</i>	0.563* (0.302)	0.695** (0.334)	0.435 (0.266)	0.261 (0.297)	-1.416 (0.904)	1.881 (1.625)
Constant	0.669 (8.765)	15.037*** (3.345)	-0.139 (7.452)	42.589 (36.633)	-12.524 (24.686)	0.000 (0.000)
Years included	YES	YES	YES	YES	YES	YES
AR1 (p-value)	0.001	0.029	0.001	0.005	0.154	0.008
AR2 (p-value)	0.870	0.616	0.152	0.199	0.536	0.876
OID (p-value)	0.106	0.527	0.709	0.016	0.109	0.349
Observations	2,770	2,770	3,508	3,508	542	542
Number of countries	141	141	158	158	42	42

Note. Robust standard errors are in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. In the two-step system GMM estimations, the variables *GDP*, *Non-private*, *Private*, *Short-term*, *Long-term*, *Domestic*, *Foreign*, and the interaction variables are considered endogenous.

**Table B5.** Impact of Sub-Components of External Debt on Economic Convergence: Quadratic Models with Interaction Effects using Two-Step System GMM Estimator. The Sample Period Runs From 1990 to 2020

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDPGrowth</i> <sub><i>t-1</i></sub>	0.548*** (0.189)	0.370*** (0.114)	1.174*** (0.440)	0.812*** (0.147)	0.164 (0.117)	0.163 (0.416)
<i>GDP</i>	-3.606** (1.573)	-1.366 (0.833)	-2.483 (3.197)	-47.629** (20.838)	-4.311 (6.576)	-11.931 (119.698)
<i>Non-private</i>	-0.496 (0.431)					
<i>GDP</i> × <i>Non-private</i>	0.058 (0.048)					
<i>Non-private</i> <sup>2</sup>	0.003 (0.003)					
<i>GDP</i> × <i>Non-private</i> <sup>2</sup>	-0.000 (0.000)					
<i>Private</i>		-0.054 (0.071)				
<i>GDP</i> × <i>Private</i>		0.005 (0.006)				
<i>Private</i> <sup>2</sup>		0.000 (0.000)				
<i>GDP</i> × <i>Private</i> <sup>2</sup>		-0.000 (0.000)				
<i>Short-term</i>			-1.870 (1.146)			
<i>GDP</i> × <i>Short-term</i>			0.207 (0.157)			
<i>Short-term</i> <sup>2</sup>			0.023 (0.026)			
<i>GDP</i> × <i>Short-term</i> <sup>2</sup>			-0.003 (0.003)			
<i>Long-term</i>				-10.714** (4.981)		
<i>GDP</i> × <i>Long-term</i>				1.171** (0.550)		
<i>Long-term</i> <sup>2</sup>				0.064** (0.031)		
<i>GDP</i> × <i>Long-term</i> <sup>2</sup>				-0.007* (0.004)		
<i>Domestic</i>					-3.444 (4.191)	

Table B5. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i> × <i>Domestic</i>					0.353 (0.473)	
<i>Domestic</i> <sup>2</sup>					0.041 (0.051)	
<i>GDP</i> × <i>Domestic</i> <sup>2</sup>					-0.004 (0.006)	
<i>Foreign</i>						-3.791 (40.402)
<i>GDP</i> × <i>Foreign</i>						0.369 (3.212)
<i>Foreign</i> <sup>2</sup>						0.033 (0.310)
<i>GDP</i> × <i>Foreign</i> <sup>2</sup>						-0.003 (0.023)
<i>Population</i>	-0.613** (0.268)	-0.994*** (0.262)	-0.873*** (0.294)	-0.495* (0.253)	-2.144 (1.580)	-2.055 (2.160)
<i>Government Expenditure</i>	-0.050 (0.077)	-0.175** (0.080)	-0.132 (0.121)	-0.291** (0.125)	-0.270 (0.547)	-0.084 (2.925)
<i>Domestic Investment</i>	0.038 (0.066)	0.111** (0.050)	-0.017 (0.083)	-0.042 (0.047)	0.086 (0.211)	0.034 (2.354)
<i>Openness</i>	0.027*** (0.009)	0.013 (0.008)	0.003 (0.014)	0.035** (0.015)	-0.018 (0.075)	0.004 (0.311)
<i>Inflation</i>	-0.001 (0.001)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.049 (0.257)	-0.215 (2.185)
<i>Telephone</i>	0.866*** (0.241)	0.380 (0.249)	0.095 (0.405)	0.245 (0.350)	1.008 (2.553)	2.253 (33.972)
Constant	21.826* (11.732)	10.625*** (3.582)	32.439* (19.417)	444.774** (195.009)	19.548 (60.042)	74.605 (836.837)
Years included	YES	YES	YES	YES	YES	YES
AR1 (p-value)	0.004	0.005	0.013	0.003	0.001	0.345
AR2 (p-value)	0.817	0.447	0.200	0.167	0.274	0.724
OID (p-value)	0.033	0.018	0.035	0.246	0.012	0.013
Observations	2,770	2,770	3,508	3,508	542	542
Number of countries	141	141	158	158	42	42

Note. Robust standard errors are in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively. In the two-step system GMM estimations, the variables *GDP*, *Non-private*, *Non-private*<sup>2</sup>, *Private*, *Private*<sup>2</sup>, *Short-term*, *Short-term*<sup>2</sup>, *Long-term*, *Long-term*<sup>2</sup>, *Domestic*, *Domestic*<sup>2</sup>, *Foreign*, *Foreign*<sup>2</sup>, and the interaction variables are considered endogenous.

**Table C1.** *Impact of External Debt on Economic Convergence: Linear, Quadratic Models, and Interaction Effects, Excluding Crisis Years*

	Dependent variable: <i>GDPGrowth</i>			
	(1)	(2)	(3)	(4)
<i>GDP</i>	-11.946*** (1.780)	-11.960*** (1.788)	-11.970*** (1.794)	-11.977*** (1.796)
<i>Debt</i>	-0.003** (0.001)	-0.006 (0.009)	-0.011 (0.036)	-0.014 (0.052)
<i>GDP</i> × <i>Debt</i>			0.001 (0.003)	0.001 (0.005)
<i>Debt</i> <sup>2</sup>		0.000 (0.000)		0.000 (0.000)
<i>GDP</i> × <i>Debt</i> <sup>2</sup>				-0.000 (0.000)
<i>Population</i>	0.389 (0.896)	0.391 (0.896)	0.400 (0.897)	0.407 (0.910)
<i>Government Expenditure</i>	-0.190 (0.199)	-0.193 (0.194)	-0.195 (0.190)	-0.196 (0.188)
<i>Domestic Investment</i>	0.095 (0.072)	0.093 (0.073)	0.092 (0.074)	0.091 (0.074)
<i>Openness</i>	0.094*** (0.026)	0.095*** (0.026)	0.094*** (0.026)	0.094*** (0.026)
<i>Inflation</i>	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
<i>Telephone</i>	0.622 (0.701)	0.616 (0.699)	0.621 (0.700)	0.621 (0.702)
Constant	85.704*** (14.099)	86.174*** (14.322)	86.185*** (14.283)	86.273*** (14.354)
Country FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Observations	1,937	1,937	1,937	1,937
R-squared	0.397	0.397	0.397	0.397

*Note.* All models are estimated with country and year fixed effects. Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table C2.** Impact of Sub-Components of External Debt on Economic Convergence: Linear Models, Excluding Crisis Years

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-10.186*** (1.552)	-10.121*** (1.518)	-12.530*** (1.795)	-12.530*** (1.795)	-10.264*** (3.589)	-10.264*** (3.589)
<i>Non-private</i>	-0.004 (0.016)					
<i>Private</i>		-0.002** (0.001)				
<i>Short-term</i>			0.133*** (0.048)			
<i>Long-term</i>				-0.133*** (0.048)		
<i>Domestic</i>					-0.019 (0.097)	
<i>Foreign</i>						0.019 (0.097)
<i>Population</i>	-0.557 (0.774)	-0.532 (0.772)	0.603 (0.875)	0.603 (0.875)	-5.482*** (1.518)	-5.482*** (1.518)
<i>Government Expenditure</i>	-0.297* (0.169)	-0.297* (0.172)	-0.224 (0.198)	-0.224 (0.198)	0.512 (0.461)	0.512 (0.461)
<i>Domestic Investment</i>	0.261*** (0.082)	0.260*** (0.079)	0.098 (0.071)	0.098 (0.071)	0.124 (0.219)	0.124 (0.219)
<i>Openness</i>	0.104*** (0.021)	0.109*** (0.022)	0.089*** (0.026)	0.089*** (0.026)	0.079 (0.056)	0.079 (0.056)
<i>Inflation</i>	-0.000 (0.000)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	0.141 (0.173)	0.141 (0.173)
<i>Telephone</i>	-0.547 (0.882)	-0.521 (0.880)	0.567 (0.703)	0.567 (0.703)	-7.223* (3.795)	-7.223* (3.795)
Constant	88.393*** (15.262)	87.176*** (14.686)	88.849*** (14.122)	102.162*** (16.543)	191.827*** (69.304)	189.888*** (69.650)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	1,537	1,537	1,933	1,933	344	344
R-squared	0.465	0.466	0.402	0.402	0.622	0.622

Note. All models are estimated with country and year fixed effects. Robust standard errors are reported in parentheses.

\*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table C3.** Impact of Sub-Components of External Debts on Economic Convergence: Quadratic Models, Excluding Crisis Years

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-10.223*** (1.566)	-10.123*** (1.518)	-12.617*** (1.746)	-12.617*** (1.746)	-10.256*** (3.584)	-10.256*** (3.584)
<i>Non-private</i>	-0.020 (0.042)					
<i>Non-private</i> <sup>2</sup>	0.000 (0.000)					
<i>Private</i>		0.005 (0.007)				
<i>Private</i> <sup>2</sup>		-0.000 (0.000)				
<i>Short-term</i>			0.184* (0.096)			
<i>Short-term</i> <sup>2</sup>			-0.001 (0.002)			
<i>Long-term</i>				-0.018 (0.276)		
<i>Long-term</i> <sup>2</sup>				-0.001 (0.002)		
<i>Domestic</i>					-0.031 (0.165)	
<i>Domestic</i> <sup>2</sup>					0.000 (0.002)	
<i>Foreign</i>						-0.009 (0.306)
<i>Foreign</i> <sup>2</sup>						0.000 (0.002)
<i>Population</i>	-0.573 (0.776)	-0.470 (0.788)	0.618 (0.875)	0.618 (0.875)	-5.495*** (1.512)	-5.495*** (1.512)
<i>Government Expenditure</i>	-0.300* (0.169)	-0.298* (0.172)	-0.215 (0.198)	-0.215 (0.198)	0.514 (0.462)	0.514 (0.462)
<i>Domestic Investment</i>	0.262*** (0.082)	0.262*** (0.080)	0.099 (0.072)	0.099 (0.072)	0.123 (0.221)	0.123 (0.221)
<i>Openness</i>	0.105*** (0.021)	0.107*** (0.022)	0.089*** (0.026)	0.089*** (0.026)	0.079 (0.056)	0.079 (0.056)
<i>Inflation</i>	-0.000 (0.000)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	0.140 (0.173)	0.140 (0.173)
<i>Telephone</i>	-0.618 (0.906)	-0.490 (0.882)	0.556 (0.705)	0.556 (0.705)	-7.190* (3.863)	-7.190* (3.863)

**Table C3.** *Continued*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	90.014*** (16.422)	86.319*** (14.882)	89.079*** (14.000)	99.175*** (19.809)	191.262*** (69.716)	190.168*** (69.793)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	1,537	1,537	1,933	1,933	344	344
R-squared	0.466	0.466	0.402	0.402	0.622	0.622

*Note.* All models are estimated with country and year fixed effects. Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table C4.** *Impact of Sub-Components of External Debt on Economic Convergence: Linear Models with Interaction Effects, Excluding Crisis Years*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-9.952*** (1.558)	-10.231*** (1.505)	-12.063*** (1.755)	-14.700*** (4.102)	-10.502*** (3.560)	-5.213 (7.562)
<i>Non-private</i>	0.073 (0.060)					
<i>GDP</i> × <i>Non-private</i>	-0.009 (0.006)					
<i>Private</i>		0.068* (0.041)				
<i>GDP</i> × <i>Private</i>		-0.006* (0.003)				
<i>Short-term</i>			0.344 (0.354)			
<i>GDP</i> × <i>Short-term</i>			-0.026 (0.040)			
<i>Long-term</i>				-0.344 (0.354)		
<i>GDP</i> × <i>Long-term</i>				0.026 (0.040)		
<i>Domestic</i>					-0.535 (0.652)	
<i>GDP</i> × <i>Domestic</i>					0.053 (0.064)	
<i>Foreign</i>						0.535 (0.652)
<i>GDP</i> × <i>Foreign</i>						-0.053 (0.064)

**Table C4.** *Continued*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Population</i>	-0.625 (0.772)	-0.431 (0.786)	0.571 (0.880)	0.571 (0.880)	-5.652*** (1.506)	-5.652*** (1.506)
<i>Government Expenditure</i>	-0.309* (0.171)	-0.299* (0.173)	-0.229 (0.197)	-0.229 (0.197)	0.537 (0.463)	0.537 (0.463)
<i>Domestic Investment</i>	0.263*** (0.083)	0.264*** (0.079)	0.100 (0.070)	0.100 (0.070)	0.135 (0.219)	0.135 (0.219)
<i>Openness</i>	0.109*** (0.022)	0.106*** (0.022)	0.087*** (0.027)	0.087*** (0.027)	0.072 (0.057)	0.072 (0.057)
<i>Inflation</i>	-0.000 (0.000)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	0.135 (0.174)	0.135 (0.174)
<i>Telephone</i>	-0.505 (0.884)	-0.495 (0.881)	0.543 (0.708)	0.543 (0.708)	-7.159* (3.809)	-7.159* (3.809)
<i>Constant</i>	85.650*** (15.542)	87.080*** (14.701)	86.078*** (13.349)	120.514*** (38.585)	192.957*** (69.135)	139.469 (100.697)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	1,537	1,537	1,933	1,933	344	344
R-squared	0.466	0.467	0.402	0.402	0.622	0.622

*Note.* All models are estimated with country and year fixed effects. Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.

**Table C5.** *Impact of Sub-Components of External Debt on Economic Convergence: Quadratic Models with Interaction Effects. The Sample Period Runs From 1990 to 2020*

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDP</i>	-10.809*** (1.634)	-10.365*** (1.497)	-11.888*** (1.805)	-12.043 (7.951)	-10.233*** (3.537)	7.414 (13.951)
<i>Non-private</i>	-0.322 (0.197)					
<i>GDP×Non-private</i>	0.037* (0.022)					
<i>Non-private</i> <sup>2</sup>	0.002** (0.001)					
<i>GDP×Non-private</i> <sup>2</sup>	-0.000** (0.000)					
<i>Private</i>		0.162 (0.106)				
<i>GDP×Private</i>		-0.015 (0.010)				

Table C5. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Private</i> <sup>2</sup>		-0.000 (0.000)				
<i>GDP</i> × <i>Private</i> <sup>2</sup>		0.000 (0.000)				
<i>Short-term</i>			0.768 (0.599)			
<i>GDP</i> × <i>Short-term</i>			-0.074 (0.069)			
<i>Short-term</i> <sup>2</sup>			-0.007 (0.012)			
<i>GDP</i> × <i>Short-term</i> <sup>2</sup>			0.001 (0.001)			
<i>Long-term</i>				0.535 (1.849)		
<i>GDP</i> × <i>Long-term</i>				-0.071 (0.201)		
<i>Long-term</i> <sup>2</sup>				-0.007 (0.012)		
<i>GDP</i> × <i>Long-term</i> <sup>2</sup>				0.001 (0.001)		
<i>Domestic</i>					1.063 (1.640)	
<i>GDP</i> × <i>Domestic</i>					-0.107 (0.165)	
<i>Domestic</i> <sup>2</sup>					-0.028 (0.026)	
<i>GDP</i> × <i>Domestic</i> <sup>2</sup>					0.003 (0.003)	
<i>Foreign</i>						4.554 (3.742)
<i>GDP</i> × <i>Foreign</i>						-0.460 (0.367)
<i>Foreign</i> <sup>2</sup>						-0.028 (0.026)
<i>GDP</i> × <i>Foreign</i> <sup>2</sup>						0.003 (0.003)
<i>Population</i>	-0.602 (0.777)	-0.515 (0.789)	0.581 (0.884)	0.581 (0.884)	-5.455*** (1.507)	-5.455*** (1.507)

Table C5. Continued

	Dependent variable: <i>GDPGrowth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Government Expenditure</i>	-0.278 (0.171)	-0.302* (0.175)	-0.209 (0.198)	-0.209 (0.198)	0.561 (0.469)	0.561 (0.469)
<i>Domestic Investment</i>	0.277*** (0.082)	0.265*** (0.080)	0.100 (0.070)	0.100 (0.070)	0.101 (0.227)	0.101 (0.227)
<i>Openness</i>	0.112*** (0.022)	0.107*** (0.022)	0.086*** (0.027)	0.086*** (0.027)	0.076 (0.056)	0.076 (0.056)
<i>Inflation</i>	-0.000 (0.000)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	0.139 (0.175)	0.139 (0.175)
<i>Telephone</i>	-0.878 (0.934)	-0.527 (0.881)	0.498 (0.709)	0.498 (0.709)	-7.009* (3.906)	-7.009* (3.906)
<i>Constant</i>	97.179*** (17.800)	88.798*** (14.668)	84.905*** (13.739)	96.578 (74.473)	186.923*** (70.565)	12.386 (161.699)
Country FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Observations	1,537	1,537	1,933	1,933	344	344
R-squared	0.468	0.468	0.403	0.403	0.624	0.624

Note. All models are estimated with country and year fixed effects. Robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* denote statistically significant at the 1%, 5%, and 10% levels respectively.