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Original Article

The Nexus between External Debt and Growth Convergence: Evidence from Asian Countries

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Abstract: This paper aims to investigate the relationship between growth and external debt in selected Asian economies during the period from 2000 to 2019. To this aim, panel data collected from the World Development Indicators (WDI) of the World Bank are analyzed by the conditional beta convergence framework. Three indicators of external debt (namely total debt service, debt stock and public and publicly guaranteed debt service) are incorporated in the model regressing the average growth rate of income on the natural logarithm of the initial level of GDP per capita. Results of the fixed effect estimations show an inverse relationship between external debt ratios and economic growth. The role of external debt in the convergence process is further examined by including debt interaction terms in the conditional convergence model. We found that a higher debt service level is associated with a higher rate of convergence. These findings reveal that over the past two decades the economic convergence among Asian countries has been much debt-led. Our findings inform policymakers of the effectiveness of government borrowings as a source for economic growth.

Keywords: Asian countries, external debt, economic growth, beta convergence.

1. Introduction

Since the seminal work of Barrow and Sala-i-Martin (1992), a lot of research efforts have been devoted to investigating convergence in national incomes. Convergence in the most general sense refers to the process of gradual reduction in differences among observed countries during a period of time. For economists, growth convergence implies that less developed countries exhibit a faster rate of economic growth than more developed countries. Broadly speaking, there are two main convergence theories in the convergence literature: sigma and beta convergence. Sigma convergence refers to the reduction in cross-

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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 convergence is supported by the neo-classical growth model (Solow, 1956), which argues that the source of convergence is the diminishing return to capital. As such, national incomes converge with one another 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 with one another in the long-term, only providing that their structural conditions (such as technologies, human capital, population growth rates, legal institutions) are identical, that implies conditional beta convergence (Mankiw et al., 1992). The equilibrium differs by economy, and each country approaches its own unique equilibrium. In the case of 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 borrowings to finance public and infrastructure development can help to enhance economic growth (Fischer, 2018). A positive association between economic growth and external debt has been reported in the studies by Demikha et al. (2021), Oberholzer (2021), Spilioti and Vamvoukas (2015). This perspective is deeply rooted in the Keynesian paradigm, which suggests that governments' intervention in economic activity may stimulate economic growth.

However, excessive borrowings without planning for investment may cause heavy debt burden and interest payment, which would be unfavorable for the economy (Munir and Mehmood, 2018). In fact, the large majority of previous studies advocate an adverse relationship between external debt and economic growth (Barik and Sahu, 2022; Yasar, 2021; Wang et al., 2021; Makun, 2021; Hakimi et al., 2019; Onafowora and Owoye, 2019; Al Kharusi and Ada, 2018; Azam, 2016; Dogan and Bilgili, 2014). These authors build their argument on the basis of the "debt overhang" theory (Krugman, 1988). Following this line of literature, "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 it exceeds the affordability of the country, incentives for domestic investment will be constrained since returns are expected to be "taxed away" by foreign creditors (Villieu et al., 2014). As domestic investment is depressed, this will exert negative impact on growth prospects.

Theoretically, government borrowing has its root in the neoclassical growth models, according to which many economies with low productivity and income and lack of savings depend on borrowings (especially external debt) as the 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 nonlinear 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). Yet, 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 a 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 role played by external debt in the convergence process among 24 Asian countries during the 2000-2019 period. We choose to explore the Asian context because the historical debt crisis in developing countries (especially in South Asia) has triggered some concern for macroeconomic instability.

Three indicators of external debt are exploited, namely total external debt stocks, total debt service and public and publicly guaranteed debt service. These debt indicators are included in the conditional beta convergence specifications and fixed effect models are estimated. The coefficients of debt indicators would capture the effects of debt on the growth convergence. Further, in order to investigate if external debt influences the rate that countries are converging, 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 effect 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 speed.

The contributions of this paper are threefold. To the best of our knowledge, this is the first study exploring the influence of external debt on economic convergence. Two closely related studies to ours include Munir and Mehmood (2018) and Rant et al. (2021); however, both studies only examine total debt. Even though the total debt figure is disaggregated into public and private debt in the latter study, the role of external debt has been largely ignored. Second, this research looks at the Asian context and in fact all countries in our sample are middle-income countries who are more dependent on external borrowings as a source of economic growth. While the empirical evidence for economic convergence among Asian economies has been established (Ghatak and De, 2021; Kwan and Malki, 2020; Canlas, 2020; Michelis and Neaime, 2004; Li and Xu, 2007), the extent to which economic convergence in the past has been driven by debt remains unanswered. Finally, we employ three different indicators of external debt in our analysis as a robustness check and unlike previous authors (for example, Munir and Mehmood, 2018), we include the debt indicators at their lagged values.

The rest of the paper is organized as follows. Section 2 outlines the methodology and describes the data. Section 3 presents the empirical results and Section 4 concludes.

2. Methodology and data

2.1. Data

Table 1: List of countries

Sub-region	Country
Central Asia	Armenia, Azerbaijan, Georgia, Iran, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkey, Turkmenistan, Uzbekistan
East Asia	China, Mongolia
South Asia	Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka
Southeast Asia	Indonesia, Lao PDR, Myanmar, the Philippines, Thailand, Vietnam

Source: Classification based on the World Bank.

In this paper, we explore data from the World Development Indicators (WDI) for 24 countries over the period from 2000 to 2019. We include countries from several Asian sub-regions: Central Asia, East Asia, South Asia and Southeast Asia. Table 1 lists the 24 countries in our sample. Among these, 16 are lower-middle-

income countries and 8 are upper-middle-income countries. High-income Asian countries are not included in our sample due to the lack of debt data.

In order to test the beta convergence, the growth rate of GDP per capita is regressed on the initial level of GDP per capita. Other independent variables include external debt stock, total debt service, and public and publicly guaranteed debt service, which serve as different proxies for debt. We also follow the previous literature and incorporate in our model a number of factors that could possibly affect economic growth (Huffman and Huffman, 2021; Marelli et al., 2019; Wamboye and Tochkov, 2015; Villaverde and Maza, 2011). Specifically, the growth rate of the total population, the percentage of the population with access to electricity, trade openness, and gross capital formation are the control variables. All data are retrieved from the World Bank database (World Bank, 2021). Table 2 summarizes the variables employed in the empirical analysis along with their definitions.

The dependent variable is the annual growth rate (log difference) of real GDP per capita, calculated as: $GDPGrowth_{i,t} = \log(GDP_{i,t}) - \log(GDP_{i,t-1})$ in which $GDP_{i,t}$ represents the real GDP per capita of country *i* in year *t*. Independent variables are the beginning of period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), the ratio of total external debt stocks to gross national income (*DebtStock*), the ratio of total debt service to gross national income (*DebtService*), the ratio of public and publicly guaranteed debt service to gross national income (*PPGDebt*), annual growth rate (log difference) of total population (*Population*) calculated as: $Population_{i,t} = \log(TotalPopulation_{i,t}) - \log(TotalPopulation_{i,t-1})$ in which $TotalPopulation_{i,t}$ represents the total population of country *i* in year *t*, the percentage of population with access to electricity (*Electricity*), the ratio of gross capital formation to GDP *(GCF*), and the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP.

Table 2: Variable definitions

Variable	Definition	Source
GDPGrowth	The annual growth rate of GDP per capita	WDI
GDP	The natural logarithm of GDP per capita	
DebtStock	The ratio of total external debt stocks to gross national income	
DebtService	The ratio of total debt service to gross national income	
PPGDebt	The ratio of public and publicly guaranteed debt service to gross national income	
Population	Annual growth rate of total population	
Electricity	The percentage of population with access to electricity	
GCF	Gross capital formation (formerly gross domestic investment)	
Openness	The sum of total imports plus export divided by GDP	

Source: World Development Inidcators (The World Bank).

3.2. Model specifications

Following the neo-classical growth theory, the beta convergence hypothesis is tested via the following equation:

$$\frac{1}{T}\ln\left(\frac{y_{i,t_0+T}}{y_{i,t_0}}\right) = B + \beta\ln(y_{i,t_0}) + \psi X_{i,t_0} + \varepsilon_i \quad (1)$$

where $\frac{1}{T}\ln\left(\frac{y_{i,t_0+T}}{y_{i,t_0}}\right)$ represents economy *i*'s growth rate of real per capita income between two times t_0 and $t_0 + T$; $\ln(y_{i,t_0})$ is the natural

logarithm of economy *i*'s GDP per capita at time t_0 ; X_{i,t_0} and includes all other factors supposedly affecting the growth rate; ε_i is the error term. A significantly negative β is indicative of beta convergence. The estimated β also indicates the rate at which countries approach their steady state (the convergence speed). If ψ is restricted to zero, *absolute convergence* is assumed. Providing that ψ is freely estimated, *conditional convergence* is assumed.

In this research, in order to determine whether debt level affects the rate of growth, we estimate the following conditional beta convergence model

$$GDPGrowth_{i,t} = \alpha + \beta \ln(GDP_{i,t-1}) + \gamma DEBT_{i,t-1} + \psi CONTROLS_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

where $GDPGrowth_{i,t}$ represents the growth rate of GDP per capita, $\ln(GDP_{i,t-1})$ is the natural logarithm of GDP per capita at the beginning of the period, $DEBT_{i,t-1}$ represents different debt ratios ($DebtStock_{i,t-1}$, $DebtService_{i,t-1}, PPGDebt_{i,t-1}$), $CONTROLS_{i,t-1}$ denotes a set of control variables and $\varepsilon_{i,t}$ is the error term. Specifically, we control for the following factors: population growth ($Population_{i,t-1}$), gross capital formation ($GCF_{i,t-1}$), trade openness ($Openness_{i,t-1}$) and a control for the percentage of population with access to electricity ($Electricity_{i,t-1}$) as a measure of living standards. It is noted that the error term $\varepsilon_{i,t}$ includes either country-specific ($\varepsilon_{i,t} = \mu_i + u_{i,t}$) or country and year-specific components ($\varepsilon_{i,t} = \mu_i + \nu_i + u_{i,t}$). In Equation (2), we include lagged values of the external debt indicator and all control variables in the model specification. The purpose is to address the endogeneity concern resulting from reverse causality bias (Li et al., 2021; Leszczensky and Wolbring, 2019; Bellemare et al., 2017; Wamboye and Tochkov, 2015).

A significantly negative β in Equation (2) implies the conditional convergence process, meaning that countries with initially lower levels of income exhibit higher growth rates. The coefficient γ captures the effect of debt indicators on convergence.

Next, we include debt interaction terms between each debt indicator and the natural logarithm of the GDP per capita in the beta convergence model:

$$GDPGrowth_{i,t} = \alpha + \beta \ln(GDP_{i,t-1}) + \gamma DEBT_{i,t-1} + \delta DEBT_{i,t-1} \times GDP_{i,t-1} + \psi CONTROLS_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

The purpose of introducing debt interaction variables is to investigate whether debt affects the rate of convergence (which is deduced from β coefficient) among the countries in our sample. If δ is statistically different from zero, debt ratios will have an influence on the speed at which the convergence process occurs. In this case, the rate of convergence will be derived from β' which is calculated as follows:

$$\beta' = \frac{\partial \triangle GDP_{i,t}}{\partial \ln(GDP_{i,t-1})} = \begin{cases} \beta + \delta DebtStock_{i,t-1} \\ \beta + \delta DebtService_{i,t-1} \\ \beta + \delta PPGDebt_{i,t-1} \\ \beta + \delta_1 DebtStock_{i,t-1} + \delta_2 DebtService_{i,t-1} + \delta_3 PPGDebt_{i,t-1} \end{cases} \quad (4)$$

The coefficient β is the estimate of the conditional convergence at an average level of external debt while the coefficient γ represents the effect of an additional percentage point of external debt stock, total debt service and public and publicly guaranteed debt service on the convergence process.

The rate of convergence can then be calculated as:

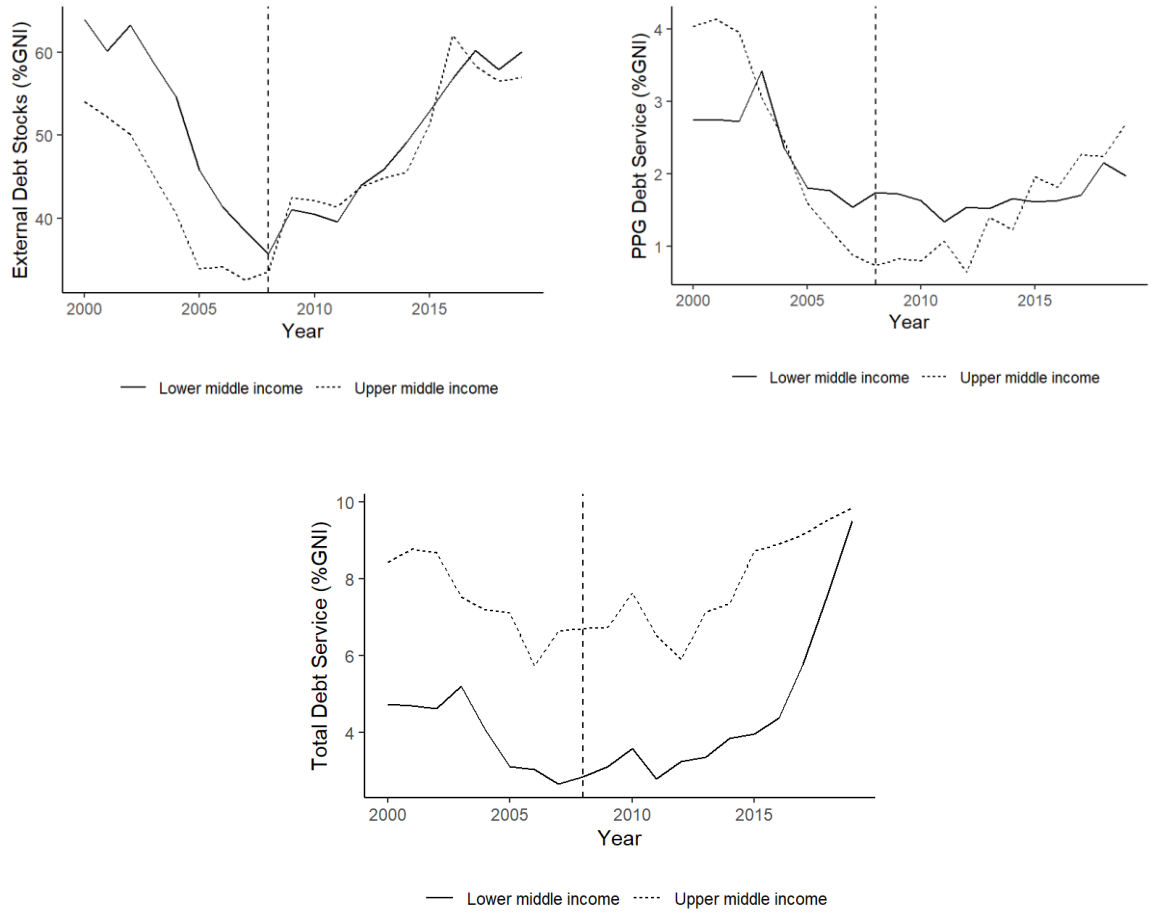
$$\tau = -100 \times \ln(1 + \beta') \quad (5)$$

3. Empirical results

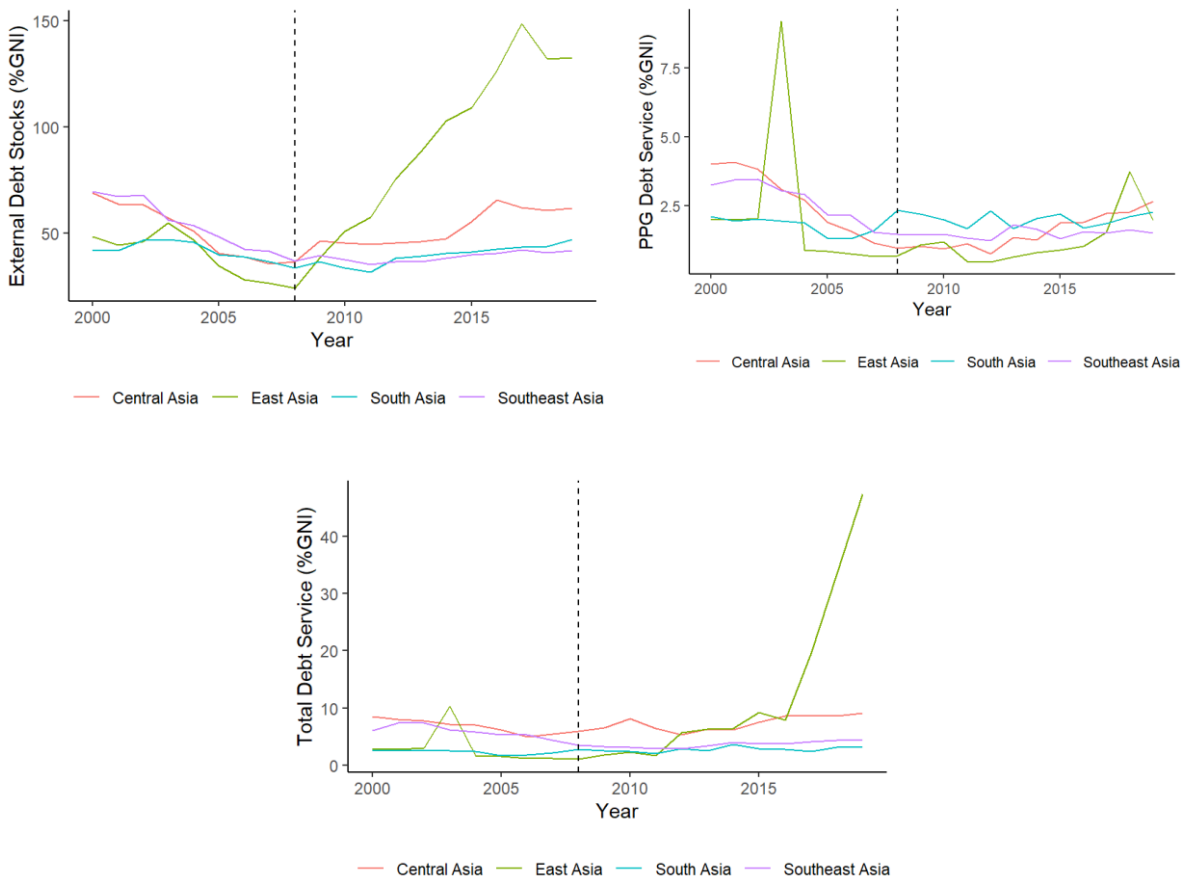
3.1. Debt indicators

Debt indicators of different country groups by income levels and by sub regions are shown in Figure 1 and Figure 2 respectively. We highlight the year 2008 (the dashed line in both Figures) in order to take into account the impact of the Global Financial Crisis.

Before 2008, *DebtStocks* of both lower-middle-income and upper-middle-income countries decreased rapidly but there seemed to be a big gap between them. After 2008, debt levels of the two groups have increased at a more or less similar pace. *PPGDebt* of the upper-middle-income group declined faster than the lower-middle-income group from 2000-2015, but after 2015, it went up again and has been at a higher level than the lower-middle-income group. However, at any point in time, *DebtService* of the upper-middle-income group was always higher than the lower-middle-income group even though *DebtService* of the latter group has increased faster after 2015. Generally speaking, the liabilities as a percentage of GDP have grown significantly across all country groups since the Global Financial Crisis.



Note: The dashed vertical line denotes the 2008 Global Financial Crisis.
Figure 1: Debt indicators of country groups by income levels
Source: Authors' compilation.



Note: The dashed vertical line denotes the 2008 Global Financial Crisis.
Figure 2: Debt indicators of country groups by sub regions
Source: Author's compilation.

3.2. Descriptive statistics

Table 3 reports the descriptive statistics of the variables employed in the growth convergence model. In total, there are 446 observations for each of the variables over the period 2000-2019. The larger the sample size of the study, the lower the error in the estimates and the more representative the population will be. According to Green (1991), a sample sizes N > 50 + 8 m (where m is the number of independent variables) for testing the multiple correlation and N > 104 + m for testing individual predictors (assuming a medium-sized relationship) is generally enough to obtain a normal sampling distribution from a strong skewness.

On average, GDP per capita of the Asian countries in our sample have grown at the rate of 4.9% annually. The average figures for debt stock, debt service and public and publicly guaranteed (PPG) debt service are 50.2%, 5.5% and 1.9% of GNI respectively. Across the countries, approximately 87.5% of the population has access to electricity and the total population has increased at an average annual rate of 1.2%. It is evident from the standard deviation that there is a great variation in the level of debt stock and the degree of trade openness among countries in our sample. Finally, the skewness and kurtosis measures reject the normality for all variables. Table 4 shows the matrix of pairwise correlation. It can

be seen from the table that the independent variables in our analysis do not show a strong correlation with each other. The highest correlation value is between two indicators of external debts - *PPGDebt* and *DebtStock*. Another notable correlation (0.439) indicates a positive association between *GDP* and *Electricity*, thus re-affirming the close relationship between economic development and living standards. Generally speaking, none of the correlation values in Table 4 is higher than 0.7, therefore we can be relatively safe that there is no multicollinearity.

Table 3: Summary statistics

Variable	N	Mean	Std. Dev	Min	Max	Skewness	Kurtosis
GDPGrowth	446	4.913	3.933	-13.519	33.03	1.21	12.745
GDP	446	7.496	1.007	4.93	11.951	0.438	4.068
DebtStock	446	50.184	40.512	0.141	283.254	1.886	8.669
DebtService	446	5.523	7.317	0.002	92.815	5.819	58.014
PPGDebt	446	1.934	1.956	0.002	17.521	3.577	23.291
Population	446	1.16	0.693	-0.897	2.823	-0.702	3.776
Electricity	446	87.507	17.188	24.6	100	-1.44	4.22
GCF	446	30.015	9.883	9.137	69.484	1.009	4.767
Openness	446	75.21	35.409	0.175	211.5	0.876	3.612

Source: Author's Stata computation.

Table 4: Matrix of pairwise correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) GDPGrowth	1								
(2) GDP	0.004	1							
(3) DebtStock	-0.083*	-0.100**	1						
(4) DebtService	-0.099**	-0.222***	0.302***	1					
(5) PPGDebt	-0.074	0.184***	0.659***	0.336***	1				
(6) Population	-0.238***	-0.209***	0.090*	0.019	-0.001	1			
(7) Electricity	0.079*	0.439***	0.013	0.026	0.244***	-0.277***	1		
(8) GCF	0.199***	0.192***	-0.037	-0.084*	-0.109**	-0.088*	0.020	1	
(9) Openness	0.129***	-0.052	0.391***	0.168***	0.251***	-0.125***	0.316***	0.048	1

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Author's Stata computation.

3.3. Impact of debt on convergence in Asian countries

Estimation results of equation (2) are reported in Table 5. We estimate eight models based on (2) by changing the debt indicators. For all eight models, country fixed effects are included to account for country-specific heterogeneity. Year fixed effects are considered in half of the models to control for the business cycle.

As can be seen from Table 5, the conditional beta coefficient for $\ln(GDP_{i,t-1})$ is significantly negative for models with only country fixed effects and insignificant when both country and year fixed effects are included. The coefficients of debt stock, debt service and PPG debt are significant and negative across the models. This implies that on average countries with higher levels of external debt tend to experience slower growth. The size of the coefficients indicate that

the PPG debt is the main external debt determinant of the conditional beta convergence. To be precise, a one-percent increase in the level of debt stock, debt service and PPG debt would lead to a decrease of economic growth by 1.7%, 10.2% and 44.5% respectively. The negative association between external debt and economic growth documented in this research echoes findings from previous studies (Rant et al., 2021; Mohsin et al., 2021; Munir and Mehmood, 2018).

Among the control variables, the effect of trade openness is highly significant across all models. The positive sign implies that countries that are more oriented to international trade grow faster. This finding is expected and supports the strong role of international trade in economic development. In half of the models, the coefficient for electricity is significantly positive, meaning that better access to electricity (i.e. a better living standard) improves economic growth.

Table 5: Impact of debt on convergence in Asian countries during the 2000-2019 period: Fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(GDP)	-1.290***	-0.143	-1.320***	-0.181	-1.664***	-0.361	-1.714***	-0.395
	(0.410)	(0.402)	(0.406)	(0.406)	(0.482)	(0.425)	(0.487)	(0.431)
DebtService	-0.102**	-0.097**					0.027	0.036
	(0.050)	(0.048)					(0.044)	(0.043)
DebtStock			-0.017**	-0.016*			-0.011	-0.012
			(0.009)	(0.008)			(0.009)	(0.009)
PPGDebt					-0.445***	-0.464***	-0.439**	-0.476**
					(0.162)	(0.160)	(0.188)	(0.185)
Population	-1.197	-0.706	-1.203	-0.761	-1.547**	-1.035	-1.396*	-0.948
	(0.738)	(0.675)	(0.740)	(0.671)	(0.721)	(0.643)	(0.743)	(0.670)
Electricity	0.028	0.071***	0.024	0.064***	0.033	0.081***	0.035	0.080***
	(0.025)	(0.023)	(0.025)	(0.022)	(0.027)	(0.024)	(0.027)	(0.023)
GCF	0.081	0.088*	0.078	0.086	0.072	0.082*	0.066	0.078
	(0.052)	(0.051)	(0.053)	(0.052)	(0.050)	(0.050)	(0.052)	(0.051)
Openness	0.028**	0.034***	0.026**	0.033***	0.027**	0.035***	0.027**	0.036***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Constant	9.517***	-4.049	10.619***	-2.700	13.010***	-2.378	13.563***	-1.719
	(1.871)	(4.041)	(1.959)	(4.152)	(2.036)	(4.076)	(2.213)	(4.188)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	NO	YES
N	424	424	424	424	424	424	424	424
R-squared	0.295	0.406	0.292	0.404	0.313	0.426	0.314	0.427

Note: All models are estimated with country fixed effects and robust standard errors. Year fixed effects are included in models (2), (4), (6) and (8). The dependent variable is the annual growth rate (log difference) of real GDP per capita. Independent variables are the beginning of period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), the ratio of total external debt stocks to gross national income (*DebtStock*), the ratio of total debt service to gross national income (*DebtService*), the ratio of public and publicly guaranteed debt service to gross national income (*PPGDebt*), annual growth rate (log difference) of total population (*Population*), the percentage of population with access to electricity (*Electricity*), the ratio of gross capital formation to GDP *(GCF*), and the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP. Robust standard errors are reported in parentheses. ***, ** and * denote statistically significant at the 1%, 5% and 10% levels respectively.

Source: Author's Stata computation.

As the result in Table 5 shows, the R-squared (0.406) of model 2 is an acceptance-of-fit measure for linear regression models but the R squared of model 1 equals 0.295 < R Squared of model 2. That is because the number of countries (24 countries) is higher than number of years of study. However, the sample size is large so it still ensures the appropriateness of the model.

Table 6: Impact of debt on convergence in Asian countries during the 2000-2019 period: Interaction effects

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
ln(GDP)	-1.187**	-0.160	-1.119**	-0.151	-1.606***	-0.377	-1.372***	-0.382
	(0.472)	(0.400)	(0.445)	(0.399)	(0.527)	(0.431)	(0.519)	(0.425)
DebtService	0.109	-0.220					1.317***	0.916**
	(0.372)	(0.395)					(0.365)	(0.415)
DebtStock			0.030	0.002			-0.018	-0.024
			(0.032)	(0.031)			(0.035)	(0.034)
PPGDebt					0.009	-0.955	-0.830	-1.300
					(1.074)	(1.156)	(1.130)	(1.157)
ln(GDP)*DebtService	-0.027	0.015					-0.153***	-0.107**
	(0.047)	(0.049)					(0.044)	(0.049)
ln(GDP)*DebtStock			-0.006	-0.002			-0.000	0.001
			(0.004)	(0.004)			(0.005)	(0.005)
ln(GDP)*PPGDebt					-0.066	0.070	0.022	0.100
					(0.146)	(0.153)	(0.160)	(0.161)
Constant	8.330***	-3.847	7.453**	-3.391	12.159***	-2.036	9.260***	-1.786
	(2.745)	(3.960)	(2.967)	(4.098)	(3.028)	(4.133)	(3.262)	(4.080)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	NO	YES
N	424	424	424	424	424	424	424	424
R-squared	0.295	0.407	0.294	0.404	0.313	0.426	0.329	0.433

Note: All models are estimated with country fixed effects and robust standard errors. Year fixed effects are included in models (10), (12), (14), and (16). The dependent variable is the annual growth rate (log difference) of real GDP per capita. Independent variables are the beginning of period (1-year lagged): natural logarithm of real GDP per capita (*GDP*), the ratio of total external debt stocks to gross national income (*DebtStock*), the ratio of total debt service to gross national income (*DebtService*), the ratio of public and publicly guaranteed debt service to gross national income (*PPGDebt*), the interaction of total external debt stocks with natural logarithm of real GDP per capita (ln(*GDP)*×*DebtStock*), the interaction of total debt service with natural logarithm of real GDP per capita (ln(*GDP)*×*DebtService*), the interaction of public and publicly guaranteed debt service with natural logarithm of real GDP per capita (ln(*GDP)*×*PPGDebt*). Control variables include the beginning of period (1-year lagged): annual growth rate (log difference) of total population (*Population*), the percentage of population with access to electricity (*Electricity*), the ratio of gross capital formation to GDP *(GCF*), and the degree of trade openness (*Openness*) measured by ratio of exports and imports to GDP. Robust standard errors are reported in parentheses. ***, ** and * denote statistically significant at the 1%, 5% and 10% levels respectively.

Source: Author's Stata computation.

Next, we incorporate the interaction terms between each debt indicator and $\ln(GDP_{i,t-1})$, as shown in Equation (3). The estimation results are reported in Table 6. Among all debt interaction terms, only the interaction of DebtService is statistically significant in the joint specification with the DebtStock interaction and PPGDebt interaction terms. The negative coefficient is evident that a higher debt service ratio is associated with a higher rate of the convergence process. This finding implies that over the past two decades the growth convergence among Asian economies has been largely driven by external borrowings. The positive association between debt ratio and the convergence rate documented in this study contrasts with the finding by Rant et al. (2021). Yet, these authors investigated the impact of total debt (public and private) on the convergence of European countries, all of which are developed economies.

On the one hand, the insignificant coefficients of the debt interaction terms in models 9-14 might be due to the use of the face value of debt, which can be misleading as countries can borrow at different maturities and with different contractual forms (Dias et al., 2014). On the other hand, the finding that the interactions of all three proxies of debt are insignificant when they stand alone in the regression model but the interaction of DebtService turns significant in the combined model, suggests the complex relationship between debt and growth. While DebtStock refers to total external debt and PPGDebt measures public debt, DebtService refers to the total debt figure, including private debt. Our finding therefore implies that private debt may be detrimental to the economic growth process, which is in agreement with the view of Gourinchas and Obstfeld (2012) and Schularick and Taylor (2012) that private debt represents a source of financial instability and crisis.

Next, we calculate the conditional convergence speed at different levels of debt service using 2019 data based on model (15) with country fixed effects. The total debt service ratio in 2019 is calculated at different percentiles based on data for 24 countries, and then the percentile values are plugged into equations (5) and (6) to derive the implied convergence rate. Two comments can be made by observing Table 6. First, the reported speeds of convergence fall mostly in the range 2-3% and are in line with the estimates from the income convergence literature. Second, while the convergence accelerates as the level of total debt service rises, the increase of the convergence speed is rather marginal.

Table 6: Convergence speed during the 2000-2019 period

Percentile	β'	τ
10th	-0.015	1.537
20th	-0.016	1.652
30th	-0.017	1.738
40th	-0.020	1.983
50th	-0.021	2.138
60th	-0.023	2.314
70th	-0.024	2.478
80th	-0.031	3.103
90th	-0.036	3.640
95th	-0.046	4.756

Source: Author's Stata computation.

5. Conclusion

This research investigates the role played by external debt in the growth convergence process. Data from the World Development Indicators are retrieved for 24 Asian countries during the 2000-2019 period. In the empirical analysis, three indicators of external debt, namely total debt service, debt stock and public and publicly guaranteed debt service, are augmented in the conditional beta convergence model. Further, to examine whether external debt influences the speed at which economies are converging, we incorporate the interaction terms between external debt ratios and the natural logarithm of the initial GDP per capita level in the convergence model.

Results of the fixed effects estimation show an inverse relationship between external debt and economic growth. Among the three chosen indicators of external debt, the influence of public and publicly guaranteed debt service is largest. When debt interaction terms are considered, only the coefficient of the interaction term for total debt service is significant. The negative coefficient implies that countries with a higher level of total debt service have experienced faster convergence. As the final step, we calculated the conditional convergence rates at varying levels of debt service. Broadly speaking, as the level of total debt service rises, the convergence speed increases but at a marginal pace.

Our findings highlight the significant role of external debt on economic growth. On the one hand, debt – especially external debt – is an important source of financing for middle-income countries as they further develop and converge economically. On the other hand, external debt adversely influences economic growth in the long term, possibly due to the increased interest burden and the crowding out effects.

The overall findings of this study have significant policy implications. They inform financial policymakers in developing countries to pay special attention to crucial capital characteristics to improve economic sustainability. They can also serve as the basis for the enforcement of financial laws restricting government borrowings from foreign capital.

However, our research is not without limitations. First, our study only explores 24 selected Asian countries due to data availability. Developed Asian countries are excluded because of the lack of debt data. Second, other factors such as human capital, institutional quality or political governance could be added in the conditional beta convergence model. That said, this research presents many opportunities for future research. For example, external debt could be decomposed into different categories such as public versus private and short-term versus long-term. In addition, the nexus between debt and economic convergence could be viewed in light of spatial analysis where the spatial interactions between countries are taken into account.

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