International Journal of Human and Society (IJHS)

P-ISSN: 2710-4966	E-ISSN: 2710-4958
Vol. 3. No. 04 (Oct-Dec) 2023	Page 01-25

ECONOMIC IMPACT OF PUBLIC DEBT ON ECONOMIC GROWTH IN ASIAN COUNTRIES

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Abstract: This study was designed to examine the economic impacts of public debt on economic growth in Asian countries between 1991 and 2020. Public debt is measured by the Public Debt Ratio, while real GDP per capita growth is measured by real GDP per capita growth. FDI, inflation, the 1997 and 2008 financial crises, as well as other determinants, are considered as control variables. With panel data regression, the study used several econometric techniques related to autoregressive distributed lag models, including unit root tests (IPS) to determine stationary at level, while LLC unit root tests were used to determine non-stationarity at level (1) and make them stationary. Co-integration tests such as Pedroni's (1999,2004) are performed on long run coefficients based on statistical significance and error correction. In this study, it is found that the long- and short-term impacts of public debt are adverse on economic growth. It was statistically significant that public debt had a negative impact on growth over the long and short terms; however, its magnitude varies. Using cointegration tests, it is established that there is an interrelationship between the variables on the panel level, while on the group level, they are interrelated within the individual groups (which is not relevant here since only one group is represented). A study found that both short- and long-term public debt negatively impacts economic growth. In both the long- and short-terms, public debt had a statistically significant negative impact on economic growth, but its magnitude varied. Hausman's test is used to compare PMG, MG, and DFE panel models. As part of our analysis, we use several mean group models, including pooled mean group models and dynamic fixed effects mean group models. When comparing data results using Hausman test results, the MG model is preferred over the PMG model. No matter how long or short-term state debt is, it adversely affects the economy's growth. In the final step, causality tests are used to identify cause and effect. Evaluating public debt and economic growth also requires considering public expenditures, according to the study.

Keywords: Economic Growth, Public Debt, Asian Countries, GDP, FDI

Introduction

The growth rate are affecting in most developing countries, due to several factors. A key factor in debt accumulation is the amount of debt serviced and the rate of debt accumulation. Insufficient exchange rate adjustments led to the loss of competitiveness in most of these countries on the international market. In developing countries, weak terms of trade, mismanagement of the economy and a crisis of governance all contributed to lower growth rates. Due to higher interest rates, decreases in external resources inflows, lower export earnings, and lower imports, countries with higher debt burdens were more affected by downward pressure than those with lower debt burdens.

The Asian Financial Crisis caused substantial losses to several Asian countries in the late 1990s. This loss was caused largely by using short-term debt to fund long-term investments within the domestic market, a phenomenon known as "maturity mismatch." During this period, government debt levels increased due to financial bailouts and deficit spending aimed at stimulating demand. Indonesia and Thailand saw their government debt reach 35-50 percent of GDP, while Indonesia and the China experienced levels as high as 90-100 percent of GDP (World Bank, 2000). By the end of 2000, the public debt-to-GDP ratio in these Asian countries exceeded the 60 percent Maastricht criterion (Nick, 2003). The crisis led to a significant economic slowdown in the Currency devaluations, rising inflation, bankruptcies, and currency devaluations are all common characteristics of Asian economies. According to Leblang & Satyanath (2005), Indonesia saw its GDP contract 15 percent in 1998, while Thai and Indonesian economies both fell nearly 10 percent.

Global Financial Crisis in 2008 did not directly affect Asia's economies. As a result, countries that depend heavily on trade, such as Thailand, Sri Lanka, and Indonesia, saw their economic growth decline. During the first half of 2009, export value declined more than 25 percent due to reduced global demand for Asian goods. Moreover, if the debt problems in Europe remain unresolved, there is a risk of a global economic slowdown, potentially leading to another crisis similar to 2008. GIIPS countries (the origin of the Euro Crisis) have already experienced sovereign bond crises and economic worsening due to public debt. A lesson learned from Europe's public debt crisis is the importance of responsible budgetary decisions for Asian countries. The public debt as a percentage of GDP has increased significantly in several Asian countries over the past few years, reaching 48-55%. Despite having the highest per capita income in the region, China's public debt ratio ranked 13th in 2015. For long-term sustainable growth, even in Asia countries with low levels of public debt, consideration must be given to its potential impacts on economic growth.

According to Central Intelligence Agency (CIA), data were collected from 179 countries in the globe having problem of high-level public debt. Japan's Gross Domestic Product is higher than 200 percent than that of other nations because of its high debt to GDP ratio. Its indicated that Japan GDP is very strong as compare to the rest of countries due to of its low level of debt to GDP. Since the 2008 global financial crisis, many academic studies have discussed this topic, which has recently forced academics and policymakers to reexamine the issue. Increasing public debt provides a greater level of liquidity to the private sector, enabling it to respond more efficiently to income and spending changes (Woodford, 1990).

The lack of infrastructure investments in Asian countries since 2000 has been filled by foreign direct investment, official development assistance, and others. Because most Asian economies have used public debt to fund infrastructure or social programs to increase productivity, they have never experienced public debt concerns. As debt in the public sector increases, Agénor and Montiel (1996) argue that distorted measures (the inflation tax) will be used to fund debt service obligations.

The study also shows that most research on public debt in Latin American countries has focused on advanced economies and emerging countries, while Asian countries have fewer studies on the subject. These selected eleven Asian countries has low infrastructure capacity

in comparison to other emerging Asian countries. Insufficient investments in infrastructure have forced Asian governments to heavily rely on external sources for financing infrastructure development projects, such as foreign direct investment (FDI) and official development assistance (ODA). As a result, these Asian economies do not have to worry about public debt because most of it is being used to invest in infrastructure or provide social services.

Emmers and Ravenhill (2010) found that Asian exports fell by more than 25 percent during the first half of 2009. Bangladesh, Malaysia, and Sri Lanka, all heavily dependent on trade, were negatively impacted by the Global Financial Crisis in 2008, despite not directly affecting those economies. One of the components of the fiscal policy section is public debt, according to Samuelson and Nordhaus (1997). Deficiencies in the past have resulted in the government borrowing to finance them. State agencies mostly issue bills and bonds with short-term rates as a form of government debt.

For instance, government obtain revenue by taxing or borrowing money from the public or other parties by issuing bonds to cover budget deficits. Foreign debt and domestic debt are the two types of debt that the government can take on. The government finances its budget by borrowing money. Based on Sukirno's (2008) analysis, Sukirno believes that economic growth depends on four factors: resident population, capital goods, geographic area, natural resources, and technological level. According to Sukirno (2008), four factors influence economic growth. Growing economies are characterized by increased economic activity (production of goods and services) over the previous year.

Our research study aims to identify the factors contributing to the downgrading of economic growth in Asian countries. A new approach to public debt (Panel data regression) attempts to fill the literature gap by looking at how public borrowing may have negatively affected economic growth (Panel data regression). This paper examines the public debt-growth nexus in 11 Asian countries whose fiscal and macroeconomic data are available over the past 30 years (1991-2020). In addition, the study determines the maximum level of indebtedness that would not reduce economic growth beyond the maximum affordable public debt level.

Specifically, this study examines how long-term and short-term public debt affects GDP growth in selected Asian countries. Additionally, GDP per capita, debt to GDP ratios, crises97, crises08, and Xes are included in the analysis, as well as fiscal balance, population growth, capital formation, foreign direct investment, inflation, and Asian Financial Crisis. As control variables, the following variables are included: real GDP growth, debt to GDP ratio, crises97, crises08, and Xes. To determine the impact of these variables on economic growth in Asian countries, these variables must be examined in the same way. Moreover, we examine the connection between public debt and capital affordability.

1) Considering the varying economic structures and developmental stages of Asian countries, this study analyzes the impact of public debt on economic growth. The choice to investigate this topic arises from a lack of comprehensive research in the Asian region, with existing studies often outdated or concentrating on specific countries. Utilizing diverse methodologies and datasets, the study seeks to provide a more thorough understanding of the debt dynamics across Asian nations. \

The paper addresses three main research questions:

1) What is the impact of public debt on economic growth in Asian countries?

2) Is there a non-linear relationship between public debt and economic growth?

3) Besides public debt, what other factors influence economic growth in these countries?

The paper follows a structured approach, beginning with a review of previous relevant studies, specifying the empirical model, describing the data and methods used, presenting the results, and engaging in a discussion of findings and policy recommendations. The study provides a unique

perspective on public debt and economic growth dynamics in Asian economies, which differentiates it from similar studies.

Literature Review

Following the debt crisis in Latin American developing countries in the early 1980s, there has been a significant increase in literature on the economic impact of public debt on economic growth. Many researchers contributed to the field of examining the impact of public debt on economic growth in developed countries in the 1990s. More recently, the sovereign debt crisis in Europe reignited concerns among policy makers and researchers, leading to a surge in studies, particularly in developed economies. Despite the extensive literature on this topic, the results vary depending on factors such as the group of countries studied, the time period examined, and the analytical methodology employed.

2.1.1 Studies on negative relationship between public debt and economic growth

Public debt, according to Krugman's 1988 paper, negatively impacts economic development when it is projected to generate less revenue than the debt itself, or when revenues are insufficient to cover debt service. Economic development can be hindered by public debt. Agénor and Montiel's 1996 research showed that as a government's debt service obligations increase, it may resort to using distorted measures like the inflation tax to finance its debt service. This underscores the consequences of a growing stock of public sector debt, as governments may rely on measures like the inflation tax to manage their increasing debt burden.In a study by Kumar and Dee in 2008, it was noted that there has been limited research on public debt in Asian countries, especially when compared to research in advanced economies and growing Latin American nations. The authors pointed out that in the case of emerging nations in Southeast Asia, there is a lack of sufficient infrastructure. This highlights the unique challenges faced by these Southeast Asian countries due to their inadequate infrastructure, underscoring the need to study the impact of public debt in this region. According to Barrios (2009), Ardagna (2007), and Laubach (2009), significant debt and deficits can have a negative impact on long-term interest rates and yield spreads in sovereign countries. High levels of debt and deficits can slow down a country's economic growth, leading to higher interest rates and wider yield spreads. Long-term interest rates and yield spreads are higher when debt and deficits increase. Kumar and Woo discovered in 2010 that the level of debt at the start of a country's economic development was in inverse relation to the growth of the country during the period from 1970 to 2007. As a result, both developed and developing countries can experience economic challenges because of high levels of public debt. Public debt and economic growth are negatively correlated, according to the study. Policymakers should prioritize debt reduction strategies to address excessive debt as part of a responsible fiscal policy. Using the instrumental variable method, Panizza and Presbitero in 2013 found that in OECD countries, public debt inversely correlated with economic growth. These results highlight the significance of responsible fiscal management and debt reduction strategies for achieving sustainable economic development. For investment, innovation, and economic growth, governments should focus on reducing public debt. An analysis of the relationship between public debt and economic growth was performed by Fincke and Greiner in 2013 using regression models. According to their findings, public debt negatively impacts economic growth.

2.2.2 Studies on positive relationship between public debt and economic growth

According to Woodford (1990), as governments cannot respond simultaneously to income and spending opportunities, higher public debt can enhance economic efficiency. Additionally, private wealth appears to be more liquid, primarily due to a larger proportion of liquid assets. During the 1980s and 2012, Fincke and Greiner found a significant positive correlation between public debt and economic growth in eight selected emerging market economies.

2.2.3 Studies on non-linear relationship between public debt and economic growth

Reinhart and Rogoff (2010), identified threshold levels of debt that were reached by 20 developed economies and 24 emerging economies between 1946 and 2009. There seems to be specific debt thresholds within both developed and emerging market economies that, once crossed, negatively affect economic growth. Both advanced and emerging countries experience low growth outcomes because of high debt-to-GDP ratios, according to Checherita and Rother (2010). They found that between 1970 and 2009, government debt was consistently negatively correlated with economic growth in 12 European countries. According to Baum et al. (2013), debt management should start when debt levels reach 70-80 percent of GDP. Cecitti and colleagues (2011) found a similar threshold effect between 1980 and 2010, with public debt hitting a threshold at 85 percent of GDP. Pham's (2011) study focused on Vietnam's public debt and its risks. Since public debt has grown substantially in recent years, public debt sustainability and liquidity have decreased below conventional safety thresholds, leading to rapid macroeconomic deterioration. To investigate spatiotemporal variability, Gonzalez-Puig and Sosvilla-Rivero (2015) conducted Granger Causality analysis. Their findings underscore the significance of this analysis in understanding economic growth, particularly when accounting for spatial and temporal dynamics. Granger Causality analysis proves valuable in capturing complex relationships across different geographical areas and time periods, highlighting its importance in economic analysis. Eberhardt and Presbitero (2015) conducted a study involving 105 economies, including emerging, developing, and established ones, to analyze the relationship between debt growth and economic performance. While some evidence suggests the presence of threshold levels, their findings indicate that the relationship between debt growth and economic performance is not linear. Debt accumulation can impact economic outcomes differently, influenced by factors like fiscal uncertainty and institutional characteristics. Kim (2015) highlighted differences between emerging Asian nations and those in Africa and Latin America. Asian countries attracted productive investments with imported capital and maintained open economies while fostering a conducive environment for high savings and investment. This context has led to increased research interest in Southeast Asia's government debt issues. Muhammad's study in 2017 focused on eight ASEAN nations from 2006 to 2015, revealing a close link between public debt and economic growth. Using Vector Auto Regression (VAR) analysis for a decade of data, the study found that a significant amount of public debt contributes to economic growth. The findings suggest that public debt may not adversely affect certain stages in the development process.

2.2.4 Synthesis of Literature Review

This study departs from previous research in both methodology and country selection. Eleven Asian countries are examined through panel data regression over the period 1991-2020 to determine how public debt affects economic growth. The study explores whether public debt affects economic growth and acknowledges that this impact may not always be negative, especially during certain developmental stages. Instead of searching for a specific debt threshold, the study focuses on understanding how public debt affects economic growth over the short and long term. Furthermore, the study investigates the combined effects of both domestic and external debt, which make up a significant portion of total indebtedness, unlike previous research that often focuses only on external debt. A panel regression model approach is employed in the study, along with several determinants and control variables, to analyze the relationship between public debt and economic growth in these Asian countries, using Auto-regressive Distributed Lag, Mean Group, Dynamic Fixed Effect, Pooled Mean Group, and Granger causality tests.

Data and Methods

In many studies of advanced economies, public debt has been examined as a factor influencing economic growth. However, this approach has not been used in studies of Asian economies. In this study employs different methodologies and

samples nations differently than previous research. Using Panel Data Regression, it to analyze the economic impact of public debt on economic growth in 11 Asian economies (such as Pakistan, China, Bhutan, Bangladesh, India, Indonesia, Turkey, Nepal, Thailand, Sri Lanka and Vietnam), from 1991 to 2020 by the research approach of Checherita and Rother (2010).

3.1. Estimated Model

The following model examines the impact of public debt on GDP growth in a panel data of 11 Asian countries for 30 years (1991 – 2020)

$$Y_{it} = \alpha_1 + \alpha_2 Y_{it} + \alpha_3 Y_{it}^2 + \alpha_4 PD + \alpha_5 X_{it} + \gamma_1 D_1 + \gamma_2 D_2 + \mu_{it} + \varepsilon_{it} \ldots\ldots\ldots eq.1$$

Where: i: country; t: year

Y_{it} is the growth rate of real GDP per capita of ith country in year t. It is measured in percentage term. Y_{it} is the real GDP per capita in the base year i.e. year 1990. Y_{it}^2 real GDP squared showing non-linear relationship between public debt and GDP growth. PD is the public debt-to-GDP ratio (in percent). X_{it} shows regulatory factors affecting expansion of the economy including fixed capital formation, population growth rate, Inflation and foreign direct investment (FDI). D_1 and D_2 are dummy variables used for Asian Crisis of 1997 and Global financial crisis of 2008 and 2009. respectively. D_1 = if years are 1997-98 and 0 otherwise. Similarly D_2 = 1 if the years are 2008 and 2009, and 0 otherwise. The Greek letters α_i and γ_i are partial regression coefficients of quantitative explanatory variables and dummy variables, respectively. Finally, the μ_{it} are fixed effect of countries under investigation and ε_{it} indicates error term.

3.2.

Data source

The present study uses annual panel data for selected Asian countries from 1991 to 2020.Thus, the availability of the data was the only barrier to including a country in the sample. Similar criteria were applied to the sample period, but with the caution that data for that period should be accessible for all of the nations considered. Additionally, we went out of our way to incorporate the 1997 and 2008 debt financial crisis in the sample.

3.3. Variable description

Due to the availability of data, researchers can only choose certain types of variables. The following four variables will be used to examine how public debt affects economic growth in selected Asian countries:

3.3.1 Dependent Variable

The dependent variable in this study is real GDP growth. It is necessary to use the local currency as a constant when calculating GDP per capita growth. The aggregates are based on the constant US dollar of 2010. To calculate the GDP, the midyear population is divided by 100. It is useful for comparing countries' relative performances when comparing them across borders.

3.3.2 Explanatory variables

GDP per capita in 1990 measures the result of dividing the country's total GDP by its population, which accounts for the various sizes of nation This variable has been adjusted for inflation since it is in US dollars at 2010 constant prices.

GDP Squared in 1990. This variable has been adjusted to findout the linear and non linear relationship in the panel data model variables.

In addition to the **public debt-to-GDP** ratio, the public debt-to-GDP ratio is also an important explanatory variable. IMF's Historical Public Debt Database (HPDD) can be used to calculate Gross Debt as a percentage of GDP. A public debt incurred by general government is to be paid off by the HPDD, according to the IMF. It was often the case that the general government lacked information about public debt, especially during the early period, so data were obtained from the central government instead. Economic growth can be negatively affected by public debt, resulting in a positive coefficient for debt.

In this model, the **financial crises of 1997 and 2008** are accounted for as well as population growth

rates, gross fixed capital formation, and inflation. Based on previous empirical studies conducted by Clements et al (2003-2010), these control variables were selected.

Population growth serves as a stand-in for the growth rates of labor, a factor input in the production process. Although Asian countries have had relatively rapid population increase over the past 20 years, the region's human resource quality is still inferior to that of other Asian countries. In addition, the eleven Asian countries' population prediction predicts a slowdown in population growth over the next 20 years, a decline in the proportion of young people, and an increase in life expectancy in Asia due to better healthcare and medical advancements. As a result, the percentage of the population that is over 65 will increase. A negative sign is therefore expected for its coefficient.

FDI is one of the main elements that directly influence the growth of the economy. The spillover effect of FDI tends to increase economic growth particularly through technology transfer and total factor productivity. As a result, it is anticipated that the FDI coefficient will be positive.

Fixed Capital Formation refers to the net increase in a country's physical capital stock over a specific period. It represents investments made in the construction, expansion, or improvement of buildings, machinery, infrastructure, and other productive assets. It is considered an independent variable for economic growth because it directly affects a nation's capacity to produce goods and services efficiently.

The concept of **inflation** refers to an economic trend in which the general price of goods and services increases continuously over time. An index that measures percentage changes in prices is the Consumer Price Index (CPI). Inflation affects economic growth and public debt both positively and negatively.

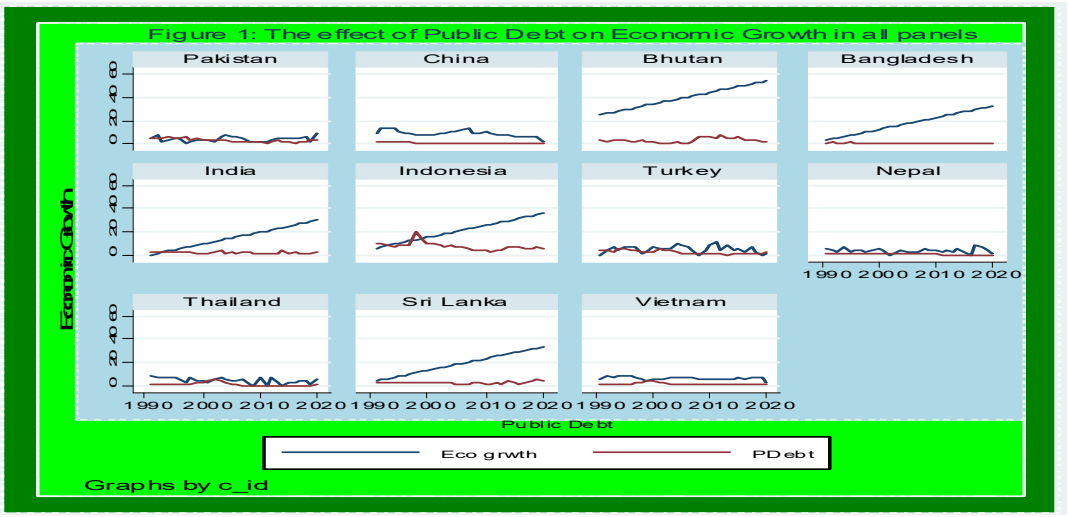
Additionally, the impact of two financial crises on economic development is captured using the dummy variables Crisis97 and Crisis08. It is anticipated that the coefficient of these variables will be negative.

Table 3.1 Summary of variables and data sources

Variables	Definition	Measurement	Period	Expected signs	Sources
GDP_gr	Economic growth	Per capita real GDP growth (%)	1991-2020		World Bank Development Indicators (2020)
GDP	GDP per capita in starting year	Based on constant 2010 US dollar prices, 1990 is the starting year for real GDP per capita.	1991-2020	-	do
GDP square	GDP square	Gross Domestic Product (% of GDP)	1991-2020	+	do
PDebt	Public debt Ratio	Inflation-adjusted gross domestic product (%)	1991-2020	+/-	do

FCF	Fixed capital formation	Gross fixed capital formation (% of GDP)	1991-2020	+	do
POP	Population growth	Population growth (annual %	1991-2020	-	do
FDI	Foreign direct investment	Foreign direct investment inflows (as % of GDP)	1991-2020	+	do
INF	Inflation	Inflation as %ge of GDP	1991-2020		do
FinCrisis$_{97}$	Asian financial crisis	In the case of 1997 and 1998, it takes the value 1, and in the case of all other years, it takes the value 0.	1991-2020	-	do
Crisis$_{08}$	Global financial crisis	If the year is 2008 or 2009, it takes the value 1, otherwise it takes 0	1991-2020		dO

Figure 1. The effect of public debt on economic growth in Asian countries



In Figure 1, the impact of public debt on economic growth from 1990 to 2020 is illustrated in a diverse manner. While some nations struggled with economic instability and slow growth despite high public debt, China stood out as an exception, maintaining robust growth despite substantial debt levels, largely due to its export-oriented economy.However, several Asian countries like Sri Lanka and Pakistan have faced economic slowdowns and increasing public debt. This rising debt has led to fiscal imbalances, reduced private investment, and decreased government spending on crucial public services, contributing to economic instability. It appears that in these Asian countries, high debt levels can sometimes slow economic growth due to the relationship between public debt and economic growth. Yet,

export-driven economies, responsible fiscal policies, and effective government spending can growth in this context.

1. Results and Discussion

In the previous chapters, we have described the theoretical basis of this study, which includes empirical analyses and observations of the impacts of public debt on economic growth in 11 Asian countries. Our study's empirical results are presented and discussed in this chapter as

also stimulate economic

follows:

1.1. Descriptive statistics

Comparing the variables in the model requires a description of each variable's characteristics as well as its characteristics in the model. By calculating the standard deviation, Table 2 represents that how the data varies.

Table 2. Results of the Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Yg	330	13.523	11.966	-1.274	54.122
GDPPC	330	2251.09	2581.011	140.631	12507.595
GDPSQ	330	41.465	23.095	11.859	111.837
PDebtR	330	2.729	2.42	.123	20.333
POP	330	2.732	5.448	.081	32.231
FCF	330	1.827	1.836	.004	11.939
FDI	330	1.82	1.837	.004	11.939
INF	330	9.219	13.61	.188	105.215
Fincrisis	330	.1	.3	0	1

Source: Author's calculation

The table presents descriptive statistics for various variables. The mean values for economic growth (Yg) and GDP per capita (GDPPC) are 13.52325 and 2251.09, respectively. The corresponding standard deviations are 11.96597 and 2581.011. The minimum values for economic growth and GDP per capita are -1.274087 and 140.631, while the maximum values are 54.12229 and 12507.59, respectively.The mean value for GDP Square is 41.46482, with a standard deviation of 23.09493. The minimum and maximum values for GDP Square are 11.85879 and 111.837, respectively.Public debt and FDI have mean values of 2.729398 and 1.820462, respectively, with standard deviations of 2.419983 and 1.837114. The minimum values for public debt and FDI are 0.1227101 and 0.0044915, while the maximum values are 20.33275 and 11.93948, respectively.The variable POP has a mean value of 2.731531. Fixed capital formation, inflation, and financial crisis have mean values of 1.826833, 9.219229, and 0.100, respectively. Their corresponding standard deviations are 5.448228, 1.835698, 13.61, and 0.30045, respectively. The minimum values for these variables are 0.0809905, 0.0044915, 0.1881497, and 0.00, respectively, while the maximum

values are 32.23064, 11.93948, 105.215, and 1, respectively.

1.2. Regression analysis

In regression analysis, variables are analyzed in relation to each other to determine whether one or more variables are related to the dependent variable. By analyzing these relationships statistically, we can better understand their nature and strength.

Table 3. Results of the regression

Yg	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
GDPPC	-.006	.001	-9.94	0	-.007	-.005	***
GDPSQ	.776	.06	12.91	0	.658	.894	***
PDebtR	.514	.216	2.38	.018	.089	.938	**
POP	-.269	.103	-2.61	.009	-.473	-.066	***
FCF	1.01	.238	4.25	0	.542	1.477	***
INF	-.101	.033	-3.05	.002	-.166	-.036	***
Constant	-7.78	1.724	-4.51	0	-11.171	-4.389	***

Mean dependent var	13.292	SD dependent var	12.223
R-squared	0.429	Number of obs	330
F-test	39.157	Prob > F	0.000
Akaike crit. (AIC)	1973.535	Bayesian crit. (BIC)	2000.128

**** p<.01, ** p<.05, * p<.1*

Source: Author's Calculation

A regression analysis is presented in Table 3 which shows the relationship between the dependent variable, economic growth (Yg), and six independent variables: GDP per capita, GDP squared, Public Debt to GDP ratio, population, Fixed capital formation, and inflation. By changing each independent variable by one unit, but keeping others constant, the coefficients represent the change in Yg (economic growth). Variability in coefficient estimates is measured by the standard error. If the null hypothesis (the coefficient is zero) is true, the p-value indicates the likelihood of obtaining an extreme value. Independent variables with smaller p-values are statistically more significant. 95% confidence intervals show what range a population coefficient is likely to fall within. The last column of the table indicates the statistical significance level for each independent variable. A * symbol denotes significance at the 1% level, ** at the 5% level, and *** at the 10% level.The table also includes the expectation, variance, and significance values for the model. The R-squared value shows the proportion of variance

in Yg explained by the independent variables. A lower Akaike and Bayesian information criterion suggests a better fit between the model and the data. The table also provides information on the mean and standard deviation for the dependent variable, the number of observations, and other model-related statistics.

1.3. Correlation Analysis

It show that there is exist a linear relationship among the variables with the dependent variable. If there is no linear relationship so there is the problem of multicolinearity occurs which means that the regressor are not linearly correlated with each others.

Table 4. Matrix Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Yg	1.000								
(2) GDPPC	-0.063	1.000							
(3) GDPSQ	0.035	0.970	1.000						
(4) PDebtR	0.218	-0.173	-0.136	1.000					
(5) POP	-0.222	-0.160	-0.159	0.015	1.000				
(6) FCF	-0.139	0.029	0.048	-0.123	-0.131	1.000			
(7) FDI	-0.127	0.041	0.065	-0.109	-0.133	0.955	1.000		
(8) INF	-0.135	0.015	0.048	0.283	-0.004	-0.149	-0.151	1.000	
(9) Fincrisis	-0.065	-0.099	-0.107	0.071	-0.019	0.045	0.047	0.100	1.000

Source: Author's Calculation

In Table 4, the correlation matrix illustrates how various variables are related to economic growth (Yg). Economic growth is negatively correlated with GDP per capita, foreign direct investment, population, fixed capital formation, inflation, and financial crisis, while it is positively correlated with GDP squared and public debt.

The relationship between economic growth (Yg) and foreign direct investment (FDI) is negatively correlated while the relationship between economic growth (Yg) and inflation is positively correlated. GDP and inflation have a positive correlation, while GDP and FCF, as well as inflation and financial crises, have negative correlations with economic growth (Yg).

A linear relationship between the variables and the dependent variable is difficult due to the positive or negative nature of all coefficients. This indicates a problem of multicollinearity, and it is necessary to conduct multicollinearity tests to address this issue.

1.4. **Unit Root Testing**

Table 5. Unit Root IPS tests results

Im-Pesaran-Shin unit-root test

Ho: All panels contain unit roots	Number of panels = 11
Ha: Some panels are stationary	Number of periods = 30
AR parameter: Panel-specific	Asymptotics: T,N -> Infinity
Panel means: Included sequentially	
Time trend: Not included	
ADF regressions: 1 lag	

Source: Author's Calculation

Table 5. Unit root IPS tests results

Variables	W-t-bar	Statistic	P-value
Yg	,,	-0.3243	0.3729
GDPPC	,,	5.9540	1.0000
GDPSQ	,,	5.0783	1.0000
PDebtR	,,	-0.1678	0.4334
FDI	,,	-4.9094	0.0000
POP	,,	1.3557	0.9124
FCF	,,	-4.5620	0.0000
INF	,,	-4.4367	0.0000
Fincrisis	,,	-8.0415	0.0000

According to the above IPS table, Fixed capital Formation, FDI, and inflation are stationary variables at levels, but GDP Growth, GDP per capita, GDP square, and Public Debt are non-stationary variables at levels. By converting all variables to stationary level, we transform them to non-stationary level.

II) LLC (Levin-Lin-Chiu) Test for the assumption of homogeneous slopes as well as it require that the data shuold be strongly balanced because it is not used due to very few holes in the data sets and though stata adjusted the data as stongly balanced. LLC also find out the stationarity of the variables on the basis of p-value< 0.05%, otherwise if p-value>0.05% so it show the variables are non-stationarity then we take first defference to make the variables values stationary.

Table 6. Unit root LLC Tests Results

xtunitroot llc Yg, lags(1)

Levin-Lin-Chu unit-root test for Yg

Ho: Panels contain unit roots — Number of panels = 11

Ha: Panels are stationary — Number of periods = 30

AR parameter: Common — Asymptotics: N/T -> 0

Panel means: Included

Time trend: Not included

ADF regressions: 1 lag

LR variance: Bartlett kernel, 9.00 lags average (chosen by LLC)

Table 6. Unit root LLC Tests results

Variables	Statistic	P-Value	Unadjusted t	Adjusted t*
Yg	0.7128	0.7856	0.7128	0.7911
d.Yg	-16.0604	0.0000	-16.0604	-8.3879
GDPPC	0.7670	0.9997	0.7670	3.4562
d.GDPPC	-8.7151	0.0049	-8.7151	-2.5843
GDPSQ	-0.0363	0.9634	-0.0363	1.7912
D.GDPSQ	-9.5371	0.0008	-9.5371	-3.1412
PDebtR	-4.5636	0.0842	-4.5636	-1.3772
D.PDebtR	-13.6584	0.0000	-13.6584	-7.4284
FDI	-8.4561	0.0000	-8.4561	4.1561
POP	1.2185	0.9119	1.2185	1.3524
D.POP	-10.4025	0.0000	-10.4025	-5.5651
FCF	-8.2618	0.0000	-8.2618	-3.9203
INF	-7.4561	0.0001	-7.4561	-3.6902
Fincrisis	-13.0896	0.0000	-13.0896	-8.2434

Source: Author's Calculation

Economic growth (Yg), GDP per capita, GDP squared and Public debt are non stationary in the LLC

table 6 listed above. Fixed Capital Formation, FDI, Inflation are stationary at levels, but Economic growth (Yg), GDP per capita, and GDP squared are non stationary at levels. By using first difference, we transform all non-stationary variables to stationary levels.

1.5. Optimal lags selection

Selection of lags use for each country per variable based on an information criteria and for the unrestricted model.

Table 7. optimal lags selection Results

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	330	.	-41.6484	7	97.29679	106.8679
330	.	-41.6484		7	97.29679	106.8679

Note: N=330 used in calculating BIC.

Source: Author's Calculation

So in the table 7 of the Mean Group and Pooled Mean Group all the variables p-values are insignificant in short run except the two variables population and inflation p-value are significant. While taking the lags of the these two variables which make the p-values of both are insignificant. So its means there is no needs for lags selection criteria.

1.6. Co-integration test

Using non-stationary panels, Pedroni (1999,2004) tested the null hypothesis of no co-integration. In the test statistics, the panel is heterogeneous both in terms of short run dynamics and long run slopes and intercept coefficients, while in the alternative hypothesis, long run homogeneity is assumed. An error correction term and long-run coefficients were statistically significant in order to determine a correlation. Levels equations with a combined importance indicates cointegration or long-term relationships.

Table 8. Results of the co-integration test

Pedroni's cointegration tests:
No. of Panel units: 11 Regressors: 7
No. of obs.: 330 Avg obs. per unit: 30
Data has been/ time-demeaned.

Test Stats.	Panel	Group
v	-0.228	.
rho	0.947	

t	-3.723	-3.647
adf	-3.201	-2.874

A null of no cointegration is applied to all test statistics N(0),

Unless panel v is included, the line diverges to negative infinity.

Source: Author's Calculation

As a result of the co-integration test in this study, the null hypothesis that no co-integration occurred is rejected at a significance level of 1% for panel data as well as group data. Based on the test statistics, we reject the hypothesis since the absolute values are greater than 0.3942.

Table 8 provides essential details about the panel datasets, including 11 panel units, a total of 330 observations, and an average of 30 observations per unit. Time-demeaning has been applied to the data, a standard practice in panel data analysis to remove time-independent factors that could influence the data.

The table also includes two measures, "v" and "rho," to assess the strength of the co-integration relationship, as well as "t" and "adf" test statistics to determine the presence of co-integration. The co-integration test is conducted at both the panel and group levels, with all variables analyzed for their overall relationship at the panel level.The results indicate strong evidence of co-integration, as the test statistics tend towards negative infinity when co-integration is assumed to be absent. This suggests that co-integration indeed exists, as the test statistics are compared to a standard normal distribution, and negative infinity values signify its presence.

4.7

PANEL ARDL (PMG, MG and DFE) MODEL ANALYSIS

Despite the Pool Mean Group's recommendation, long-run equilibrium can be heterogeneous between countries, but short-run equilibrium can remain homogeneous. It examines the short-run heterogeneity of countries as a result of shocks from outside, different stabilization policies, or financial crises. In the long-run and short-run, MG estimation can produce heterogeneous results. This estimator is appropriate for a wide range of countries. The method of Favara (2003) is sensitive to outliers and permutations of a small number of N (number of countries).

Table 4.7.1 Results of the pooled mean group

Pooled Mean Group Regression
(Estimate results saved as pmg)

Panel Variable (i): c_id
Time Variable (t): Years

Number of obs = 330
Number of groups = 11
Obs per group: min = 30
avg = 30
max = 30

Log Likelihood = -97.1849

D.Yg	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
_LR_ec						
GDPPC	-0.001	0.001	-0.950	0.342	-0.003	0.001
GDPSQ	0.059	0.132	0.450	0.655	-0.200	0.318
PDebtR	0.287	0.504	0.570	0.569	-0.701	1.276
POP	0.102	0.078	1.310	0.189	-0.050	0.254
FCF	-0.378	0.434	-0.870	0.384	-1.230	0.473
INF	0.031	0.076	0.400	0.686	-0.118	0.179
Fincrisis	-1.390	1.161	-1.200	0.231	-3.666	0.885
SR						
__ec	-0.909	0.109	-8.310	0.000	-1.123	-0.695
GDPPC						
D1.	-0.016	0.012	-1.270	0.205	-0.040	0.009
GDPSQ						
D1.	1.447	0.661	2.190	0.029	0.151	2.742
PDebtR						
D1.	0.943	1.153	0.820	0.413	-1.317	3.203
POP						
D1.	0.402	0.402	1.000	0.317	-0.386	1.190
FCF						
D1.	1.156	0.508	2.280	0.023	0.160	2.152
INF						
D1.	-0.014	0.159	-0.090	0.930	-0.325	0.298
Fincrisis						
D1.	1.239	0.078	15.930	0.000	1.086	1.391

_cons	4.286	3.571	1.200	0.230	-2.712	11.285

Source: Author's Calculation

The provided table displays the results of a Pooled Mean Group (PMG) regression analysis. It lists estimated coefficients for various independent variables (GDP per capita, GDP squared, Public debt to GDP-ratio, Population, Fixed capital formation, Inflation, and Financial crisis) and their statistical significance. Although the dependent variable is not explicitly mentioned, it can be inferred as D.Yg (difference of economic growth).

P-values greater than 0.000 indicate a strong relationship between the independent variables and the dependent variables. For instance, Financial crisis has a statistically significant coefficient. However, some independent variables like GDP per capita and GDP squared have coefficients exceeding 0.05, suggesting they lack statistically significant associations with the dependent variable.

The table presents both short- and long-run analyses with two sets of coefficients: the first difference coefficient (D1) for short-run effects and the level coefficient (L0) for long-run effects. For example, consider Financial crisis: the short-run coefficient (D1) is 1.239, representing the immediate impact of a financial crisis on the dependent variable. To infer the long-run effect, we can calculate it as exp(1.239) = 3.448, indicating a strong positive relationship between Financial crisis and the dependent variable over the long term.

To fully grasp the relationships in this regression analysis, it's crucial to consider the significance (or lack thereof) of the independent variables and comprehend their short- and long-run effects on the dependent variable.

Table 4.7.2. Results of the mean group model (MG)

D.Yg	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
__ec						
GDPPC	0.001	0.008	0.180	0.860	-0.013	0.016
GDPSQ	-0.100	0.633	-0.160	0.875	-1.340	1.140
PDebtR	-0.679	1.692	-0.400	0.688	-3.995	2.636
POP	-10.972	7.525	-1.460	0.145	-25.719	3.776
FCF	-6.009	5.189	-1.160	0.247	-16.179	4.162
FDI	7.042	4.706	1.500	0.135	-2.181	16.265
INF	-0.476	0.340	-1.400	0.161	-1.142	0.190
Fincrisis	6.535	6.868	0.950	0.341	-6.926	19.996
SR						

__ec	-0.613	0.186	-3.300	0.001	-0.977	-0.248
GDPPC						
D1.	0.004	0.007	0.560	0.574	-0.010	0.017
GDPSQ						
D1.	-0.103	0.450	-0.230	0.819	-0.986	0.780
PDebtR						
D1.	-0.417	0.764	-0.550	0.586	-1.915	1.081
POP						
D1.	-0.193	2.806	-0.070	0.945	-5.693	5.306
FCF						
D1.	4.091	3.523	1.160	0.245	-2.813	10.995
FDI						
D1.	-3.255	3.255	-1.000	0.317	-9.635	3.125
INF						
D1.	0.016	0.020	0.790	0.431	-0.023	0.055
Fincrisis						
D1.	0.365	0.437	0.840	0.403	-0.491	1.222
_cons	4.237	4.684	0.900	0.366	-4.942	13.417

Source: Author's Calculation

The provided table presents results from the Mean Group Model (MG) estimation with corrections based on the Error Correction Form. It includes coefficients, standard errors, z-statistics, p-values, and confidence intervals for various independent variables (GDP per capita, GDP squared, Public Debt, Population, Fixed capital formation, FDI, Inflation, and Financial crisis) in relation to the dependent variable (D.Yg).

The table provides insights into how these variables interact within an error correction model, indicating their significance and direction of influence. Standard errors offer precision estimates, while Z-statistics determine the statistical significance of the coefficients.

However, the table lacks essential context. It doesn't provide information about the data used, the methodology, or the model's usefulness. It offers only a static view of variable relationships, not capturing their dynamics over time.

Regarding short and long-run analysis, the table presents results for both. The SR (short run) column represents immediate effects, while the

__ec column shows long-run effects after considering the error correction term. Unfortunately, the LR (long run) column is missing.

This table aids interpretation within the error correction framework but should be supplemented with additional data and methodological details for comprehensive analysis.

	Coef.	Std.Err.	Z	P>z	[95%Conf.	Interval]
__ec						
GDPPC	-0.010	0.004	-2.500	0.012	-0.018	-0.002
GDPSQ	1.023	0.394	2.600	0.009	0.250	1.796
PDebtR	0.405	1.465	0.280	0.782	-2.466	3.276
POP	-0.782	0.673	-1.160	0.245	-2.102	0.537
FCF	-4.310	5.137	-0.840	0.401	-14.377	5.758
FDI	1.573	4.811	0.330	0.744	-7.857	11.003
INF	-0.383	0.250	-1.530	0.126	-0.872	0.107
Fincrisis	1.801	7.096	0.250	0.800	-12.107	15.709
SR						
__ec	-0.064	0.025	-2.600	0.009	-0.112	-0.016
GDPPC						
D1.	-0.001	0.001	-1.010	0.312	-0.003	0.001
GDPSQ						
D1.	0.129	0.132	0.980	0.328	-0.130	0.388
PDebtR						
D1.	0.099	0.121	0.820	0.412	-0.138	0.336
POP						
D1.	-0.050	0.286	-0.180	0.860	-0.610	0.510
FCF						
D1.	0.354	0.203	1.750	0.081	-0.043	0.752
FDI						
D1.	0.097	0.198	0.490	0.624	-0.291	0.485
INF						
D1.	-0.014	0.022	-0.670	0.505	-0.057	0.028
Fincrisis						
D1.	-0.371	0.350	-1.060	0.290	-1.057	0.316
_cons	0.512	0.768	0.670	0.505	-0.994	2.017

Table 4.7.3. Dynamic Fixed Effects (DFE) Panel Model Results

Source: Author's Calculation

An analysis of the effects of various independent variables on the dependent variable is presented in the following table using Dynamic Fixed Effects (DFE) panel models. Significance is assessed through z-values and p-values, with values greater than 1.96 or less than 0.05 indicating statistical significance.

A 5% level of significance is indicated by GDP per capita and GDP squared in the table. Economic growth is negatively correlated with GDP per capita, meaning higher GDP per capita leads to lower economic growth. Conversely, GDP squared has a positive coefficient, indicating that increased GDP squared leads to greater economic growth.

However, several independent variables, including Public debt rate, Population, Fixed capital formation, FDI, inflation, and Financial crisis, do not exhibit statistical significance at the 5% level due to p-values exceeding 0.05. These variables are not considered significant influences on economic growth.

The table also illustrates how independent variables affect short-term (D1) and long-term (C) outcomes. For instance, a unit increase in GDP per capita decreases long-term economic growth by 0.01 units, while an increase in GDP squared leads to a 1.023-unit increase in

economic growth over the long term. Short-run effects of independent variables do not display statistical significance, indicating limited influence on economic growth in the short term.

In summary, GDP squared and GDP per capita significantly impact economic growth, while foreign direct investment, foreign capital flows, and inflation have no significant effects. Additionally, lagged economic growth negatively correlates with lagged economic activity, emphasizing the importance of considering economic growth when analyzing these relationships.

Table 4.7.4 . Hausman (1978) test for the comparison between PMG and MG Panel Data Model

Using the comparison between MG and PMG estimators, test the Null Hypothesis of homogeneity.

Deciesion : Reject the null hypothesis if the P-value <0.05 then the MG is appreciated.

Accept the null hypothsis, if the P-value >0.05 then PMG is appropriated.---- Coefficients ----

(b)	(B)	(b-B)	sqrt(diag(V_b-V_B)
pmg	mg	Difference	S.E.
GDPPC	-.0010546	.0013327	-.0023873	.
GDPSQ	. 0590042	-.099686	.1586902	.
PDebtR	.2874052	-.6794127	.9668179	.
POP	. 1017942	-10.97152	11.07331	.
FCF	-. 3784151	-6.008782	5.630367	.
INF	. 0305851	-.4759193	.5065044	.
Fincrisis	- 1.390104	6.534534	-7.924638	.

b = consistent under Ho and Ha; obtained from xtpmg

B = inconsistent under Ha, efficient under Ho; obtained from xtpmg mg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= -14.57

chi2<0 ==>

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

For PMG and MG panel data models, Hausman's test results are shown in the table. In this test, the null hypothesis assumes homogeneity between the two models. An invalid null hypothesis is invalidated by a P-value below 0.05, indicating that the PMG model should be replaced by the MG model. For variables like GDP per capita, GDP squared, Public debt to GDP ratio, Population, Fixed capital formation, Inflation, and Financial crisis,

we also provide coefficients and standard errors for both models.

This comparison results in a preference for the MG model over the PMG model according to Hausman's test results.

Table 4.7.5. Hausman (1978) test for the comparison between MG and DFE panel data model

	---- Coefficients ----			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
		mg	dfe	Difference	S.E.
GDPPC		.0013327	-.0100461	.0113788	.0264286
GDPSQ		-.099686	1.023053	-1.122739	2.200494
PDebtR		-.6794127	.4049428	-1.084355	5.7946
POP		-10.97152	-.7822543	-10.18926	26.57868
FCF		-6.008782	-4.309857	-1.698924	17.60058
FDI		7.042211	1.572968	5.469243	15.91611
INF		-.4759193	-.382573	-.0933463	1.174455
Fincrisis		6.534534	1.801358	4.733176	23.20647

b = consistent under Ho and Ha; obtained from xtpmg

B = inconsistent under Ha, efficient under Ho; obtained from xtpmg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 0.69

Prob>chi2 = 0.9984

(V_b-V_B is not positive definite)

The table presents the results of a comparison between MG (Mundlak and Groll) and DFE (Differential Fixed Effects) panel data models using the Hausman test. Tested is the null hypothesis that there are no systematic differences between models in coefficients. Rejecting the null hypothesis would indicate that one of the models is consistent and preferable over the other.

The table displays coefficients for both models (b for MG and B for DFE), as well as the difference in coefficients (b-B) and the standard error of this difference (sqrt(diag(V_b-V_B))). The difference in coefficients is not zero for any variable, suggesting that the coefficients differ between the two models.

A chi-squared distribution follows a seven-degrees-of-freedom distribution when seven coefficients are being tested. Hence, the null hypothesis that MG and DFE models do not systematically differ in coefficients is rejected. In other words, 0.69 and 0.9984, respectively, are significantly higher than 0.05. This implies that the null hypothesis regarding the lack of a systematic difference between MG and DFE models cannot be accepted.

In the presence of the null hypothesis, the DFE

model is considered efficient, while the MG model is inconsistent. The variation in coefficients does not exhibit a positive definite pattern, indicating an issue with the estimation process.

4.9. Estimate the Model

According to Hausman (1978), models are estimated based on the results of hausman's test. If the PMG estimator is preferred, determine the statistical significance of the long- and short-run coefficients, as well as the coefficients used to adjust for error by group. Analyze the results and interpret them appropriately.

4.10. Causality Tests

Granger, Wald, or Weak are the best tests to perform to determine exogeneity. The significance of the following can also be used to determine a causal relationship:

- Error correction term (for joint causality)
- Long run coefficients (for LR causality)
- Short run coefficients (for SR causality)
- ECT,LR and SR coefficients (for strong causality)

Dumitrescu & Hurlin (2012) Granger non-causality test results:

Lag order: 1
W-bar = .
Z-bar = (p-value = 0.0032)
Z-bar tilde = (p-value = 0.0001)

H0: GDPPC does not Granger-cause Yg.

H1: GDPPC does Granger-cause Yg for at least one panelvar (c_id).

The Granger causality tests conducted have null hypotheses (H0) and alternative hypotheses (H1) for several independent variables:

H0: Public Debt Ratio (PDebtR) does not Granger-cause Yg (economic growth).

H1: PDebtR does Granger-cause Yg for at least one panel variable (c_id).

H0: Foreign Direct Investment (FDI) does not Granger-cause Yg.

H1: FDI does Granger-cause Yg for at least one panel variable (c_id).

H0: Population (POP) does not Granger-cause Yg.

H1: POP does Granger-cause Yg for at least one panel variable (c_id).

H0: Fixed Capital Formation (FCF) does not Granger-cause Yg.

H1: FCF does Granger-cause Yg for at least one panel variable (c_id).

H0: Inflation (INF) does not Granger-cause Yg.

H1: INF does Granger-cause Yg for at least one panel variable (c_id).

The p-values for these Granger causality tests are below 5%, indicating that there is evidence of Granger causality between the independent variables and economic growth. However, it is important to note that these tests do not conclusively prove that economic growth is solely caused by these independent variables; they only provide evidence of a causal relationship.

Conclusion

An analysis of public debt and economic growth has been conducted for 11 Asian countries over the past three decades (1991-2020). We conducted a panel data analysis incorporating factors such as foreign direct investment, fixed capital formation, population, inflation, and financial crises in 1997 and 2008. The study

focused on the Asian region, where public debt has received less attention in this context than previous studies focused on advanced economies or Latin American emerging nations. To determine whether these Asian countries' debt levels could negatively affect economic growth and how public debt impacts it, the debt levels of these countries were examined. An estimation using dynamic Panel ARDL found that public debt and economic growth are significantly correlated. The study conducted empirical tests on various variables in 11 Asian countries to assess their stationarity, revealing that some were stationary at the level form, while others were non-stationary in their first difference. Public debt's stationarity was inconsistent between different tests. Cointegration tests were conducted to examine the long-term relationship between public debt and GDP growth. Results indicated cointegration between variables, indicating a connection between them. As a result of this study, higher debt levels in these countries have an impact on economic growth in these countries. A significant positive correlation between economic growth and public debt has been observed between 1991 and 2020 in selected Asian countries because of lack of experience in managing high levels of debt.

Recommendations and Implications for Further Research

Public debt appears to negatively affect economic growth according to this research study. Additionally, they recommend improving the relationship between public debt and economic growth and prioritizing projects with economic value over less productive ones when evaluating public expenditures.

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