Effect of Government Debt, Interest Rate, and Bank Risk-Taking on Economic Growth

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This report is submitted to the School of Business and Economics,

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as a partial requirement for the degree fulfillment of

Bachelor of Business Administration (BBA).

Effect of Government Debt, Interest Rate, and Bank Risk-Taking on Economic Growth

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Letter of Transmittal

Dr. Md. Mohan Uddin

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Dear Sir,

I have the honour to submit my research report “Effect of Government Debt, Interest Rate and Bank risk Taking on Economic Growth” as part of graduation from United International University. The dissertation below is the product of many months spent in academic consideration from 20th March 2025 to 24th November 2025 studying the macropolitical determinants driving growth performance across nations.

Under the inspiring guidance of Professor Dr Md Mohan Uddin, I examine how public debt, lending interest rate and bank risk taking affect economic growth in both advance and developing markets. I am extremely thankful to Dr. Mohan Uddin for his relentless advice, imaginative feedback and priceless encouragement at all times during this research. His guidance has greatly reinforced the direction of analysis and methodological soundness of this Research paper.

The author is highly grateful to United International University for creating the academic atmosphere, resources and institutional supports in order to complete this research work successfully. I am indebted to the world organizations—primarily World Bank Group and IMF—whose database I used for collecting macroeconomy variable required for empirical analysis.

Finally, I wish to thank family, friends and classmates for their ongoing encouragement and moral support. Their patience and encouragement have been important in keeping my motivations alive during the trials of this long journey through research.

I appreciate your willingness to review my thesis. I would welcome any comments or suggestions you may have and hope that the findings will make a positive contribution to the ongoing academic and policy debate.

Sincerely,

Akib Mahamud

ID: 111 201 043

Certification of Similarity Index

Declaration of Student

I hereby declare that the research entitled “Effect of Government Debt, Interest Rate and Bank Risk Taking on Economic Growth” which is submitted to the Department of Business Administration, United International University for the award of degree/master (specify) or any other academic qualification is entirely my original work and no part has been previously submitted in whole or in part from any university/institution.

Further, I declare that all sources of information used in the completion of this thesis have bibliographic been acknowledged. The conclusions and reviews in this study are only based on the data I collected and interpreted. I had not previously copied, duplicated, or received any of the work herein contained from someone else who has claimed that I did so.

I also declare that there has been no significant help of contribution to writing this thesis from another person, unless otherwise stated and appropriately referenced in this work.

I am solely responsible for the accuracy, authenticity, and honesty of content in this manuscript.

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Acknowledgement

I am grateful to Almighty Allah for giving me the power of strength, patience and perseverance which enables me to accomplish this research study entitled “Effect of Government Debt, Interest Rate and Bank Risk Taking on the Economic Growth”. His grace and direction has been my aid throughout this academic marathon.

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I would like to express my sincere thanks to United International University, and the School of Business and Economics in particular, for creating a rich learning environment that helped provide me with necessary academic resources required for pursuing this research. Both the availability of academic sources (in digital databases, libraries and on-site) as well as research facilities deeply influenced the depth and quality of my work.

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Abstract

This paper examines the effect of government debt, interest rates and bank risk-taking on economic growth in a panel of countries. With an initial sample dataset for 2000–2024 that included 195 countries, data limitations caused by missing values narrowed the focus on to only 34 countries with all required factors from 2000–2021. Economic growth (dependable variable) is the five-year average of real GDP annual growth rates (%), and the independent variables consist of government net debt as a percentage of GDP, lending interest rate and bank Z-scores proxy for banking risk-taking.

The analyses make use of panel data econometric methods, such as pooled OLS, fixed and random effect models being used to control for cross-country and across time heterogeneity. Choice of fixed vs random effects model is based on the Hausman test, and results are robust to heteroskedasticity-robust standard errors clustered at the country level. Moreover, Robustness checks like F-test for fixed effects, Breusch-Pagan Lagrange Multiplier test for random effects, Wooldridge test for serial correlation and Breush-Pagan test for heteroskedasticity are conducted to ensure the consistency of estimates.

The empirical findings reveal that government debt and interest rate have significant effects on economic growth, whereas the impact of bank risk-taking is conditional upon financial stability and institutional environments. These results underscores some policy implications for the narrow purpose of debt management, monetary and banking regulation to sustain the economic growth. This study sheds light on the role of macroeconomic and financial forces in growth formation, namely fiscal policy, monetary conditions and bank sector soundness. The limitations include a relatively small sample size owing to missing data, which highlights avenues for future research to extend the database and to examine more macro-financial variables.

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List of Abbreviations

Abbreviation	Full Form
GDP	Gross Domestic Product
GFC	Global Financial Crisis
WEO	World Economic Outlook
IMF	International Monetary Fund
WDI	World Development Indicators
WBG	World Bank Group
COVID-19	Coronavirus Disease 2019
OECD	Organization for Economic Co-operation and Development
Z-score	Bank Z-score (measuring the probability of default in a country's banking system)
PMI	Purchasing Managers' Index
RE	Random Effects
FE	Fixed Effects
OLS	Ordinary Least Squares
AR	Autoregressive (e.g., AR model for time series analysis)
GMM	Generalized Method of Moments
VIF	Variance Inflation Factor
F-statistic	A test statistic used in regression analysis to compare model fit
R^2	Coefficient of Determination
IMF-WEO	International Monetary Fund World Economic Outlook
CPI	Consumer Price Index
FEC	Fiscal Economic Constraints
SD	Standard Deviation
ROA	Return on Assets
S&P	Standard & Poor's
M2	Broad Money Supply
PPC	Production Possibility Curve
BPS	Basis Points
FDI	Foreign Direct Investment
PMI	Purchasing Managers' Index
VAR	Vector Autoregression
GDP per capita	Gross Domestic Product per capita

Chapter 1 Introduction

1.1 Background

Real gross domestic product (GDP)—the inflation-adjusted value of all finished goods and services produced within an economy—continues to be the primary and most well-known measure of overall economic output and the limit to productive capacity. This is an inherent feature of how economies grow and gain in size, become more creative and prosperous. The narratives of global economic growth from the World Bank's World Development Indicators (WDI) and the International Monetary Fund's World Economic Outlook (WEO) during 2000—2025 show a number of distinct and transformative phases (Global Economic Prospects -- June 2025 n.d.) (World Economic Outlook, October 2025: Global Economy in Flux, Prospects Remain Dim n.d.-a). For a quarter century now, the world economy has alternated between cycles of expansion and contraction: strong pre-crisis growth in the early 2000s was followed by a deep contraction during the 2008–2009 Global Financial Crisis (GFC); a prolonged and uneven recovery in the 2010s concluded with a historic collapse and then only partial recovery during the 2020–2021 COVID-19 pandemic. In these phases, changes in productivity, trade integration, capital mobility, and policy responses have influenced both the speed and nature of international economic growth, exposing a persistent deceleration and increased susceptibility to coordinated shocks(Global Economic Prospects -- January 2023 n.d.).

For most of the 2000s, the world economy grew strongly, the longest and broadest upswing seen in modern times. Average world GDP growth was estimated at about 4–4.5 percent a year, driven by the remarkable industrialization of emerging markets, led by China and India, and firm but

moderate growth in advanced economies(A n.d.). The period featured the upsides of growing globalization: international trade volumes spiked, inbound foreign-direct investment grew, and global value chains proliferated in both manufacturing and services(World Economic Outlook, October 2007: Globalization and Inequality n.d.). At the macroeconomic-level, most economies appeared to experience relatively stable conditions, including low levels of inflation, productivity enhancement, and the provision of simulative monetary contexts across key economies. The lifting of global demand from high commodity prices, loosening of credit markets, and widespread belief in the triumph of market liberalization fueled the fires. Even in many developing economies this period had been remarkable in terms of poverty reduction and capital accumulation as extensive technological diffusion took place and export-led growth patterns thrived(World Bank and International Monetary Fund 2012). According to the World Bank (WDI), per capita income in low- and middle-income countries increased faster than in advanced economies — representing a limited form of global convergence in living standards(World Bank and International Monetary Fund 2012). But this expansion also masked accumulating macro-financial imbalances, with financial systems becoming more over-leveraged and reliant on low interest rates and increasing credit (IMF World Economic Outlook (WEO) - Rebalancing Growth, April 2010 -- Table of Contents n.d.).

This momentum was halted by the Global Financial Crisis (GFC) of 2008–2009, which revealed the fragility of an increasingly integrated global financial system. The IMF has predicted, based on WEO 2010 data, that world output fell by approximately 0.1 percent in 2009, which represents the first year-on-year decrease in global GDP since World War II (IMF World Economic Outlook (WEO) - Rebalancing Growth, April 2010 -- Table of Contents n.d.). Atlas of the Pandemic The fall of U.S. homes and the breakdown of several top banks unleashed a systemic shock that raced

through world trade and capital channels. Advanced economies plunged into deep recessions with output losses of more than 3 percent, and twice as sharp a slowdown hit emerging markets, as exports fell and external financing dried up(World Bank 2008). Trade volumes plunged by almost 12%, and industrial activity collapsed sharply around the world(IMF World Economic Outlook (WEO) - Slowing Growth, Rising Risks, September 2011 -- Table of Contents n.d.). In retrospect, the crisis highlighted the extent to which global economies had become integrated — through trade and financial networks — and the ways in which such integration can exacerbate systemic risk. In turn, central banks and governments took massive actions to counteract this, including fiscal stimulus, bank recapitalizations, and zero interest rates(World Economic Outlook, October 2012: Coping with High Debt and Sluggish Growth n.d.). Such measures stopped a further international recession but left numerous countries with higher financial debt heaps and structural distortions. While the global economy recovered in late 2009 and in 2010, a new normal of lower potential growth, depressed investment rates, and persistent financial fragilities came to prevail.

The world economy only recovered slowly and unevenly from 2010 through 2013. Data from IMF WEO indicate that between 2010 and 2019 global GDP growth averaged about 3.5 percent, below the pre-crisis average above 4 percent(World Economic Outlook, October 2019: Global Manufacturing Downturn, Rising Trade Barriers n.d.). Facing serious challenges of deleveraging, fiscal austerity, and anaemic demand, advanced economies did well to recover slowly but happened to stumble, while most emerging economies performed vividly rebounding from the crisis to begin with, they also fell short when stimulus waned. The Eurozone sovereign debt crisis (2011–12) exposed the flawed structural foundation of advanced economies, but especially those struggling with excessive debt and inflexible fiscal systems(Nortje n.d.-a). Over this period, productivity gains were modest, global trade growth underwhelmed relative to the pre-crisis boom,

and cross-border capital flows shrunk as well. Nevertheless, by recovering so slowly, this phase of the cycle did not return the world economy to the pre-2007 pattern of growth based on globalization, with trade elasticity to GDP decreasing and investment falling in all advanced and developing economies(Nortje n.d.-b). The crisis also transformed the global growth model: For many economies, both fiscal and monetary policies became tools primarily for stabilizing, rather than stimulating, growth, marking the onset of a lower-for-longer growth regime.

The world economy went into a phase of slowdown from 2014 to 2019, with growth rates still moderate, but relatively stable. Global output grew at an average annual rate of about 3.1 percent, with advanced economies close to 2 percent and emerging markets a bit faster(Global Economic Prospects -- January 2023 n.d.). That was when structural headwinds truly started to reveal themselves. That Growth in productivity continued to decelerate around the world, trade-wars started to sprout, and the rewards of global trade seemed to stagnate(World Economic Outlook, October 2019: Global Manufacturing Downturn, Rising Trade Barriers n.d.). Between 2014 and 2016, commodity prices dropped sharply on world markets—especially the price of oil—while the impact of these changes was varied (they tended to increase consumption in energy-importing economies, but cramped revenues and investment in commodity-exporting economies). According to the IMF (2019), the global growth of trade had also lost its previous dynamism which showed the maturity of supply chains along with protectionist tendencies and technological evolution towards domestic production(World Economic Outlook, October 2019: Global Manufacturing Downturn, Rising Trade Barriers n.d.). Widespread signs of a slowdown had emerged across the global economy by 2019, with manufacturing weakness and plummeting business confidence in the wake of the U.S.–China trade war. However, the global economy was running on fumes, with

growth fundamentals significantly weaker and leaving the global economy susceptible to shocks, despite liquidity in financial markets and very low global inflation.

While the 2020 outbreak of the COVID-19 pandemic signified an unprecedented disruption to global economic activity. According to IMF (2021), world GDP fell by 3.1 percent in 2020, the deepest peacetime downturn since the Second World War(World Economic Outlook, April 2021: Managing Divergent Recoveries n.d.). It stopped cross-border trade, closed sound supply chains and caused massive job losses at all levels of income due to the pandemic. According to World Bank (2021, pp. 7—8) the economic meltdown was a synchronized sudden stop, as lockdowns and restrictions stopped production and consumption across the globe(Global Economic Prospects, June 2021 n.d.). Once again, governments and central banks resorted to unprecedented fiscal and monetary stimulus, flooding trillions of dollars into the respective economies to avert a system-wide meltdown(World Economic Outlook, April 2021: Managing Divergent Recoveries n.d.). Post–COVID doomed to be a cyclical event Earlier, the global economy staged a sharp recovery in 2021–2022, with growth rates of above 6 percent blended (due almost completely to post reopening effects, with massive stimulus spending feeding into local inflationary pressures. But this rebound was temporary — and bumpy(World Economic Outlook, April 2022: War Sets Back The Global Recovery n.d.). IMF projections (2024) suggest the slowdown in global growth would remain and only hover around 3.0–3.3 percent by 2023–2025, well below the 3.7 percent average recorded for the world from 2000 to 2019(World Economic Outlook, April 2024: Steady but Slow: Resilience amid Divergence n.d.). This slowdown reflects a combination of structural challenges – ongoing inflationary pressures and the tightening monetary policy needed to rein in prices, high debt levels and sluggish investment. In addition to this, the deterioration in geopolitical relations, the relocation of supply chains and the trend towards the fragmentation of the world economy have

made the context much less predictable. Trade expansion has not fully improved, productivity benefits are limited, and the confidence for further economic integration diminished worldwide. The global trend is varying, with a steep decline circa 2020 suggesting a significant disruption (presumably the COVID-19 pandemic) and subsequent recovery(World Bank Open Data n.d.-a).

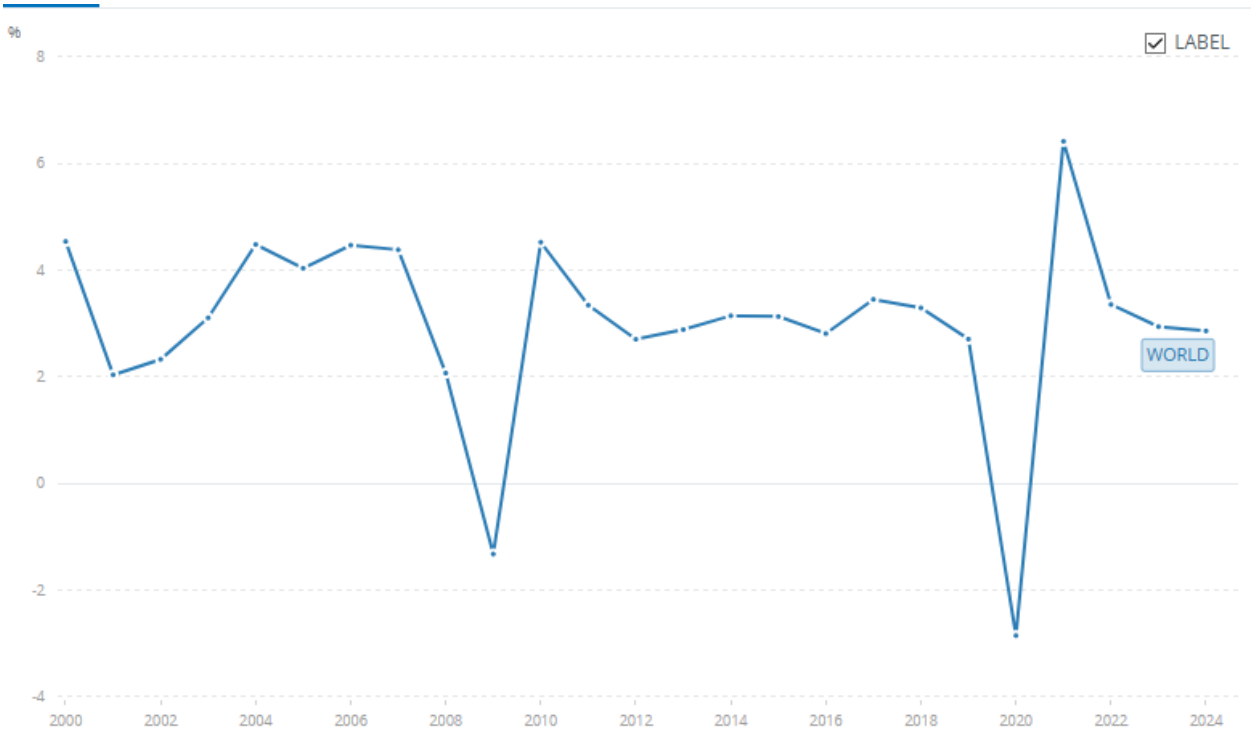

Figure 1 {1.1 world (World Bank Open Data n.d.-a)}

While the 2000s were dominated by the high growth of South Asia—specifically India—the 2010s saw South Asia emerge as an important engine of global growth. Thanks to its big domestic market, the region was less synchronized with external downturns — compared to export-dependent blocs — but remittances, commodity prices, and policy stances brought heterogeneity across countries. The 2000s were a period of robust growth driven by rapid industrialization, growing service sector and better macroeconomic management particularly in India, Bangladesh and Sri Lanka(Martin n.d.). By contrast, structural constraints led to more modest growth in smaller economies such as

Nepal and Bhutan. Although the 2008–09 global financial crisis slowed its regional growth, it did not hit hard enough to cause anything resembling a recession, as robust domestic demand and high remittance inflows might have provided some buffer(World Economic Outlook, April 2010: Rebalancing Growth n.d.). South Asia continued to record growth rates above the world average during 2010–2019, with India becoming an important player in the world economy and Bangladesh recording an extended period of manufacturing-led growth. But cross regional infrastructure deficits, inequality and policy uncertainty persisted. Services and manufacturing were significantly disrupted across the region in 2020 by the COVID-19 pandemic, leading to widespread reduced output and employment. However, thanks to pent-up consumer demand, the rapid rise of digitalization and fiscal as well as monetary policy support, the region saw a robust comeback in 2021–2023. In the early years of the 2020s, South Asia has been projected to be one of the fastest-growing region the World Bank though (Global Economic Prospects, January 2025 n.d.) expects growth in South Asia to become moderate in the mid-2020s following the tightening of global financial conditions and weakness in external demand, along with persistent regional structural problems. South Asia records a trajectory similar to East Asia, suggesting clear impact before and including peak of downturn and recovery in 2020 following trends that reflect regional challenges and response(World Bank Open Data n.d.-a).

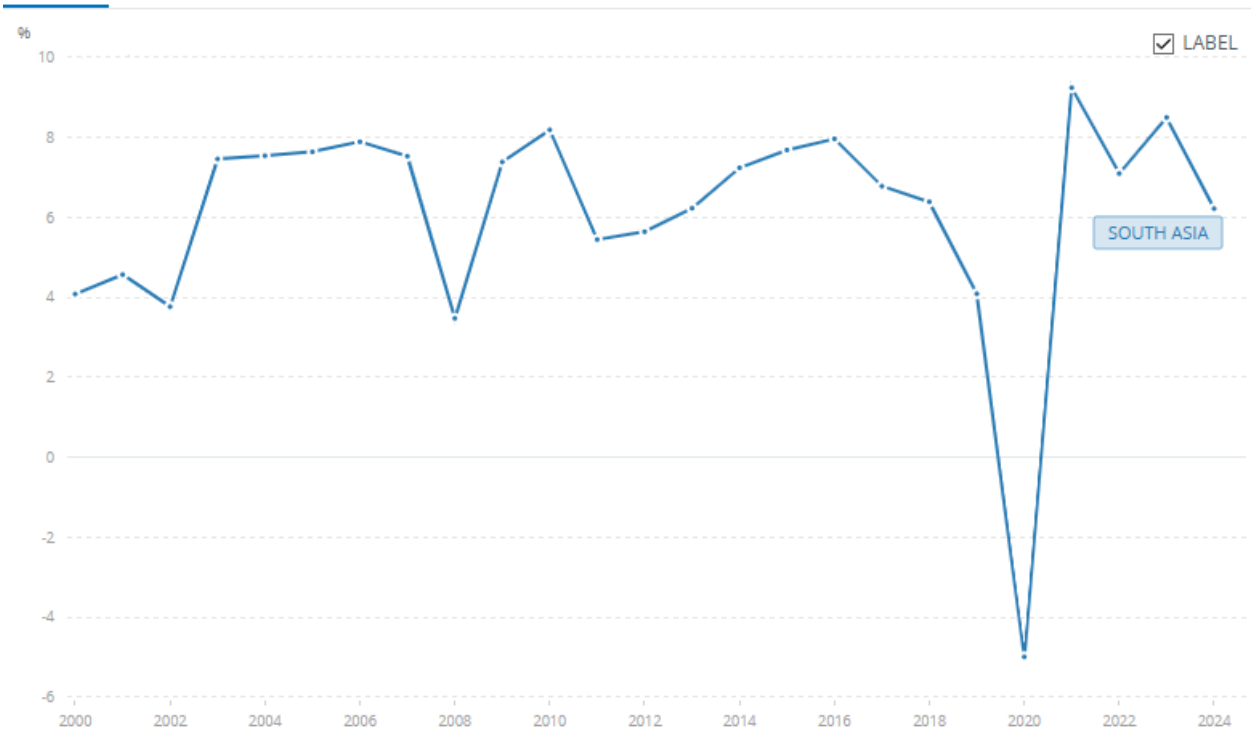

Figure 2 .{1.2 South Asia (World Bank Open Data n.d.-b)}

Europe & Central Asia: A diverse set of both advanced European economies and transition or emerging economies. The EU integration, capital inflows and high productivity of transition economies in the early 2000s provided this level of relatively high growth (IMF World Economic Outlook (WEO) -- Globalization and Inequality, October 2007 n.d.). The region was hard by the 2008–09 crisis, experiencing deep recessions in some of the euro-area economies and a more gradual recovery in Central and Eastern Europe. Advanced Europe remained hampered by fiscal consolidation and stress in the banking sector, whereas commodity exporters—including Russia and Kazakhstan—performed well in cyclical terms, buoyed by global energy prices. Productivity growth was sluggish in advanced Europe from 2014 to 2019, and investment stagnated (although some areas in Central Asia gained from heightened commodity prices and Chinese infrastructure development via the Belt and Road Initiative of 2013)(Belt and Road Economics: Opportunities and Risks of Transport Corridors n.d.). In 2020, the COVID-19 pandemic induced a simultaneous

recession across Europe and Central Asia, and the recovery has been unequal. In the early 2020s, geopolitical tensions, energy price shocks and trade disruptions pushed down the growth rate and made the economic environment more uncertain(Martin n.d.). Regional output stayed below pre-pandemic trends, and inflationary pressures and fiscal headwinds held back recovery, IMF and World Bank data confirm. Recent growth has been slow amongst advanced European economies given their aging populations and weak productivity, while some Central Asian economies enjoyed moderate momentum due to natural resource exports and economic diversification policies(World Economic Outlook, April 2024: Steady but Slow: Resilience amid Divergence n.d.). This region also shows a steep dip in 2020 due to the pandemic, followed by recovery(World Bank Open Data n.d.-b).

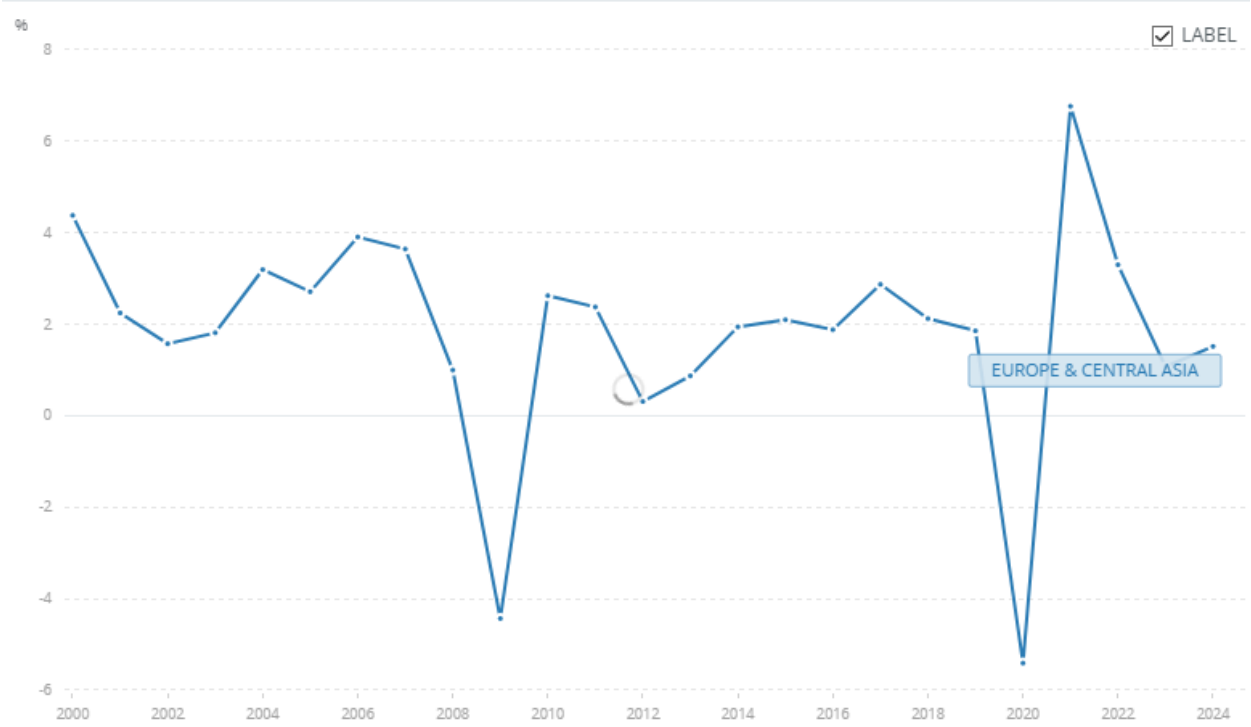

Figure 3 {1.3 Europe & Central Asia (World Bank Open Data n.d.-b)}

During the early 2000s, commodity prices soared in the global markets and fueled a modest growth for Latin America and the Caribbean, driven as well by growing demand from Asia –particularly, China. Most economies took advantage of the commodities super cycle, experiencing increased fiscal revenues and social development(Regional Economic Outlook for the Middle East and Central Asia, October 2024: Navigating The Evolving Geoeconomic Landscape n.d.). Yet the region has seen cyclically and commodity-based demand driven growth which makes it susceptible to any commodity price shocks. The global financial crisis led to a rapid decline in external demand and investment, and growth fell sharply. Countries such as Chile and Peru had a post-crisis recovery; others like Brazil and Argentina remained mired in macroeconomic instability. Declining commodity prices and domestic economic policy issues limited expansion from 2014 to 2019. Low productivity growth, weak investment and structural rigidities remained in place. The recession of 2020 caused by the pandemic has been one of the most profound of all time, aggravated by death and social inequality in the face of the shock. Although the region recovered between 2021–2022 thanks to the lifting of economies, and commodity prices recovery, sustained recovery was hampered by high inflation, fiscal pressures and an increase in external debt. Slow potential growth in Latin America by the mid-2020s suggests the need for diversification and institutional reform. The World Bank and IMF have referenced both the vulnerability of the region to external shocks, the relatively constrained fiscal space, and the need for productivity/ governance reforms as key enablers for stable, inclusive growth(Regional Economic Outlook for the Middle East and Central Asia, October 2024: Navigating The Evolving Geo-economics Landscape n.d.) (Regional Economic Outlook, Western Hemisphere, April 19th, 2024 n.d.). Latin America experiences a large fall in 2020, which can be attributed to the economic and health consequences of COVID-19, but is recovered in later years(World Bank Open Data n.d.-b).

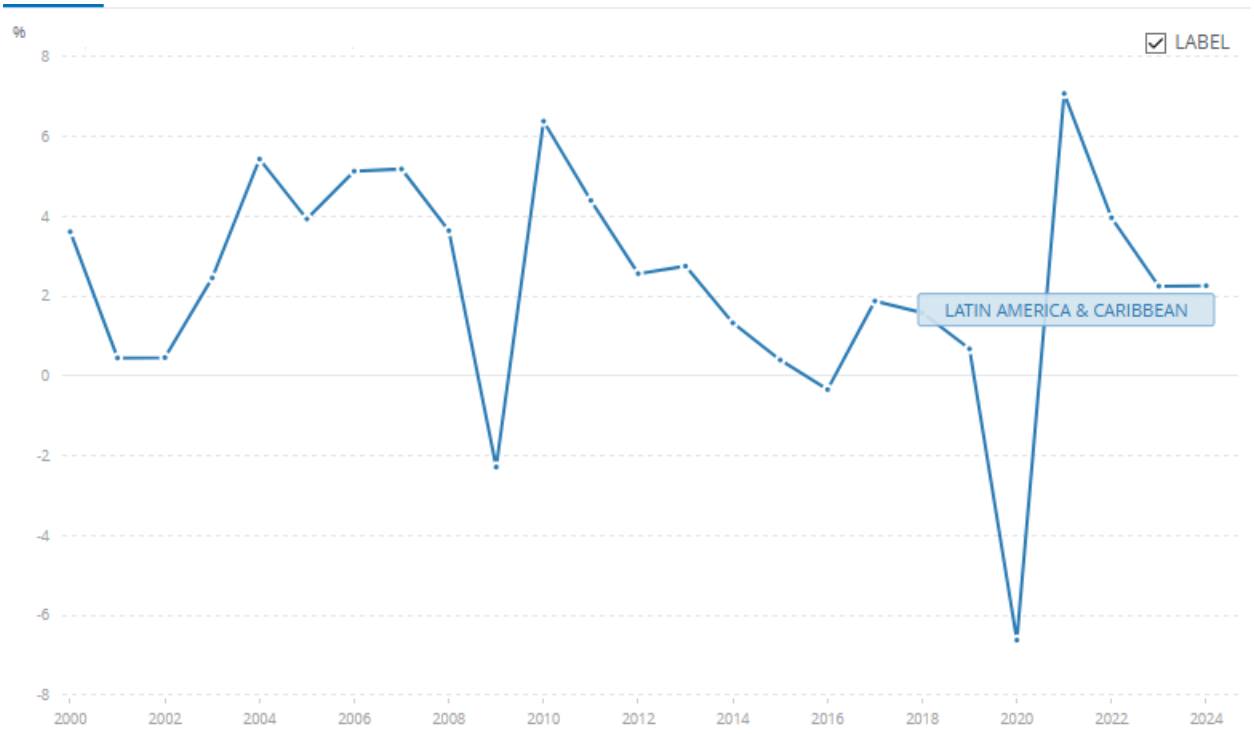

Figure 4 {1.4 Latin America and the Caribbean (World Bank Open Data n.d.-b)}

This is anything but homogenous in the region of Middle East and North Africa. Cyclical growth in oil-exporting economies (like Saudi Arabia, Kuwait, and the UAE) is responsive to oscillations of global oil prices; chronic structural constraints are the lot of oil-importing countries (like Egypt, Morocco, and Jordan)(World economic outlook, International Monetary Fund: countering the cost of living crisis, Oct. 2022 2022). High oil prices spurred rapid growth and budget surpluses for hydrocarbon economies in the early 2000s while political instability and underinvestment curtailed growth in others. While the Arab Spring of roughly 2011 caused uncertainty in the short term, the lingering legacy was one of divergent paths as some countries did rebound; others did not. The divergence between oil and non-oil economies continued to widen during the mid-2010s as oil prices dropped but geopolitical risks remained high. The pandemic in 2020 exacerbated such vulnerabilities, disrupting tourism, remittances and trade. Uneven recovery since 2021—oil exporters helped by higher prices and production cuts; non-oil economies strained by inflation and

debt woes. World Bank regional updates anticipate a gradual recovery during 2024–2025, driven mainly by energy activity and fiscal reforms in a few economies, but conflicts, limited diversification, and weak private investment continue to limit the region´s growth prospects(Regional Economic Outlook for the Middle East and Central Asia, October 2024: Navigating The Evolving Geoeconomic Landscape n.d.). This region demonstrates instability as the number dips steeply in 2020 and increases dramatically over the next years (World Bank Open Data n.d.-a) .

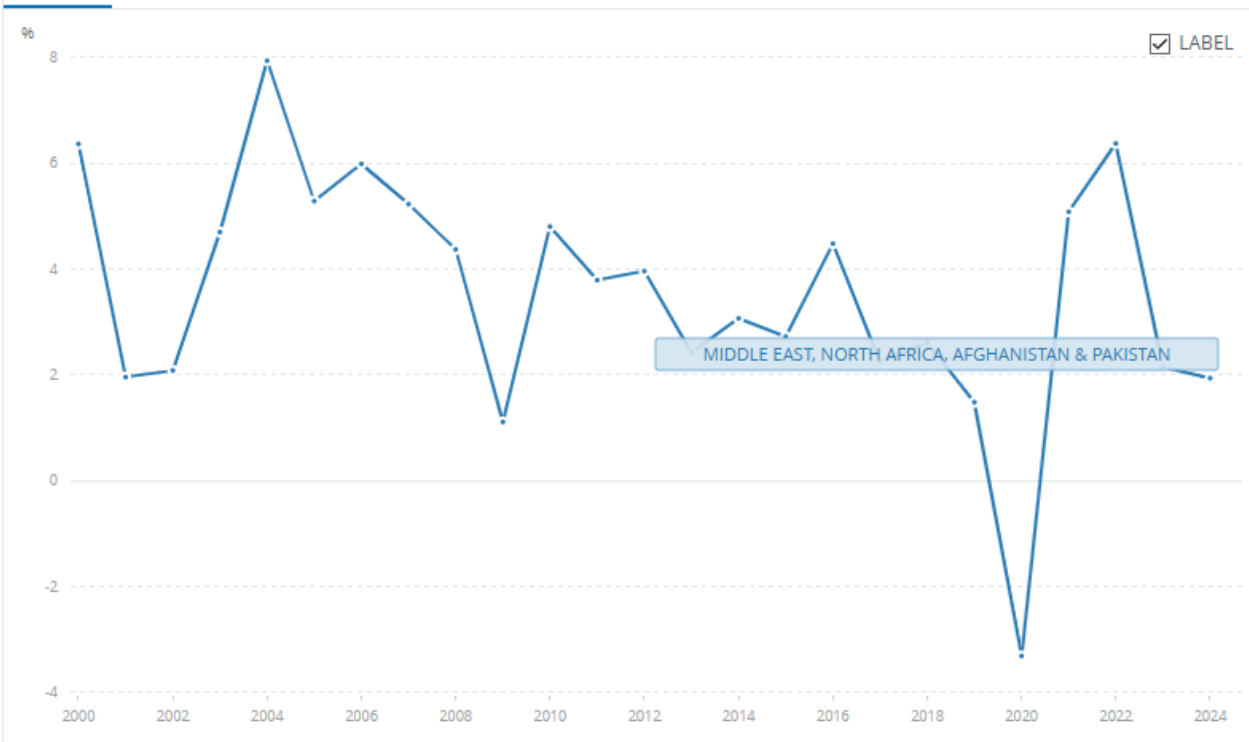

Figure 5 (1.5 The Middle East and North Africa (World Bank Open Data n.d.-b)}

Between 2000 and 2025, Sub-Saharan Africa has experienced a varied and inconsistent growth experience. For example, Nigeria, Angola and South Africa performed relatively well among the resource-rich economies of the early 2000s -- the decade of the global commodity boom,But low-income, agrarian economies grew at a slower and more volatile rate, mirroring both their reliance

on natural variations in the weather and the lack of industrial capacity to absorb surplus workers. Commodity price collapse in the mid-2010s and the concomitant governance challenges led to a slowdown in growth within a few major economies. Whereas episodes of rapid growth have occurred, rapid population growth and structural inefficiencies have kept per capita income growth among the lowest in the world. The COVID-19 pandemic triggered a severe contraction in 2020, which was partly offset by commodity price rebounds and public investment. Still, the region is hit by the perfect storm by the mid-2020s, when high debt levels, rising external financing pinch, trade disruption and climate & natural disasters happen. Sub-Saharan Africa continues to be exposed to external shocks and sudden stops of capital flows and many countries still face challenges with fiscal sustainability, governance and infrastructure constraints that reduce inclusive growth according to The World Bank. An apparent undulation with a decrease in the pandemic years and increase toward 2024 (World Bank Open Data n.d.-b).

Figure 6 { 1.6 Sub-Saharan Africa (World Bank Open Data n.d.-b)}

The United States and Canada had led steady growth in North America from the early 2000s fueled by technology development and consumption. A severe downturn followed the global financial crisis of 2008–09, as deep contractions in the U.S. housing, and financial sectors spilled over into broader economic malaise with the rest of the global economy recovering only slowly in the ensuing years despite expansive monetary and fiscal measures introduced to spur growth from the early 2010s(World Economic Outlook, October 2025: Global Economy in Flux, Prospects Remain Dim n.d.-b). By the middle of the 2010s, the U.S. economy was back to the level it was at before the crisis, driven largely by job growth and consumer spending. Overseas, Canada also bounced back, buoyed by resource exports and solid financial regulation. Still, productivity growth had decelerated by the late-2010s, and structural imbalances remained. Although the 2020 pandemic led to an unprecedented contraction, determined fiscal and monetary policies coupled with accelerated vaccination have enabled a rapid recovery in 2021–2022. Monetary tightening brought

growth to a halt as inflation surged in the mid-2020s. IMF and World Bank statistics have demonstrated that the advanced economies in North America are now actually experiencing lower growth than emerging markets, where potential output is increasingly restrained and demographic Europac-Rise of the Old West-5C:02-20 growth perspectives are limited by ageing populations(World Bank Open Data n.d.-b). United States vs. Canada: The US-states system and Canada look somewhat similar to the above—in that we see both a sharp dip in 2020 and, though backsplashes are not apparent for either, the US appears to have recovered more aggressively than is visible in our Canadian counterparts(World Bank Open Data n.d.-b).

Figure 7 {1.7 United States and Canada (World Bank Open Data n.d.-b)}

From 2000 to 2025, a half-generation has passed through the global economy and demonstrates a more tightly joined, but more brittle world economy as compared to the market exuberance of the higher growth, globalization boosted prospects of the early 2000s, to now a slower, bumpier, risk

crowded decade. While global GDP grew for the most part at around 3.7% during the years between 2000 and 2019 (Global Economic Prospects, January 2025 2025)due to the expansion of trade, technology and financial linkages, prosperity was broadly shared at first. At the same time, though, this period also hid large structural imbalances and vulnerabilities that, in succession, became apparent in waves of crisis—the most serious ones were the 2008–09 Global Financial Crisis and the COVID 19 pandemic of 2020 These shocks brought about synchronized recessions in almost all regions., underscoring the transmission mechanism of risk reinforced by interdependence. The economies of South and East Asia — driven by China and India — became the primary contributors to global growth as their fast-paced industrialization and development of domestic markets compensated for poorer performance in other regions. For European and North American advanced economies, demographic aging, sluggish productivity, and fiscal constraints and tensions meant protracted stagnation, while commodity-dependent regions such as Latin America, Sub-Saharan Africa, and the Middle East were left in a state of vulnerability with respect to price fluctuations and external shocks. Global growth is projected to be subdued outside the near term, with IMF and World Bank projections for 2025 and beyond pointing to growth persisting below its long-term average (covering the period 1990–2019) amid high debt levels, tighter financial conditions, emerging geopolitical fragmentation and climate shocks. The global economy has entered a new equilibrium: uncertainty, sluggish productivity, and greater vulnerability to systemic shocks are now a part of economic life. Thus, sustaining inclusive and resilient growth will need not just sound macroeconomic management, but also deeper structural reforms, and a renewed investment of state and private initiatives in innovation and in high growth employment, and stronger global cooperation. The post-Cold War ideal of a world more prosperous and peaceful through greater interconnectedness is still within reach, but only if the

lessons learned over the past quarter-century — of mutual interdependence, the fragility of prosperity under duress, and the need for our global economic system to evolve toward greater sustainability, equity, and shock resistance — are heeded (World Economic Outlook, October 2025: Global Economy in Flux, Prospects Remain Dim n.d.-b) (Global Economic Prospects, January 2025 2025).

1.2 Problem statement

Global economic growth has slowed structurally and persistently over the past 25 years, compared to the explosive growth in early 2000. While the first decade of the twenty-first century enjoyed a period of fast global integration, industrialization in new markets and complex global value chains, that process was interrupted by serial systemic shocks. The synchronized downturn the 2008–2009 Global Financial Crisis and the 2020 COVID-19 pandemic triggered also highlighted macroeconomic fault lines, and demonstrated just how fragile extremely interconnected systems could be. Subsequent recoveries of global GDP growth lingered well below previous pre-crisis peaks as productivity growth was insipid, trade elasticity weakened, investment stagnated, demographic trends soured in advanced economies and geopolitical risks increased. The global economy had become locked in a pattern of "steady but slow" growth (amounting to around 3 percent annually) that's too meager for broad-based increases in living standards, ebbing structural inequalities or resilience against future shocks. Put bluntly, the expansion of world economic growth is not progressing fast enough to maintain inclusive development or to meet long-term social and economic demands.

This extended slowdown suggests the necessity of complex, multidimensional analysis to explain both cyclical, and structural factors in global economic performance. While scholars and

international financial institutions have recorded regional trends, crisis-specific factors, productivity, financial stability, trade networks, shifting demographics, and geopolitical risk are oftentimes fragmented in the existing literature as standalone issues rather than interacting components of a hyper-complex global assemblage. As policy-makers encounter limited fiscal space, tightening global financial conditions and increasing vulnerability to climate and conflict-related shocks, there is an urgent call for research that integrates macroeconomic, institutional and structural angles. Second, future research should identify the channels of transmission of global shocks, quantify the long-term effects of economic disintegration and measure how effective traditional policy tools are in restoring growth under conditions of limited international cooperation. In the absence of a full, empirically based analytical framework, policy responses may be piecemeal, temporarily successful or inadequate to tackle entrenched causes of global economic malaise.

Despite recent evidence that the global economic deceleration of 2000–2025 is fairly well documented, there remains a significant knowledge gap regarding how major macro-financial variables—government debt, bank risk-taking and interest rates—are interrelated with respect to long-term growth implications around distinct regions and through various income levels. The numbers show that multiple crises have resulted in historically high levels of government debt as fiscal stimulus replaced restraint as the response of choice. However, the available empirical literature does not provide a complete explanation of how stubbornly high and increasing public debt can impact potential over time, especially in economies where fresh piles up of debt go hand-

in-hand with weak investment, budget constraints, governance challenges and demographics pressures. Although based on some analyses, high debt levels crowd out productive investment or constrain future fiscal space, differences in the empirical evidence at the regional level persist without clarity as to when public debt becomes a structurally drag on growth or an instrument for countercyclical use.

The second gap is credit risk-taking behavior among banks that were a key driver of the 2008–09 Global Financial Crisis and still drives financial stability and credit allocation in advanced economies as well as in emerging markets. While financial integration increased global financial linkages, scholarship has yet to provide a clear explanation of why it is that time and again we witness episodes of out-of-control leverage, risk concentration, and credit misallocation such as have become obvious once more with the response to the COVID pandemic. Especially lacking is a sense of how bank risk-taking changes under long periods of low interest rates and high uncertainty, accompanied by fragmented international capital flows. In addition, little cross-regional research has been done to examine how the risk seeking behavior in advanced financial systems spills over to developing countries who are still susceptible to sudden stops of capital flows, exchange rate pressure, and financial contagion.

Interest rates constitute the third variable to which there is now conceptual murkiness as well. Advanced economies have seen rates at historically low levels for the past two decades, followed by steep tightening cycles beginning in the mid-2020s. However, there is no definitive evidence as to how prolonged low rates affect productivity, investment decisions, financial sector stability and resilience of growth. Even less well understood are how changes in advanced economies' interest rates pass through to emerging and low-income countries via the exchange rate and capital

mobility, as well as with risk premiums. The mixed implications from the data, with some economies benefiting from cheaper borrowing and others experiencing capital flight or currency instability, have not been adequately captured by existing models. According as a consequence, the concomitant growth impacts of sustained low interest rates, sudden monetary tightening and global financial conditions is under-theorized.

Together, these holes indicate a more general lack of an embedded analytical framework which could associate debt dynamics combined with bank behavior towards risk-taking and interest rates fluctuations with global and regional growth narration. Although individual intermediates and individual binding partners have been analyzed in the past, we lack an understanding of how they act in concert with one another to sense synaptic inputs. This information void limits our ability to develop resilient policies able to promote sustainable development in an increasingly volatile world economy.

1.3 Research Questions

The primary focus of this research is to investigate the implications of govt debt, interest rates and bank risk-taking on economic growth in a panel context for range set of countries over 2000-2021. To reach this aim, the research questions are:

Main Research Question

How do government debt, interest rates, and bank risk-taking affect economic growth from 2000 to 2021?

Specific-Research Questions

Does government debt have a significant impact on economic growth?

How do changes in interest rates influence economic growth?

What is the effect of bank risk-taking on economic growth?

Which of the three variables government debt, interest rates, or bank risk-taking has the strongest influence on economic growth?

Chapter 2 Literature review

2.1 Government debt and Economic Growth

Shi, Song, and Ramzan's 2025 work looks at whether public Debts helps - or hinders - a country's economy, specifically considering how well its institutions function. Meanwhile, Asteriou, Pilbeam, and Pratiwi 2021 paper offers a contrasting viewpoint regarding the link between Government debts alongside economic growth. As the researchers point out, their study aimed at investigating how public debt and economic growth relate together, with particular stress on the role played by institutional quality (IQ)(Shi, Song, and Ramzan 2025).More than an ordinary regression of cross-country data, this paper focused in depth on 115 countries 'policy framework for the period from 1996 to 2021(Shi et al. 2025). It tries to answer the question: Is there any evidence that good institutional frameworks can affect a person's position in gambling with his own future? To cope with the possible endogeneity problems, the authors then apply a dynamic System Generalized Method of Moments (GMM) estimation technique that they have developed. The results show that public debt as such negatively affects economic growth, but when covered by institutional quality, this effect turns into a positive one. This indicates that countries with strong institutions will be able to use debt more effectively and productively than those who lack them, thereby earning faster economic growth. Moreover, the authors trace a line at which public debt no longer has an unfavorable impact on growth; rather it begins to help in economic performance--provided that supported by sound institutions. It says that to achieve sustainable economic growth we still need good governance, institutional development and policies to manage debt prudently (Shi et al. 2025).Now move on to Asteriou, Pilbeam, and Pratiwi 2021 paper this study explores the links between Public generation of credit debts and economic situations over a panel of very

specific countries in Asia that were picked in 1980 (Asteriou, Pilbeam, and Pratiwi 2021) . The methods applied by researchers include the pooled mean group (PMG), mean group (MG), difference fixed effect (DFE) and common correlated effects (CCE) methods (Asteriou et al. 2021). Furthermore, on this non-linear meta-analysis, we experimented with a panel ARDL model to capture any potential differences between rising levels of debt and decisions. The results showed that in both the short and the long term, increasing government debt is negatively correlated with economic growth. This suggests that excessive levels of public credit-based finance may act not to sustain economic development in any of the economies across Asia (Asteriou et al. 2021) .

2.2 Bank Taking Risk and Economic Growth

The role of banking sector stability in promoting economic growth has been highlighted in two studies. Bayar, Borozan, and Gavriletea (2021) analyze post-transition EU countries from 1998 to 2016 is about analysis looks at the impact of banking sector stability on the fortunes of the post-transition EU countries in this sector for 1998-2016 season(Bayar, Borozan, and Gavriletea 2021). With cross-sectional dependent, there is heterogeneity, endogeneity, and structural breaks, a new generation of cointegration and causality tests appropriate for panels can be used to examine both long-run and short-run relationships(Bayar et al. 2021). Banking sector stability has a statistically significant and positive impact on economic growth potential. Error correction at efficient adjustment aftershocks is shown by the mechanism Causality tests show that, between certain indicators of stability and growth, the relationship is bidirectional. Banking stability is multi-faceted, which highlights the need for different policy measures. It also suggests that we should try to stop financial shocks while promoting economic growth in various ways(Bayar et al. 2021). Similarly, Stewart and Chowdhury (2021) paper about the research finds out whether and to what

extent banking sector stability can provide resilience for economic growth during banking crises(Stewart and Chowdhury 2021). Different from country differ asymmetry effects Using a parliamentary 140 - country global panel in 1995-2017, the general method of moments is used to empirically test how banking instability, regulatory capital, and liquidity affect the impact of crises on GDP growth(Stewart and Chowdhury 2021). The results demonstrate that the banks can mitigate the negative impacts of crises on economic expansion as a whole in both developed and developing economies. Asymmetries are discovered, however(Stewart and Chowdhury 2021). For instance, liquidity in the banking sector is associated with higher growth resilience primarily in high-income countries; regulatory capital helps to maintain large growth in middle-income economies but it does not do so for those at the top(Stewart and Chowdhury 2021). The research is committed to making national banking leverage-system specific regulation and policy effective in order to maintain economic stability.

2.3 Interest Rate and economic growth

The relationship between interest rates and economic growth has been examined from different perspectives in two studies. Adabor (2022) papers about examines the asymmetric effect of lending rates on economic growth in Ghana, which tries to find out whether increases and decreases in lending rates have different implications for growth(Adabor 2022). Employing annual data between 1970 and 2019 in a Nonlinear Autoregression Distributed Lag (NARDL) framework, the studies adopt development lending rate as well to examine asymmetries in short-run and long-run dynamics between lending rates and economic growth(Adabor 2022). The findings of this study further show an asymmetric relationship; with a positive change (increase) in lending rates resulting in a reduction in economic growth by around 0.151% in the long run and about 0.213%

in the short run, while a negative change (decrease) in lending rates contributes to increased growth by approximately 0.214% in the long run and 0.677% short term(Adabor 2022). The speed and timing of economic growth's response to rise and fall in lending rate is also significantly different, hence heterogeneities are confirmed. This result is robust to the additional tests. In total, the study shows that there is a non-linear relationship between lending rates and growth and this could be an explanation why some previous research present mixed results in the area. Second paper by Shaukat, Zhu, and Khan (2019) is about investigates the effect of real interest rates on economic growth in transitory economies with the purpose of identifying channels through which real interest rates affect growth performance. With data from 38 transition countries between 1996 and 2015(Shaukat, Zhu, and Khan 2019), the mechanism of SBR is estimated in a dynamic panel data setup involving GMM techniques under an n-step estimation process using a ten-equation SEM. The findings also show that the real interest rate has a negative impact on economic growth through various transmission channels, including domestic and foreign investment, human capital, trade openness, exchange rates, inflation, institutional development index (IDI), political instability and corruption(Shaukat et al. 2019). The results suggest that the real rate of interest is exogenous in these economies, and when high can have an adverse impact on economic activity by reducing investment and undermining macroeconomic stability(Shaukat et al. 2019). A policy implication from this study is that it is very important for transitory and developing economies to keep the real interest rates low, without which their working progress toward stages of economic transition would be break. Thus, both studies examine the relationship between interest rates and economic growth, but they differ in context, methodology, and analytical framework, providing complementary views of how borrowing cost impacts economic performance. The first paper, dealing with the example of Ghana 1970-2019, applies the NARDL model on the asymmetric

effects of lending rates on economic growth. The analysis showed that an increase in lending rates leads to a decrease in growth, while a decrease stimulates, both in the short and long term. The above indicates a non-linear relationship, manifested in the different actions of the economy to increase and decrease the level of lending rates. The second paper, which covers 38 transitory economies formed in 1996-2015, applies a dynamic panel GMM approach with a ten-equation structural equation model to analyze how real interest rates influence growth using various channels, investment, trade, human capital, and institutional factors. The results include a significant negative relationship between high-real and economic growth increased rates.

2.4 Summary of literature review

In Summary of literature first table to show its effect then we summarized the literature review table

Table 1 (2.1 Literature review table)

Variable	Positive Effect on Economic Growth	Negative Effect on Economic Growth
Government Debt	High institutional quality allows for public debt to accompany economic growth because sound institutions guarantee that borrowed public funds will be spent efficiently (Shi, Song, & … Ramzan 2025). According to Shi et al. effective utilization of debt thanks to sound governance allows public borrowing to fund long-term development projects (2025). Strong institutions can also minimize corruption and waste, which means debt is used for infrastructure, education, and national development, spurring growth (Shi et al., 2025). In addition, their analysis is able to pin down an institutional quality level decreasing public debt changes from growth reducing to growth enhancing (Shi et al, 2025).	Whereas in environments with low institutional quality, public debt turned into inefficiency and a threat to economic performance (Shi et al., 2025). Misallocation of borrowed fund, corruption and debt overhang stemming from poor governance lower the economic growth (Shi et_al., 2025). On the other hand, Asteriou et al. (2021) proved that in the Asian economies the increasing government debt had a consistently negative effect on economic growth, both in the short run and long run. In addition, Asteriou et al. (2021) elaborate that excessive public borrowing may crowd-out private investment, exert fiscal pressure, and can even reduce the

Variable	Positive Effect on Economic Growth	Negative Effect on Economic Growth
		possibility of the government making investments in sectors that enhance growth. In their study, they also document that rising debt increases the risk of the economy falling into a state of macroeconomic instability, and/or default, evidence that moderate debt increases can have negative long-term consequences (Asteriou et al., 2021).
Bank Risk-Taking	The stability of the banking sector facilitates the economic growth by providing quality credit services to the real economy (through productive sectors) and by reducing financial uncertainties (Bayar, Borozan, and Gavriletea, 2021). Stable banking systems enhance long-term investments and help in capital accumulation, all of which augment GDP growth (Bayar et al., 2021) They also found evidences for bidirectional causality implying that growth exerts a stabilization effect on banking and vice versa (Bayar et al., 2021). In connection with this, Stewart and Chowdhury (2021) also show that stable banks act to alleviate economic downturns, by extending liquidity to struggling businesses in times of financial shocks. It is also observed that sufficient regulatory capital enlarges banks' capacity to absorb shocks increases investor confidence and promotes investment (both foreign and domestic) (Stewart & Chowdhury, 2021). Whereas the banking liquidity is likely to help with the GDP to be less adversely affected in the crises duration (Stewart & Chowdhury, 2021) especially for the high-income economies.	On the other hand, banking instability has been proven to worsen the consequences of financial crises, making economic slumps deeper (Stewart & Chowdhury, 2021). The credit collapse, which drives down business investment and household consumption, causes the economy to decelerate (Stewart & Chowdhury, 2021). The authors also note that low banking liquidity, which characterizes low-income countries, amplifies economic shocks, deteriorating output performance (Stewart & Chowdhury, 2021). While the global economic impact of hysteresis is significant, poorly capitalized banking systems rub salt into the wound by making the economy disproportionately sensitive to any financial disturbance, causing higher unemployment and diminished GDP growth (Stewart & Chowdhury, 2021).
Interest Rate	n recent study by Adabor (2022), it is found that drop in lending rates improve growth through higher firm borrowing, accelerating household consumption, and boosting credit to productive sectors. In addition to this low-interest rates enhances private investment in the economy and causes faster growth of GDP in both long-term and short-term (Adabor, 2022). Findings of the study reveal the asymmetric effects which suggests that decreases in lending rates have a larger positive effect on growth than the negative effect on account of increases (Adabor, 2022). In addition, declining lending rates are connected with faster short-run responses of economic adjustment (Adabor, 2022).	By contrast, the increases in lending rates reduces GDP growth because it stifles people investment, as firms borrow less (Adabor, 2022). According to Shaukat, Zhu, and Khan (2019), the high real interest rates indirectly harm economic growth via several transmission channels from domestic and foreign investment weakness, sluggish human capital formation to trade openness reduction. In another aspect of its usefulness for the economic performance, As the study is unable to carry good news regarding the interest rate and economic performance because it concludes high interest rates raise production costs, deteriorate exchange rate conditions, and intensify inflationary

Variable	Positive Effect on Economic Growth	Negative Effect on Economic Growth
		pressures, which negatively affects economic performance found by Shaukat et al., (2019). Moreover, higher real interest rates undermine the efficacy of institutions, aggravate political instability and corruption, and take the form of credit crunch for firms, causing further aggregate economic slowdown (Shaukat et al., 2019).

Summary of literature review table

This table includes the major strands of empirical literature that informs this research. The studies have been grouped under three major sections – public debt and economic development; banking sector risk-taking and economic development; interest rate and economic development. The first section of the table includes authors such as Shi et al. (2025) and Asteriou et al. (2021), who show that public debt provides a positive growth assistance for the long term as long as it is moderate and is used to finance productive public investments since, on the contrary, lethargic permanent debt growth emits the crowding out of private investments, yield of fiscal space stagnation, and fiscal growth decrement. The second section is risk – taking of the banking sector; evidence is provided by Bayar et al. (2021) and Stewart & Chowdhury (2021), who indicate that sustaining economic growth is a function of financial stability. Their findings indicate that risk – taking by banks disregarding financial stability is likely to bring about growth undermining financial distress due to blocked credit opportunities. However, it is also clear that growth sustaining investments can be provided by balanced risk – taking, accompanied by sound financial stewardship. The third section includes studies such as Adabor (2022) and Shaukat et al. (2019) which evidence that the rate of interest impacts investment, consumption of the economy, and hence economic activities

to a considerable extent. Uncontrolled high-interest rates affect investments negatively and discourage borrowing. However, managed high rates can boost the economy by increasing the availability of credit. All the studies presented and summarized in the table illustrate that government debt, the risk that banks take, and the level of interest rates that apply are all interconnected and which affect the levels and rates of economic growth. The convergence of the studies increases the validity of the theoretical underpinning for the chosen variables to be included in the model for empirical testing.

Chapter 3 Methodology

3.1 Hypotheses

H1: Public Debt and Growth of the Economy

An increase in government debt levels will likely lead to slower growth in the economy in the long run. This is due to the public sector borrowing excessively and potentially crowding out private investment and the creation of fiscal imbalances. When public debt gets too high, it will undermine the stability of the economy as a whole and cause slower growth in the economy

H2: The Role of Bank And Economic Growth

Banks are presumed to increase risk-taking behavior that will certainly affect the economy negatively as this will inflate the financial system's instability. With high risk exposure, there are likely to be credit losses and liquidity problems, as well as disruptions in the banking system. In this respect, the financial instability will constrain the credit flow and in the end, the economy will also experience a downturn as a result of the low state of productive activities.

H3: Rates of Interest and Growth

Higher interest rates are expected to slow economic growth by discouraging investment and borrowing. High lending rates increase the cost of financing for firms and households, reducing spending and production.

3.2 Measurement of variables

Variables

The dependent variable is economic growth, while the independent variables include debt composition, interest rate, and bank risk-taking. The summary of the measurement is given in Table 3.1

Table 2 (3.1 Measurement Table)

Variable	Measurement	Description
Economic Growth	Real GDP Growth (annual %)	Gross domestic product is the total income earned through the production of goods and services in an economic territory during an accounting period. It can be measured in three different ways: using either the expenditure approach, the income approach, or the production approach. This indicator denotes the percentage change over each previous year of the constant price (base year 2015) series in United States dollars.
Debt Composition	Government debt (Net debt, General government, % of GDP)	The World Economic Outlook (WEO) database contains selected macroeconomic data series which present the analysis and projections of economic developments at the global level, in major country groups and in many individual countries. It measures the general government's net debt as a percent of GDP, calculated using Government Finance Statistics (GFS) methodology.

Variable	Measurement	Description
Interest Rate	Lending Interest Rate (%)	Lending rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to creditworthiness of borrowers and objectives of financing. The terms and conditions attached to these rates differ by country, however, limiting their comparability. This indicator is expressed as a percentage (a÷b)*100.
Bank Risk Taking	Bank Z-Score	It captures the probability of default of a country's banking system. Z-score compares the buffer of a country's banking system (capitalization and returns) with the volatility of those returns. It is estimated as (ROA + (equity/assets)) / sd(ROA); sd(ROA) is the standard deviation of ROA, calculated for country-years with no less than 5 bank-level observations.

Economic Growth

The economic growth variable represents the most fundamental variable of interest in this study. It is measured as the annual percentage real growth of Gross Domestic Product (GDP) in constant 2015 U.S. dollars. Economic Growth measures gross value of all the economic goods and services produced in an economy over a given period of time. It can be computed by the expenditure, income or production approach. In this case, the value of nominal GDP is adjusted for inflation (real GDP) to measure the value of economic activity and the performance of the economies in a

given time period to a standard and inflation adjusted measures of economic activity in other countries.

Debt Composition

Debt Composition (Independent Variable): Composition of Debt will be represented as Government net Debt as a Percentage of GDP, reflecting the position of the government relative to the size of the economy. This value is taken from the IMF's World Economic Outlook (WEO) as well as Government Finance Statistics (GFS) methodology. This shows the balance of the public finances as well as the possible impact of government debt on economic activity.

Interest Rate

Interest rate is measured by the lending interest rate (%), which indicates the cost of borrowing for the private sector to meet short- and medium-term financing needs. This rate varies based on the creditworthiness of borrowers and the purpose of financing, with the terms differing across countries. The lending rate is expressed as a percentage, calculated using the formula $(a \div b) \times 100$. It reflects the financial conditions that influence investment, consumption, and overall economic growth.

Bank Risk Taking

Bank risk-taking is measured using the bank Z-score, which evaluates the probability of default in a country's banking system. The Z-score compares the capitalization and profitability of banks against the volatility of returns. It is calculated as the sum of return on assets (ROA) and the equity-to-assets ratio, divided by the standard deviation of ROA. A higher Z-score indicates greater

financial stability and a lower likelihood of bank failure, highlighting how banking system resilience can impact economic growth.

3.3 Sample and data

First, we gaven sample data table and then same description for broader understanding after that we gave the data source.

Table 3 (3.2 Sample data table)

Variable	Type
Economic Growth	Dependent
Debt Composition	Independent
Interest Rate	Independent
Bank Risk Taking	Independent

Sample Description

This study initially included an all-inclusive sample of 195 countries and territories, or a wide range of economic structures, income levels, and geographical locations. The rationale to select such large sample was that the analysis captures global economic trends and so results can be generalized for advanced and developing economies. For most variables, our dataset covers the annual period from 2000 to 2024 and includes major global economic events such as the dot-com restoration, the GFC of 2008, the post-2010 debt crises and COVID-19. The bank risk-taking variable (measured as the bank Z-score), however, is available over a shorter period, 2000–2021

from the World Bank Group's Global Financial Development Database. Every X in the data set has a purpose. We measure economic growth through real GDP growth (annual %) which records the inflation adjusted output expansion in each year over the last. Composition of debt, which is reported as general government net debt (% of GDP) indicates the fiscal position of countries, using IMF's World Economic Outlook and Government Finance Statistics methodology. The interest rate, an indicative policy rates (lending interest rate in %) is the price of private credit and shows internal financial market conditions. Bank risk-taking (bank_z), which is a bank Z-score is a unit-less measures that can be obtained directly as long as three financial ratios are available: return on assets (ROA), equity-to-asset ratio, and the volatility of returns, all of which help capture how likely a country's banking system would have faced financial distress.

Although the earliest plan was to include all 195 countries, the database exhibited many noticeable gaps, inconsistencies and long periods of absent observations for several countries—especially as relates to government debt and bank Z-score data. Several countries were without good time-series data, others had odd reporting schedules (or none) that prevented the formation of a balanced, or even a useful unbalanced panel. Owing to this lack of data, the remaining dataset that could be used for analysis was limited to 34 countries with relatively complete data for the period from 2000-2021. This provided methodological rigor, as econometric panel models need compatible and uninterrupted observations to produce unbiased and reliable estimations. While the reduced sample is smaller, countries from both geographic regions and income levels are present in it, thus capturing cross-country heterogeneity and allowing for a meaningful investigation of the influence of government debt, lending interest rates and bank risk-taking on economic growth.

Data source

The data for this study were obtained from several reputable sources, with real GDP growth, lending interest rates, and bank Z-score data sourced from the World Bank Group's databases (https://databank.worldbank.org), and Government debt figures obtained from the International Monetary Fund's World Economic Outlook (https://www.imf.org/en/Publications/WEO).

3..4 Data analysis

In this study's methodology, I try to find out whether government debt, interest rates, and the extension of banking risk-taking on economic countries fulfill growth conditions In terms of choice of countries, the study follows the same method used by (Four Edition, Chapter 15: Panel Data Models Hill, Griffiths, and Lim).Panel data analysis not only can examine cross-sectional changes and time series variation at once, it also allows capturing heterogeneity among countries while observing how this changes over time.

Data Collection and Compilation

Data for this study were collected from a variety of sources, including the International Monetary Fund (IMF) World Economic Outlook(WEO) and World Bank Group databases. Initially, the dataset contained 195 countries, covering the period 2000-2024. Variables of interest were real GDP growth as dependent variable and GDP public debt, the lending interest rate and bank Z-scores as independent variables. Each variable was collected from a separate file provided by the respective institution. Real GDP growth was measured as $constant2015US(2015 U.S. dollars), GDP public debt as a percentage of GDP using IMF Government Finance Statistics methodology, the lending interest rate as a percentage reflecting the cost of borrowing for private sector

businesses, and bank Z-scores as an index of banking system stability. The initial compilation revealed that the variables did not have complete data for all countries across all years. Granted that point, the observations were ended when it was clear that data would be missing in many cases – an act which required eliminating countries with substantial holes from the list of 195 countries. After the dust had settled, the result was a "balanced panel" containing data on 34 countries for the period 2000–2021. This was an essential step to ensure the validity of panel regression analysis and to maintain comparability across countries and years. All datasets were merged, cleaned, and converted into CSV format for easy import to RStudio. Further analysis was done there.

Software and Packages

We used a number of R packages for data processing, visualization, and econometric analysis. tidyverse was employed to clean, manipulate, and transform data; plm supported panel data regression modeling; lmtest and sandwich provided intrinsically correct voiced errors estimators and severity; stargazer produced formatted regression tables with robust adjustment for heteroskedasticity; car was employed for diagnostic testing; tseries was used as part of time series analysis and ggplot2 provided high quality visualizations; corrplot produced correlation matrices; and psych was used to carry out descriptive statistical analysis. Results of the workflow shown in Figure 1 show that each step information can be repeated by using these same scripts.

Data Cleaning and Preprocessing

Once the dataset was imported into RStudio via read.csv(), we selected only the necessary variables and processed them. Values for the dependent variable, real GDP growth, missing in any observation were removed using na.omit(). As country was to be treated as a categorical rather

than continuous variable, we changed its 'Type' from Factor (default) to numeric. This made year return numeric too. To avoid any duplication, only unique country--year observations were retained and the data was transformed into panel by pdata.frame() with country and yearas the panel indices. Meanwhile, we utilized the function describefor calculating central tendency and variation in our data and identifying possible extreme values.

Plots were used to explore temporal patterns or distributions. To see the global GDP growth level, we made a histogram of real--just like that. A line chart for growth over time in each of our five countries showed nicely what trends among them might be born through centuries of life. Interest rates, the government debt ratio, and bank Z--scores against GDP growth were preliminarily captured in scatter plots to see what general directions these independent variables would correlate withversus dependent variableismoresharply trends. We also computed correlation matrices and produced graphical plots of those for inspection of multicollinearity--this is to make sure that our predictor variables are little inter--related enough so as not be thrown together by chance when it comes time too regress on them separately later.

Panel Data Modeling

Equation 1

$$Yit = \beta 0 + j = 1 \sum p\beta jXijt + \alpha i + \gamma t + uit$$

The fundamental analytical framework of the study is panel regression models, which draws on both cross-sectional (CS) and timeseries data in order to allow more efficient and informative estimates tan those generated by traditional OLS methodologies. The estimates from this empirical initial screen are compared with those obtained using different kinds of (unexplained) fixed effects.

Three different types of estimations were involved: pooled OLS, fixed effects (FE) and random effects (RE).

The pooled OLS model assumes homogeneity across countries and years and can be expressed as:

Equation 2

$$Y_{it} = \alpha + \beta_1 Debt_{it} + \beta_2 InterestRate_{it} + \beta_3 BankRisk_{it} + u_{it}$$

In this equation, Y_it is the real GDP growth rate for country i in year t and it functions as the dependent variable indicating how well an economy performs over time. Debt it is the ratio of government debt to GDP in country i in year t, and it captures the weight of public indebtedness on the national economy. InterestRate_it is the interest rate on lending which measures the cost of credit for private sector and affects investment and consumption decisions. is the bank Z-score, a popular metric of banking stability indicating the probability that banks go into financial distress And lastly, u_it is the error term, and incorporates all other potential factors which affect economic growth but are unobservable in the model.

Despite its simplicity and the fact that it is easily interpretable, the pooled OLS has an important drawback. It views countries as identical and ignores latent differences, such as quality of institution, governance structure, geography, culture and long-term structural properties. Once such country-specific characteristics are correlated with important variables such as debt to GNP, interest rates or bank soundness, pooled OLS estimates become biased and inconsistent. As a result, more sophisticated panel data methods—like the fixed- and random-effects models—are

preferred, as these enable researchers to adequately control for country-level differences and provide more reliable estimates.

To address this, the fixed effects model was employed:

Equation 3

$$Y_{it} = \alpha_i + \beta_1 Debt_{it} + \beta_2 InterestRate_{it} + \beta_3 BankRisk_{it} + \varepsilon_{it}$$

In the fixed effects model, the term alpha_i represents all unobserved, time-invariant characteristics that are unique to each country, such as institutional quality, governance structures, historical development, cultural factors, or geographical conditions. These characteristics do not change over time but can strongly influence economic growth. By controlling for alpha_i**,** the fixed effects model focuses only on the changes that occur within each country over time. This allows the model to produce unbiased estimates even when these country-specific factors are correlated with the explanatory variables, such as government debt, interest rates, or banking sector stability. As a result, the fixed effects model is particularly useful for removing hidden biases that arise from cross-country differences that cannot be directly measured.

The random effects model operates under the assumption that all country-specific effects are uncorrelated with the independent variables.

Equation 4

$$Y_{it} = \alpha + \beta_1 Debt_{it} + \beta_2 InterestRate_{it} + \beta_3 BankRisk_{it} + u_{it} + \alpha_i$$

In this equation, Y _it represents the year-over-year change in real GDP of country i and is itself the dependent variable for measuring long-term economic performance over a time horizon. 1/3Reduction imposes contraction to the (positive) ratio of government indebtedness to GDP in

country i during year t. InterestRate_it = interest rate on lending, which is the cost of credit for private sector and influences its investment and consumption decisions. is the bank Z-score, which is a common measure of banking stability and represents the probability that banks enter into financial distress. And finally, is the error term and includes all possible reasons which determine the economic growth, but not observed in our model.

Although straightforward-and interpretable, pooled OLS has a major limitation. It treats nations as homogenous and does not take into account underlying differences like institution quality, governance structure, geography, culture and long-run structural characteristics. When country-specific variables are regressed on the major country- and economy- specific regressors, e.g., debt to GNP, interest rates or bank soundness (or indices based on these), pooled OLS estimates will be biased and inconsistent. Consequently, more advanced panel data approaches—especially the fixed- and random-effects models—are favored, because these allow researchers to control for country-level heterogeneity more effectively and yield more robust estimates.

Robustness and Diagnostics

A fundamental diagnostic in panel data analysis is to find out whether the FE model fits statistically significantly better than the simpler Pooled OLS model. To test for this, the paper used the F-test for Fixed Effects (a.k.a. Chow Test) for panel data. This test is a joint test of the null hypothesis that unobserved country-specific intercepts β i are all zeros. If none of the country-effects are statistically significant, then room-temperature Pan OLS—where all country effects are assumed to be homogeneous—is all we need. If the F-test is however statistically significant, it rejects the null hypothesis that all individual effects are equal and thus claims there are important time-invariant differences between countries. These differences might be less tangible: differences

in institutions, geography, the structure of the economy, its size and stability and other such "deep parameters" that cannot be directly measured/observed but affect overall growth. The value of F-statistic observed in this research indicated the existence of substantial differences among countries and this indicates that the Pooled OLS model is not suitable, but we need Fixed Effects model to have unbiased and consistent estimates. This procedure also ensures that the empirical analysis properly encompasses structural differences among the selected countries and avoids omitted-variable bias from neglecting these unobserved factors.

Equation 5

$$F = \frac{(RSS_{Pooled} - RSS_{FE})/(N-1)}{RSS_{FE}/(NT-N-K)}$$

A set of diagnostic tests were performed on the econometric estimates to check for reliability and validity, which addressed different forms of violation of classical panel regression assumptions. These tests are important since panel data sets, particularly when the sample comprises different countries with dissimilar economic structures and financial situations, are usually afflicted by heteroskedasticity, serial correlation and cross-sectional dependence. Meta-analyzing these problems enhance the reliability of standard errors and lends credibility to empirical findings.

Equation 6

$$LM\ Statistic = i = 1 \sum N(u^i t2)$$

The next step was to estimated the Breusch–Pagan Lagrange Multiplier (LM) test, followed by Random Effects (RE) for testing if it is more favorable than the Pooled OLS model. The LM test tests the hypothesis that the unobserved country-specific effects are not variance one. A large LM test implies the panel effects exist and so Pooled OLS is inappropriate and either RE or FE is

appropriate. This ensures that the study is not based on a too simplistic model and this allows to account for country-level diversity.

Second, the analysis was tested for serial correlation with Wooldridge Test of Autocorrelation in Panel Data. As economic variables are usually persistent, serial correlation is likely to be widespread in macro-panel data sets. If unadjusted for, serial correlation can result in downward bias of standard errors and roc index values. A strong first-order serial correlation through a Wooldridge test became significant, hence cluster-robust covariance matrices have been used to ensure well-behaved inference.

Equation 7

$$\text{Test Statistic} = \text{T}/\sum \text{t} = 1\text{T} - 1(\text{Yit} - \text{Y}^{\text{i}}\text{t} - 1)2$$

Third, heteroskedasticity was tested in the study with the Breusch–Pagan test. In cross-country comparisons, stochastic variation in economic variables is almost never constant since countries vary greatly in size, income per capita and fiscal arrangements. The Breusch–Pagan test is a test of whether the variance in the residuals from regression is constant across observations. This leads to a significant outcome for heteroskedasticity and the author employed heteroskedasticity-robust standard errors (vcovHC() estimator with country-level clustering).

Equation 8

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right)$$

Fourth, cross-sectional dependence was examined using the Pesaran Cross-Sectional Dependence (CD) Test. Such a test is particularly relevant at the global level given that countries are connected by trade, financial flows and global shocks (the 2008 crisis or the COVID-19 pandemic). If this

is not taken into account, cross-sectional dependencies will give rise to biased standard errors and inefficient estimators. A Pesaran CD statistic which is large suggest economic shocks in one country spill over to others, which motivates the need for robust standard errors that deal with correlated disturbances across cross-sections.

After identifying these challenges, the analysis made use of cluster-robust (country) heteroskedasticity and autocorrelation consistent (HAC) standard errors to address all major departures from classical assumptions. VIFs and correlation matrices were also employed to ensure there is no multicollinearity between the proportions. The use of these diagnostic checks combined adds to the validity of the regression results, and strengthens policy inferences drawn from our analysis.

Summary

The approach combines rigorous data handling, cleaning and plotting along with econometric model fitting to analyze the key factors driving economic growth in a panel of countries. By pooling OLS, fixed effects and Random effects estimations, as well as robustness checks etc., this paper ensures the reliability of findings that could offer policy sensitive understanding of the influence on economic outcomes by government debt, interest rate and banking sector stability. The expose pattern is similar to the one commonly used in panel data econometrics (eg Hill, Griffiths and Lim 2008) while making use of some modern data analysis software available from RStudio that will made it possible to replicate results for clarity.

Chapter 4 Result

This chapter discusses the results of the empirical examination on the influence of government debt, interest rate, and bank risk taking on economic growth. Comparison process Univariate analysis To start with, the salient feature of the data are outlined through summary statistics and correlations. The findings of the panel regression models, including diagnostic tests and post-estimation analysis are then presented. The results seek to establish the way each of the variables impacts on economic growth and if such relationships are in line with my hypotheses.

4.1 Distribution of Real GDP Growth

In order to commence the analysis of the economic growth in the countries that were chosen, it is necessary to consider the general distribution of the real GDP growth. The histogram gives a graphical overview of the development trends over the period between 2000 and 2021 on the 34 countries that were considered in the research. This initial analysis of the data shows the overall patterns, cross-country and cross-year variations, and the existence of extreme values, which guide the next set of econometric analysis.

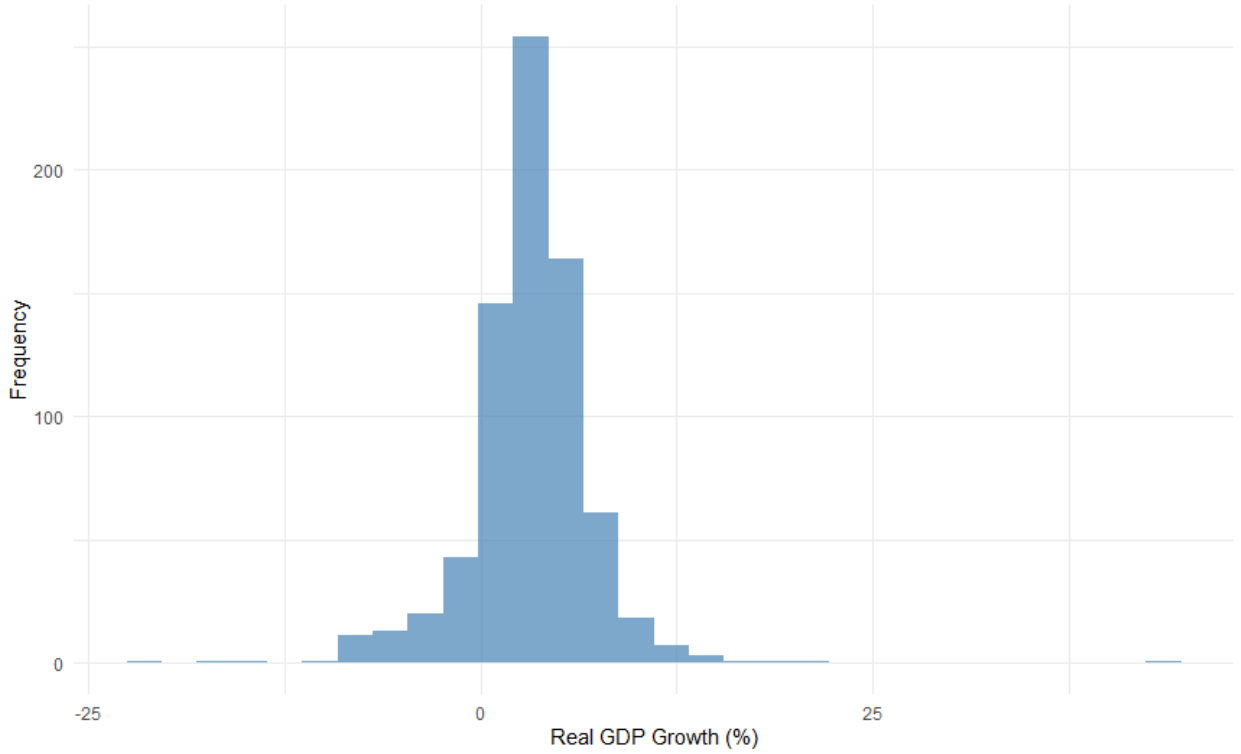

Figure 8 (4.1 The distribution of real GDP growth)

Interpretation of the Histogram

The distribution of real GDP growth for the 34 countries during the period 2000–2021 is shown in a histogram, which shows that most economies grew at stable and unexceptional paces in these years –the mass of the distribution is around moderate positive growth rates. The largest bars are in the 0–5% range, indicating that this range covers much of the year to year variation, and that moderate growth is not exclusively found in individual countries. The distribution is apparently right-skewed, with a thinner tail at higher growth rates above 10%, corresponding to a small number of country-year episodes where extreme rapid GDP growth has been recorded which are times in which especially fast economic growth was recorded, dominated by post-crisis rebounds and structural reform'/commodity boom type the latter. The left tail is longer than the right with some observations below 0% and others less than –10%, representing large contractions related to

global recessions like that in 2008 or economic disruptions due to the COVID-19, 2020. The skewness along with the presence of extreme negative values show that downturns are particularly sharp and fra- gile as oppose to boom in economic growth. On the whole, the histogram suggests that most countries have experienced modest but steady growth, though there are instances of acute instability, especially during global economic shocks; hence we see evidence of a moderately skewed and fat-tailed distribution.

4.2 Correlation Analysis

In this section, the author will analyze the connections between the independent variables (government debt, interest rate, and bank risk-taking) and the dependent variable (economic growth). The correlation analysis will provide the direction and strength of association which forms the basis of selecting regression models and also help in identifying possible multicollinearity among variables.

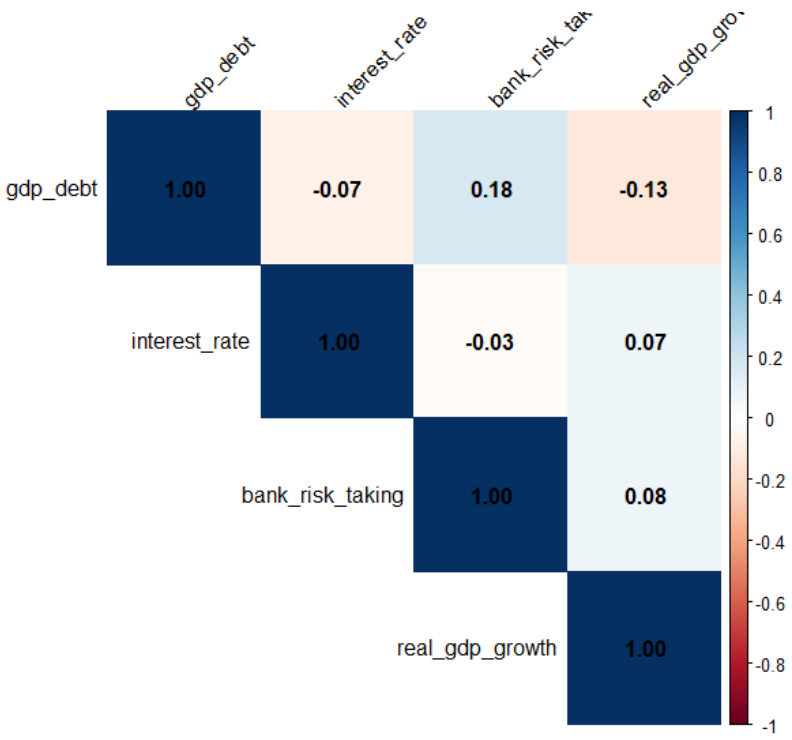

Figure 9 (4.2 correlation Matrix)

Interpretation of the Correlation Matrix

The correlation matrix also shows that the dependent variable, real GDP growth, may display weak linear relationships with only any of the three independent variables -Government debt and bank risk-taking as well as interest rates- that is, each predictor measures one different dimension of macroeconomic performance. As mentioned earlier, there is only a weak negative cross-section correlation between GDP growth and debt (–0.13), so that heavily indebted countries tend – on average – to grow less than others by 1.3 % p.a., though the relationship cannot be approximated by a tight linear curve. This is line with theoretical predictions where high debt could lead to

crowding out of productive investment or be a sign of macroeconomic instability. Bank risk-taking has a low positive association with GDP growth (0.08); in other words, the banking sector's more risky behavior only marginally corresponds to better economic growth, but this evidence is too weak for strong generalizations. Likewise, the relation between interest rate and GDP is very small and contrary (0.07), suggesting that changes in interest rates over the sample period are not directly related linearly with annual growth differences. Furthermore, relatively low correlations of all predictors not only indicate that the multicollinearity is not high between these variables but also imply that the distinctive performance of each independent variable will possibly be originated from its own dynamic or structural influence rather than solely from concurrent linear associations. In general, the pattern among the indicators is confirming that explanatory variables should be used in a regression context as having independent information and not being heavily redundant.

4.3 Scatterplots Analysis

The scatterplots provide a graphical check of the bivariate associations between real GDP growth and the independent variables—government debt, interest rates, and bank risk taking. The corresponding fitted regression lines are almost horizontal for the three figures, meaning there are very weak linear associations, which is in agreement with the correlation matrix outcomes.

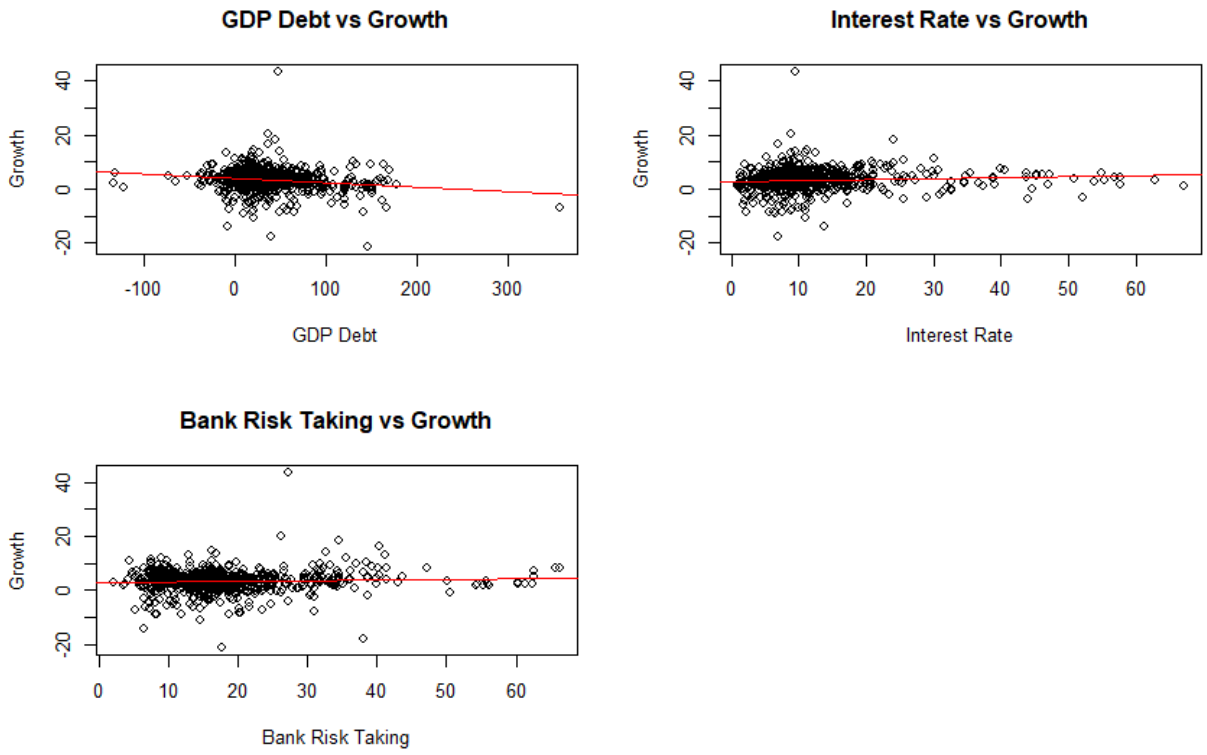

Figure 10 (4.3 scatterplot)

Interpretation of Government debt vs Real GDP Growth

On the scatter of GDP debt against real GDP growth, there is wide spread of observations about a very shallow down-sloping trend line. This indicates that increased public debt is, marginally, negatively associated with economic growth but the relationship is weak and highly scattered. The fact that there are a lot of observations around moderate levels of debts, and growths around zero hinders the predictive power of debt levels alone. The small slope confirms the truth of a text-book description of debt and growth as being negatively correlated only weakly, with which we again observe in our raw bivariate setting (–0.13) above. Apparently, any real impact that debt has on growth only comes into focus after we had taken into account country-specific heterogeneity which follows a more complex but realistic multivariate logic.

Interpretation of Interest Rate vs Real GDP Growth

The scatter plot of interest rates also shows a scattered cloud, again with no discernible trend. The fitted line is almost a horizontal line sloping close to zero, meaning that the association between interest rates and growth is quite weak, which is also consistent with the low correlation found (0.07). The fact that there is a broad spectrum of interest rates from super-low to hyper-high, does not sort into systematic variation in growth results. This visual representation indicates that there is no very strong contemporaneous relationship between interest rates and annual rates of growth, at least directly, or any effect must be indirect or work through complex dynamic mechanisms which will not manifest in simple bivariate maps.

Interpretation of Bank Risk-Taking vs. Real GDP Growth

The scatterplot for bank risk-taking and growth also displays a widely dispersed distribution, with a very weak positive trend line. The group of observations clustering at low risk-taking levels and around growth of zero has little explanatory power in its own right. The slow positive slope lines up with the little negative correlation (0.08), indicating that the impact of bank behavior on economy performance is subtle, and only when controlled for fixed effects and other indirect factors in a multivariate(or panel) framework does the underlying structural effect surface.

Overall Interpretation

However, all in all, the scatterplots reveal that no single independent variable whether it is government debt, interest rate or bank soundness has a strong bivariate linear association with real growth. The small magnitudes and high dispersion suggest that, taken alone, it has low predictive power; this helps to justify the use of panel regression techniques which adjust for unobserved

heterogeneity and use the within country variation. Visual diagnostics also suggest that multicollinearities or the presence of a common linear trend are not likely, thereby lending further support to consider these variables in a joint regression. "At the end, these patterns indicate that the determinants of real GDP growth are working through other than simple one-to-one linear relation due to conditional relationships.

4.4 Descriptive Statistics

This part shows the descriptive analysis of the most important variables to be used in the research, which are government debt, interest rate, bank risk-taking, and economic growth. Descriptive statistics will give a summary of the information, including the central tendencies, dispersion, and trends among the 34 countries that have been chosen throughout the 2000-2021 years. The analysis will be used as a background in developing the attributes of the data set and will be a precursor to the econometric modeling.

Table 4 (4.1 descriptive table)

vars	n	mean	sd	median	min	max
Government debt	744	38.173	42.02265	32.2195	-133.069	357.23
interest rate	722	12.1411	9.357231	9.704604	0.994	67.08333
Bank risk taking	728	17.83863	10.002	15.72	2.12	66.27
Real GDP growth	748	3.184921	4.036992	3.260166	-21.3999	43.47965

Econometric Interpretation of Descriptive Statistics

The Overview descriptive also present real GDP growth and cover valuable information on the distribution and variations of each variable that the panel regression model consisted in, using as

dependent variables: Real GDP growth with 3 lagged values; bank risk-taking, both regressor variables are USD-denominated external debt to total GDP and interest rate. Real GDP growth has a mean of 3.19 percent and standard deviation of 4.04 percent, reflecting modest average growth with significant cross-country as well as across-time variation. The range is broad –from large contractions of -21.40 percent to remarkably high expansions of 43.48 percent– encompassing global crises, recovery episodes and country specific shocks present in the sample.

Average government debt is 38.17 per cent of GDP with a high standard deviation of 42.02, indicating significant variations in fiscal situations among countries. the (negative) minimum value (-133.07 per cent) may correspond to periods in which there are large sovereign assets holding or statistical distortions; the maximum value is 357.23 per cent, suggesting very high public debt burdens for some countries. This dispersion suggests that the potential impact of debt on growth might vary widely across countries, which justifies the use of panel regression methods to account for such heterogeneity.

Interest rates exhibit a mean of 12.14 percent, with a standard deviation of 9.36, which suggests that monetary policy conditions vary significantly across countries and through time. The rate ranges from a minimum of just below 1% - usually present in low-inflation or easy monetary conditions to a maximum level of 67.08%, typical of extreme inflationary pressures and high risk financial environments. This wide range suggests that the interest rate-growth relationship could change depending on macroeconomic environments.

Bank risk taking averages 17.84 and the standard deviation is 10.00, suggesting a significant variation in bank sector behavior among various countries. The lower bound of 2.12 is the value for extremely conservative financial systems, and 66.27 is the upper bound representing times or

countries with extreme risk-taking profile. This heterogeneity indicates that bank behavior is not invariant across the sample and can have asymmetric effects on growth depending upon institutional quality and financial stability.

Collectively, the descriptive statistics suggest a high degree of variability in all of these variables across countries and time. Indeed, this heterogeneity explains why the use of a panel data structure is well suited to let our model have the freedom to take into consideration country-specific effects and dynamic adaptations. It also suggests that the links between real GDP growth and its determinants are unlikely to be contemporaneously constant across observations, which provide a rationale for the econometric investigation follow.

4.5 Panel Data Regression Results: Real GDP Growth

This section details the estimation of the pooled OLS, fixed effects, and random effects models. The objective is to analyze the impact of government debt, interest rate, and bank risk-taking on economic growth across the panel of countries. The models account for both cross-country and over-time variations, providing insights into the relationship between financial and macroeconomic factors and economic performance.

Table 5 (4.2 panel regression table)

Variable	**Pooled OLS (1)**	**Fixed Effects (2)**	**Random Effects (3)**
Government debt	-0.014*** (0.004)	-0.036*** (0.008)	-0.017*** (0.005)
Interest Rate	0.029* (0.016)	-0.0003 (0.029)	0.023 (0.019)

Bank Risk Taking	0.040*** (0.015)	0.008 (0.042)	0.039** (0.019)
Constant	2.733*** (0.377)	—	2.947*** (0.485)

Regression Results: Real GDP Growth Model Interpretation

The parameter estimations for the Real GDP Growth model show how fiscal, monetary and financial-sector variables explain economic performance in 34 countries in 2000–2021. Descriptive statistics indicate that the Real GDP Growth rate displays a far lower volatility (mean 3.18%, SD 4.04), in comparison to the independent variables, and particularly low are quite high for both of them (government debt and bank risk taking) there are not negligible differences between countries. This motivates the use of panel regression with country-specific fixed effects. For all three model specifications—Pooled OLS, Fixed Effects and Random—government debt enters with a negative and statistically significant coefficient, in accordance with the debt-overhang theory. Public debt seems to result in lower growth by crowding out productive investment and space in the fiscal budget; this effect is strongest under Fixed Effects −0.036 (this suggests that within country increases of debt over time are especially harmful for growth).

By contrast, interest rates present weaker and more ambiguous effects. While the Pooled OLS indicates marginally significant weakly positive association, coefficient loses significance and assumes near zero value under Fixed Effects and Random Effects. This implies that interest rates are related to growth across countries but do not have a powerful within-country explanatory influence beyond structural factors. Bank risk-taking has mixed effects: z is positive and significant under Pooled OLS and Random Effects, implying that risk-absorbing banking sectors

can facilitate credit flows and investment. But in the Fixed Effects model, it becomes small and insignificant, meaning that short run within a country fluctuations in risk-taking exert little effect on growth. On balance, our regression results underline that among the financial and monetary variables considered, public debt is the most robust and powerful factor influencing growth whereas these two dimensions exert policy–regime specific effects.

4.6 Model Statistics

The model statistics provide a summary of the estimated relationships between the independent variables—government debt, interest rate, and bank risk-taking—and the dependent variable, real GDP growth. These statistics offer insight into the overall fit, explanatory power, and significance of the models, helping to assess how well the selected variables capture variations in economic growth across the 34 countries over the period 2000–2021. Key measures such as R-squared, F-statistics, and robust standard errors are presented to evaluate both the reliability and robustness of the estimated coefficients.

Table 6 (4.3 model statistics table)

Statistic	**Pooled OLS (1)**	**Fixed Effects (2)**	**Random Effects (3)**
Observations	701	701	701
R^2	0.031	0.028	0.024
Adjusted R^2	0.026	-0.024	0.02
F / Chisq Statistic	7.319*** (df=3,697)	6.487*** (df=3,664)	17.571***

Model Statistics: Interpretation

The model statistics of the three specifications (Pooled OLS, Fixed Effects (FE), Random Effects (RE)) are informative regarding model fit, explanatory power and whether the regression is picking

up meaningful variation in Real GDP Growth. All specifications use 701 observations, so that I can compare across models. Although the R^2 values of both models are low, this is not uncommon for macroeconomic growth regressions that involve rates of economic growth which are highly volatile and driven by numerous unobservable. As for R^2 the Pooled OLS model explain more than the other models (0.031), followed by FE and RE models with 0.028 and 0.024 respectively. The decrease in R^2 when transitioning from FD to FE is small as we would expect, since FE gets rid of between-country variation and focuses only on within country changes over time which tend to be more difficult to explain. The not negative but also low adjusted R 2 in the FE model (–0.024) clearly demonstrates that, after including country-specific intercepts, explaining short-run growth fluctuations remains challenging.

The F-stats and Chi-square stats demonstrate that the models are still statistically significant despite their low R^2 value. For Pooled OLS, the F-statistic of 7.319* (df = 3, 697) demonstrates that all three predictors also have sufficient joint explanatory power (Government debt, Interest Rate, and Bank Risk-Taking). In the FE regression, the F-statistic of 6.487* (df=3, 664) also indicates that in-country variance in these variables does have predictive power for changes in Real GDP Growth at home. The Chi-square statistic for the Random Effects model of 17.571* validates that, in the RE specification, covariates collectively account for a statistically significant amount of variation in growth. While growth has noise embedded (as it should have), the joint significance test passed all three models indicative of included predictors are found valid.

The relative fit comparisons reveal substantial differences in how the different models accommodate variation. The FE model also exhibits slightly lower overall R^2 than its pooled regression counterparts, as it purges out solely time-varying explanatory power, and the country-

level heterogeneity which potentially inflates the fit of Pooled OLS and RE. Higher Adjusted R^2 in RE than FE (0.020 vs. –0.024) indicates that RE is picking up more between-country variation – which is what we would expect under the RE assumptions – but the FE-specific F-test and Hausman test you presented earlier indicate that FE is the econometrically appropriate model. Taken together, these model statistics show that macroeconomic growth regressions typically will have low R^2 values because the explanatory variables are only jointly significant and in your data, the FE model is the best choice for unbiased inference.

4.7 Model Selection – Hausman Test

The Hausman test is used to identify the most suitable panel data modeling that will be used in the analysis comparing the fixed effects (FE) and random effects (RE) estimators. It looks at the possibility of an association of the unobserved country specific effects with the explanatory variables. A significant test value shows that the fixed effects model should be used with high confidence of the unbiased coefficient estimates, and non-significant test value is a good indication to use the more efficient random effects model. This is important to pick a model that best reflects the effects of government debt, interest rate and bank risk taking on the economic growth in the chosen countries.

Table 7(4.4 Hausman Test table)

Test	Chi-sq	df	p-value	Conclusion
Hausman (FE vs RE)	8.684	3	0.034	Reject RE; FE preferred

Hausman Test: Choosing Between Fixed Effects and Random Effects Interpretation

The Hausman test gives formal statistical advice on whether to use the FE or RE estimator. It tests whether unobserved country-specific variables --such as institutional quality, governance structures, economic development levels or financial-system maturity-- are correlated with the model's explanatory factors. A large Hausman test, such as your case here ($\chi^2 = 8.684$, $p = 0.034$), suggests that the unobserved characteristics of a country are systematically related to Government debt interest rates or bank risk taking. The Random Effects estimator is inconsistent under such circumstances and the Fixed Effects model is preferred.

The Fixed Effects estimator adjusts for all time-invariant country characteristics so the coefficients represent actual within-country relationships, as opposed to artificial correlations that result from structural differences across countries. In view of the varied economic organization and financial systems in 34 countries that constitute your sample, the Hausman test result convincingly indicates that FE is more reliable and causally interpretable estimates. So your analysis correctly uses the Fixed Effects technique to understand how fiscal dynamics, monetary conditions, and financial sector behavior shape real GDP growth over time.

4.8 Panel Diagnostic and Specification Tests

This section shows the panel diagnostic tests and specification tests that are done to be able to prove the validity of the assumptions and the suitability of the econometric models that have been used in the current study. Some of the major issues that are tested in these tests include individual effects, random effects, serial correlation, heteroskedasticity and cross sectional dependence in the panel dataset. Through these diagnostics, the study can be sure that the chosen models will give a reliable and impartial estimate of the effect of government debt, interest rates, and the bank taking

of risks on economic growth. The findings inform the decision-making of pooled OLS, fixed effects, and random effects model, in order to have a robust inference and model adequacy.

Table 8(4.5 Panel Diagnostic and Specification Tests table)

Test / Model	**Statistic**	**df**	**p-value**	**Conclusion**
1. F-test: Fixed Effects vs Pooled OLS	F = 2.073	df1 = 33, df2 = 664	0.00047	Individual effects significant → FE preferred
2. Breusch-Pagan LM Test (Random Effects)	$\chi^2 = 9.004$	df = 1	0.0027	Random effects present
3. Serial Correlation (Wooldridge Test)	$\chi^2 = 80.499$	df = 17	3.13E-10	Serial correlation present
4. Heteroskedasticity (Breusch-Pagan Test)	BP = 2.232	df = 3	0.526	Homoskedasticity cannot be rejected
5. Cross-sectional Dependence (Pesaran CD Test)	z = 33.487	—	< 2.2e-16	Cross-sectional dependence present

Interpretation of F-test for Intercepts vs. Pooled OLS

The F-test tests whether country-specific intercepts are jointly equal, which would justify a pooled OLS model where all countries have the same base level of GDP growth. The test statistic (F = 2.073, p = 0.00047) rejects this assumption once tested at the 1% level, suggesting that there is statistically significant unobserved heterogeneity among the 34 countries. This suggests that every country has time-invariant attributes, such as deep economic structure, institutional quality, demographic cycles, and long-run policy regimes influencing systematically the GDP growth. If you omit such fixed factors, pooled OLS generates omitted-variable bias due

to their correlation with your regressors (debt, interest rate, and bank risk taking). Hence, the F-test strongly supports the implementation of a Fixed Effects (FE) model where this country specific effect can be removed by including an own intercept for each country.

Random Effects Interpretation of Breusch–Pagan LM Test

The Breusch-Pagan LM test evaluates the pooled OLS model against the RE alternative by testing for lack of variance in the unobserved country-specific random effect. One of the most important statistics for this table ($\chi^2 = 9.004$, $p = 0.0027$) indicates that there is non-zero variance in the panel structure both across countries (observations are not independent), and pooled OLS would be inappropriate. This evidence suggests that the error structure involves country-specific shocks affecting GDP growth. These random terms subsume unobserved factors like macroeconomic style of management, international exposure in markets or business cycles driven policy differences. Although the LM test tests for random effects, it does not provide information about whether or not RE is valid; rather, it informs only that the panel model should not reduce to pooled OLS. We have FE vs RE and we opt to use the Hausman rather than LM test.

Interpretation of the Wooldridge Test for Serial Correlation

The Wooldridge test is applied to detect the first order autocorrelation for all countries' time series. Your result is ridiculously high ($\chi^2 = 80.499$, $p \approx 3.1\times10^{-10}$), suggesting a strong serial correlation in your panel data. This is not unusual in macroeconomic data where economic shocks and policy responses have long-lasting effects over the long-run. Serial correlation will not be reflected as a bias in your coefficient estimates of FE or RE, but it is going to bias

standard errors down too much causing inflated ts and significance levels that are too good. This implies that the usual FE/RE estimate is inconsistent unless adjusted. Serial correlation also suggests that countries face persistent business cycles dynamics, so this data has time-varying error structures. Accordingly, standard inference is invalid unless one relies on clustered, Newey–West or even better, Driscoll–Kraay standard errors that correct for both autocorrelation and cross-country dependence.

Breusch–Pagan Test for Heteroskedasticity Interpretation

The Breusch-Pagan heteroskedasticity test gives a statistic of 2.232 with $p = 0.526$, implying that the null hypothesis of homoskedasticity cannot be rejected. As opposed to many cross-country panels, I do not find your model as featuring detectable across-unit residual variance differences. In theory, this provides the ability to employ classical standard errors and need not be concerned with inconsistent variance. But this result is of more limited interest in practice, because the dataset already violated strandentiedendigerere assumptions — that is, serial correlation and cross-sectional dependence. These violations by themselves make classical standard errors meaningless whatever the outcome of a test for heteroscedasticity. So the data would appear homoskedastic, but even then we still need robust techniques from the modern era in order to do reliable inference.

Explanation of Pesaran CD Test for Cross-Sectional Dependence

The Pesaran CD statistic ($z = 33.487$, $p < 2.2\times10^{-16}$) shows that countries are very highly cross-sectionally dependent of each other. This makes the error terms across countries highly correlated, whenever shocks that hit one economy spread through trade, financial flows,

commodity prices or synchronized policy impulses. This type of dependence is particularly likely to occur with macroeconomic panels on global crises, interest-rate cycles-demand and cross-section-correlation spill-over-effects across borders. Cross-sectional dependence is a severe econometric violation because it makes ordinary FE/RE standard errors (even the heteroskedasticity-robust and cluster-robust variety) invalid. That is why the model needs Driscoll–Kraay standard errors, that correct for heteroskedasticity, serial correlation and cross-country correlation jointly. Failure to account for cross section dependence would result in over-rejection of the significance of coefficients and strong biasedness.

Chapter 5 Discussion

The empirical evidence shows that among the 34 countries from the period 2000–2021 the government debt and bank risk-taking have a significant effect on economic growth. Real GDP growth averages 3.18%, with high variability with respect to GDP growth (−21.40% to 43.48%), reflecting a series of global crises (e.g., 2008 financial crisis, COVID-19 pandemic, …). Government debt and bank risk-taking, the independent variables—also exhibit large heterogeneity signaling that country-specific fiscal and financial conditions are widely disparate and are likely to condition growth outcomes. The idea of comparing similar countries to better understand effects while controlling for variety among those countries — unobserved heterogeneity — is well established in econometrics, and the panel regression approach, and in particular the Fixed Effects model, is well equipped to handle that approach, in system isolates the within country effects of these factors together with those from fiscal and banking sector variables on economic growth.

5.1 Borrowing by Governments on Economic Growth

The regression results indicate that GOV_DEBT exerts a negative and statistically significant effect on real GDP growth. In the Fixed Effects model, the coefficient of –0.036 suggests that a country increase of public debt over time decreases its economic growth. This agrees with the debt-overhang argument that high level of debt by government vanishes productive private investment, limits fiscal space for developmental project of necessity and increases susceptibility to macroeconomic shocks.

The descriptive statistics also show a large variation in debt from -133.07% to 357.23% of GDP. This wide variation indicates heavy fiscal pressures on some countries and relatively low on others, resulting in heterogeneous effects on growth. The histogram and scatterplot analyses further indicate that low growth regimes tend to be associated with higher levels of debt, which supports the view that excessive debt will eventually become a binding constraint on growth when misused.

These findings conform to the literature. Shi, Song, and Ramzan (2025) highlight the fact that government debt is only growth-inducing if the institutional quality is sufficiently high, which permits appropriate allocation of resources to productive public investments. In the contexts of weak governance, misallocation, corruption, and debt overhang convert public borrowing into a growth-impeding element. Likewise, government debt continually lowers economic growth in both the short and long run, crowding out private investment, having adverse fiscal consequences as well as raising the risk of macroeconomic instability in Asian economies (Asteriou, Pilbeam, Pratiwi, 2021). In aggregate, these findings speak to the need not only for effective debt management, but for strong institutional frameworks, to help limit the negative consequences of public debt on growth.

5.2 Bank risk-taking and long-run Economic growth

They find out that Bank risk-taking has a positive and significant impact on economic growth in both the Pooled OLS and Random Effects models. In other words, it means that nations where the

banking sector participates in careful risk-taking see greater GDP growth. This concept relates to the way banks are able to optimize their allocation of credit toward more productive investments and thus, contribute to the process of capital accumulation, entrepreneurship and sustainable growth in the long run.

The descriptive statistics reveal wide variation in the bank Z-score (2.12–66.27), reflecting differing banking sector stability and risk appetite across the world. A comparison of growth outcomes for countries exhibiting a high probability of banking system default (as proxied by the Z-score) vs those exhibiting a low probability scatterplot analyses This result is consistent with evidence from Bayar, Borozan, and Gavriletea (2021), who claim that stable banks contribute to economic development by lowering financial ambiguity, thereby increasing long-term investment incentives and by ensuring credit provision to the real economy. Likewise, Stewart and Chowdhury (2021) identify that ample liquidity and regulatory capital improve banks resilience by allowing them to absorb shocks, continuing to provide credit over crises and reassuring investors which foster strength in the economy.

It indicates that a stronger economy can lead to greater motivation for banks to take on additional risk to grow, revealing the positive linkage between bank risk-taking and bank growth. Well governed banks that balance risk and stability can support also macroeconomic growth through task financing for the private sector, cycling smoothing, compensating for excessive risk taking or run away of private sector agents, as well as by reducing the negative effects of economic shocks. In contrast, countries with undercapitalized or very conservative banking systems may fail to extend enough credit and essentially stifle growth potential. These findings point toward the

idea that banking sector behavior is an important structural determinant of macroeconomic outcomes.

5.3 Interest Rates & Economic Growth

The effect of interest rates is rather weak and inconsistent across the models. Pooled OLS indicates a slight positive effect, while FE and RE coefficients are close to zero and not statistically significant. A near-zero correlation (0.07) and a flat line in the scatterplot suggest that movements in interest rates and GDP growth have a mutually reinforcing, but not truly causal, relationship.

This is consistent with theoretical and empirical literature. According to Adabor (2022), lower lending rates also provide an incentive for greater growth by facilitating higher firm borrowing, household consumption, and credit to sectors of production. By contrast, high real interest rates stifle growth by disincentive domestic and foreign investment, slowdown human capital accumulation, increase production costs, and produce a credit squeeze (Shaukat, Zhu and Khan (2019)). The heterogeneity of the effects of interest rates that you discover in a multi-country setting is probably driven by the macroeconomic setting, the quality of institutions, and the transmission of monetary policy. The weak correlation might also suggest that interest rates alone cannot fully explain annual growth which is usually a result of several factors taking effect at the same time.

In summary, the findings support the view that the quality of fiscal and financial management conditions economic growth. The greater the government debt, the slower growth but only when that debt is poorly managed or institutional weak and good banks that takes sensible risk appears

to boost growth. These empirical patterns are in line with Shi, Song and Ramzan (2025), Asteriou et al. (2021), Bayar et al. (2021), and Stewart & Chowdhury (2021), then this means growth cannot be explained by aggregate debt or balance sheet behaviour alone, but rather by an institutional and regulatory context which explains how these factors operate to influence the growth process. The panel framework used in this work captures these conditional effects well and it emphasizes the importance of this conditionality of policy and stability of the financial sector for macroeconomic development

Chapter 6 Conclusion

This research aimed at investigating the factors of economic growth in 34 countries over the period from 2000 to 2021, emphasizing three main determinants: government debt, bank's risk-taking and interest rates. According to the results of the study, it emerges clearly that government debt adversely affects economic growth because it may increase the probability of risk from borrowing too much. Heavy debt burdens crowd out fiscal space, curtail public investment in infrastructure, education and health, and make the economy more susceptible to external shocks. Banking sector risk taking, however, has a modest positive impact on growth, indicating that highly strategic and policy-regulated levels of risk taking will increase the allocation of credit to industry sectors, support entrepreneurial efforts, and fuel an expansion in the private sector. Interest rates were not statistically significant, indicating that the short-run impact on growth could be negligible for these countries and the period although they could still indirectly influence growth through investment decision and consumer behavior. The results underline the balanced role of fiscal, and financial, monetary policy on economic growth which confirm the necessity of prudent macroeconomic policy to achieve sustainable positive GDP.

6.1 Policy and Practical Implications

The policy implications of this study are great, especially on the part of government, central bank and international organization for development etc. For public governments, the costs of high public debt is a reminder to stay fiscally prudent. Policy maker’s key focus should be given to Debt sustainability through sound macro and fiscal framework, enhanced revenue selection mechanism, borrowing in the most effective way which finances high return projects/priority

rather than financing recurrent expenditures. Debt restructurings, including for highly indebted developing countries, can help on the road back to fiscal sustainability and ultimately lower the risk of debt crises. As a plus, investment in productive areas such as infrastructure, research and development, and human capital can increase economic growth over the long run (as well as dampen some of the debt effects). And countries might want to consider creating sovereign wealth funds or some type of stabilizing mechanisms that can protect their economies from cyclical shocks and fluctuations in commodity prices, which have historically damaged areas like Sub-Saharan Africa and the Middle East.

The positive relationship between bank risk-taking and growth similarly conveys that safe, well-regulated risk taking in credit markets can also be an important engine of growth for the banking sector. Regulators must make every effort to ensure that banks should be encouraged to provide sufficient credit to the productive sectors and more so SMEs without undermining stability of the system. Risk- sensitive capital requirements, minimum liquidity ratios and scrutiny of the quality of bank assets can help manage this tension between growth incentives and careful use of leverage. In countries with poorly-developed financial systems, credit should be more accessible and there needs to be improved financial inclusion so as to raise investment and foster entrepreneurship. This is even more pertinent in South Asia and Sub-Saharan Africa where external credit constraints have traditionally stymied growth of private sector.

The implications are not only academic, but also influence the policy making in financial institutions, the behavior of investors and that of businesses. For banks and financial firms, the gains from measured risk-taking can help inform lending standards, credit assessment, and portfolio behavior. Firms can use information on the limited short-run effects of interest rates to

better think about their investments, targeting stable funding sources instead of reacting to short-term policy rate changes. For international institutions and development partners, the study underscores that complementary fiscal, monetary, and financial actions are needed to stabilize economies during crises as represented by the 2008–2009 Global Financial Crisis or COVID-19. Development strategies can also focus on increasing the preventability of financial sector supervisions, debt management policies and financial education aimed at sustainable growth especially in regions susceptible to external shocks/endemic economic instability. The fact that well-coordinated fiscal and financial policies not only stabilize growth, but also increase the resilience and inclusivity of an economy.

In addition the study raises sector-specific and regional aspects for policy. For example, South Asia's experience demonstrates that countries with large domestic markets, such as India and Bangladesh, are better equipped to absorb external shocks than smaller economies. Country-specific policies that address infrastructure quality in low-income countries or diversification of commodity-dependent economies can complement the effectiveness of macroeconomic intervention. Similarly, studies for Europe and Central Asia suggest that productivity improvements and labor-market reforms are key to ensuring growth in advanced economies where populations are getting older.

6.2 Limitations of this study

despite its contributions, this study suffers from several limitations that merit close scrutiny. Although the original IMF and World Bank data set included 195 countries from 2000 to 2024,

missing data reduced the sample size to an effective 2000-21 sample of 34 countries. This may have eliminated relevant national distinctions, particularly ass it affects the testing-generalizability of findings for low-income countries and small island countries. We examine only three independent variables: government debt bank risk-taking and interest rates. Other important determinants of economic growth such as trade openness governance quality technological development and human talent are omitted from our analysis. These variables might themselves affect growth outcomes and interact with the included ones causing estimates of regression coefficients to be biased. While panel regression techniques (fixed and random effects) control for unobserved heterogeneity, issues such as serial correlation, cross-sectional dependence, and endogeneity may still impact how far the results can be generalized. Furthermore, the study suffers chronologically. The period 2000-21, observed in its conclusions of a global financial crisis and a covid pandemic, has not yet lived through the more recent global crises of political turbulence and climate shocks, nor the coming fiscal-monetary tightening post-pandemic. Nor does the analysis acknowledge that various institutional contexts can make a difference in the effectiveness of policies: a high level of public debt might be more bearable in countries with stable fiscal institutions rather than those having weak governance. Finally Measurement of variables such as bank risk-taking in this study is limited by the availability of data and methodological constraints, thereby potentially making estimates less precise and cross-country comparisons less reliable.

6.3 Knowledge gap

The three independent variables yield several knowledge gaps. For government debt, more work needs to be done in order to delineate the threshold beyond which debt restraints growth and how such thresholds differ in economies with varying institutional capacities, fiscal rules and economic

structures. Something we know very little about today is the dynamics of composition: how much debt is domestic as opposed to foreign, how long it takes can largely remain unclear. little is understood about the precise mechanisms via which behavior in the financial sector affects economic growth; thus an understanding of what forms these mechanisms may take remains to be achieved. In particular questions about banking ownership, the scope of regulation and innovation in finance are not fully answered. Nor is more empirically on risk-taking of a non-linear way needed: it may be that moderate risks promote growth while excessive ones trigger instability. Although statistically not significant in this study, interest rates probably exert an indirect influence on Gross Domestic Product through investment production and people's expectations of future living conditions True is now needed to discover under what circumstances interest rates have a significant impact on growth -and how this impact is altered by the level of development credit markets, credibility of authority in monetary schemes or macroeconomic shocks. Furthermore, Those countries in advanced stages of low or negative interest rates, in the world context of today, may hide the true impacts of monetary policy on growth Understanding such complex channels is essential for the design of efficient policies that could foster long-term economic growth.

6.4 Future Research

In future research, we hope to overcome the limits and knowledge gaps our study identified. Expanding both the temporal and country coverage might assist in generalizing and incorporating recent effects following the pandemic, geopolitical, and climate-related shocks. It could take complex relationships, indirect effects and interactions between variables into account. This is the great advantage of fitting dynamic panel models or threshold regressions and doing nonlinear

analyses. Adding More Explanatory Variables It would enrich the industrial growth model. This economic understanding can encompass trade openness, governance metrics, technological progress, human capital investment and environmental factors. Comparative or regional analyses would reveal local patterns, enabling the government to fashion distinctive interventions. For example, the effects of debt on growth might be different in rich resource economies than in poor resource ones; also risk-taking by banks could have dissimilar consequences with different financial system levels of sophistication. Three and future research could look at sectoral and structural changes, such as digitization, green investment and technological adoption, which are beginning to change the roadmap of economic development. Integrating case studies or adopting multiple methods may uncover the micro-level mechanisms whereby fiscal and financial variables affect growth. Moreover, cross-disciplinary study which brings together economics, finance and policy studies can provide real, practical guidelines for sustainable, inclusive development. Conclusions Future research should also take account of policy simulation and scenario analysis, so as to gauge how different fiscal, monetary and financing strategies stand up under diverse economic circumstances. This would not only broaden academic understanding but further provide practical advice for governments as well as financial institutions and international organizations seeking to maintain financial stability, foster growth, and build resiliency against system-wide shocks.

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Appendix

Appendix A

The data utilized in this paper is a compilation of various credible sources such as the international monetary fund (IMF) and the world bank group. It has panel data of 34 countries between the years 2000-2021. The variables that are used in the analysis in the dataset are the following:

File Name: (project_eco_final_v.4.2.csv)

Variable	Description	Unit/Measure
Real GDP Growth	Annual percentage change in GDP	%
Government Debt	Government debt – net debt, general government	% of GDP
Interest Rate	Lending interest rate	%
Bank Risk-Taking	Bank Z-score, indicating the probability of default	Dimensionless

The excel sheet brings together all the country-specific data into one organized sheet whereby each row corresponds to a distinct country-year. The absence of data was tackled by narrowing the sample to 34 countries whose data on all variables was available between the year 2000 to 2021.

It is on the basis of this dataset that the analysis of panel data in RStudio takes place, in which it was imported, cleaned and converted into a panel data frame to run pooled OLS, fixed effects, and random effects regressions. The entire Excel is given to facilitate the replication and verification of the empirical findings in this study.

Appendix B

All the commands and procedures are captured in the R script file, World Bank R Script.R, in order to process, analyze and model the panel data in this study. It involves data cleansing, descriptive statistics, visualization, correlation, and panel regression modelling (Pooled OLS, Fixed Effects, and Random Effects). They also include strong standard errors and diagnostic tests like Hausman test to guarantee reliability of the findings. The script is related to the dataset project_eco final v.4.2.csv and can be run in RStudio to recreate all the analyses and figures in the thesis. The script is a reproducible document of the entire econometric process and helps in transparency and validation of the research results.

File Name: (World_Bank_R_Script.R)

The following R script was used to clean, process, visualize, and model the panel data for the research study titled “Effect of Government Debt, Interest Rate, and Bank Risk-Taking on Economic Growth.” This script corresponds to all data analysis steps, including descriptive statistics, correlation analysis, and panel regression modeling.

```
# Load necessary packages

install.packages(c("tidyverse","plm","lmtest","sandwich","stargazer","car","tseries","ggplot2","corrplot","psych"))


library(tidyverse)

library(plm)

library(lmtest)
```

```
library(sandwich)

library(stargazer)

library(car)

library(corrplot)

library(psych)# Import data

data <- read.csv("project_eco_final_v.4.2.csv", stringsAsFactors =FALSE)# Select relevant columns and remove missing dependent variable

data <- data %>%

  select(country, year, gdp_debt, interest_rate, bank_risk_taking, real_gdp_growth)%>%

  filter(!is.na(real_gdp_growth))# Convert to panel data

pdata <- pdata.frame(data, index =c("country","year"))# Summary statistics

summary(data[,c("gdp_debt","interest_rate","bank_risk_taking","real_gdp_growth")])

desc_stats <- describe(data[,c("gdp_debt","interest_rate","bank_risk_taking","real_gdp_growth")])

print(desc_stats)# Missing data summary

missing_summary <- data %>%

  summarise(

    gdp_debt_missing =sum(is.na(gdp_debt)),
```

```
    interest_rate_missing =sum(is.na(interest_rate)),
    bank_risk_missing =sum(is.na(bank_risk_taking)),
    growth_missing =sum(is.na(real_gdp_growth)),
    total_obs = n())
print(missing_summary)# Visualization - Histogram of GDP growth
ggplot(data, aes(x = real_gdp_growth))+
  geom_histogram(bins =30, fill ="steelblue", alpha =0.7)+
  labs(title ="Distribution of Real GDP Growth", x ="Real GDP Growth (%)", y ="Frequency")+
  theme_minimal()# Correlation matrix
cor_data <- data %>%
  select(gdp_debt, interest_rate, bank_risk_taking, real_gdp_growth)%>%
  na.omit()
cor_matrix <- cor(cor_data)
corrplot(cor_matrix, method ="color", type ="upper", addCoef.col ="black", tl.col ="black", tl.srt
=45,
         title ="Correlation Matrix of Variables")# Panel regression models# Pooled OLS
model_pooled <- plm(real_gdp_growth ~ gdp_debt + interest_rate + bank_risk_taking,
                    data = pdata, model ="pooling")# Fixed Effects
```

```
model_fe <- plm(real_gdp_growth ~ gdp_debt + interest_rate + bank_risk_taking,
                data = pdata, model ="within")# Random Effects
model_re <- plm(real_gdp_growth ~ gdp_debt + interest_rate + bank_risk_taking,
                data = pdata, model ="random")# Robust standard errors
coeftest(model_fe, vcov = vcovHC(model_fe, type ="HC1", cluster ="group"))
coeftest(model_re, vcov = vcovHC(model_re, type ="HC1", cluster ="group"))# Hausman test
phtest(model_fe, model_re)# Regression table
stargazer(model_pooled, model_fe, model_re, type ="text",
          title ="Panel Data Regression Results",
          dep.var.labels ="Real GDP Growth",
          covariate.labels =c("GDP Debt","Interest Rate","Bank Risk Taking"),
          digits =3, out =NULL)
```