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Currency Crosscurrents: Nominal Exchange Rate and US Economic Growth (1960-2024)

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ABSTRACT: This research delves into the intricate relationship between nominal exchange rate and US GDP growth from 1960 to 2024. This study establishes a comprehensive analytical foundation through the lens of key theoretical frameworks, including the Marshall-Lerner condition, the Balassa-Samuelson hypothesis, and the monetary policy transmission mechanism. Rigorous pre-estimation tests and the Autoregressive Distributed Lag (ARDL) model reveal that exchange rates have a substantial long-term positive impact on GDP growth, validating concepts such as import substitution and the J-curve effect. Conversely, inflation emerges as a significant detriment to GDP growth, while interest rates and imports show positive short-term effects, driven by factors like enhanced investment, consumption, and technological advancements. Debt is identified as harming GDP growth in both short and long-term horizons and the model's high explanatory power, accounting for 81.62% of the variation in US GDP growth, underscores the profound linkage between exchange rate management and economic stability. Additionally, this study identifies key policy implications for the Federal Reserve and the U.S. Treasury, effective inflation control through monetary tools, proactive exchange rate management via forward guidance and interventions, and fiscal responsibility, including supply-side reforms and coordinated fiscal policies, are paramount.

1. INTRODUCTION

The importance of international finance and currency rates in influencing economic activity has increased due to the growing interconnectedness of the world's economies. Interconnected financial markets, investment flows, and cross-border trades are becoming essential components of the contemporary economic environment. (Obstfeld, 2019)Exchange rates and the relative values of currencies make these worldwide transactions possible. They impact the value of foreign assets and liabilities, the competitiveness of imports and exports, and the cross-border transmission of economic shocks. Therefore, to navigate the global economy's intricacies, politicians, corporations, and investors must have a thorough grasp of exchange rate fluctuations and how they affect economic performance.

Exchange rate tides may significantly impact several facets of economic performance. For example, a country's exports may become more affordable, and its imports may become more costly if its currency depreciates, increasing export competitiveness and improving the trade balance (Ghosh et al., 2014). On the other hand, appreciation may have the opposite impact, because investors weigh the relative returns on investments in various currencies. Additionally, firms involved in international trade may experience uncertainty due to exchange rate fluctuation, which might affect investment choices and the stability of the economy. To fully comprehend the complicated interactions between exchange rates and macroeconomic factors, a thorough examination is required.

Being the largest economy in the world, the US is especially vulnerable to the effects of fluctuations in exchange rates because of its close ties to the global financial system. The significance of comprehending the fluctuations of the US dollar's exchange rate is further enhanced by its status as the global reserve currency. Recent research has demonstrated the intricate connection between the value of the dollar and several US economic factors, including trade, inflation, and financial circumstances. (Clarida, 2021). Meanwhile, this study focuses on the long-term relationship between exchange rates and US economic growth from 1960 to 2024.

It aims to add to the body of literature by thoroughly examining this important economic relationship during a profound global financial and economic change.

1.1. Historical Overview of International Monetary Systems (1960- 2024)

Between 1960 and 2024, the international monetary system underwent a significant transformation, moving from the Bretton Woods era's quasi-fixed exchange rates to a mostly floating regime. Under the dollar-gold standard, exchange rates were relatively stable in the early 1960s. Still, systemic forces, such as imbalances in the US balance of payments, led to the system's collapse in the early 1970s. This shift signaled the emergence of floating exchange rates and increased exchange rate volatility, which was made worse by circumstances such as the oil crisis. Growing financial integration and the US dollar's continued supremacy as a reserve currency, notwithstanding sporadic volatility and difficulties, were hallmarks of the following decades (Eichengreen, 2008).

1.1.1. The Legacy of Bretton Woods and Early Stability of the pre-1960s

The Bretton Woods Agreement of 1944 influenced the post-World War II international monetary system by tying member currencies to the US dollar, which was convertible to gold at a set price of $35 per ounce and this system produced a fixed exchange rate regime. After the war's interruptions, this agreement sought to restore global investment and commerce stability. The US was a key player in this system because of its robust economy and substantial gold holdings. As the global reserve currency, the dollar made it easier to conduct and hold foreign transactions (Obstfeld & Rogoff, 1995).

1.1.2. Increasing Strains and Eurodollar Market (1960s)

Even while Bretton Woods was initially successful, in the 1960s, underlying tensions started to show. A large amount of US dollars left the country because of the rising need for them to fund expanding international commerce and investment. Although this outflow increased global liquidity, it also sparked worries about the US's capacity to keep the dollar's gold convertibility. The issue was made more complex by the rise of the Eurodollar market, which allowed US dollars to be exchanged outside of the direct jurisdiction of US authorities. This market also helped to increase global capital flows and liquidity (McCauley & Schenk, 2020)

1.1.3. The Smithsonian Agreement and the Fall of Bretton Woods (Early 1970s)

The Bretton Woods system was under too much strain by the late 1960s and early 1970s. Confidence in the currency was damaged by rising US inflation and ongoing balance of payments deficits. As dollar speculation grew more intense, significant gold withdrawals from US reserves occurred. The Bretton Woods era came to an end in August 1971 when President Nixon declared that the dollar would no longer be convertible into gold. With a modest dollar devaluation and a slight expansion of exchange rate bands, the following Smithsonian Agreement in December 1971 sought to preserve the fixed exchange rate system, although this was only a short-term solution (Humpage, 2010).

1.1.4. The Floating Exchange Rates and Rise of Volatility (The mid-1970s to 1980s)

In the middle of the 1970s, major currencies started to fluctuate against one another when the Smithsonian Agreement failed. An era of increased exchange rate volatility was ushered in by this momentous upheaval in the global monetary system. The 1970s oil crisis made exchange rate swings even worse and added to the instability of the world economy. During this time, the value of the dollar fluctuated significantly, which affected inflation and the competitiveness of US commerce (Obstfeld, 1985).

1.1.5. Increased Financial Integration and the Strengthening of the Dollar (1990s to 2000s)

Global financial integration increased dramatically in the late 20th and early 21st centuries, as evidenced by the rise of sophisticated financial markets and significant cross-border capital flows. As the world's reserve currency, the US dollar remained dominant, and its value was impacted by several variables, including interest rate differences, global risk perception, and US economic performance. The value of the dollar and international financial markets were significantly impacted by the dot-com boom of the late 1990s and the global financial crisis that followed in 2008 (Garber, 1993).

1.1.6. The Post-Financial Crisis Era and the Dollar's Continued Dominance (2010s to 2024)

The dollar's reputation as a safe-haven currency was further cemented by the 2008 global financial crisis and its aftermath. Investors often gravitate toward the dollar during times of uncertainty in the world economy, which raises its demand and value. The dollar still plays a major role in international trade, banking, and reserve holdings, despite debates over alternative currencies' capacity to threaten its hegemony. The significance of the dollar in the global financial system was further highlighted by the recent COVID-19 outbreak and the ensuing worldwide economic upheavals (Federal Reserve History, 2010).

1.2. Theoretical Framework

1.2.1. Theories establishing relationship

1.2.1.1. The Balassa-Samuelson Hypothesis:

The Balassa-Samuelson hypothesis provides an essential lens through which to comprehend long-run price level differences among nations and their possible impact on exchange rate dynamics. According to this

theory, which was independently put out by Balassa (1964) and Samuelson (1964), systematic fluctuations in price levels may be explained by variations in productivity development across tradable and non-tradable industries between countries (Balassa & Samuelson, 1964).

The contrast between tradable (i.e., readily sold worldwide, like manufactured commodities) and non-tradable (i.e., services like haircuts or local transportation, which face considerable impediments to international commerce) items lies at the heart of the Balassa-Samuelson effect. According to the idea, international rivalry and the spread of technology cause productivity growth in the tradable sector to tend toward convergence across nations. On the other hand, there should be more cross-country variance in productivity growth in the non-tradable sector.

Importantly, the theory contends that, in contrast to impoverished nations, wealthier nations generally see faster productivity development in their tradable industries. In wealthier nations, this increased productivity results in greater salaries in the tradable sector. In these wealthier countries, salaries in the non-tradable sector are also driven upward due to labor mobility within national economies. However, the prices of non-tradable items are higher in wealthier nations because productivity improvements in the non-tradable sector do not always keep up with those in the tradable sector. In wealthier economies, the price difference in non-tradable raises the general level of prices.

A simple mathematical explanation of this theory can be calculated for both versions of domestic and foreign levels which are as follows:

$\Delta P^{NT} - \Delta P^{T} = \Delta A^{T} - \Delta A^{NT}$ (Domestic Version)……..……..(1)

ΔP^{NT} – changes in the price of non-tradable goods

ΔP^{T} – changes in the price of tradeable goods

ΔA^{T} – changes in the productivity of tradable goods

ΔA^{NT}- changes in the productivity of non-tradable goods

$$\Delta P - \Delta P^{*} = \Delta E + (1-A)(\Delta A^{T} - \Delta A^{NT}) - (1-A^{*})(\Delta A^{*T} - \Delta A^{*NT}) \quad \ldots\ldots\ldots\ldots\ldots(2)$$

ΔP – changes in the price of combined tradable and non-tradeable goods in one country

ΔP^{*} - changes in the price (T+NT) goods in second country (*)

ΔE – changes in the exchange rate among both countries

This equation simplifies the complexity of determining exchange rates among different nations addressing the price of tradable and non-tradable goods:

$$\Delta E = \Delta P - (1-A)(\Delta A^{T} - \Delta A^{NT}) - \Delta P^{*} + (1-A^{*})(\Delta A^{*T} - \Delta A^{*NT}) \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

To conclude, if a nation's tradable sector's stronger productivity growth results in higher salaries in that industry, prices for non-tradable products and services rise because of these increased earnings in the non-tradable sector. Furthermore, the nominal exchange rate of the nation must increase (the currency gets stronger) to preserve purchasing power parity (PPP). As a result, nations with higher GDP growth rates due to the productivity of their tradable sectors typically see rising real and nominal exchange rates, which affects their ability to compete in international trades and may influence future economic growth.

1.2.1.2. The Marshall-Lerner Condition:

The Marshall-Lerner condition, which looks at the link between exchange rates and economic growth, is essential to comprehend how exchange rate changes affect a nation's trade balance. A fundamental tenet of international trade theory, this condition outlines the prerequisites for a country's currency to depreciate (or devalue) to improve its trade balance. This condition depicts that depreciation will improve the trade balance only if the price elasticity of demand for both imports and exports is greater than one which is a condition, that is why it has been named as ML condition rather than hypothesis (Lerner, 1944).

Theoretical foundations of the connection between changes in the exchange rate and adjustments to the trade balance are rooted in the work of several influential economists, although Abba Lerner was the one who formally articulated what is now known as the Marshall-Lerner condition. Meanwhile, Alfred Marshall's foundational contributions to the concept of elasticity in the late 19th and early 20th centuries provided the essential framework for understanding how price changes influence quantities demanded (Marshall, 1944).

A simple mathematical equation can be formed as:

$|PED^{Export}| + |PED^{Imports}| > 1$……(4)

$|PED^{Export}| + |PED^{Imports}| < 1$……(5)

$|PED^{Export}| + |PED^{Imports}| = 1$……(6)

If the combined price elasticity of demand for exports and imports exceeds one, depreciation enhances the trade balance, positively affecting economic growth. Conversely, if this combined elasticity is less than one, depreciation deteriorates the trade balance. Finally, if the sum of these elasticities equals one, depreciation does not affect the trade balance and economic growth.

1.2.1.3. The Monetary Policy Transition Mechanism

Understanding the monetary policy transmission mechanism in the context of this study requires tracing how central bank activities affect macroeconomic variables, specifically the exchange rate which in turn affects economic growth. The exchange rate channel of monetary policy transmission has become especially significant due to the transition from the Bretton Woods system to floating exchange rates. This study will look at how the dollar's value has changed because of US monetary policy changes, such as interest rate adjustments, and how these exchange rate movements have influenced US trade, investment, and overall economic performance (Mishkin, 1995).

The Monetary Policy Transition Mechanism works through several means of impact. When interest rates are lowered, borrowing costs decrease for businesses and consumers, which in turn boosts consumption and causes high aggregate demand while increasing interest rates works oppositely. Lower interest rates increasingly attract foreign investors and lead to capital outflows causing depreciation of the domestic currency. Meanwhile, the valued currency means expensive imports and a competitive level of exports which boosts net exports affecting economic growth positively. Conversely, higher interest rates cause capital inflows, leading to an increased valuation of dollars and potentially decreasing net exports (Taylor,1993).

The Mechanism includes several complex facets. As for the study in hand, two important aspects construct the idea behind dependence on this mechanism to form a comprehensive model and relationship equation among indicators in this study.

- The IS-LM model: The IS-LM model provides a straightforward but practical framework for comprehending how exchange rates, monetary policy, and US economic growth interact in the short term. The model demonstrates how monetary policy impacts the LM curve and in turn, influences exchange rates can have a ripple effect on aggregate demand and output by including net exports (NX) as a function of the exchange rate (e) within the IS curve. Meanwhile, the LM curve projects a state of equilibrium concerning the interest rates and output levels, which is highly essential to capture while observing the functionality of exchange rates to increase GDP growth. As factors directly involved in this study, this model provides an essential framework to create a sound model.

  Y = C(Y-T) + I(r) + G + NX (e) – IS Curve……..(7)

  Y (GDP output) depends on the function of consumption [C, disposable income (Y-T)], Investments based on the Interest rate functionality I(r), Government spending, and Net exports based on exchange rates functionality.

  M/P = L(r, Y) – LM Curve...……..(8)

  Money supply over price depends on the amount of money demand based on the interest rate and output functionality.

- The Taylor Rule: as it explicitly combines monetary policy actions with macroeconomic circumstances, which in turn affect exchange rates, this rule is extremely pertinent to this study. For example, according to the Taylor Rule, the central bank will raise interest rates if inflation surpasses its objective, and this increase in interest rates may subsequently have an impact on the exchange rate and cause the US dollar to appreciate which in turn impacts net exports and eventually influencing US economic growth.

  $I = \pi + r^* + \alpha(\pi-\pi^*) + \beta(y-y^*)$……..(9)

  I – Nominal interest rate

  Π – Current inflation rate

  R* - equilibrium point of real interest rate

  Π* - targeted inflation rate

  Y – log real GDP output

  Y* - log of potential GDP output

  A,β – coefficients representing the response to inflation and GDP output.

1.2.2. Impact channels

1.2.2.1. Trade Channel

The trade channel is the most direct connection between exchange rate changes and economic activity. Relative prices change as the value of the home currency declines, making foreign products and services more costly for local consumers and domestically produced goods and services less expensive for overseas customers. This change in relative competitiveness can improve the trade balance and increase aggregate demand by boosting export demand while reducing import demand. An increase in imports and a decrease in export competitiveness might have the opposite impact on domestic currency appreciation, which could put downward pressure on net exports and economic growth. According to the Marshall-Lerner condition, the size of these impacts depends on the price elasticities of demand for imports and exports (Krugman & Obstfeld,2003).

1.2.2.2. Investment Channel

Changes in exchange rates also impact investment choices, especially when it comes to FDI and other capital flows. Because foreign investors can purchase local assets at a reduced cost when assessed in their currency, a country's appeal as a destination for foreign direct investment (FDI) can be increased by depreciating its currency. In the end, this FDI inflow can spur economic growth by promoting capital accumulation, technology transfer, and productivity increase. However, because it raises the risk of future returns on foreign investments, currency rate volatility can also breed uncertainty and deter investment. Therefore, it may be easier to draw in and keep foreign investment in an environment where currency rates are steady and predictable (Caves, 1996).

1.2.2.3. Inflation channel

Through their effects on import prices, exchange rate variations have a major impact on domestic price levels. The price of imported commodities, both final consumption items and intermediate inputs utilized in local production, rises in direct proportion to a depreciation of the home currency. Especially in economies that rely heavily on imports, this increase in import costs may exacerbate inflationary pressures inside the home economy. However, some variables can affect how well exchange rate changes are passed through to domestic prices, including market structure, business pricing strategies, and the credibility of monetary policy. Increased inflation may impede economic growth by weakening buying power, lowering consumer spending, and causing uncertainty for firms (Taylor, 2001).

1.2.2.4. Financial Channel

Financial stability and asset values can also be impacted by changes in exchange rates. Exchange rate fluctuations can affect wealth and investment choices by affecting the valuation of assets owned by both domestic and international investors. Depreciation, for example, might lower the value of assets owned by local investors denominated in foreign currencies, which may cause capital flight and financial instability. Furthermore, the stability of financial markets may be impacted by exchange rate volatility, which can raise the risk involved in cross-border financial transactions. Exchange rate changes may therefore have a big impact on capital flows, asset prices, and general financial stability in open countries with linked financial markets. These factors can then have an impact on economic development (Branson, 1983).

2. LITERATURE REVIEW

Lee and Yue (2017) examined the complex relationship between US dollar exchange rates, economic growth, and environmental impacts. Using quarterly data from 1989 to 2015, they applied a Structural Vector Autoregression (SVAR) model to capture the intricate interactions among these variables. This methodological approach enabled a thorough analysis of their interdependencies. Key indicators such as the real trade-weighted US dollar index, petroleum and renewable energy consumption, net imports of pollution-intensive products, real GDP, and CO2 emissions were included in the study, covering 105 observations over 27 years. The findings indicated that an appreciated US dollar generally results in cheaper imports and increased net imports.

While this study shares a common objective with the present research – examining the impact of exchange rates on US economic growth – it diverges significantly in terms of methodology, indicators, and theoretical underpinnings. A notable limitation of the Lee and Yue study lies in the apparent lack of a robust theoretical framework guiding the selection of indicators. The chosen variables, while relevant, may not have been explicitly derived from established economic theory explaining the intricate relationships among the variables under investigation. In contrast, the current study focuses on analyzing the interplay among key macroeconomic variables, with a primary emphasis on the exchange rate's influence on US economic growth over a more extended period, spanning from 1960 to 2024.

Hoang, Thi, and Minh (2020) conducted a comprehensive analysis of the intricate linkages between inflation, exchange rates, and economic growth in Vietnam from 1986 to 2017. While focused on a developing economy, this study offers valuable insights for understanding these dynamics within the context of the United States, contributing significantly to the broader literature on exchange rate impacts on economic performance. The authors employed a robust methodological approach, utilizing both the Vector

Error Correction Model (VECM) and the Autoregressive Distributed Lag (ARDL) bounds testing technique. A key strength of this approach lies in its ability to accommodate variables with different orders of integration (I(0) and I(1)), a common challenge in time series analysis. Conversely, many simpler models rely on the restrictive assumption of stationarity for all variables.

Their findings underscore the existence of strong long-term relationships between exchange rates and key macroeconomic variables in Vietnam. Notably, the study supports the export-promotion hypothesis, demonstrating that exchange rate depreciation exerts a positive long-term influence on economic growth. However, this positive impact comes with a trade-off: exchange rate depreciation was also found to significantly increase inflation. Interestingly, the study revealed a statistically insignificant short-term impact of exchange rates on economic growth. This suggests that the growth-enhancing benefits of depreciation may not be immediately apparent, potentially due to time lags in trade flow adjustments or the presence of J-curve effects.

Rodrik (2008) in his seminal work, posits a strong argument for the role of real exchange rate (RER) undervaluation in fostering economic growth, particularly within developing economies. He contends that an undervalued RER can act as a catalyst for growth by stimulating tradable sectors, mitigating market failures, and facilitating the necessary structural transformations within an economy. While the current study focuses on the United States, a developed economy with distinct market characteristics, Rodrik's emphasis on the significance of the RER and its influence on tradable sectors remains highly pertinent.

This research underscores the critical distinction between nominal exchange rates and real exchange rates when analyzing their impact on economic performance. While my study primarily examines the relationship between nominal exchange rates and US economic growth, it acknowledges the crucial role of the RER in mediating these effects by explicitly considering inflation differentials between the US and its key trading partners, this research aims to provide a more nuanced and comprehensive understanding of how exchange rate movements have influenced US trade flows, investment patterns, and ultimately, the trajectory of US economic growth over the specified period.

The study by Rodrik used cross-country panel data and instrumental variables to analyze RER undervaluation's impact on growth across diverse economies. Meanwhile, my study examines the US specifically from 1960-2023, necessitating a different approach. Focusing on a single country over time allows for in-depth time-series analysis, potentially using techniques like structural break econometrics, cointegration, or VAR models to capture exchange rate dynamics and their influence on US economic growth. Unlike Rodrik's (2008) RER undervaluation index, this research analyzes both nominal and real exchange rate *movements* using readily available US macroeconomic data, enabling a more granular examination of the US historical and policy context.

Morina, Hysa, and Voica (2015) investigated the impact of exchange rate volatility on economic growth within a panel of Central and Eastern European (CEE) countries spanning the period from 1999 to 2013. This study contributes significantly to the broader literature on the effects of exchange rate fluctuations, providing a valuable comparative perspective to the present research, which focuses on the United States. By examining a distinct economic context, their findings offer valuable insights into the potential consequences of exchange rate volatility in different economic environments.

The authors employed a rigorous econometric approach, utilizing both fixed and random effects models within a panel data framework to assess the relationship between exchange rate volatility, measured as the standard deviation of monthly exchange rate changes, and real GDP growth. To ensure a comprehensive analysis, the study controlled for other key macroeconomic factors, including inflation, government expenditure, and foreign direct investment.

A central finding of the study is that exchange rate volatility exerts a statistically significant and negative impact on economic growth within the CEE countries. This finding suggests that increased fluctuations in exchange rates can impede economic performance by creating heightened uncertainty for businesses engaged in international trade and investment activities. This increased uncertainty can, in turn, discourage investment, disrupt trade flows, and ultimately hinder economic growth. Furthermore, the study revealed that the negative impact of exchange rate volatility is more pronounced in countries with less developed financial markets, highlighting the importance of robust financial systems in mitigating the adverse effects of exchange rate instability.

Eichengreen (2008) expands upon Rodrik's (2008) work by delving deeper into the mechanisms through which real exchange rate (RER) undervaluation can stimulate economic growth. While Rodrik primarily focuses on the positive impact of undervaluation, Eichengreen explores the underlying channels, including increased investment, structural transformation towards tradable sectors, and the generation of positive externalities within these sectors. A key finding of Eichengreen's research is that the positive influence of RER undervaluation is more pronounced in developing economies compared to developed economies. This finding carries significant implications for the present study, which centers on the United States, a highly developed economy.

The author employed a comprehensive cross-country panel dataset spanning several decades to investigate the intricate relationship between the real exchange rate (RER) and economic growth. A significant methodological contribution of the study lies in the construction of an RER undervaluation index, carefully adjusted to account for the Balassa-Samuelson effect, which reflects the tendency for prices in more developed economies to be higher due to higher productivity in the tradable sector. This meticulously constructed index, along with a suite of control variables including initial income levels, investment rates, educational attainment, and institutional quality, is utilized in panel regressions to estimate the impact of RER undervaluation on economic growth. To address potential endogeneity concerns, the study employs a robust instrumental variables estimation strategy, utilizing terms of

trade and government consumption as instrumental variables. A key focus of the analysis lies in differentiating the effects of RER undervaluation across developing and developed economies.

Yeyati and Sturzenegger (2003) conducted a groundbreaking study examining the intricate relationship between exchange rate regimes and economic growth, analyzing a comprehensive dataset spanning the post-Bretton Woods era. A key innovation of their work lies in its utilization of a de facto classification of exchange rate regimes, meticulously analyzing actual macroeconomic behavior rather than solely relying on official declarations. This rigorous approach, focusing on exchange rate volatility, reserve volatility, and monetary base volatility, provides a more accurate representation of real-world exchange rate behavior. While much of the existing literature at the time primarily focused on the impact of exchange rate regimes on inflation, Levy-Yeyati and Sturzenegger significantly expanded the scope of inquiry by explicitly investigating their influence on economic growth.

The study's findings challenge conventional wisdom, revealing a significant negative correlation between less flexible (more fixed) exchange rate regimes and economic growth in developing countries. Conversely, for industrialized countries, the study found no statistically significant relationship between exchange rate regimes and growth. This finding has crucial implications for the present study, which focuses on the US economy.

The authors employed a rigorous methodological approach, utilizing panel data regression techniques and addressing potential endogeneity concerns through instrumental variables estimation. This robust analysis, combined with the comprehensive dataset encompassing a large sample of countries(over 183 countries), provides strong empirical support for their findings. The study's emphasis on de facto regime classification is particularly valuable, as it acknowledges the reality that countries often deviate from their officially declared exchange rate regimes. This consideration is highly relevant for the present study, which will examine the impact of exchange rate fluctuations within the context of the US economy, recognizing that while the US officially maintains a floating exchange rate regime, periods of de facto exchange rate management have occurred.

Ito, Isard, and Szymanski (1997) empirically examined the relevance of the Balassa-Samuelson hypothesis in explaining real exchange rate (RER) movements within rapidly growing Asian economies. The study focused on a selected group of high-growth economies, including Japan, Korea, Taiwan, Hong Kong, and Singapore, while also analyzing other fast-growing ASEAN countries. The authors found evidence supporting the Balassa-Samuelson hypothesis in Japan, Korea, and Taiwan, where rapid economic growth, driven by productivity gains in the tradable sector, was associated with RER appreciation.

However, the study finds less conclusive evidence for Hong Kong and Singapore, suggesting that other factors, such as high productivity growth in the service sector, may have mitigated RER appreciation. This research contributes significantly to our understanding of the factors driving RER movements in high-growth economies, highlighting the importance of considering country-specific characteristics beyond the traditional Balassa-Samuelson framework.

Wong (2012) examined the critical role of real exchange rate (RER) misalignment in influencing Malaysian economic growth over the period 1970-2009. Recognizing that deviations of the actual RER from its equilibrium level can significantly impact trade competitiveness and overall economic performance, the study aims to quantify these effects within the Malaysian context. Employing the Behavioral Equilibrium Exchange Rate (BEER) approach, the study estimated the equilibrium RER by regressing it on a set of fundamental macroeconomic variables, including relative productivity, terms of trade, net foreign assets, and government consumption.

The study then calculated RER misalignment as the deviation between the actual RER and the estimated equilibrium RER. The findings revealed a statistically significant negative relationship between RER overvaluation and economic growth, suggesting that an overvalued Malaysian Ringgit hinders export competitiveness and negatively impacts economic performance. While some evidence suggests a potential positive impact of RER undervaluation on growth, this effect is less robust than overvaluation's negative impact.

Barguellil, Ben-Salha, and Zmami (2018) investigated the adverse impact of exchange rate volatility on economic growth within a panel of 45 developing and emerging economies from 1985 to 2015. Utilizing GMM estimators and GARCH-based volatility measures, their findings robustly demonstrate a statistically significant negative relationship between exchange rate volatility and economic growth, particularly in countries with flexible exchange rate regimes and greater financial openness. While this study provides valuable insights into the challenges posed by exchange rate volatility in developing economies, the present research focuses on the unique economic context of the United States, a developed economy with a reserve currency, over an extended time horizon (1960-2023). This distinct context necessitates a tailored methodological approach, potentially incorporating more advanced time-series techniques to accurately capture the specific dynamics of the US economy.

3. DATA AND METHODOLOGY

Grounded in established theories of the exchange rate-economic growth nexus, this study investigates the dynamic relationship between GDP growth and the nominal exchange rate. To provide robust analysis, we incorporate key control variables: inflation (to capture monetary policy transmission), imports (essential for assessing the Marshall-Lerner condition), and central government debt. Focusing on the nominal exchange rate, rather than the real exchange rate, allows us to isolate its unique impact on growth while accounting for the influence of inflation, thus yielding a more complete and nuanced understanding of their combined effects.

The data were taken from the World Bank, International Monetary Fund, Bureau of Economic Analysis, National Bureau of Economic Research, and National Data databases. Constructing 63 observations, the study covers from 1960 to 2024.

Table 3.1 Variable Description

Variables	Description	Source
GDP growth	Percentage change of the sum of all value added by all resident producers.	World Bank, IMF, NBER, National Data, Bureau of Economic Analysis
Nominal Exchange rate	Without adjustment for inflation, it is essentially the price of one currency in terms of another currency	World Bank, IMF, NBER, National Data, Bureau of Economic Analysis
Import	The import of goods and services represents the total value of all goods and services acquired from other countries. This includes merchandise, freight, insurance, transportation, travel, royalties, license fees, and various other services like communication, construction, financial, information, business, personal, and government services.	World Bank, IMF, NBER, National Data, Bureau of Economic Analysis
CPI	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	World Bank, IMF, NBER, National Data, Bureau of Economic Analysis
Real Interest rate	Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.	World Bank, IMF, NBER, National Data, Bureau of Economic Analysis
Central Government Debt	Government debt is the total amount a government owes to others at a specific time, including domestic and foreign liabilities like currency, deposits, securities (excluding shares), and loans, minus any equity or financial derivatives it holds. It's measured at a specific date, usually the end of the fiscal year.	World Bank, IMF, NBER, National Data, Bureau of Economic Analysis, Census Bureau

3.1. Pre-estimation analysis

3.1.1. Summary Statistics

As per the result shown in table 3.2, The data encompasses 64 observations for all variables except import, which has 54. The average GDP growth rate is 2.97%, with a median of 2.79%, indicating a slightly left-skewed distribution and moderate variability. The average exchange rate is 120.49, demonstrating a roughly symmetric distribution with modest volatility. The average interest rate is 3.50%, indicating moderate right-skewness and fluctuation. The CPI is 3.77% on average, with a noticeable right skew and significant variability. The central government debt has a high degree of variability and a right-skewed distribution, with an average of 52.41. Finally, the average import value is 27.41, demonstrating minor left-skewness and minimal variability.

Table 3.2: Summary Stats

	GDP Growth	Exchange Rate	Interest Rate	CPI	C_Gov_Debt	Import
Mean	2.972911	120.4854	3.500889	3.770332	52.40851	27.4074
Median	2.795606	114.5682	3.101104	3.212435	46.05014	27.59432
Maximum	7.236453	150.1921	8.594601	13.54920	124.7332	29.00882
Minimum	-2.576500	95.00856	-1.281581	-0.355546	27.62943	24.74432

Std. Dev.	2.093837	14.97189	2.375049	2.762789	28.96461	1.195751
Skewness	-0.5021539	0.1024093	0.1962393	1.553222	1.052998	-0.587174
Kurtosis	3.24362	1.753324	2.425817	5.387302	2.864577	2.278973
Jarque-Bera	3.132054	2.675610	1.854748	25.16501	8.868899	4.178476
Probability	0.208873	0.262421	0.395591	0.000003	0.011862	0.123781
Sum	144.4236	6182.275	196.9509	213.8317	2998.078	1452.592
Sum Sq. Dev.	222.2606	9382.288	325.0377	435.7450	38832.02	74.35063
Observations	64	64	64	64	64	54

3.1.2. Multicollinearity

3.1.2.1. Correlation Matrix

The correlation matrix shows numerous significant correlations between the variables. Log imports and GDP have a significant positive correlation (0.5917), indicating that imports often rise as GDP does. This is in line with economic theory, which states that rising demand for imported products and services is usually a result of greater economic activity. On the other hand, there is a somewhat negative correlation (-0.5373) between GDP and debt, meaning that as GDP increases, the debt-to-GDP ratio tends to decrease.

Additionally, there is a positive connection between the exchange rate and the CPI (0.3409), indicating that greater inflation may be linked to a depreciation of the native currency or an increase in the exchange rate. The interest rate and CPI have a weakly positive association (0.2360), indicating that increased interest rates might have a little inflationary effect. Finally, there is a somewhat negative connection (-0.5089) between debt and log imports, indicating that greater debt levels can be linked to lower import levels due to increasing import restrictions or decreased demand for imports.

Although the correlation matrix in Table 3.3 below shows an initial correlation among the study's variables, the main purpose is to observe whether there is a strong correlation among variables establishing the issue of multicollinearity or not. In this case, it is not present, as the highest value is 0.5917, and less than 60% does not constitute multicollinearity (Gujarati,2009).

Table 3.3: Correlation Matrix

	GDP	Exchange Rate	Interest rate	Cpi	Debt	Log Imports
GDP	1.0000					
Exchange Rate	0.2747	1.0000				
Interest Rate	0.2698	-0.0647	1.0000			
Cpi	-0.0760	0.3409	0.2360	1.0000		
Debt	-0.5373	-0.1045	-0.2896	-0.2408	1.0000	
Log Imports	0.5917	0.2539	0.2549	0.4771	-0.5089	1.0000

3.1.2.2. Variance Inflation Factor

The correlation matrix may not completely indicate the existence of multicollinearity, despite providing insightful information about the pairwise correlations between variables. This is due to the matrix's exclusive evaluation of correlations between individual variable pairs. This may allow it to miss situations in which multicollinearity results from intricate relationships between three or more variables.

In this situation, the Variance Inflation Factor (VIF) is an essential instrument. In contrast to the correlation matrix, VIF can identify hidden multicollinearity, which occurs when a combination of variables shows notable interdependence although the individual pairwise correlations may not seem overly strong. Furthermore, in contrast to the qualitative information gleaned from the correlation matrix, VIF offers a precise numerical value that quantifies the degree of multicollinearity, providing a more impartial evaluation (Gujarati,2009).

A significant degree of multicollinearity among the predictor variables is often indicated by VIF values larger than 5 or 10. However, the number of predictors in the model and the context might affect the precise threshold for concern (Kutner,2007). As shown in Table 3.4, the VIF values are lower than 5 and the mean VIF is 1.37 indicating the absence of any hidden multicollinearity to address.

Table 3.4 VIF

Variable	VIF	1/VIF
Exchange Rate	1.18	0.844402
Interest Rate	1.17	0.855267
Cpi	1.43	0.697243
Debt	1.40	0.713061
Log Imports	1.68	0.595951
Mean VIF	1.37	

3.1.3. Homoscedasticity

A fundamental tenet of linear regression is homoscedasticity, which states that the variance of the errors (residuals) is constant at all levels of the independent variable or variables. Simply put, the distribution of the data points around the regression line ought to be constant over the independent variable's range(Gujarati,2009).Thus, it can be challenging to get reliable findings from the research when this assumption is violated since it might result in skewed and ineffective estimations of the model's parameters. Table 3.5 below indicates that the null hypothesis of constant variance in this study cannot be rejected as the p-value is 0.777 and is well-established and the variance of errors is constant at all levels of independent variables.

Table 3.5 Breusch–Pagan/Cook–Weisberg test for heteroskedasticity

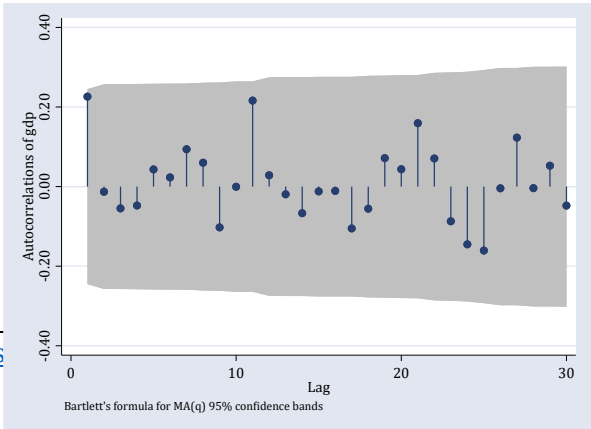
Assumption: Normal error terms
Variable: Fitted values of GDP
H0: Constant Variance
Chi2(1) = 0.08
Prob > chi2 = 0.7777

3.1.4. Autocorrelation

When looking for autocorrelation in time series data, correlograms are a useful tool. By giving a visual depiction of the relationship between a time series and its lag values, they make it simple to spot trends and dependencies across time. Meanwhile, Significant autocorrelations that go beyond the confidence bands are shown via correlograms, which depict the autocorrelation function (ACF) at various delays and show a high connection between the time series and its historical values. The correlogram's pattern, whether it displays oscillations, a rapid drop, or a slow fall, offers information on the time series characteristics, including trend, short-term dependency, and seasonality (Hamilton,1994).

Figures 3.1 and 3.2 present the correlogram for GDP growth. The presence of several autocorrelation coefficients extending beyond the confidence bands indicates significant autocorrelation at various lags. However, the pattern of autocorrelation is not readily discernible, exhibiting an oscillatory behavior with both positive and negative correlations at different lags.

Figures 3.3 and 3.4 illustrate the correlogram for the Exchange Rate. This plot reveals a significant positive autocorrelation, evident from multiple coefficients surpassing the 95% confidence bands. Notably, the autocorrelation exhibits a gradual decay pattern, suggesting strong positive correlations at lower lags that progressively diminish as the lag increases.



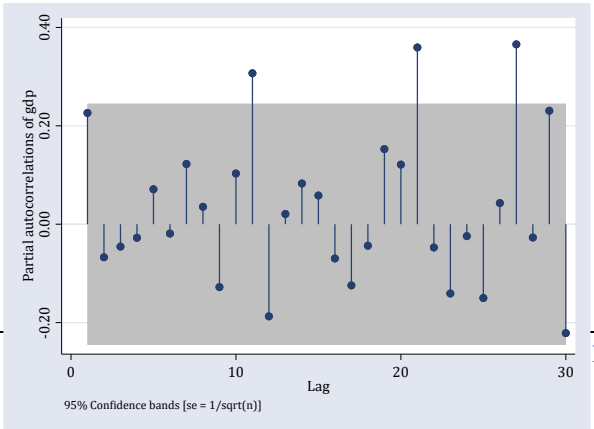


Figure 3.1 (Autocorrelation Plot – GDP growth- Stata 17.0)

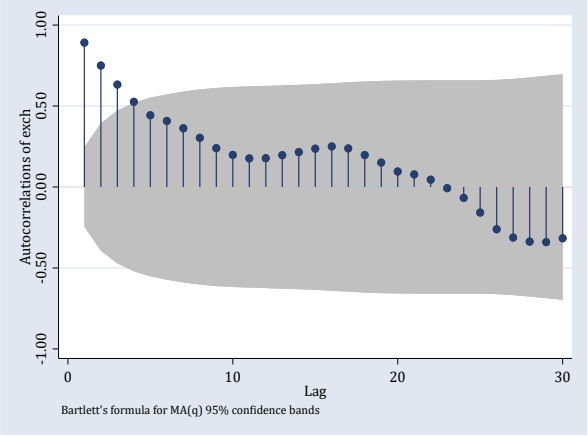


Figure 3.2 (Partial Autocorrelation Plot – GDP growth)

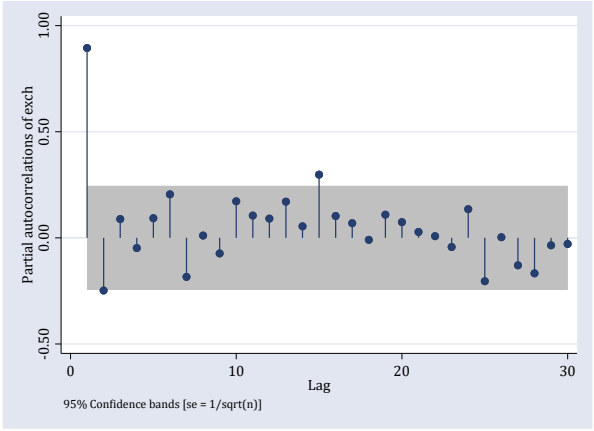


Figure 3.3 (Autocorrelation Plot – Exchange Rate)

Figure 3.4 (Partial Autocorrelation Plot – Exchange Rate)

With the help of this diagnostic test, it is evident that a simple time series regression model is not suitable for the analysis with the existence of significant autocorrelation in the main dependent and independent variables of the study. Furthermore, the partial autocorrelation plots help to determine which lag order to select in case an AR model is selected. Therefore, to assess which model is appropriate for the study further pre-estimation analysis is required, and the most important one in any time series analysis is stationarity tests which will clear the way to an optimal model.

3.1.5. Stationarity

The stationarity test is crucial for identifying the data's integration order, allowing for the selection of the best analysis model given the time series dimension. To achieve this, the ADF and Philips-Perron tests are conducted to check whether the variance, covariance, and mean of the variables remain constant, thus facilitating the establishment of a regression-based relationship between them,

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_p \Delta y_{t-p} + \varepsilon_t \quad \text{.....(10)}$$

$$\Delta y_t = \beta 0 + \beta 1 t + \sum \beta 2 y_{t-1} + \sum \alpha 1 \, \Delta y_{t-i} + \varepsilon_t \quad \text{.....(11)}$$

Where Y represents the series with t as time, Δ denotes the difference operator, and β0, β1, β2, and α1 are the estimated coefficients. The error term is indicated as ε_t. For tests targeting nonstationary series, the null hypothesis (H0) posits that the series is not stationary. This hypothesis is rejected when the t-statistic is lower than the critical values at the 1%, 5%, and 10% levels, with p-values below the 0.05 significance threshold.

Table 3.6: ADF and PP Unit Root Tests

UNIT ROOT TEST TABLE (PP)						
At Level						
	CG Debt	CPI	GDP	Exchange rate	Interest rate	Log Imports
t-Statistic	1.7017	-2.6939	-6.2279	-2.0305	-1.8365	-7.0842
Prob.	***0.9996***	***0.0807***	***0.0000***	***0.2734***	***0.3599***	***0.0000***
	n0	*	***	n0	n0	***
At First Difference						
	d(CGD)	d(CPI)	d(GDP)	d(EXCH)	d(INTER)	d(LOG_IMP)
t-Statistic	-7.5644	-9.3851	-39.1267	-6.2707	-7.1522	-6.4678
Prob.	***0.0000***	***0.0000***	***0.0001***	***0.0000***	***0.0000***	***0.0000***
	***	***	***	***	***	***
UNIT ROOT TEST TABLE (ADF)						
At Level						
	CG Debt	CPI	GDP	Exchange rate	Interest rate	Log Imports

t-Statistic	1.0513	-2.1922	-6.2322	-2.3991	-1.6493	-3.4884
Prob.	***0.9967***	***0.2112***	***0.0000***	***0.1462***	***0.4518***	***0.0122***
	n0	n0	***	n0	n0	**
At First Difference						
	d(CGD)	d(CPI)	d(GDP)	d(EXCH)	d(INTER)	d(LOG_IMP)
t-Statistic	-7.5647	-7.9956	-6.7183	-6.3371	-7.1522	-6.4754
Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
	***	***	***	***	***	***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant *MacKinnon (1996) one-sided p-values.

Table 3.6 above illustrates the result of combined ADF and PP tests of stationarity. As per the result, the null hypothesis of non-stationarity can be rejected for GDP and imports at 1%, at 10% for Cpi, and the rest of the variables are non-stationary at level. Meanwhile, at the first difference, all the variables are stationary which establishes a mixed order of integration for the variables (GDP I(0), Import I(0), Cpi I(1), Exchange rate I(1), CG Debt I(1), and Interest rate I(1)).

The choice of an appropriate time series model hinges on the stationarity properties of the variables involved. If all variables are stationary at level (I(0)), meaning their mean and variance remain constant over time, Ordinary Least Squares (OLS) regression can be employed for univariate models, while Vector Autoregression (VAR) models are suitable for multivariate systems. When all variables are integrated of order one (I(1)), implying that their first differences are stationary, OLS regression can be applied to the differenced series in univariate cases, and Vector Error Correction Models (VECM) should be considered for multivariate systems to capture long-term equilibrium relationships. The Autoregressive Distributed Lag (ARDL) model provides a flexible approach for cointegration analysis when dealing with a combination of I(0) and I(1) variables (Hamilton, 1994), (Enders, 2010).

When dealing with time series where all variables are integrated of order one (I(1)), investigating cointegration is crucial. Cointegration signifies the presence of a long-run equilibrium relationship among these variables, despite their non-stationarity. If cointegration is established, OLS regression can be applied to the level data in univariate models, while Vector Error Correction Models (VECM) are suitable for multivariate systems to capture both the long-run equilibrium and short-run dynamics. Conversely, in the absence of co-integration, estimation should proceed on the first differences of the data using OLS for univariate models or VAR models for multivariate systems.

The ARDL approach is particularly valuable when working with time series exhibiting a mix of I(0) and I(1) variables. If cointegration is evident within the ARDL framework, the model itself can estimate the long-run cointegration relationship. However, if cointegration is not found, the analysis should proceed based on the order of integration of individual variables. For I(0) variables, OLS regression is appropriate, while for I(1) variables, estimation should be

conducted on their first differences using OLS or VAR models, depending on the nature of the model (Enders, 2010; Gujarati & Porter, 2009)

3.1.6. ARDL Bounds Cointegration Analysis

The ARDL approach is particularly valuable when working with time series exhibiting a mix of I(0) and I(1) variables. If cointegration is evident within the ARDL framework, the model itself can estimate the long-run cointegration relationship. However, if cointegration is not found, the analysis should proceed based on the order of integration of individual variables. For I(0) variables, OLS regression is appropriate, while for I(1) variables, estimation should be conducted on their first differences using OLS or VAR models, depending on the nature of the model (Enders, 2010; Gujarati & Porter, 2009)

The order of integration was identified to be as stationary at the level for GDP growth, Import, and stationery at the first difference I(1) for Central Government Debt, Exchange rate, Interest rate, and Cpi. The ARDL Bounds cointegration is the appropriate analysis based on the following reasons:

- This test allows the co-integration analysis of data with different order of stationarity, a mixture of I(0) and I(1) if they are not stationary at the second difference I(2).
- The ARDL bounds test allows this option to provide an optimum lag level for the series separately, so different series can have different optimum lag levels.
- ARDL will form a single equation for variables in the study.

The ARDL Bounds cointegration test is crucial for assessing the potential for a long-term equilibrium relationship among variables. This process involves estimating the unrestricted error correction general equation:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-1} + \sum_{j=0}^{q} \lambda_j \Delta x_{t-1} + \varphi_1 y_{t-1} + \varphi_2 x_{t-1} + e_t \quad \text{.....(10)}$$

If cointegration is found, these equations (11), (12), and (13) will be applied to determine both the long-run relationship and short-run relationship among variables.

Long-run equation - $CGD_t = \alpha_0 + \alpha_1 LogGDP_t + \alpha_2\ Exports_t + \varepsilon_t$ .....(11)

ECM - $\Delta\ CGD_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta\ CGD_{t-i} + \sum_{j=0}^{q} \lambda_j \Delta\ Ex_{t-j} + \sum_{j=0}^{r} \lambda_j \Delta\ LGDP_{t-j} + \delta\ z_{t-1} + \varepsilon_t$.....(12)

Short-run equation $\Delta\ CGD_t = \beta_0 + \theta_0 CGD_{t-1} + \sum_{j=1}^{p} \beta_j \Delta\ CGD_{t-j} + \theta_1 Ex_{t-1} + \sum_{j=0}^{q} \lambda_j \Delta\ Ex_{t-j} + \theta_2 LGDP_{t-j} + \sum_{j=0}^{r} \lambda_j \Delta\ LGDP_{t-j} + \varepsilon_t$ .....(13)

Recalling the rule set forth, if the cointegration is found means a long-run relationship exists and the coefficients will itself get determined by the ARDL cointegration model (Pesaran, Shin & Smith, 2007). Before that, it is critical to first assess the existence of cointegration which is shown in table 3.7 below.

Table 3.7: ARDL Bounds Cointegration Test

H0: no levels of relationship F = 19.851
t = -10.042

Critical Values (0.1 - 0.01), **F-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
K_2	2.26	3.35	2.62	3.79	2.96	4.18	3.41	4.68

accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1 - 0.01), **T-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
K_2	-2.57	-3.86	-2.86	-4.19	-3.13	-4.46	-3.43	-4.49

accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

Results in Table 3.7 indicate that there is a long-run relationship, and the coefficients can be determined through the ARDL model itself as the F-statistic is bigger than all critical values for I(0) and I(1) regressors and the null hypothesis of no levels relationship can be rejected. Meanwhile, the t-statistic is lower than critical values for all I(0) and I(1) regressors.

4. EMPIRICAL RESULTS

Addressing the basic assumptions of linear regression and an important tenet of any time series analysis (stationarity), the optimal model to perform the estimation through is the Autoregressive Distributed Lag Model, and the result is shown in Table 4.1 and 4.2 for both short and long-term relationships among variables of the study.

Table 4.1: Long-run ARDL regression

Dependent Variable	GDP Growth	R-squared – 0.8162
Sample	1961 to 2024	Adjusted R-squared – 0.7819
Obs (adjusted)	63	
Exchange Rate	0.19435***	
Coefficient	(0.478767)	
Interest Rate	0.10303	
	(-0.023560)	
CPI	0.0131365***	
	(-0.3139757)	
Central Gov Debt	0.0131365	
	(-0.0058644)	
Imports	0.0885128	
	(0.0039167)	

*Denotes significance at 10%, **significance at 5%, and *** significance at 1%.

The R-square of the model is 0.8162, explaining that the combined behavior of variables exchange rate, interest rate, CPI, Debt, and Imports can explain 81.62% of the variation in the GDP growth. The coefficient for the exchange rate is 0.478 with a small standard error of 0.194 indicating a positively significant relationship with GDP growth at 1% level in the long run. It implies that a one percent increase in the exchange rate is associated with a 0.478 percent increase in GDP growth.

The relationship between exchange rates and GDP growth is multifaceted. Currency depreciation (an increase in the exchange rate) can initially harm trade and slow GDP growth according to the J-curve effect, where the short-term costs of adjusting to higher import prices outweigh the benefits of increased exports. However, over time, as exporters gain competitiveness and import demand falls, the trade balance improves, boosting GDP (Krugman, 2009).

The Marshall-Lerner condition further emphasizes that a depreciation of exchange (increase in exchange rate) only benefits the trade balance if the combined price elasticity of imports and exports exceeds one. This means that depreciation will increase net exports and stimulate growth only if the demand for imports and exports is sufficiently responsive to price changes (Krugman, 2009).

Furthermore, depreciation enhances export competitiveness by making domestic goods cheaper for foreign buyers, leading to increased exports and GDP growth. It can also encourage import substitution, as higher import prices incentivize domestic production, further stimulating economic growth (Feenstra, 2015).

In conclusion, the impact of exchange rate depreciation on GDP growth is complex and depends on various factors, including the J-curve effect, the Marshall-Lerner condition, competitiveness effects, import substitution, and inflationary pressures. While theory suggests that depreciation can stimulate growth, the actual outcome varies significantly across countries and economic contexts.

For the Consumer price index, the coefficient is -0.313 indicating a negative relationship between inflation and GDP growth at 1% significance level. Furthermore, the standard error is 0.01313 indicating the accuracy of the estimated parameters, suggesting that a one percent increase in inflation (CPI) is associated with a -0.313 percent decrease in GDP growth.

For the short-run impacts, Table 4.2 below explains the temporary relationship that exists among GDP growth, interest rate, central government debt, and imports:

Table 4.2: Short-run ARDL regression

Dependent Variable	GDP Growth	R-squared – 0.8162
Sample	1961 to 2024	Adjusted R-squared – 0.7819
Obs (adjusted)	63	
Interest Rate	0.180627***	
	(0.4052516)	

Central Gov Debt	0.0472265***
	(-0.122438)
Imports	0.2689009***
	0.8839818

*Denotes significance at 10%, **significance at 5%, and *** significance at 1%.

The R-square of the model is 0.8162, explaining that the combined behavior of interest rate, Debt, and Imports can explain 81.62% of the variation in the GDP growth. The coefficient for the interest rate is 0.40525 with a minimal standard error of 0.1806 indicating a positive relationship with GDP growth in the short term. The central government debt has a coefficient of -0.1224 indicating a negative relationship with the GDP growth and a minimal 0.047 standard error. Import has a coefficient of 0.883 and a standard error of 0.268 indicating a positive relationship with GDP growth in the short term.

Interest rates and GDP growth have a complicated and nuanced relationship. There are some situations in which this relationship might be positive, despite the widespread belief that rising interest rates can hinder economic growth by making borrowing more expensive for consumers and firms, which discourages investment and consumption (Mishkin, 2016).

An example of this is when the economy is experiencing high rates of inflation which is the case for the United States. By lowering aggregate demand in such a situation, rising interest rates could help stabilize inflation, enhancing company and consumer confidence that may eventually result in more economic activity and faster GDP growth (Taylor, 1993).

Furthermore, in countries with stable economies, higher interest rates could bring in international investments, and by raising investment, exports, and job creation, this inflow of foreign capital can spur economic growth (Obstfeld & Rogoff, 1996). Furthermore, higher interest rates may encourage people and companies to expand their savings, and long-term economic growth can be promoted by directing these savings into profitable ventures (Barro & Sala-i-Martin, 2004). Meanwhile, it is important to recognize, though, that the effect of interest rate increases on GDP growth depends heavily on several variables, such as the state of the economy generally, the pace of inflation, and how sensitive the economy is to changes in interest rates. However, Economic activity may suffer from a large and long-term increase in interest rates, which could result in slower GDP growth.

The positive relationship between Imports and GDP growth in the short term can be explained by many theories providing theoretical background. Firstly, the intermediate inputs idea indicates that for domestic industrial processes, imports are frequently essential intermediate inputs. Importing more capital equipment, components, and raw materials can boost economic growth and increase domestic productivity (Feenstra, 2015). Secondly, Imports have the potential to directly influence both domestic investment and consumption. Imported capital equipment for investment reasons, durable products, and consumer goods all boost economic activity and aggregate demand. Lastly, Imports can help spread knowledge and technology, and access to imported goods and services, such as sophisticated equipment and software, can boost creativity and improve domestic technological capabilities, resulting in higher economic growth and productivity.

5. CONCLUSION

This study examined the intricate relationship between exchange rate fluctuations and US GDP growth from 1960 to 2024. Throughout this analysis, it became evident that the international monetary system has undergone a dramatic transformation since the Bretton Woods era. The transition from fixed exchange rates to the current floating exchange rate regime has been fraught with challenges, including oil crises, the surge of global financial integration, and recurrent economic shocks. The US dollar has consistently held its position as the world's reserve currency, exerting a profound influence on exchange rate dynamics and consequently impacting global economic activity.

Several important theoretical frameworks served as the basis for the analysis: the Marshall-Lerner condition clarified the critical role that price elasticities of demand for imports and exports play in determining the impact of exchange rate changes on the trade balance; the Balassa-Samuelson hypothesis offered a lens through which productivity differences across tradable and non-tradable sectors can influence exchange rate dynamics and price levels; and the monetary policy transmission mechanism, which includes the IS-LM model and the Taylor Rule, emphasized how central bank actions, such as interest rate adjustments, can influence exchange rates and thereby affect economic activity. These theoretical foundations provided a strong framework for analyzing the empirical findings and making insightful conclusions about the intricate relationship between exchange rates and economic growth in the US context.

Throughout this study, rigorous pre-estimation analysis was performed to address the basic assumptions of linear regression and potential concerns to consider before choosing an optimal analysis model and reaching a comprehensive conclusion. To provide a basic understanding of the quality of data, summary statistics are provided followed by a correlation matrix and variance inflation factor to address the issue of multicollinearity to avoid the issue of severe correlation between independent variables within

regression. Moreover, addressing the issue of normality of error terms, the Breusch–Pagan/Cook–Weisberg test was performed, and the result suggested normal error terms for the regression.

The second most important element of the pre-estimation analysis was the issue of Autocorrelation, with the help of ACF and PACF plots it is determined that the main variables of the study suffer from this issue and a simple linear regression cannot address the complexity of time series analysis in hand. Meanwhile, the existence of autocorrelation itself suggested that it is more optimal to use any Autoregressive model to be able to capture the dynamics involved.

The most important element of the pre-estimation analysis was to construct a stationary time series which could demonstrate that there are no trends or seasonal patterns eventually leading to altered behavior as time progresses. Thus, ADF and PP tests were performed that suggested a mixed order of integration between variables, and as provided by (Hamilton,1994) (Enders,2010) (Gujarati,2009) and many more scholars, the Autoregressive Distributed Lag (ARDL) model provides a flexible approach for cointegration analysis when dealing with a combination of I(0) and I(1) variables. Therefore, the ARDL bounds cointegration was performed which indicated an existing long-term cointegration and relationship among variables and provided the key findings of this study.

The model was able to capture 81.62% variation within GDP growth in the US context and several key findings came from this analysis. The exchange rate has a long-term positive impact on GDP growth, bolstering ideas of import substitution, increased export competitiveness, the Marshall-Lerner condition, and the J-curve effect. As anticipated, inflation has a negative effect on GDP growth, most likely because of lower buying power and greater uncertainty. Moreover, It's interesting to note that interest rates have a short-term positive impact on GDP growth, due to encouraging savings, attracting foreign investment, and stabilizing inflation. Lastly, Short-term GDP growth is also positively impacted by imports, most likely because of their use as intermediate inputs, their ability to stimulate investment and consumption, and their capacity to advance technology.

5.1. Policy Implications

This study reveals critical policy junctures demanding the attention of the Federal Reserve and the US treasury departments as they navigate the complexities of the U.S. macroeconomic sphere. While a comprehensive exploration of policy instruments necessitates a dedicated policy brief, this research underscores several key implications:

- Inflation Control: Using efficient monetary policy instruments, the Fed must place a high priority on preserving low and steady inflation. This is essential for maintaining steady economic growth and creating a stable business environment.
    - Interest rate adjustments: Supported by the Quantity Theory of Money and the Fisher Effect, the Federal Reserve can reduce inflation through interest rate adjustments, which can result in a more stable exchange rate. Decreased inflation lowers the chance of currency depreciation, boosting investor confidence and attracting foreign capital to support economic growth. Lower interest rates can also promote borrowing and spending by households and businesses, which will boost the economy even more (Fisher,1930).
    - Open Market Operations: based on the Keynesian Theory, The Federal Reserve can inject liquidity into the economy by buying government assets, which lowers inflation and stabilizes prices, and consequently a stronger currency could improve trade balances and spur economic growth because of this inflation stability (Keynes,1936).
    - Reserve Requirements: Supported by the Monetary Policy Transmission Mechanism, lowering inflation creates a more favorable environment for the currency, and modifying reserve requirements will enable Banks to lend more when reserve requirements are lowered, which expands the money supply and promotes economic growth. International trade, export competitiveness, and general economic development are all boosted by a strong and stable exchange rate (Friedman, 1936).
    - Discount Rate Adjustments: Reduced discount rates make borrowing less expensive for banks, which promotes lending and investment (Bernanke, 2013).
- Exchange Rate Management: Policies that increase the competitiveness of US goods and services are crucial, even when direct exchange rate intervention may have drawbacks.
    - Forward Guidance: based on the Expectations Theory, the Federal Reserve's forward guidance for future monetary policy measures can influence market expectations and lower volatility and uncertainty. Investment and economic growth are stimulated by a stable exchange rate supported by reliable forward guidance (Woodford, 2012).
    - Currency Intervention: according to the purchasing power parity theory, the exchange rate should move towards a rate that equalizes the prices of identical goods and services in different countries. Based on this theory, the Fed shall control price stability, and boost export competition by correcting misalignments in exchange rates that deviate from purchasing power parity through direct interventions (Rogoff, 1996).
    - Macroprudential Policies: These policies, which include things like loan-to-value ratios, stress tests for financial institutions, and countercyclical capital buffers, help prevent asset bubbles and excessive credit expansion. These policies support stable inflation and exchange rates, which are necessary for long-term economic growth, by preserving a stable financial system. Utilizing macroprudential regulation, the Fed and US Treasury may enhance

their resilience to financial shocks and foster sustained economic growth and stability (Hanson, Kashyap, & Stein, 2011).

- Fiscal Responsibility: Long-term economic viability depends on effective management of debt. A more stable economy that can ensure sustainable GDP growth depends on policies meant to lessen the burden of the national debt, such as well-thought-out tax or expenditure cutbacks.
    - Supply-side improvements: According to supply-side economic theory, encouraging supply-side reforms can reduce inflation and boost economic growth. These changes improve labor market efficiency, lower regulatory burdens, and boost productivity, which results in a stable exchange rate and a growth-friendly sphere (Laffer, 2004).
    - Fiscal Policy Coordination: The general economic system can be stabilized by coordinating government taxing and spending policies with the Fed's monetary policy objectives. This cooperation fosters economic progress by assisting in the achievement of adjusted inflation, interest rate, debt, trade balance, and exchange rate (Blinder & Solow, 1973).
- Trade Policy: Altering the balance of trade through tariffs, quotas, and trade agreements can affect exchange rates. For instance, free trade agreements may weaken the dollar by raising imports, while protectionist policies may strengthen it by decreasing imports (Krugman,1991).

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