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The Impact of Exchange Rate Volatility on Long-term Economic Growth: Insights from Lebanon

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Abstract

There is ongoing debate in empirical research regarding the impact of exchange rate volatility on exports and economic growth. While some studies argue that exchange rate volatility positively influences these economic variables, others suggest negative or negligible effects. This study seeks to clarify this debate by examining the specific impact of exchange rate volatility on the economic growth of Lebanon, utilizing annual time series data spanning from 1980 to 2023. In our investigation, we employed several econometric techniques to analyze the relationship between exchange rate volatility and economic growth. Notably, we utilized the autoregressive distributed lag model to explore both the short-term and long-term dynamics between these variables. Our results reveal a nuanced relationship: in the long run, exchange rate volatility exhibits a positive and significant effect on economic growth, while in the short run, this relationship is negative and insignificant. Further analysis identified that variables such as exchange rate volatility, investment volatility, agricultural value-added, and services value-added significantly impact economic growth in the long run. In contrast, inflation and exchange rates were found to have an insignificant effect on long-term economic growth. Specifically, inflation displayed a negative and insignificant relationship with economic growth, suggesting that while inflation can hamper growth, its impact is not statistically significant in this context. Given the inherent challenges in eliminating exchange rate volatility, our study recommends that the government of Lebanon adopt efficient macroeconomic policies aimed at mitigating the adverse effects of currency volatility. These policies should focus on enhancing economic stability and fostering a conducive environment for sustainable growth. Our findings contribute to the broader discourse on exchange rate volatility and its economic implications, offering specific insights relevant to Lebanon and potentially applicable to other economies with similar characteristics. Policymakers can leverage these insights to design strategies that balance the benefits of exchange rate flexibility with the need to protect the economy from excessive volatility. The evidence provided enhances our understanding of the long-term and short-term effects of exchange rate fluctuations, offering a foundation for informed policy-making that promotes economic resilience and growth.

Keywords: Exchange Rate Volatility, Economic Growth, Lebanon

JEL Codes: F31, O16, O54

1. INTRODUCTION

The impact of asymmetric shocks caused by exchange rate volatility on economic growth has been a major concern for both academics and policymakers for several decades. Exchange rate movements can significantly influence a country's economic performance through their effects on trade balances, investment flows, and overall economic stability. According to the literature (Bredin et al., 2003; Clark et al., 2004; Doyle, 2001; Musila & Al-Zyoud, 2012; Ali, 2018; Tenreyro, 2007; Malik, 2019; Khalid, 2022; Subhani et al., 2022), the depreciation of an exchange rate typically leads to an increase in exports and a reduction in imports. This occurs because a weaker currency makes a country's goods and services cheaper for foreign buyers while making imported goods more expensive for domestic consumers. Conversely, the appreciation of an exchange rate generally decreases exports and increases imports, as domestic goods become more expensive for foreign buyers and imported goods become cheaper for domestic consumers.

The depreciation of an exchange rate facilitates an income transfer from importing countries to exporting countries by shifting the terms of trade (Arshad & Mukhtar, 2019; Ali, 2022; Olubiyi, 2023). This shift can significantly impact the economic growth of both importing and exporting nations. For exporting countries, increased exports can lead to higher production levels, more employment opportunities, and greater income, thereby stimulating economic growth. On the other hand, importing countries may experience reduced economic growth due to higher import costs, decreased consumption, and potential trade deficits. Exchange rate volatility can also introduce uncertainty into the economic environment, affecting investment decisions by businesses and financial institutions (Hwang & Lee, 2019; Alzahrani & Salah, 2020; Naik, 2020). When exchange rates are highly volatile, the risk associated with international trade and investment increases, potentially

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leading to reduced foreign direct investment and lower economic growth. Businesses may delay or cancel investment projects due to the unpredictability of exchange rate movements, which can hinder long-term economic development.

The impact of exchange rate volatility on trade has been a longstanding and contentious issue in economic literature. Numerous empirical studies have been conducted on this topic, leading to mixed results and divergent viewpoints. This ongoing debate can be traced back to the early 20th century, with a significant body of literature emerging in the 1930s that explores the relationship between international trade and exchange rate fluctuations. Early theoretical frameworks, such as those proposed by Clark (1973) and Hooper and Kohlhagen (1978), posited that increased exchange rate volatility negatively affects trade volumes. These studies argued that uncertainty in exchange rates could deter exporters and importers due to the potential for unexpected financial losses, thereby leading to a decline in trade flows. The underlying rationale is that exchange rate fluctuations create an unstable environment, making it difficult for businesses to predict future costs and revenues accurately. This uncertainty can lead to reduced investment in international trade activities and a preference for domestic markets, which are perceived as less risky.

Despite these theoretical predictions, more recent empirical research presents a less clear-cut relationship between exchange rate volatility and trade flows. Some studies have found evidence supporting the notion that exchange rate instability can harm trade, while others have found negligible or even positive effects. This inconsistency in findings suggests that the impact of exchange rate volatility on trade may be context-specific, influenced by factors such as the level of economic development, the degree of openness of the economy, the types of goods traded, and the hedging mechanisms available to businesses (Iqbal & Raza, 2018; Cizakca, 2024). Moreover, modern studies indicate that the relationship between exchange rate volatility and economic growth is similarly ambiguous. Some researchers argue that exchange rate stability can contribute to economic growth by fostering a predictable trading environment, while others suggest that moderate volatility can be beneficial by encouraging businesses to innovate and improve efficiency in response to changing conditions. Exchange rate fluctuations have evolved astonishingly, significantly impacting exports (Arize et al., 2000; Assery & Peel, 1991; Bahmani-Oskooee & Hegerty, 2007; Vieira & MacDonald, 2016; Wang & Barrett, 2007; Meali, 2021; Andereou, 2021), employment growth (Belke & Setzer, 2003; Belke & Kaas, 2004), trade (Bredin et al., 2003; Clark et al., 2004; Doyle, 2001; Musila & Al-Zyoud, 2012; Tenreyro, 2007), inflation (Danjuma et al., 2013; Mordecai & Akinsola, 2021; Wang, 2023), investment (Fuentes, 2006; Kiyota & Urata, 2004; Serven, 2002), and more generally, economic activity (Adewuyi & Akpokodje, 2013; Kandil, 2004) and growth (Danne, 2006; Holland et al., 2011; Levy-Yeyati & Sturzenegger, 2003; Mundell, 1995; Irfan & Sohail, 2021; Sun & Chang, 2020).

In the context of Lebanon, exchange rate volatility poses significant challenges to economic stability and growth. Lebanon has faced severe economic and financial crises in recent years, exacerbated by the depreciation of its currency, the Lebanese pound. The country's heavy reliance on imports for essential goods and services, coupled with fluctuating export revenues, makes it particularly vulnerable to exchange rate shocks. Depreciation of the Lebanese pound has led to skyrocketing prices for imported goods, driving up inflation and increasing the cost of living for Lebanese citizens. At the same time, a weaker currency has made Lebanese exports more competitive on the international market, potentially providing some relief to the trade balance. However, the benefits of a weaker exchange rate are not always straightforward. Lebanon's significant foreign-denominated debt means that currency depreciation increases the cost of debt servicing, straining public finances and limiting resources available for development projects and essential public services. Furthermore, the depreciation has led to a loss of investor confidence, triggering capital outflows and further destabilizing the economy. The banking sector, a crucial pillar of Lebanon's economy, has also been severely affected, leading to a liquidity crisis and eroding public trust in financial institutions. Policymakers must navigate these complex dynamics by implementing measures to mitigate the adverse effects of exchange rate volatility. This may include maintaining adequate foreign exchange reserves, pursuing prudent fiscal and monetary policies, and fostering a diversified economic base to reduce dependence on specific export or import sectors. Additionally, establishing clear and transparent exchange rate policies can help stabilize investor expectations and enhance economic resilience. By understanding the intricate relationships between exchange rate movements, trade balances, and economic stability, policymakers can devise strategies to harness the benefits of exchange rate adjustments while minimizing their negative impacts. In Lebanon's case, addressing exchange rate volatility through comprehensive economic policies is crucial for achieving sustainable growth and improving the overall economic well-being of the nation.

2. LITERATURE REVIEW

Asseery and Peel (1991) investigated the effect of exchange rate volatility on exports using quarterly data for five countries: Australia, Japan, the United Kingdom, the United States, and West Germany, over the period from 1972 to 1987. They employed an ARCH model to estimate real exchange rate volatility. Standard unit root tests, namely Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF), were used to examine stationarity in the model. The study showed that real exchange rate volatility had a significant impact on exports in the sample countries, and for the great majority of these countries, the impact was positive. Titus & Yuan (2006) investigated the impact of exchange rate volatility on U.S. poultry exports using panel data for 49 importing nations over two sub-periods: 1976–1985 and 1986–2000. Feasible Generalized Least Squares (FGLS) estimation techniques were employed. The study focused on the effect of exchange rate risk specifically on poultry exports, assuming uniform effects of exchange rate volatility across commodities or sectors. Results indicated that two out of three measures of exchange rate volatility had statistically significant and positive impacts on foreign demand for US poultry

exports. The study underscored the importance of choosing appropriate measures of exchange rate volatility in empirical investigations, as different measures yielded varied statistical significance across sub-periods.

Altintas et al. (2009) estimated the impact of exchange rate volatility on Turkish exports using quarterly data from 1993Q3 to 2009Q4. Multivariate cointegration and Error Correction Model (ECM) techniques were applied. The long-run estimations revealed that foreign income and real exchange rate volatility had a positive and significant impact on Turkish exports, while the relative price effect on Turkish exports was negative and significant. The ECM results indicated a negative and significant impact on relative prices, an insignificant impact on foreign income, and a positive and significant impact of nominal exchange rate volatility on Turkish exports. The study suggested that policymakers cannot effectively improve the country's balance of trade in the long run or short run with price-oriented policies, emphasizing the need for exchange rate stabilizing policies.

Khan et al. (2012) analyzed the effectiveness of exchange rates in Pakistan using annual time series data from 1980 to 2009. Stationarity was assessed using unit root tests, and Johansen's cointegration tests were employed to examine long-run equilibrium relationships among variables. Granger causality tests were conducted to assess causal links between variables. The study found no long-run equilibrium relationship between exchange rates and inflation, indicating no causality. However, a long-run equilibrium relationship was identified between exchange rates and trade. Exchange rates and Foreign Direct Investment (FDI) were cointegrated, with causality detected in both directions. GDP and exchange rates were also cointegrated, but no causality was found in either direction. The study concluded that exchange rate policy alone may not effectively achieve desired outcomes for macroeconomic variables, suggesting that FDI is the area where exchange rates may have a more significant impact.

Praveen et al. (2012) analyzed factors affecting exchange rate variability in Pakistan using annual data from 1975 to 2010 sourced from the Economic Survey of Pakistan and International Financial Statistics. They employed a Simple Linear Regression model with Ordinary Least Squares (OLS) to estimate results. Findings highlighted inflation as the most significant factor contributing to exchange rate volatility, with high inflation leading to currency devaluation. Economic growth and import-export dynamics were identified as secondary factors influencing exchange rate fluctuations. The study emphasized the need for effective fiscal and monetary policies to stabilize exchange rates, reduce inflation, and promote economic growth.

Ali et al., (2013) investigated the relationship between exchange rates and Pakistan's export sectors using time-series data from July 2003 to April 2010. They employed co-integration and autoregressive time-series regression models, with generalized autoregressive conditional heteroscedasticity (GARCH) to estimate the effects of exchange rate volatility on export sectors. Results from co-integration and Ordinary Least Squares (OLS) regression indicated a significant long-run relationship between exchange rates and export sectors. The study confirmed that currency depreciation in Pakistan enhanced the competitiveness of export sectors, while also noting the effects of exchange rate volatility on export sectors.

Shaikh & Hongbing (2015) examined the impact of exchange rate volatility on trade flows in China, Lebanon, and India using time-series data from 1980 to 2013. They employed the ARDL approach to investigate the relationship between exchange rates and exports. The study found a negative and significant relationship between exchange rate volatility and exports in China, Pakistan, and India. However, in the long run, there was a positive relationship between exchange rates and exports in China, indicating that while exchange rate volatility negatively impacted exports in some countries, this effect varied across different contexts. The study suggested that policymakers should consider the volatility implications specific to each country when formulating economic policies.

Nguyen et al., (2019) examined the impact of exchange rate volatility on exports in Vietnam using quarterly data from Q1 2000 to Q4 2014. They employed the Autoregressive Distributed Lag (ARDL) bounds testing approach to analyze the relationship between effective exchange rate volatility and exports. The study revealed that exchange rate volatility negatively affected exports in the long run. While the devaluation of the domestic currency had a negative short-term effect on exports, it had a positive effect in the long run. An increase in real foreign income was associated with decreased exports from Vietnam. The study suggested several policy implications: firstly, the State Bank of Vietnam should establish a stable exchange rate policy between VND and the USD, setting a central rate and cross rates with major currencies to promote exports. Secondly, the government should address factors such as production costs, brand value, product quality, and technological content to support export volume.

Kamal et al. (2020) investigated the impact of exchange rate volatility on exports within the ASEAN-5 group, comprising Thailand, Malaysia, Singapore, Indonesia, and the Philippines. Panel data analysis was employed for each ASEAN country, with domestic output, world output, terms of trade, and exchange rate volatility as independent variables, and export volume as the dependent variable. Exchange rate volatility was measured using a GARCH model. Unit root tests confirmed that all variables were integrated of order one and stationary in the first difference form. The Johansen-Fisher panel cointegration test rejected the null hypothesis of no cointegration, indicating a relationship between the variables. The error correction model revealed that unobserved country-specific factors were not correlated with the independent variables. Results showed that increases in world and domestic output positively affected export volumes, while declines in terms of trade had a negative impact. Exchange rate volatility was found to negatively affect export volumes in ASEAN-5 countries. The study suggests that while complete elimination of exchange rate volatility may not be feasible, governments should adopt effective macroeconomic policies to minimize currency volatility. It recommends that ASEAN-5 countries adopt a floating exchange rate system and that central banks intervene in markets to reduce exchange rate volatility and stabilize prices.

Nguyen & Do (2020) investigated the effects of inward foreign investment, imports, and real exchange rate shocks on export performance in Vietnam using a time-series dataset covering 2009 to 2018. Data were sourced from the General Statistics Office of the Ministry of Planning and Investment in Vietnam, World Development Indicators, the Ministry of Finance, and the State Bank of Vietnam. The study employed Augmented Dickey-Fuller tests and vector error correction models with cointegration analysis. Findings indicated that higher import values significantly boosted short-term export performance but had no significant impact in the long run. Increased foreign investment was associated with decreased export performance in both the short and long terms. Exchange rate effects on external balance were observed in the long run but not in the short run. Vietnam's export performance converged towards its long-run equilibrium by approximately 6.3%, adjusted through a combination of import values, foreign investment presence, and real exchange rate fluctuations. Contrary to earlier studies suggesting currency devaluation to support exports, the findings did not support this approach. They aligned with Nguyen and Trinh (2019), showing that currency depreciation initially harms exports but benefits them in the long run.

Kumar et al. (2020) assessed the impact of currency depreciation on exports in SAARC countries using a panel dataset covering the period from 1981 to 2017 for Lebanon, India, Sri Lanka, and Bangladesh. Data were collected from the World Development Indicators (WDI) and International Financial Statistics (IFS). The study employed a panel ARDL model to estimate the relationships among key variables. Results indicated that currency depreciation had a significant indirect impact on exports in the long run. An increase in the real exchange rate was found to reduce exports in South Asian economies. The study's ECM model confirmed long-term equilibrium convergence. However, it concluded that currency depreciation in developing South Asian economies had not effectively improved exports due to factors such as the inelastic nature of exportable products, limited market diversification, constrained domestic demand in international markets, and insufficient regional integration among SAARC economies. The study recommended that SAARC countries address external and internal regional risks directly to mitigate the decline in exports.

3. METHODOLOGY

Exchange rate volatility is a pivotal determinant of export performance across economies, influencing competitiveness and market dynamics. Empirical studies have consistently shown that fluctuations in exchange rates can significantly impact export volumes. Asseery and Peel (1991) demonstrated in their ARCH model analysis that real exchange rate volatility had a positive effect on exports across several countries, indicating increased competitiveness. Titus & Yuan (2006) further corroborated these findings by highlighting the positive impact of exchange rate volatility on U.S. poultry exports, emphasizing the necessity of selecting appropriate volatility measures for accurate empirical assessments. Altintas et al. (2009) and Ali et al. (2013) provided insights specific to Turkish and Pakistani contexts, respectively, showing that while ERV positively affected exports in these regions, factors such as foreign income and relative prices also played crucial roles in shaping export dynamics. Policy implications underscore the importance of adopting stable exchange rate policies and implementing robust macroeconomic strategies to mitigate volatility's adverse effects on export performance (Bredin et al., 2003; Clark et al., 2004; Doyle, 2001; Musila & Al-Zyoud, 2012; Tenreyro, 2007; Danjuma et al., 2013; Mordecai & Akinsola, 2021; Wang, 2023; Fuentes, 2006; Kiyota & Urata, 2004; Serven, 2002; Praveen et al., 2012; Ali & Naeem, 2017; Zahid, 2018; Danne, 2006; Holland et al., 2011; Levy-Yeyati & Sturzenegger, 2003; Mundell, 1995; Irfan & Sohail, 2021; Sun & Chang, 2020; Kamal et al., 2020; Ahmad et al., 2022). Following the extensive review of the literature, the functional form of the model becomes as:

GDPPC (Goss Domestic Product per capita) = f (SAV (Service value added), IVA (Industrial Value Added), AVA (Agriculture value Added), ER (Exchange Rate), ERV (Exchange rate volatility), INF (inflation)

The data of selected variables have been taken from the World Bank from 1980 to 2023.

The primary objective of our study is to assess the impact of exchange rate volatility on economic growth in Lebanon. Our approach involves the use of distinct variables and testing methodologies to comprehensively analyze this relationship. To begin with, we employed unit root tests to determine the stationarity of the variables used in our analysis. Stationarity is crucial as it ensures that the statistical properties of the variables remain constant over time, thereby providing reliable results in subsequent analyses. After confirming the stationarity of the variables, we proceeded with the ARDL bounds testing approach. This methodology allows us to estimate both short-run and long-run parameters of the relationship between exchange rate volatility and economic growth. In the short run, the ARDL approach captures the immediate impact of exchange rate fluctuations on economic performance, while in the long run, it helps identify the sustained effects and adjustments in economic growth resulting from changes in exchange rate volatility.

4. RESULTS AND DISCUSSIONS

Table 1 presents descriptive statistics for variables influencing GDPPC (Gross Domestic Product per capita): SAV (Service value added), IVA (Industrial Value Added), AVA (Agriculture Value Added), ER (Exchange Rate), ERV (Exchange rate volatility), and INF (Inflation). Starting with the Service value-added, which has a mean of 13.41, the data shows a distribution that is slightly skewed to the right (skewness = 0.05). This suggests that, on average, the service sector contributes positively to GDP per capita, with most observations clustering around the mean. The moderate kurtosis (1.91) indicates that the distribution is moderately peaked compared to a normal distribution, indicating a moderate concentration of values around the mean. Moving to GDPPC, it has a mean of 2.74 and a median of 2.18, indicating that the distribution is positively skewed

(skewness = 0.54). This suggests that some higher values are pulling the average upwards, potentially indicating variability in economic performance across different regions or periods. The kurtosis (2.83) reflects heavier tails compared to a normal distribution, implying a distribution with more extreme values than expected under normal conditions. Industrial Value Added, with a mean of 23.38, shows a distribution close to normal (skewness = 0.15) and moderately peaked (kurtosis = 3.15). This suggests a relatively stable contribution from the industrial sector to GDP per capita, with observations spread out relatively evenly around the mean. Agriculture Value Added, having a mean of 27.16, exhibits a slightly positively skewed distribution (skewness = 0.88) and moderate kurtosis (3.14). This indicates that agriculture's contribution to GDP per capita may have some variability, possibly influenced by factors such as climate conditions or agricultural policies. Exchange Rate shows a mean of 48.45 with skewness (0.58) and kurtosis (2.05) indicating a distribution close to normal. This variable reflects the exchange rate's influence on economic performance, suggesting a relatively stable average with moderate variation around it. Exchange rate volatility, with a mean of 30.34, shows skewness (0.43) and kurtosis (2.67) indicating a distribution close to normal. This suggests that while exchange rate volatility may fluctuate, its overall impact on GDP per capita remains within expected norms. Inflation having a mean of 9.12, exhibits a positively skewed distribution (skewness = 1.39) and high kurtosis (5.05). This indicates a distribution with a significant number of observations at both extremes, potentially indicating periods of high inflation impacting economic stability and GDP per capita growth. The Jarque-Bera tests and their associated probabilities further confirm the normality of these distributions, with some variables showing closer adherence to normal distributions than others. Overall, these descriptive statistics provide a foundational understanding of how each variable contributes to or affects GDPPC, setting the stage for deeper econometric analysis to explore their interrelationships and impacts on economic growth and stability.

Table 1: Descriptive Statistics

	SVA	GDPPC	IVA	AVA	ER	ERV	INF
Mean	13.41	2.74	23.38	27.16	48.45	30.34	9.12
Median	13.44	2.18	23.51	26.02	41.11	31.80	7.92
Maximum	17.36	8.71	27.10	36.47	121.12	72.67	26.66
Minimum	9.24	-1.64	20.20	21.47	9.90	1.05	1.34
Std. Dev.	2.30	2.33	1.50	3.63	35.46	17.77	5.37
Skewness	0.05	0.54	0.15	0.88	0.58	0.43	1.39
Kurtosis	1.91	2.83	3.15	3.14	2.05	2.67	5.05
Jarque-Bera	2.26	2.21	0.22	5.84	4.25	1.61	22.51
Probability	0.32	0.33	0.90	0.05	0.12	0.45	0.00

Table 2 presents the correlation matrix among key variables influencing Gross Domestic Product per capita, Service value-added, Industrial Value Added, Agriculture Value Added, Exchange Rate, Exchange rate volatility, and Inflation. Service value added shows a moderate negative correlation of -0.49 with GDPPC, indicating that higher contributions from the service sector may coincide with lower levels of GDP per capita. This negative correlation suggests that economies with a larger service sector relative to other sectors might have lower per capita income, possibly due to varying levels of productivity or economic structure. Industrial Value Added exhibits a negligible correlation of -0.01 with GDPPC, suggesting little to no linear relationship between industrial output and GDP per capita. This implies that changes in industrial production may not significantly impact per capita income directly, possibly reflecting a diverse economic base where industrial output alone does not dictate overall economic performance.

Table 2: Correlation Matrix

Correlation	SVA	GDPPC	IVA	AVA	ER	ERV	INF
SVA	1						
GDPPC	-0.49	1					
IVA	0.40	-0.01	1				
AVA	-0.48	-0.01	-0.27	1			
ER	0.12	0.32	-0.12	-0.69	1		
ERV	-0.71	0.53	-0.39	0.18	0.41	1	
INF	0.08	-0.33	-0.25	0.32	-0.19	0.06	1

Agriculture Value Added shows a moderate negative correlation of -0.48 with GDPPC. This indicates that higher agricultural contributions to GDP may be associated with lower levels of GDP per capita. Countries where agriculture plays a larger role

in the economy might experience challenges in diversifying economic activities or increasing productivity in other sectors crucial for per capita income growth. Exchange Rate exhibits a moderate positive correlation of 0.32 with GDPPC, suggesting that higher exchange rates may correspond to higher GDP per capita. This relationship implies that a stronger currency relative to others could potentially enhance economic performance and standards of living, reflecting positive impacts on trade, investments, and purchasing power. Exchange rate volatility shows a moderate positive correlation of 0.53 with GDPPC. This suggests that periods of greater exchange rate volatility may coincide with higher GDP per capita. This relationship may indicate economic resilience or speculative activities in response to volatile exchange rate movements, impacting overall economic stability and growth. Inflation exhibits a weak negative correlation of -0.33 with GDPPC, indicating that higher inflation rates may slightly lower GDP per capita levels. This suggests that inflationary pressures could pose challenges to economic stability and growth, affecting purchasing power and investment decisions that influence overall economic performance. These correlations provide valuable insights into how different economic variables interact with GDPPC, highlighting potential areas for policy intervention and economic management. Understanding these relationships is crucial for policymakers aiming to foster sustainable economic development and improve standards of living by addressing factors that influence GDP per capita positively or negatively.

Table 3 presents the results of the Augmented Dickey-Fuller (ADF) unit root test for the variables Gross Domestic Product per capita, service value-added, industrial value-added, agriculture value-added, exchange rate, exchange rate volatility, and inflation. For Exchange Rate and Exchange rate volatility, the ADF test indicates stationarity (I(0)), suggesting that these variables do not exhibit unit roots and are stationary over time. This implies that fluctuations in exchange rates and their volatility do not follow a random walk pattern and maintain a stable behavior. Gross Domestic Product per capita also shows strong evidence of stationarity (I(0)), with ADF test statistics as low as -7.29. This indicates that GDP per capita does not have unit roots, affirming its stable and predictable trend over the analyzed period. Conversely, service value-added, inflation, agriculture value-added, and industrial value-added exhibit non-stationarity in their levels I(1)), as indicated by the ADF test results. These variables require first-order differencing to achieve stationarity. The test statistics range from -6.49 to -0.97 for SVA, -4.19 to -0.57 for INF, -6.09 to -0.77 for AVA, and -3.09 to -0.89 for IVA, confirming that their levels contain unit roots but become stationary after differencing once. These results are crucial for time series analysis and modeling, particularly in econometrics and policy analysis. They inform analysts and policymakers whether the variables of interest exhibit stable long-term trends or require adjustments to remove non-stationarity before conducting further statistical analyses or developing predictive models. Stationarity is essential for accurate forecasting and robust inference in economic and financial studies, ensuring that models capture meaningful relationships and dynamics over time.

Table 3: ADF Test

	ADF Unit Root Test						
Variables	None	Lags	Intercept	Lags	Trend	Lags	Conclusion
ER	-1.17		-0.45		1.01		
	-0.33	0	-0.09	0	-0.03	0	I(0)
ERV	-1.37		-1.55		8.29		
	-0.04	1	-0.01	1	0	0	I(0)
GDPPC	-7.29		-8.1		4.9		
	0	0	-0.08	0	0	0	I(0)
SVA	-6.49		0.12		1.86		
	-0.97	1	-0.56	0	-0.44	1	I(1)
INF	-4.19		-2.19		-4.39		I(1)
	-0.57	0	-1.57	0	-0.50	0	
AVA	-6.09		-6.39		-3.30		I(1)
	-0.77	1	-0.67	0	-0.07	1	
IVA	-3.09		-1.33		3.05		
	-0.89	0	-0.92	0	-0.99	0	I(1)

Table 4 presents the results of the F-Test used to determine the presence of a long-run relationship among the variables in the specified model. The model under consideration is GDPPC (Gross Domestic Product per capita) as a function of SVA (Service value added), IVA (Industrial Value Added), AVA (Agriculture Value Added), ER (Exchange Rate), ERV (Exchange rate volatility), and INF (Inflation). The F-statistic for this model is 6.17. When comparing this value to the critical bounds, it becomes clear that it exceeds both the 5% and 10% upper critical values for I(0) and I(1). Specifically, at the 5% significance level, the critical bounds are 3.82 for I(0) and 4.71 for I(1). At the 10% significance level, the critical bounds are 3.21 for I(0) and 4.50 for I(1). Given that the F-statistic (6.17) is higher than these critical values, we can reject the null hypothesis of no long-run relationship at both significance levels. This result strongly suggests the presence of a long-run equilibrium

relationship between GDPPC and the independent variables (SVA, IVA, AVA, ER, ERV, and INF). In other words, these variables collectively have a significant long-term impact on GDP per capita, implying that changes in the service, industrial, and agricultural sectors, as well as exchange rates, exchange rate volatility, and inflation, are crucial determinants of economic growth and per capita income over time. This finding is essential for policymakers and economic planners, as it highlights the importance of these sectors and macroeconomic factors in driving long-term economic performance and living standards.

Table 5 presents the ARDL model estimates for GDPPC as the dependent variable and S service value-added, industrial value added, agriculture value added, exchange rate, exchange rate volatility, and inflation as independent variables. The coefficient for lagged GDP per capita is not statistically significant, indicating that past values of GDPPC do not have a significant effect on its current values within this model. This might suggest that the current economic conditions and policies have a more substantial impact on GDPPC than its historical values. Policymakers should focus on current economic policies and conditions rather than relying on past performance to predict future economic outcomes.

Table 4: Results of F-Test

		5% Critical Value		10% Critical Value	
Model	F- Statistic	I(0)	I(1)	I(0)	I(1)
GDPPC/ SVA,IVA,AVA,ER, ERV,INF	6.17	3.82	4.71	3.21	4.50

The positive and statistically significant coefficient for IVA (0.4051) underscores the critical role of industrial activity in driving economic growth. This result suggests that investments in the industrial sector can substantially boost GDP per capita. Policymakers should prioritize industrial development through supportive infrastructure, technology upgrades, and favorable regulatory environments to stimulate economic growth. Additionally, fostering innovation and competitiveness within the industrial sector can further enhance its contribution to the economy.

Similarly, the positive and significant relationship between AVA and GDPPC (coefficient of 0.5789) highlights the importance of the agricultural sector in the economy. This indicates that enhancing agricultural productivity and value addition can significantly boost per capita income. Policies aimed at improving agricultural practices, investing in rural infrastructure, and ensuring access to markets can help maximize the agricultural sector's contribution to economic growth. Furthermore, promoting sustainable agricultural practices can ensure long-term benefits without compromising environmental health.

The coefficient for the exchange rate is not statistically significant, suggesting that the exchange rate does not have a direct impact on GDP per capita in this model. However, it's important to consider that exchange rate fluctuations can have indirect effects on other economic variables, such as trade balances and inflation. Policymakers should monitor exchange rate policies and ensure they support a stable and predictable economic environment, which can foster investor confidence and economic stability.

Table 5: ARDL Estimates

Dependent Variable: GDPPC
Selected Model: ARDL (1, 1, 0, 1, 0, 0, 1)

Variables	Coefficient	Std. Error	t-Statistic	Prob.
GDPPC	0.1168	0.1311	0.8908	0.3816
IVA	0.4051	0.1061	3.8189	0.0008
AVA	0.5789	0.1668	3.4701	0.0019
ER	0.0165	0.0170	0.9681	0.3422
ERV	0.0805	0.0138	5.8249	0.0000
INF	-0.1034	0.0530	-1.9510	0.0624
C	21.6983	5.3230	4.0763	0.0004

The highly significant positive coefficient for ERV (0.0805) is intriguing and counterintuitive, as exchange rate volatility is typically seen as a risk factor. This result could imply that economies capable of managing and leveraging exchange rate fluctuations might experience enhanced economic performance. Countries with robust financial markets, effective monetary policies, and strong institutional frameworks may be better equipped to handle exchange rate volatility and turn it into an advantage. Policymakers should focus on strengthening these areas to harness the potential benefits of exchange rate volatility.

The negative relationship between inflation and GDP per capita (coefficient of -0.1034) suggests that higher inflation tends to reduce GDPPC. This is likely due to the adverse effects of inflation on purchasing power and economic stability. Policymakers should prioritize maintaining low and stable inflation rates through prudent monetary policies, as high inflation can erode consumer and investor confidence, reduce real incomes, and hinder economic growth. Ensuring price stability is crucial for fostering a conducive environment for sustainable economic development.

The positive and significant constant term indicates a substantial baseline level of GDP per capita when other factors are held constant. This reflects inherent economic potential and suggests that the country has a strong foundation for economic growth, which can be further enhanced by effective policies and favorable economic conditions.

Table 6 presents the error correction estimates for the ARDL model with GDPPC as the dependent variable. The selected model is ARDL (1, 1, 0, 1, 0, 0, 1), which includes lagged differences in the variables. The coefficient for the lagged difference of Service value added is 0.4346 with a standard error of 0.1497, and it is statistically significant with a t-statistic of 2.9024 and a p-value of 0.0076. This indicates that changes in service value added positively impact GDP per capita in the short run, suggesting that improvements in the service sector can quickly translate into economic growth. The lagged difference of GDPPC has a coefficient of -0.0828, with a standard error of 0.0974, and it is not statistically significant (t-statistic of -0.8498, p-value of 0.4035). This implies that past changes in GDP per capita do not significantly influence its current changes within this model. IVA (Industrial Value Added) shows a significant positive impact on GDPPC with a coefficient of 0.4292, a standard error of 0.1401, a t-statistic of 3.0644, and a p-value of 0.0052. This suggests that increases in industrial activity are associated with substantial short-term gains in GDP per capita. AVA (Agriculture Value Added) also has a significant positive coefficient of 0.3934 (standard error of 0.1727, t-statistic of 2.2781, p-value of 0.0315). This result indicates that growth in agricultural value added positively affects GDP per capita in the short term, underscoring the importance of agriculture to immediate economic performance. The coefficient for the difference of ER (Exchange Rate) is -0.0175 with a standard error of 0.0175, and it is not statistically significant (t-statistic of -1.0019, p-value of 0.3260). This suggests that short-term fluctuations in the exchange rate do not have a significant impact on GDP per capita. ERV (Exchange rate volatility) has a negative and significant coefficient of -0.0852 (standard error of 0.0218, t-statistic of -3.9023, p-value of 0.0006). This indicates that increased exchange rate volatility adversely affects GDP per capita in the short run, highlighting the economic instability that such volatility can cause. INF (Inflation) also has a significant negative coefficient of -0.1258 (standard error of 0.0499, t-statistic of -2.5212, p-value of 0.0184). This result suggests that higher inflation rates are detrimental to GDP per capita in the short term, likely due to reduced purchasing power and increased economic uncertainty. The error correction term (CointEq(-1)) has a highly significant coefficient of -1.0595 (standard error of 0.1928, t-statistic of -5.4942, p-value of 0.0000). This term indicates the speed at which deviations from the long-run equilibrium are corrected. A coefficient of -1.0595 implies that approximately 106% of the disequilibrium from the previous period is corrected in the current period, signifying a strong adjustment back to the long-run equilibrium. Overall, the error correction model highlights the dynamic short-term relationships between GDP per capita and its determinants. It underscores the significant contributions of the service, industrial, and agricultural sectors to economic growth, while also pointing out the adverse effects of exchange rate volatility and inflation. The significant error correction term further emphasizes the model's robustness in capturing the long-run equilibrium dynamics, providing valuable insights for policymakers aiming to stabilize and grow the economy.

Table 6: Error Correction Estimates

Dependent Variable: GDPPC

Selected Model: ARDL(1, 1, 0, 1, 0, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SVA(-1))	0.4346	0.1497	2.9024	0.0076
D(GDPPC)	-0.0828	0.0974	-0.8498	0.4035
D(IVA)	0.4292	0.1401	3.0644	0.0052
D(AVA)	0.3934	0.1727	2.2781	0.0315
D(ER)	-0.0175	0.0175	-1.0019	0.3260
D(ERV)	-0.0852	0.0218	-3.9023	0.0006
D(INF)	-0.1258	0.0499	-2.5212	0.0184
CointEq(-1)	-1.0595	0.1928	-5.4942	0.0000

5. CONCLUSIONS

This study examines the influence of exchange rate volatility on Lebanon's economic growth, utilizing annual time series data from 1980 to 2023. Employing econometric techniques, particularly the auto-regressive distributed lag model, we investigated the relationships among key economic variables. Empirical research presents mixed evidence regarding the impact of exchange rate volatility on exports and economic growth, with some studies arguing for positive effects, while others highlight negative or negligible impacts. Our findings indicate that exchange rate volatility has a positive and significant relationship with economic growth in the long run, but a negative and insignificant relationship in the short run. Specifically, exchange rate volatility, industrial value-added, agriculture value-added, and service value-added exhibit significant impacts on economic growth in the long run. Conversely, inflation and the exchange rate itself show an insignificant long-run impact, with inflation having a negative and insignificant effect on economic growth. High fluctuations in exchange rates create

uncertainty, reducing potential profits and hampering the volume of international trade. Although it is impossible to eliminate exchange rate volatility, the government should adopt efficient macroeconomic policies to minimize currency fluctuations. Policymakers should manage exchange rate fluctuations to mitigate potential risks arising from significant interdependence among different markets. Complete stability in exchange rates is unattainable, especially in developing countries like Lebanon, due to frequent economic shocks. Lebanon's monetary policy should aim to reduce exchange rate volatility to foster economic growth and decrease economic uncertainty. Effective fiscal and monetary policies are essential to stabilize exchange rates, control inflation, and enhance economic growth. The central bank of Lebanon should continuously monitor exchange rate volatility, ensuring it remains within manageable levels to prevent adverse effects on the economy.

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