Bulletin of Applied Economics, 2024, 11(2), 1-13
https://doi.org/10.47260/bae/1121

# Exchange Rate Volatility and Economic Growth in Eurozone Markets

**Mohammad Robbani**[1]

## Abstract

Firms involved in foreign trade (exports and imports) are generally sensitive to fluctuations in the exchange rates and carefully take it into consideration while planning their future trading. In this paper, we study the inter-relationship between exchange rate volatility and economic growth in the Eurozone markets. Specifically, we study how volatility of a country's foreign currency exchange rate affects economic development. For an economy that is heavily dependent on foreign trade, its overall economic productivity may be affected by fluctuation of its currency with the currencies of the trading partners. We investigate this relationship between the GDP growth rates of twenty Eurozone countries with the exchange rate volatility of thirteen developed countries. Our results indicate that GDP growth rates of most of the Eurozone countries are generally affected by exchange rate volatility of its trading partners. Most of these impacts are negative indicating that the GDP growth rates of the Eurozone countries decline with the volatility of the exchange rates of trading partners. The result is consistent with the findings of previous literature in this area. Our findings are important for the policymakers to consider in planning the management of their currencies to minimize the negative effect of exchange rate volatility.

**JEL:** E24, F31, G15.
**Keywords:** Volatility, Exchange rates, GDP growth rate, Regression.

[1] Alabama A&M University.

Article Info: Received: November 9, 2023. Revised: May 25, 2024. Published online: June 1, 2024

# 1 Introduction

The relationships between exchange rate volatility have been the subject of study by many authors in the past. For example, Aghion, Bacchetta, Ranciere and Rogoff (2009), Habib, Mileva and Stracca (2017), and others find that exchange rate volatility can have a significant impact on the productivity growth of an economy. In this paper, we study the inter-relationship between exchange rate volatility and economic growth in the Eurozone markets. Specifically, we study how volatility of a country's foreign currency exchange rate affects economic development. We hypothesize that exchange rate volatility affects the economic growth of a country negatively. The argument for the negative effect is because higher volatility of the exchange rate creates higher uncertainty about the value of the currency which in turn creates uncertainty on the economic activities that are either directly or indirectly affected by the currency value. For an economy that is heavily dependent on foreign trade, its overall economic productivity may be affected by fluctuation of its currency with the currencies of the trading partners. Firms involved in foreign trade (exports and imports) are generally sensitive to fluctuations in the exchange rates and carefully take it into consideration while planning their future trading. The conclusion of the previous literature on the subject is not very definitive. The literature in this area of study is very rich in terms of covering the exchange rate volatility, both real and nominal, and its effect on economic development, economic growth, and financial markets, in both developed and developing economies. Our objective in this paper is to investigate and analyze the exchange rate volatility of Euro with some of the major global currencies, such as, US dollar, British pound, Japanese yen, Chinese yuan, Canadian dollar and Australian dollar. Then, we estimate the GDP growth rate of Eurozone markets and use it as a proxy for economic development of those countries.

Fluctuation of a currency can have a significant impact on the economic growth of a country (Aghion, Bacchetta, Ranciere and Rogoff, 2009). A reduction in the exchange rate of a country would make its products less expensive, thus making it easier to increase its exports. Increase in exports means an increase in production, which in turn should increase employment. Therefore, during economic downturns, especially in recessions, it would be logical to devalue the country's currency to stimulate the economy. However, devaluation reduces the purchasing power of the currency, making it necessary to work more to obtain the same standard of living or to accept a lower standard of living for the same amount of work. Appreciation of the currency would have the opposite effect. It reduces the exports but allows greater imports for less currency, which is the same as obtaining more goods and services for the same work or obtaining the same amount of goods and services with less work. It would be unwise to appreciate one's currency during economic downturns or to devalue during economic booms.

The presumption here is that the exchange rate can be manipulated, and that the government is willing and able to intervene in the economy. For such an activist government the exchange rate valuation could become a policy instrument. The question is whether a government can intervene and influence the foreign exchange rate perpetually over a long period. The exchange rate was fixed among countries between 1870 to 1944 but the fixed exchange rate did not completely end until 1971 when the United States suspended convertibility as well (Hodrick 1987). But very few economists would agree that the exchange rate could be set arbitrarily and maintained indefinitely without serious consequences for the economy. These policy decisions and economic fluctuations basically set the currency exchange rates to be more volatile.

One way a country can choose and set its exchange rate is through buying and selling foreign currencies. In other words, it is necessary to have an ample amount of foreign currency for sale or the ability to buy, which allows maintaining a desired level of exchange rate. The alternative option is to allow the market to determine the value of foreign exchange that allows a predictable and relatively constant flow of foreign exchange. In general, the smaller economies have been pursuing fixed exchange rates more commonly than the larger economies (Hodrick 1987). A country might peg its currency to one or several currencies. The ultimate act of pegging a currency is to use another country's currency to set the exchange rate with other currencies, as in the case of Ecuador, El Salvador, Panama, and Zimbabwe (US Dollar). A fixed exchange rate might encourage speculative capital inflow, overinvestment, and moral hazard (Fischer 2001), while it might help to stabilize the economy (McKinnon and Schnabl 2003). In some cases, the reasons for the use

of foreign currency are not solely financial, such as for the central, eastern, and south-eastern European countries (CESE). Nevertheless, the consequences are the same. The present study does not engage in the discussion of whether one regime or the other results in more or less volatility of exchange rate or the economy of a country. Instead, the focus is on whether exchange rate volatility would assist or hinder economic growth, a long run concern. Some attribute in the East Asian "miracle" to the stability of foreign exchange rates for the region during the 1990s (World Bank 1993, McKinnon 2006). Eventually, the region adopted a more flexible foreign exchange policy combined with lower rates of economic growth. However, the direction of causality is not clear. There have been many other economic and non-economic events and policy changes during the same period making the correlation less causal. Pegging one's currency to another prevents it from appreciation and depreciation in response to domestic causes while make it vulnerable to factors causing fluctuations in the other currency.

## 2 Literature Review

Understanding the nature of exchange rate volatility and its impact on various economic indicators has been the subject of study for a long time, especially since the floating exchange rate era. For example, Hodrick and Srivastava (1984) study the risk and return characteristics and the existence of risk premia in the foreign exchange markets of several currencies. They find evidence of heteroskedasticity in their model and find that the expected risk premium is a nonlinear function of forward premium. Aghion, Bacchetta, Ranciere and Rogoff (2009), Habib, Mileva and Stracca (2017), and others find that exchange rate volatility can have a significant impact on the productivity growth of an economy. Mees and Rogoff (1983) study various empirical exchange rate models of the seventies and investigate if those models fit out of sample data. Edwards and Levy-Yeyati (2003) report countries with more flexible exchange rates have higher growth rates, while Ghosh, Gulde, and Wolf (2003) find little evidence to support the claim. Using only 12 countries with very long data sets Eichengreen and Leblang (2003) find an inverse relationship between the two. There are good reasons for foreign exchange volatility to affect economic growth. As is well established in the finance literature, volatility causes uncertainty and uncertainty causes a reduction in investments and an increase in the required rate of return. Kappler, Reisen, Schularick and Turkisch (2012) find a very limited effect on productivity when they studied the effect of real and nominal appreciations of foreign currencies of 128 developing and advanced economies between 1960 to 2008.

There have been many studies on this subject from various perspectives. Some more recent studies find a significant relationship between exchange rate volatility and economic growth. Schnabl (2008) studies the exchange rate volatility and growth in 41 small economies at the EMU periphery and finds a negative relationship between exchange rate volatility and growth for those countries. Using the firm-level data set, Demir (2013) examines the effects of exchange rate volatility on the growth of domestic versus foreign and publicly traded versus non-trade manufacturing firms and finds a significant growth reducing effect on manufacturing firms. Another study (Sabina, Manyo and Ugochukwu, 2017) looks at the impact of exchange rate volatility on the economic growth of Nigeria during the period of 1981-2015 and finds that the volatility has negative and significant impact on the Nigerian economy.

Using a panel data of 194 countries for the period of 1995-2019, Ramoni-Perazzi and Romero (2022) investigates the effect of exchange rate volatility on the economic growth and find a significant negative effect of exchange rate volatility on the economic growth. Another study by Barguellil, Ben-Salha and Zmami (2018) investigates the impact of exchange rate volatility on economic growth. Using a sample of 45 developing and emerging countries over the period of 1985-2015, the study finds that nominal and real exchange rate volatility has a negative impact on economic growth.

Many recent studies also investigate the effects of exchange rate volatility on exports, imports and trade balances in different countries and regions. We look at the literature on the effect of exchange rate volatility on exports, imports and trade balances because exports, imports and trade balances have direct and indirect impact on the economic growth of a country. For example, Bahmani-Oskooee and Arize (2022) study the effect of exchange rate volatility on U.S. bilaterial trade of 20 African countries. They find a significant short-run effect of exchange rate volatility on almost all U.S. exports to and imports from each of the 20

countries. They also find a significant long-run effect on exports to 15 countries and imports from 12 countries. Bosupeng, Athula and Su (2024), find a significant influence of exchange rate volatility on international trade. Their results show that exchange rate volatility reduces the positive effect of appreciation on the trade balance while it increases the negative effect of depreciation on the trade balance. Lal, et al (2023) also study the effect of exchange rate volatility on international trade and find that exchange rate volatility has significant impacts both exports and imports. However, the impacts are different on different exporters, sectors, and regions.

## 3 Methodology

The end of the Bretton Woods system of fixed exchange rates in 1944 marks the era of the *de jure* floating exchange system. Calvo and Reinhart (2002, 2006) demonstrate the existence of discrepancy between *de jure* and *de facto* floating systems. They also point out that the range of fluctuations is limited. Frankel and Wei (1994 and 2008) use the percentage change in the country's exchange rate against a pegged currency as the country's *de facto* exchange range. Exchange rate volatility can be measured in different ways, such as, 1) the mean of the percentage exchange rate changes, 2) the standard deviation of percentage of exchange rate changes, 3) the square root of the square of the mean of the percentage exchange rate plus its variance, $\sqrt{\mu^2 + \sigma^2}$ (Ghosh, Gulde, and Wolf 2003), 4) the yearly relative exchange rate changes by comparing January with December, and 5) the standard deviation of the percentage changes in the periodic exchange rates. In this study, we use the last method. This measure provides the overall volatility over a period eliminating the short-term effect of extreme fluctuations. We use the GDP growth rate as a proxy for the economic growth of the countries in our sample. The economic growth rate is measured in terms of percentage change in the quarterly GDP for each country. To measure the impact of foreign exchange volatility on economic growth, we run a joint regression of economic growth rate of each Eurozone country on the exchange rates of euro with all other currencies in our sample.

## 4 Data and Samples

In this paper, we study the interrelationship between the exchange rate volatility and economic growth for twenty Eurozone countries. We utilize two types of data for this study: 1) exchange rates and 2) GDP growth rates. The sample period covers January 2006 through December 2017. We collect daily exchange rates for each country and calculate the daily percentage change in the exchange rate. Using these daily percentage changes, we calculate the standard deviation for each quarter. This provides us with 48 (12 years x 4) quarterly standard deviations for each country. Using quarterly GDP values for each country in our sample, we calculate the GDP growth rate for each quarter. We collect the GDP values for all countries from 2006 through 2017 both in current and 2011 constant prices in the local currency (i.e., euro).[2] *In addition to using the GDP growth rates in current prices, we also use GDP growth rates in constant prices to account for the inflationary effects on the GDP and to eliminate any unexplained outcome in our results.* The Eurozone countries that are included in this study are: Austria (AUS), Belgium (BEL), Croatia (CRO), Cyprus (CYP), Estonia (EST), Finland (FIN), France (FRA), Germany (GER), Greece (GRE), Ireland (IRE), Italy (ITA), Latvia (LAT), Lithuania (LIT), Luxembourg (LUX), Malta (MAL), The Netherlands (NET), Portugal (POR), Slovakia (SLO), Slovenia (SLV) and Spain (SPA). All twenty countries in the Eurozone use the Euro as the common currency. We will use the monthly exchange rates for the same time period between euro and US dollar (USD), British pound (BP), Australian dollar (AUD), Brazilian real (BRR), Canadian dollar (CAD), Chinese yuan (CHY), Hong Kong dollar (HKD), Indonesian Rupiah (INR),

[2] Eurozone GDP data were retrieved from International Monetary Fund website.

Japanese yen (JAY), Korean won (KOW), Mexican peso (MXP), New Zealand dollar (NZD) and Russian ruble (RUR).[3]

# 5 Empirical Results and Analysis

Table 1 presents the descriptive statistics for exchange rate changes for the 13 countries used to obtain exchange rates with Euro between 2006 and 2017. All means and the medians are near zero and some evidence of skewness and kurtosis also exists. However, the standard deviation for the total period for all currencies ranges from 1.84% to 3.98%.

**Table 1: Descriptive statistics of daily exchange rates changes of euro with thirteen major currencies from 2006 through 2017**

| | AUD | BRR | CAD | CHY | HKD | IND | JAY | KOW | MXP | NZD | RUR | BP | USD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | -5E-04 | 0.0045 | -4E-04 | 7.54E-05 | 0.0004 | 0.0027 | 0.0005 | 6.93E-05 | 0.0033 | -7E-04 | 0.0048 | 0.0012 | 0.0004 |
| Median | -0.002 | 0.002 | -0.003 | 0.00086 | 0.0016 | 0.0018 | 0.001 | -0.00043 | 0.0031 | -0.003 | -3E-04 | -0.001 | 0.0009 |
| Maximum | 0.1027 | 0.1438 | 0.0703 | 0.06767 | 0.0676 | 0.1281 | 0.0891 | 0.09992 | 0.1006 | 0.0768 | 0.2227 | 0.0889 | 0.0639 |
| Minimum | -0.058 | -0.093 | -0.052 | -0.07309 | -0.076 | -0.137 | -0.128 | -0.07091 | -0.071 | -0.057 | -0.129 | -0.036 | -0.075 |
| Std. Dev. | 0.024 | 0.0398 | 0.0223 | 0.0233 | 0.0237 | 0.0348 | 0.0281 | 0.02595 | 0.0311 | 0.0251 | 0.0358 | 0.0184 | 0.0238 |
| Skewness | 0.5269 | 0.7743 | 0.3296 | 0.03547 | 0.0139 | -0.084 | -0.248 | 0.54988 | 0.3121 | 0.374 | 1.441 | 0.9497 | 0.0185 |
| Kurtosis | 4.1395 | 4.3915 | 2.8611 | 3.29455 | 3.2424 | 5.6531 | 5.2653 | 4.6919 | 3.0656 | 3.2049 | 11.157 | 5.2089 | 3.1988 |

Table 2 provides average of the quarterly GDP growth rates of the twenty countries in the Eurozone both in current and constant (in 2011) prices from 2006 through 2017. The average GDP growth rates vary from country to country with the lowest rate of -0.65% for Greece to the highest of 6.65% for Latvia in constant prices and with the lowest of -0.17% for Italy to the highest of 4.29% for Ireland in current prices. Only Greece and Italy had the negative average GDP growth rates among the selected sample countries.

**Table 2: Average quarterly GDP growth rates of twenty Eurozone countries during 2006 through 2017**

| Countries | Constant Prices (2011) | Current Prices | Countries | Constant Prices (2011) | Current Prices |
|---|---|---|---|---|---|
| Austria | 0.013088 | 0.03071 | Italy | -0.00171 | 0.01145 |
| Belgium | 0.012407 | 0.02857 | Latvia | 0.019791 | 0.06649 |
| Croatia | 0.01245 | 0.02135 | Lithuania | 0.027027 | 0.06217 |
| Cyprus | 0.008577 | 0.02075 | Luxembourg | 0.03052 | 0.05598 |
| Estonia | 0.020503 | 0.06416 | Malta | 0.037284 | 0.06277 |
| Finland | 0.007594 | 0.02629 | Netherlands | 0.013272 | 0.02498 |
| France | 0.009639 | 0.02152 | Portugal | 0.00213 | 0.01725 |
| Germany | 0.015653 | 0.02915 | Slovakia | 0.036205 | 0.04480 |
| Greece | -0.0158 | -0.00647 | Slovenia | 0.015471 | 0.03288 |
| Ireland | 0.042915 | 0.04966 | Spain | 0.008966 | 0.01910 |

[3] Daily exchange rates between euro and US dollar, British pound, Australian dollar, Brazilian real, Canadian dollar, Chinese yuan, Hong Kong dollar, Indonesian Rupiah, Japanese yen, Korean won, Mexican peso, New Zealand dollar and Russian ruble were collected from European Central Bank website.

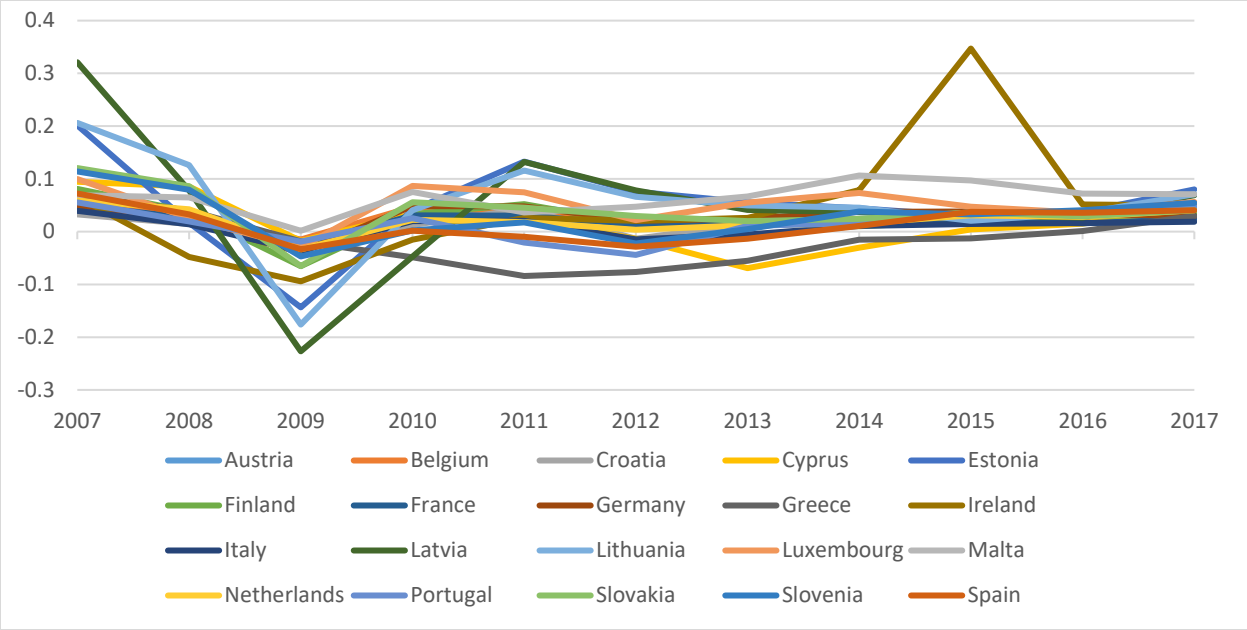


**Figure 1: Quarterly GDP growth rates of Eurozone countries under current prices during 2006 through 2017**

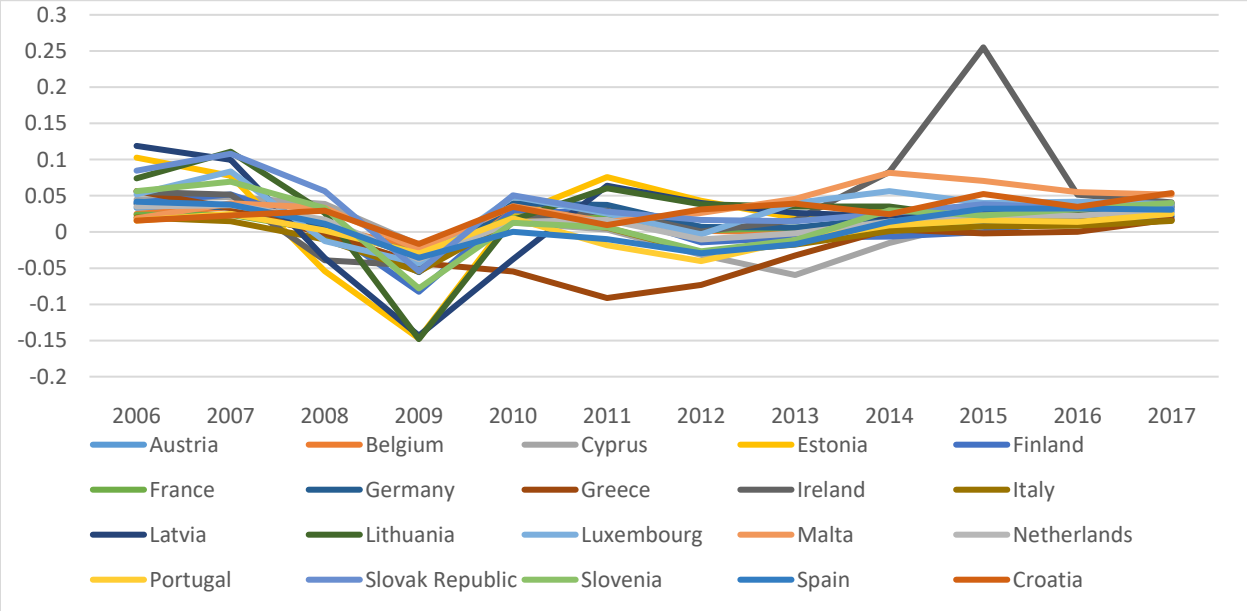


**Figure 2: Quarterly GDP growth rates of Eurozone countries under constant Prices during 2006 through 2017**

Table 3 displays the results of regressions of the GDP growth rates in current prices for each of the twenty countries using the exchange rate volatilities of Euro against each of the 13 currencies included in the study. For example, the value -0.224 in the first row of the first column is the slope of the simple regression of the growth rate of GDP for Austria using the exchange rate volatility of Euro against Australian dollar. Most of the coefficients are negative (155 out of 260; 20 Eurozone countries times 13 currencies). This result indicates that, in general, the exchange rate volatility affects the GDP growth rate of most of the countries negatively. The main outcome, however, is that only forty-five (45) of those negative coefficients are statistically significant at either 1%, 5% or 10% levels. Results in table 3 also show that the GDP growth rates of the countries that are significantly affected by the exchange rate volatility of most of the countries are Estonia, Greece, Ireland, Latvia, Lithuania, Luxemburg, Slovakia and Solvania. Most of the currencies have a negative effect on the GDP growth rates of the Eurozone countries with the exception of New Zealand dollar. It will be interesting to explore the economic arguments for such relationship between the volatility of New Zealand dollar and GDP growth rates of Eurozone countries.

**Table 3: Coefficients of linear regression of GDP growth rate with the volatility of exchange rate changes. Values below the coefficients represent the standard error of the coefficients. GDP growth rates are based on the current prices of domestic currency**

| | **AUS** | **BEL** | **CRO** | **CYP** | **EST** | **FIN** | **FRA** | **GER** | **GRE** | **IRE** |
|---|---|---|---|---|---|---|---|---|---|---|
| AUD | -0.224 | -0.514 | 0.532 | -0.381 | -2.520 | 0.335 | -0.162 | -0.251 | -1.294** | 0.582*** |
| | (0.890) | (0.814) | (0.845) | (2.208) | (3.941) | (1.540) | (0.871) | (1.061) | (2.438) | (4.754) |
| BRR | 0.016 | -0.123 | 0.118 | 0.437 | -1.048** | 0.156 | 0.114 | 0.036 | 0.712 | 3.621** |
| | (0.479) | (0.443) | (0.564) | (1.177) | (2.129)** | (0.826) | (0.466) | (0.570) | (1.306) | (2.278) |
| CAD | 0.219 | 0.697 | 0.398 | 3.707 | -2.945** | 0.839 | 0.562 | 0.488 | 0.510 | 0.620 |
| | (1.038) | (0.942) | (1.254) | (2.292) | (4.588)** | (1.777) | (1.001) | (1.230) | (2.874) | (5.537) |
| CHY | -0.210 | 0.008 | 0.761 | 1.242 | -2.948** | -0.185 | 0.058 | -0.069 | -0.669* | 0.365 |
| | (0.727) | (0.679) | (0.654) | (1.764) | (3.152) | (1.260) | (0.713) | (0.870) | (2.010) | (3.888) |
| BP | -1.091 | -0.754 | 1.164 | 0.423 | -7.276** | -1.359 | -0.928 | -1.103 | -0.329* | -2.82*** |
| | (0.726) | (0.708) | (0.952) | (1.985) | (2.792) | (1.320) | (0.728) | (0.892) | (2.222) | (4.186) |
| HKD | -0.123 | 0.100 | 0.725 | 1.710 | -2.788** | 0.046 | 0.091 | -0.087 | -0.605* | -1.161** |
| | (0.702) | (0.653) | (1.627) | (1.654) | (3.039) | (1.214) | (0.686) | (0.837) | (1.936) | (3.726) |
| IND | -0.295 | -0.195 | 0.685 | 0.742 | -2.404** | -0.199 | 0.018 | -0.280 | 0.752 | 1.243** |
| | (0.606) | (0.567) | (0.738) | (1.500) | (2.655) | (1.058) | (0.600) | (0.726) | (1.682) | (3.245) |
| JAY | -0.688 | -0.678 | 1.675 | -0.466 | -4.791 | -0.731 | -0.628 | -0.733 | -2.441 | -3.175** |
| | (0.670) | (0.619) | (1.385) | (1.737) | (2.786) | (1.195) | (0.659) | (0.807) | (1.790) | (3.615) |
| KOW | -1.172 | -1.058 | 0.826 | -0.212* | -7.668** | -1.888 | -1.002 | -1.231 | -0.814* | 2.528*** |
| | (0.761) | (0.713) | (0.234) | (2.095) | (2.942) | (1.336) | (0.765) | (0.931) | (2.330) | (4.440) |
| MXP | -0.982 | -0.886 | 1.432 | 0.651 | -6.745** | -1.428 | -0.849 | -1.328 | 0.491 | -2.883** |
| | (0.765) | (0.715) | (0.956) | (2.034) | (3.046) | (1.354) | (0.761) | (0.890) | (2.281) | (4.304) |
| NZD | 0.704 | 0.483 | 1.715 | 1.875 | 2.950** | 1.105 | 0.737 | 0.448 | 0.799 | 7.559** |
| | (0.784) | (0.742) | (0.642) | (1.929) | (3.549) | (1.364) | (0.762) | (0.961) | (2.242) | (3.625) |
| RUR | -0.359 | -0.323 | 0.579 | -0.818 | -2.042* | -0.658 | -0.342 | -0.146 | -0.341 | 2.527* |
| | (0.246) | (0.230) | (1.254) | (0.619) | (1.035) | (0.420) | (0.242) | (0.320) | (0.743) | (1.203) |
| USD | -0.115 | 0.119 | 1.958* | 1.707 | -2.670** | 0.057 | 0.105 | -0.072 | -0.607* | -1.197** |
| | (0.694) | (0.645) | (2.685) | (1.633) | (3.013) | (1.201) | (0.678) | (0.828) | (1.914) | (3.683) |
| **Adj. $R^2$** | **0.058** | **0.012** | **0.043** | **0.062** | **0.151** | **0.167** | **0.187** | **0.025** | **0.122** | **0.013** |

| | ITA | LAT | LIT | LUX | MAL | NET | POR | SLO | SLV | SPA |
|---|---|---|---|---|---|---|---|---|---|---|
| AUD | -0.609 | -0.662*** | 1.438** | -2.365 | 0.617 | 0.008 | -0.661 | 0.338* | 0.226* | -0.775 |
| | (0.930) | (6.096) | (4.086) | (1.645) | (1.206) | (1.139) | (1.354) | (2.164) | (2.017) | (1.640) |
| BRR | 0.094 | -0.176** | 0.505* | -0.533 | 0.668 | 0.502 | 0.506 | 0.658 | 0.696 | 0.635 |
| | (0.508) | (3.268) | (2.197) | (0.954) | (0.620) | (0.590) | (0.716) | (1.142) | (1.059) | (0.866) |
| CAD | 0.657 | -3.571*** | 0.711** | -0.447* | 0.693 | 0.766 | 0.933 | 1.835* | 0.931* | 0.660* |
| | (1.086) | (7.011) | (4.782) | (2.099) | (1.406) | (1.304) | (1.568) | (2.455) | (2.331) | (1.920) |
| CHY | -0.084 | -3.627** | -0.497** | -0.644 | 0.202 | -0.053 | -0.356 | 0.617 | -0.353 | -0.498 |
| | (0.776) | (4.852) | (3.357) | (1.463) | (0.997) | (0.931) | (1.114) | (1.760) | (1.646) | (1.346) |
| BP | -0.715 | -9.858*** | -4.887** | -2.967* | -0.321 | -0.679 | 0.033 | -1.762* | -1.073 | -0.689 |
| | (0.824) | (4.516) | (3.361) | (1.328) | (1.094) | (1.002) | (1.232) | (1.868) | (1.784) | (1.476) |
| HKD | -0.048 | -3.494** | -0.140** | -0.895 | -0.066 | 0.051 | -0.347 | 0.727 | -0.277 | -0.445 |
| | (0.747) | (4.671) | (3.235) | (1.394) | (0.961) | (0.896) | (1.072) | (1.689) | (1.586) | (1.297) |
| IND | -0.103 | -2.064** | -0.356* | -0.633 | 0.329 | 0.241 | 0.430 | 0.730 | 0.309 | 0.261 |
| | (0.651) | (4.138) | (2.822) | (1.225) | (0.833) | (0.779) | (0.931) | (1.470) | (1.383) | (1.136) |
| JAY | -1.009 | -5.540** | -1.492** | -2.659* | -0.153 | -0.884 | -1.538 | -1.005 | -1.346 | -1.976 |
| | (0.677) | (4.479) | (3.208) | (1.150) | (0.962) | (0.854) | (0.965) | (1.679) | (1.533) | (1.149) |
| KOW | -0.940 | -10.05*** | -5.581** | -2.995* | -0.119 | -0.832 | -0.383 | -1.996 | -1.565* | -0.926 |
| | (0.850) | (4.830) | (3.476) | (1.428) | (1.158) | (1.048) | (1.293) | (1.955) | (1.848) | (1.545) |
| MXP | -0.772 | -8.613** | -3.908** | -2.856* | -0.449 | -0.380 | -0.041 | -1.257 | -0.728 | -0.484 |
| | (0.843) | (4.939) | (3.596) | (1.406) | (1.121) | (1.047) | (1.267) | (1.964) | (1.852) | (1.526) |
| NZD | 0.565 | 5.432** | 2.334** | 0.625 | -0.432 | 0.824 | 0.463 | 1.853* | 0.888* | 1.254 |
| | (0.848) | (5.294) | (3.679) | (1.637) | (1.107) | (1.006) | (1.242) | (1.888) | (1.820) | (1.461) |
| RUR | -0.211 | -2.871 | -1.982* | -0.590 | 0.559 | -0.301 | 0.056 | -0.941 | -0.407 | -0.160 |
| | (0.280) | (1.613) | (1.079) | (0.516) | (0.326) | (0.332) | (0.415) | (0.586) | (0.599) | (0.501) |
| USD | -0.032 | -3.380** | -0.130** | -0.813 | -0.101 | 0.043 | -0.347 | 0.748 | -0.290 | -0.440 |
| | (0.739) | (4.624) | (3.199) | (1.382) | (0.950) | (0.886) | (1.060) | (1.669) | (1.568) | (1.283) |
| **Adj. $R^2$** | **0.021** | **0.023** | **0.186** | **0.013** | **0.012** | **0.063** | **0.015** | **0.021** | **0.042** | **0.122** |
| Note: Standard errors are in parentheses. *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance | | | | | | | | | | |

Table 4 presents the coefficients for similar regressions as in table 3 except the GDP growth rates used are in 2011 constant prices. Under this regression analysis, the number of negative coefficients increased to 179 and 39 of those negative coefficients are statistically significant at 1%, 5% or 10% levels. Again, the countries whose GDP growth rates were significantly affected by the exchange rate volatilities are Estonia, Ireland, Latvia, Lithuania, and Luxemburg. The significant negative coefficients for Estonia correspond to most of the currencies except Brazilian real, Russian rubble and US dollar. The only currency that has positive coefficient on Estonia's GDP growth rate is New Zealand. The significant negative coefficients of Ireland correspond to Australian dollar, British pound, Hongkong dollar, Japanese yen, and Mexican peso while the positive coefficients correspond to Indonesian rupiah, Korean wow and New Zealand dollar. In case of Latvia, all currencies except Brazilian real and Russian rubble have significant effect on its GDP growth rate. The only currency that has positive coefficient is New Zealand. For Lithuania, except Brazilian real, Chinese yuan, Indonesian rupiah and Russian rubble, all other currencies have significant effects on its GDP growth rates except for a positive coefficient in case of New Zealand. Finally, those for Luxembourg correspond to Japanese yen, the Korean wow and Mexican peso. The only positive and statistically significant coefficient belongs to Ireland and is for the exchange rate volatility with Russia.

**Table 4: Coefficients of linear regression GDP growth rate with the exchange rate change volatility. Values below the coefficients represent the standard errors. GDP growth rates are based on 2011 constant prices of domestic currency**

| | **AUS** | **BEL** | **CRO** | **CYP** | **EST** | **FIN** | **FRA** | **GER** | **GRE** | **IRE** |
|---|---|---|---|---|---|---|---|---|---|---|
| AUD | -0.244 | -0.506 | 0.522 | -0.651 | -2.473* | -0.509 | -0.411 | -0.588 | -1.141 | -0.426** |
| | (0.856) | (0.642) | (0.335) | (1.474) | (2.808) | (1.542) | (0.629) | (1.119) | (1.907) | (3.398) |
| BRR | 0.020 | -0.082 | 0.428 | 0.433 | -0.908 | -0.003 | -0.056 | -0.054 | 0.648 | 2.193 |
| | (0.461) | (0.354) | (0.454) | (0.786) | (1.535) | (0.831) | (0.344) | (0.608) | (1.020) | (1.685) |
| CAD | 0.379 | 0.507 | 0.465 | 2.367 | -2.792** | 0.895 | 0.136 | 0.531 | -0.730 | 0.817 |
| | (0.994) | (0.754) | (1.534) | (1.563) | (3.277) | (1.783) | (0.747) | (1.310) | (2.248) | (3.951) |
| CHY | -0.171 | -0.021 | 0.261 | 0.453 | -2.586* | -0.401 | -0.219 | -0.079 | -1.240 | 0.330 |
| | (0.701) | (0.541) | (0.624) | (1.208) | (2.238) | (1.261) | (0.521) | (0.927) | (1.537) | (2.778) |
| BP | -0.855 | -0.659 | 1.044 | 0.674 | -5.397** | -1.168 | -0.733 | -1.181 | -0.807 | -1.681** |
| | (0.725) | (0.558) | (0.742) | (1.322) | (1.991) | (1.345) | (0.530) | (0.950) | (1.727) | (3.013) |
| HKD | -0.042 | -0.033 | 0.740 | 0.752 | -2.534* | -0.112 | -0.179 | -0.024 | -1.374 | -0.864* |
| | (0.676) | (0.521) | (1.387) | (1.147) | (2.149) | (1.220) | (0.503) | (0.893) | (1.464) | (2.662) |
| IND | -0.269 | -0.164 | 0.632 | 0.275 | -2.453* | -0.409 | -0.274 | -0.365 | 0.292 | 0.652* |
| | (0.584) | (0.452) | (0.548) | (1.018) | (1.846) | (1.057) | (0.433) | (0.771) | (1.330) | (2.327) |
| JAY | -0.654 | -0.648 | 1.355 | -0.844 | -3.857* | -1.299 | -0.675 | -0.915 | -2.501 | -2.498* |
| | (0.646) | (0.480) | (1.081) | (1.143) | (1.948) | (1.151) | (0.460) | (0.847) | (1.310) | (2.563) |
| KOW | -1.082 | -0.810 | 0.346 | 0.172 | -5.534** | -1.945 | -0.882 | -1.415 | -1.021 | 1.876** |
| | (0.740) | (0.573) | (0.464) | (1.410) | (2.139) | (1.335) | (0.542) | (0.978) | (1.811) | (3.170) |
| MXP | -0.805 | -0.833 | 1.282 | 0.545 | -5.320** | -1.329 | -0.797 | -1.260 | -0.228 | -2.255** |
| | (0.753) | (0.552) | (0.296) | (1.365) | (2.106) | (1.371) | (0.538) | (0.971) | (1.793) | (3.063) |
| NZD | 0.499 | 0.323 | 1.525 | 1.080 | 1.372* | 0.696 | 0.291 | 0.349 | 0.160 | 4.746* |
| | (0.769) | (0.595) | (0.922) | (1.314) | (2.624) | (1.398) | (0.579) | (1.030) | (1.770) | (2.717) |
| RUR | -0.334 | -0.128 | 0.562 | -0.141 | -0.959 | -0.581 | -0.176 | -0.292 | 0.098 | 2.069 |
| | (0.239) | (0.197) | (1.084) | (0.449) | (0.831) | (0.433) | (0.187) | (0.332) | (0.588) | (0.798) |
| USD | -0.037 | -0.017 | 2.358** | 0.741 | -2.460 | -0.097 | -0.167 | -0.007 | -1.382 | -0.870 |
| | (0.669) | (0.515) | (2.985) | (1.134) | (2.130) | (1.206) | (0.497) | (0.883) | (1.445) | (2.632) |
| **Adj. $R^2$** | **0.041** | **0.023** | **0.065** | **0.015** | **0.011** | **0.073** | **0.013** | **0.018** | **0.122** | **0.054** |
| | **ITA** | **LAT** | **LIT** | **LUX** | **MAL** | **NET** | **POR** | **SLO** | **SLV** | **SPA** |
| AUD | -0.837 | -1.603* | 0.425* | -1.354 | 0.627 | -0.355 | -0.620 | 0.129 | -0.423 | -0.602 |
| | (0.951) | (2.999) | (2.716) | (1.470) | (1.214) | (0.930) | (0.950) | (1.754) | (1.751) | (1.182) |
| BRR | 0.068 | -0.365 | 0.100 | -0.439 | 0.609 | 0.256 | 0.251 | 0.438 | 0.457 | 0.491 |
| | (0.528) | (1.626) | (1.457) | (0.809) | (0.630) | (0.495) | (0.514) | (0.930) | (0.930) | (0.623) |
| CAD | 0.663 | -3.906** | -0.798** | -0.756 | -0.038 | 0.507 | 1.009 | 1.513 | 0.796 | 0.518 |
| | (1.130) | (3.319) | (3.156) | (1.767) | (1.432) | (1.079) | (1.084) | (1.986) | (2.029) | (1.384) |
| CHY | -0.203 | -3.155* | -1.233 | -1.323 | -0.317 | -0.242 | -0.095 | 0.260 | -0.464 | -0.474 |
| | (0.804) | (2.277) | (2.188) | (1.180) | (1.000) | (0.762) | (0.792) | (1.432) | (1.428) | (0.967) |
| BP | -0.608 | -5.825** | -3.955* | -2.020 | -0.464 | -0.610 | 0.092 | -1.367 | -1.219 | -0.295 |
| | (0.867) | (2.024) | (2.102) | (1.221) | (1.097) | (0.820) | (0.872) | (1.518) | (1.532) | (1.073) |
| HKD | -0.146 | -3.161* | -1.118* | -1.478 | -0.524 | -0.176 | -0.085 | 0.313 | -0.398 | -0.440 |
| | (0.775) | (2.175) | (2.110) | (1.111) | (0.954) | (0.735) | (0.763) | (1.377) | (1.376) | (0.932) |
| IND | -0.274 | -2.232* | -0.926 | -0.804 | -0.024 | -0.143 | 0.159 | 0.475 | -0.123 | -0.017 |
| | (0.672) | (1.966) | (1.845) | (1.021) | (0.845) | (0.642) | (0.664) | (1.196) | (1.205) | (0.822) |
| JAY | -1.145 | -4.040* | -1.756* | -2.244** | -0.320 | -0.939 | -0.990 | -1.082 | -1.620 | -1.454 |
| | (0.689) | (2.030) | (2.071) | (0.977) | (0.965) | (0.676) | (0.698) | (1.341) | (1.286) | (0.825) |
| KOW | -0.860 | -5.534** | -4.355* | -2.608* | -0.336 | -0.772 | -0.276 | -1.763 | -1.710 | -0.510 |
| | (0.895) | (2.292) | (2.180) | (1.195) | (1.161) | (0.854) | (0.916) | (1.567) | (1.575) | (1.124) |
| MXP | -0.753 | -5.236** | -3.684* | -2.710** | -0.563 | -0.565 | -0.117 | -1.399 | -1.121 | -0.346 |
| | (0.881) | (2.274) | (2.228) | (1.127) | (1.123) | (0.848) | (0.896) | (1.561) | (1.584) | (1.102) |
| NZD | 0.313 | 2.249* | 1.280* | 0.231 | -0.595 | 0.462 | 0.068 | 1.517 | 0.447 | 0.583 |
| | (0.895) | (2.683) | (2.448) | (1.395) | (1.107) | (0.842) | (0.885) | (1.528) | (1.596) | (1.077) |
| RUR | -0.068 | -1.002 | -0.995 | -0.117 | 0.583 | -0.101 | 0.119 | -0.597 | -0.210 | 0.141 |
| | (0.299) | (0.867) | (0.763) | (0.463) | (0.325) | (0.282) | (0.292) | (0.498) | (0.529) | (0.361) |
| USD | -0.137 | -3.105* | -1.101* | -1.423 | -0.567 | -0.180 | -0.086 | 0.339 | -0.406 | -0.449 |
| | (0.767) | (2.153) | (2.087) | (1.103) | (0.940) | (0.727) | (0.754) | (1.361) | (1.360) | (0.921) |
| **Adj. $R^2$** | **0.025** | **0.122** | **0.029** | **0.133** | **0.166** | **0.154** | **0.012** | **0.023** | **0.043** | **0.051** |

Note: Standard errors are in parentheses. *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance

Table 5 shows the summary of positive and negative coefficients at different significance levels both under current and constant prices. Out of the 105 positive coefficients under the current price regime, only nineteen are significant at different significance levels, while 45 out of 155 negative coefficients under the current price regime are significant at different significance levels. Under 2011 constant price regime, 81 coefficients are positive with only eight coefficients are significant at different significance levels. On the other hand, the total number of negative coefficients is 179 and 49 of those coefficients are significant at different significance levels.

**Table 5: Number of positive and negative regression coefficients at different significance levels under both current and constant prices.**

| | Positive Coefficients | | | | | Negative Coefficients | | | | | Total Coefficients |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1% Level | 5% Level | 10% Level | Not Significant | Total | 1% Level | 5% Level | 10% Level | Not Significant | Total | |
| Current Prices | 3 | 8 | 15 | 79 | 105 | 6 | 23 | 18 | 109 | 155 | 260 |
| Constant Prices | 1 | 3 | 9 | 68 | 81 | 0 | 14 | 30 | 135 | 179 | 260 |

The economic argument for negative coefficients of exchange rates both in current and constant prices reinforce the fact that exchange rate volatility has detrimental effects on economic growth. These results support the findings of past studies on the inter-relationship between exchange rate volatility and economic growth. These results are demonstrated by Schnabl (2008), Eichengreen and Leblang (2003), Sabina, Manyo and Ugochukwu (2017), Barguellil, Ben-Salha and Zmami (2018) and Ramoni-Perazzi and Romero (2022), among others. Our findings also validate the findings of past research that show that exchange rate volatility diminishes the positive effect of currency appreciation on the trade balance while it increases the negative effect of currency depreciation on the trade balance (Bosupeng, Athula and Su, 2024). The study by Lal, et al (2023) also shows a significant effect of exchange rate volatility on international trade which supports our findings. The economic arguments for positive coefficients may be little more subtle than the arguments for negative coefficients. One argument for having the positive coefficients for some countries is that the economic agents plan to take advantage of the exchange rate volatility and avoid its negative consequences.

Our overall results basically support the findings of past studies on the inter-relationship between exchange rate volatility and economic growth. We show that GDP growth rates of most of the Eurozone countries are generally affected by exchange rate volatility of its trading partners. Most of these impacts are negative indicating that the GDP growth rates of the Eurozone countries decline with the volatility of the exchange rates of trading partners. While there are some positive coefficients. The result is consistent with the findings of previous literature in this area.

# 6 Other Determinants of Economic Growth

Our study specifically investigates the effect of exchange rate volatility on economic growth. We acknowledge that there can be other factors that may affect the economic growth of a country. As many prior studies have shown, each economy can have its own determinants that may be unique compared to other economies. However, there are some common determinants that may be similar in most economies. Some of those determinants are social and demographic, such as, education level, population statistics, labor force participation, etc. while some others are economic determinants, such as, inflation, unemployment level, government spending etc. By studying the relevant literature, we have identified some of those common economic determinants that affect economic growth and run a robustness check on our findings in this paper. Those determinants are international trade (Chen and Feng, 200; Bruns and Ioannidis, 2020; Vedia-Jerez and Chasco, 2016), inflation (Chen and Feng, 2000), unemployment (Pekarcikov, Vanek and Sousedikova, 2022), capital accumulation (Lee and Hong, 2022; Vedia-Jerez and Chasco, 2016), and domestic investment and government spending (Hossain and Mitra, 2013).

Chen and Feng (2000) find positive impact of high-volume international trade on the economic growth while negative impact of inflation on the economic growth in China. Bruns and Ioannidis (2020) finds a significant positive impact of trade on economic growth. Vedia-Jerez and Chasco, 2016 also find the similar impact of trade on the economic growth in South American countries from 1960 to 2008. Pekarcikov, Vanek and Sousedikova (2022) find a negative effect of unemployment on the economic growth in OPEC countries. Lee and Hong (2022) find a positive impact of capital accumulation on the economic growth of twelve developing Asian economies over three decades (1981-2007). Similarly, Vedia-Jerez and Chasco (2016) find positive impact of capital accumulation on the economic growth of South American countries during the period of 1960 to 2008. Hossain and Mitra (2013) study the impact of foreign aid, foreign direct domestic investment, external debt and government spending on the economic growth of thirty-three African countries during the period of 1974-2009. They find significant positive effects of domestic investment and government spending on economic growth.

We have selected some of these determinants of economic growth, such as, inflation, international trade balance, unemployment and foreign direct investment to check the robustness of the effect of exchange rate volatility on the economic growth. We have collected data for these variables for the Eurozone counties for the period of 2006 to 2017 from the World Development Indicators[4] database. Then we run a joint regression of these variables along with the exchange rate volatility for each of the Eurozone countries. Our results show that inflation and unemployment have a significant negative effect on the economic growth for most of the countries and international trade balance and foreign direct investment have a significant positive effect on the economic growth of these countries. However, the presence of these variables does not diminish the effect of exchange rate volatility on the economic growth of Eurozone countries in any significant way.

# 7 Conclusions

In this paper, we attempted to explore the effect of the exchange rates volatility of the euro with thirteen major trading partners on the economic growth of twenty Eurozone countries. The results are mixed in terms of the number of significant regression coefficients. The regression results of the volatility of exchange rates of thirteen trading partner countries on the growth rate of GDP of the twenty Eurozone countries in the study indicate that majority of the slopes have the expected signs when constant prices are used. As the previous study documented (Aghion, Bacchetta, Ranciere and Rogoff (2009), Habib, Mileva and Stracca (2017), Kappler,M., H. Reisen, M. Schularick and E. Turkisch (2012)), the exchange rate volatility can have a negative impact on the economic growth of a country. Out of the total possible 260

[4] https://databank.worldbank.org/source

regression coefficients, 155 coefficients are negative under current prices and 179 coefficients are negative under constant prices. However, the number of statistically significant negative slopes are higher when current prices are used (45) than when the constant prices are used (49). The only anomaly is the presence of the positive and statistically significant coefficients of New Zealand dollar on the GDP growth rates of Estonia, Ireland, Latvia, Lithuania, Slovakia, and Slovenia under current price regime, and on the GDP growth rates of Estonia, Ireland, Latvia and Lithuania under constant price regime. The presence of few other positive and significant coefficients is also unexpected, such as, Brazilian real, British pound, Indonesian rupiah and Russian rubble on Ireland, US dollar on Croatia and Canadian dollar in Spain under current prices. Under constant prices, few of the significant positive correlations that are found are: US dollar on Croatia, Indonesian rupiah and Korean wow in Ireland, and Australian dollar on Lithuania. The presence of these significant positive correlations makes it difficult to make a direct conclusion on the real effect of exchange rate volatility on economic growth. However, our overall results indicate that the exchange rate volatility exerts a negative impact on the economic growth of the Eurozone countries. Findings of our study are important for the policy makers in the sense that they can try to manage currency value fluctuation to minimize the negative effects of exchange rate volatility on the economy. Some of the possible steps would be 1) to prepare a short-term and long-term forecast of the future exchange rate volatility, 2) to forecast the short-term and long-term trade balances with the major exporting and importing partner countries, 3) to forecast the short-term and long-term economic productivity growth in the presence of other social, demographic and economic factors, and 4) finally, to use these forecasts to prepare for any unexpected effect on the economy due to exchange rate volatility.

## References

Aghion, P., P. Bacchetta, R. Ranciere and K. Rogoff (2009), Exchange Rate Volatility and Productivity Growth: The Role of Financial Development, *Journal of Monetary Economics*, 56, 494-513.

Bahmani-Oskooee, Mohsen and Augustine C. Arize (2022), The effect of exchange rate volatility on U.S. bilateral trade with Africa: Symmetric and asymmetric analysis, *Economic Systems*, 46.

Barguellil, Achouak, Ousama Ben-Salha and Mourad Zmami (2018), Exchange rate volatility and economic growth, *Journal of Economic Integration* 33(2), 1302-1336, https://doi.org/10.11130/jei.2018.33.2.1302

Bruns, B. Stephan and John P. Ioannidis (2020), Determinants of economic growth: Different time different answer, *Journal of Macroeconomics*, 63, https://doi.org/10.1016/j.jmacro.2019.103185

Calvo, Guillremo and Carmen Reinhart. 2002. Fear of Floating. *Quarterly Journal of Economics*. 117: 379-408.

Calvo, Guillremo and Carmen Reinhart. 2006. Fixing for your Life. In *Emerging Capital markets in Turmoil: Bad Luck or Bad Policy*? Guillermo Calvo, MA: MIT Press.

Chen, Baizhu and Yi Feng (2000), Determinants of economic growth in China: Private enterprise, education and openness, *China Economic Review*, 11(1), 1-15. https://doi.org/10.1016/S1043-951X(99)00014-0

Demir, First (2013), Growth under exchange rate volatility: Does access to foreign or domestic equity market matter? *Journal of Development Economics*, 100(1), 74-88. https://doi.org/10.1016/j.jdeveco.2012.08.001

Edwards, Sebastian and Eduardo Levy-Yeyati. 2003. Flexible Exchange Rates as Shock Absorbers. NBER Working Paper 9867.

Eichengreen, Barry and David Leblang. 2003. Exchange Rates and Financial Fragility. NBER Working Paper 7418.

Fischer, Stanley. 2001. Exchange Rate Regimes: Is the Bipolar View Correct? *Journal of economic Perspective.* 15(2): 3-24.

Frankel, Jeffrey, and Shang-Jin Wei. 1994. Yen Bloc or Dollar Bloc? Exchange Rate Policies of the East Asian Economies. *In Macroeconomic Linkages: Savings, Exchange Rates, and Capital Flows*, Takatoshi Ito and Anne Krueger, eds. Chicago: University of Chicago Press. 295-329.

Frankel, Jeffrey, and Shang-Jin Wei. 2008. Estimation of De Facto Exchange Rate Regimes: Synthesis of the Techniques for Inferring Flexibility and Basket Weights. IMF Staff Papers 55(3): 384-41.

Ghosh, Atish, Anne-Marie Gulde, and Holger Wolf. 2003. *Exchange Rate Regimes: Choices and Consequences*, Cambridge. Massachusetts: MIT Press.

Habib,M., E. Mileva and L. Stracca (2017), The Real Exchange Rate and Economic Growth: Revisiting the Case Using External Instruments, *Journal of International Money and Finance*, 3, 386-398.

Hodrick, R.J. and S. Srivastava (1984), An Investigation of Risk and Return in Foreign Exchange, *Journal of International Money and Finance*, 3, 5-29.

Hossain, Sharif and Rajashri Mitra (2013), The Dterminants of economic growth in Africa: a dynamic causality and panel cointegration analysis, *Economic Analysis and Policy*, 43(2), 217-226. https://doi.org/10.1016/S0313-5926(13)50019-1

Josepha Ramoni-Perazzi and Hector Romero (2022), Exchange rate volatility, corruption and economic growth, *Heliyon*, 8(12), 1-11.

Kappler, M., H. Reisen, M. Schularick and E. Turkisch (2012), The Macroeconomic Effect of Large Exchange Rate Appreciations, *Open Economic Review*, 24(3), 471-494.

Lal, Madan, Satish Kumar, Dharen K. Pandey, Varun K. Rai and Weng M. Lim (2023), Exchange rate volatility and international trade, *Journal of Business Research*, 167(23)

Lee, Jong-Wha and Kiseok Hong (2022), Economic growth in Asia: Determinants and prospects, *Japan and the World Economy*, 24(2), 101-113, https://doi.org/10.1016/j.japwor.2012.01.005

McKinnon, Ronald and Gunther Schnabl. 2003. Synchronized Business Cycles in East Asia and Fluctuations in the Yen/Dollar Exchange Rate. *The World Economy*. 26 (8):1067-1088.

McKinnon, Ronald. 2006. *Exchange Rates Under the East Asian Dollar Standard: Living with Conflicted Virtue*. Cambridge, Massachusetts

Meese, R.R. and K. Rogoff, (1983), Empirical Exchange Rate Models of the Seventies: Do They Fit out of Sample? *Journal of International Economics*, 14,3-24.

Mpho Bosupeng, Athula Naranpanawa and Jne-Je Su (2024), Does Exchange Rate volatility affect the impact of appreciation and depreciation on the trade balance? A nonlinear bivariate approach, *Economic Modelling*, 130

Pekarcikov, Katerina, Michal Vanek and Radmila Sousedikova (2022) Determinants of economic growth: Panel data analysis of OPEC. https://doi.org/10.1016/j.resourpol.2022.103129

Sabina, Nsofor E, Takon S. Manyo andUgwuegbe S. Ugochukwu (2017), Modeling Exchange rate volatility and economic growth in Nigeria, *Noble International Journal of Economics and Financial Research*, 2(6), 88-97.

Schnabl, Gunther (2008), Exchange rate volatility and growth in small open economies at the EMU periphery, *Economic Systems*, 32(1), 70-91.

Vedia-Jerez, Daniel and Coro Chasco (2016), Long-run Determinants of economic growth in South America, *Journal of Applied Economics*, 19(1), 169-192. https://doi.org/10.1016/S1514-0326(16)30007-1

World Bank. 1993. *The East Asian Miracle: Economic Growth and Public Policy*. Oxford University Press.