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Impact of Exchange Rate Fluctuations on Trade Volume and Compositions

ECON F311 International Economics Assignment

Group 10

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Abstract

This study empirically analyzes the effects of exchange rate volatility on volume of trade for India using quarterly time series data for the period from 2011-2019. The study implements Augmented Dickey-Fuller (ADF) test to check the stationary of data for each variable, Granger Causality test to check the existence of short-run relationships among the variables and Johansen's cointegration technique to find the long-run relationship between trade volume and exchange rate volatility. The results show that there exists a negative relationship between trade volume and exchange rate volatility and a positive relationship between trade volume and gross domestic product (GDP). The empirical results show that a moderation in exchange rate volatility can increase trade volume and consequently GDP in the case of India. Further, bidirectional causality from trade volume and GDP is found, while unidirectional causality from trade volume to exchange rate volatility is detected.

Introduction

The Bretton Woods agreement of 1944 initiated a new international monetary system. The agreement essentially replaced the gold standard with the U.S. dollar as the global currency. Under the agreement, countries would maintain fixed exchange rates between their currencies and the dollar. If a country's currency value became too weak relative to the dollar, its central bank would buy its currency in foreign exchange markets. The agreement was needed to promote international economic growth and prevent trade wars and hyperinflation due to World War 1. The Bretton Woods agreement collapsed in 1971, leading to the advent of floating exchange rates.

Under the floating exchange rate system, the currency price of an economy is set by the foreign exchange market based on demand and supply relative to other currencies. The underlying economy's strengths and weaknesses also play a role in determining the exchange rate. Fluctuations in a country's exchange rate are caused by trade and capital movements, monetary policy, political conditions, and so on. Furthermore, exchange rate changes influence economic policy, economic growth, capital flows, interest rates, inflation, etc.

The growth rate of an economy is predominantly dependent on the exchange rate due to increased international trade activities. There has been a considerable change in trade composition of developing countries with a shift from exporting primarily agricultural goods to exporting manufacturing goods. This change in trade composition has made the terms of trade of developing countries more stable but has made trade volume more sensitive to exchange rate volatility.

The consequences of fluctuations in exchange rates on international trade and the overall economy have become significant research areas. In general, exchange rate uncertainty has a varied impact on the economy. For instance, since international trade prices are closely related to exchange rate fluctuations, exchange rates can affect international trade earnings and trade volumes. While theory suggests a negative relationship between exchange rate volatility and international trade, empirical evidence suggests that the theoretical argument might not always be accurate.

In light of this contradictory theoretical and empirical evidence, our study's main aim is to analyze the relationship between India's exchange rate volatility and India's volume of trade. The study is organized as follows. Section 2 gives a review of the current literature. Section 3 describes the data and explains the methodology used in this study. Section 4 provides inferences and results from the methods used in this study. Finally, section 5 provides conclusive remarks and policy suggestions.

Literature Review

Sherzod Yarmukhamedov (2007), In this paper "Trade Effects of Exchange Rate Fluctuations: Evidence from Sweden," the author empirically investigated trade effects of exchange rate fluctuations from the export and import perspective for Sweden. The aggregate monthly data between January 1993 to December 2006 were collected. Import and export were stationary at order zero. In contrast, all other variables like income level, real effective exchange rate, etc., were stationary at order 1. Export and import volumes were considered from the point of their determinants, including exchange rate volatility, measured through the EGARCH model. The results show that the short-run dynamics of volatility are negatively associated with both export and import for Sweden in the given period.

Najia Saqib (2013), In their paper "The Effect of Exchange Rate Fluctuation on Trade Balance: Empirical Evidence from Saudi Arab Economy," the author believes that a long term fluctuation of the real exchange rate from the nominal rate can lead to drastic macroeconomic imbalances. This study aims to analyze the long-run relationship between the fluctuation of exchange rate and trade balance in Saudi Arabia within a 30 year period of 1982-2011. The paper uses the Purchasing Power Parity (PPP) model, the two-step Engel-Granger cointegration technique, which involves the long-run estimation of the exchange rate equation through standard regression. The analysis shows a significant long-run relationship between the exchange rate fluctuation and trade balance for Saudi Arabia but no short run relationship.

Pratik Sharma and Amber Tiwari (2015), In their paper "Fluctuating Exchange rates and Balance of trades in India: An Empirical Study," the authors examined the impact of fluctuations of Indian currency on foreign trading in India between April 1997 and December 2012 to estimate the dollar rate fluctuation in accordance with foreign trading with the help of a regression model using Ordinary Least Squares (OLS) method and Augmented Dickey-Fuller (ADF) test to check the stationarity of the data. The variables under consideration - Exchange Rate and Balance of Trade are found to be non-stationary at the level but integrated of order one using the ADF tests for unit root. Exchange rate fluctuations were determined to have a significant negative impact on the balance of trade.

Sidheswar Panda and Ranjan Kumar Mohanty (2015), In their paper "Effects of Exchange Rate Volatility on Exports: Evidence from India," the authors empirically examine the effects of real exchange rate volatility on India's exports for the period from 1970-71 to 2011-12. This analysis uses a simple rolling standard deviation as a measure of exchange rate volatility. It implements the Johansen Cointegration technique to understand the long-run relationship among the variables where India's real export volume is used as a dependent variable. The exchange rate volatility of India and World GDP are used as independent variables. It finds that there exists a co-integrating relationship among exports, exchange rate volatility, and World GDP. India's export volume is negatively related to its own real exchange rate volatility, whereas the export volume is positively related to the World GDP. The empirical results indicate that moderation in the exchange rate volatility can increase the export volume in India's case.

Data and Methodology

Data

To analyze the relationship between volume of trade and exchange rate fluctuations, we used quarterly time-series data for the period from 2011-2019. We extracted the data of GDP, exports and imports from the Handbook of Statistics on India Economy published by the Reserve Bank of India (RBI). For the exchange rate, we used the historical data of the USD-INR exchange rate.

The variables taken in consideration are as follows:

1. Exports + Imports (Vol) is used as a proxy for volume of trade. We have used logarithmic values since the actual values are of a high magnitude.
2. India's GDP is used as a proxy for the economy's activities since economic activities also affect trade volume through exchange rate. We have used logarithmic values since the actual values are of a high magnitude.
3. USD-INR exchange rate is used as a proxy for exchange rate. We have used moving average standard deviation for calculating exchange rate volatility (XRV).

Methodology

We have performed the following tests to establish a relationship between Exchange Rate and Trade Volume:

1) Augmented Dickey-Fuller Test (ADF)

   The ADF test was performed to check the stationarity of data for each variable.

2) Granger Causality Test

   The Granger Causality test was performed to check the existence of short-run relationships among variables.

3) Johansen Cointegration Test

   The Johansen Cointegration test was performed to find out the relationship between Trade Volume and Exchange Rate.

We have used **STATA** to perform all the tests mentioned hencewith.

Results

1. Augmented Dickey-Fuller Test

Null Hypothesis: Data is Non-Stationary

Alternative Hypothesis: Data is Stationary

```
. dfuller logGDP, trend regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        34

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.355            -4.297            -3.564           -3.218
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4035

------------------------------------------------------------------------------
D.logGDP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
logGDP       |
         Ll. |  -.3817363   .1620624    -2.36   0.025    -.7127119   -.0507607
         LD. |  -.0978716   .1740343    -0.56   0.578    -.4532971    .257554
      _trend |   .0015851   .0007661     2.07   0.047     .0000204    .0031498
       _cons |   3.818731   1.621751     2.35   0.025     .5066741    7.130787
------------------------------------------------------------------------------
```

For logGDP, we can see that the Test statistic value is greater than the critical value at all the significance levels (10%, 5% and 1%), implying that the NULL hypothesis can't be rejected. Thus, we can conclude that logGDP is Non-Stationary.

```
. dfuller logVol, trend regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        34

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -1.175            -4.297            -3.564           -3.218
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9155

------------------------------------------------------------------------------
D.logVol |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
logVol       |
         Ll. |  -.1281374   .1090552    -1.17   0.249    -.3508578    .0945831
         LD. |  -.4264377    .164831    -2.59   0.015    -.7630675   -.0898079
      _trend |  -.0006836   .0011132    -0.61   0.544    -.0029571     .00159
       _cons |   1.195727   1.030817     1.16   0.255    -.9094826    3.300936
------------------------------------------------------------------------------
```

For Trade Volume (logVol), we can clearly see that the Test statistic value is greater than the critical value at all the significance levels (10%, 5% and 1%), implying that the NULL hypothesis can't be rejected.

Thus, we can conclude that logVol is Non-Stationary.

```
. dfuller XRV, trend regress lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        34

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -3.063            -4.297            -3.564           -3.218
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.1154

------------------------------------------------------------------------------
D.XRV |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------+-----------------------------------------------------------------------
      XRV |
      L1. |  -.4248707   .1387283    -3.06   0.005    -.7081917   -.1415497
      LD. |   .1351763   .1701501     0.79   0.433    -.2123167    .4826692
   _trend |  -.0132947   .0129337    -1.03   0.312    -.0397088    .0131194
    _cons |   .9766503    .358268     2.73   0.011     .2449694    1.708331
------------------------------------------------------------------------------
```

For Exchange Rate Volatility (XRV), we can clearly see that the Test statistic value is greater than the critical value at all the significance levels (10%, 5% and 1%), implying that the NULL hypothesis can't be rejected. Thus, we can conclude that logVol is Non-Stationary.

To conclude, **all the variables that we have used are non-stationary** according to the ADF test.

2. Granger Causality Test

```
. vargranger

Granger causality Wald tests
```

Equation	Excluded	chi2	df	Prob > chi2
logGDP	logVol	71.937	4	0.000
logGDP	XRV	4.579	4	0.333
logGDP	ALL	90.168	8	0.000
logVol	logGDP	8.2771	4	0.082
logVol	XRV	4.8659	4	0.301
logVol	ALL	18.103	8	0.020
XRV	logGDP	1.7401	4	0.783
XRV	logVol	30.466	4	0.000
XRV	ALL	32.999	8	0.000

From the above table, we can see that the Volume of Trade causes the Economic Activities (GDP) in the nations at 5% significance level as P-Value is less than 5%. Further, the reverse is true for 10% significance level. Similarly, the Volume of Trade also causes fluctuations in Exchange-Rate at 5% significance level. However, the reverse is not true, i.e., fluctuations in

Exchange Rate do not cause Volume of Trade.

3. Johansen Cointegration Test

```
. vecrank logVol logGDP XRV, trend(constant) lags(4) max

                    Johansen tests for cointegration
Trend: constant                                      Number of obs =      32
Sample:  2012q1 - 2019q4                                    Lags =       4
```

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	30	113.92977	.	61.1272	29.68
1	35	137.56713	0.77175	13.8525*	15.41
2	38	144.40557	0.34780	0.1756	3.76
3	39	144.49338	0.00547		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	30	113.92977	.	47.2747	20.97
1	35	137.56713	0.77175	13.6769	14.07
2	38	144.40557	0.34780	0.1756	3.76
3	39	144.49338	0.00547		

Model: $\mathbf{- \log (Vol)_t = \beta_0 + (\beta_1 * \log (GDP)_t) + (\beta_2 *(XRV)_t) + \varepsilon_t}$

Null Hypothesis: There is no Cointegration

Alternative Hypothesis: Cointegration Exists

The optimal lag for our model was found using the **Varsoc test** in STATA. The value of the optimal lag was found to be 4 for our model. Using this, we performed the Johansen test.

From the above result, we can see that for Rank-0, both Trace and Max statistics are greater than the 5% critical values. Thus, we reject the NULL hypothesis that there is no Cointegration. However, for Rank-1, Trace and Max statistics are less than the 5% critical values, we indicate that only one Co-Integration equation exists.

The Long-Run Relationship between the variables was found using this model, since we have proved that Cointegration does exist.

Using the **VECM test**, we find the coefficients β_0, β_1 and β_2

$\log (Vol)_t = -10.8 + (0.157* \log (GDP)_t) - (0.04 *(XRV)_t)$

From the above equation, we can see that there exists a **negative relationship between Volume of Trade and Exchange Rate Volatility, and positive relationship between Volume of Trade and GDP.**

Conclusions

The consequences of fluctuations in exchange rates on international trade and the overall economy have become significant research areas recently. In general, exchange rate uncertainty has a varied impact on the economy. Exchange rates can affect international trade earnings and trade volumes, since international trade prices are closely related to exchange rates. To understand the relationship between volume of trade and exchange rate fluctuations for India, we used quarterly time-series data for the period from 2011-2019. The study implements Augmented Dickey Fuller (ADF) test to check the stationary of data for each variable, Granger Causality test to check the existence of short-run relationships among the variables and Johansen's cointegration technique to find the long-run relationship between Trade Volume and Exchange Rate.

We conclude that there exists bidirectional causality from Trade Volume to GDP and unidirectional causality from Trade Volume to Exchange Rate Volatility. Further, there exists a negative relationship between Trade Volume and Exchange Rate Volatility and a positive relationship between Trade Volume and Gross Domestic Product (GDP).

Policy Implications

Since there exists a negative relationship between Volume of Trade and Exchange Rate Volatility, the RBI should moderate exchange rate volatility. This will lead to a reduction in fluctuations in exchange rates, and thus an increase in volume of trade. Further, since there exists a positive relationship between volume of trade and GDP, this will also lead to an increase in GDP, thus leading to economic growth.

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