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The Symmetric J-curve Phenomenon: Evidence from Brazil and its top trading Partners

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Abstract:

This paper uses panel data to scrutinize symmetries in the 'J-curve' effects of the exchange rate on trade balance of Brazil and it top eight trading partners China, U.S, Argentina, Chile, Netherland, South Korea, Singapore, and Mexico from 1999 to 2020. Pooled Mean Group estimation approach is applied in the linear ARDL framework. The Pooled Mean Group estimation results based on the symmetric exchange rate assumption reveals that, the 'J-curve' effect is not observable across Brazil and its top eight trading partners. The currency depreciation is observed to improves the trade balance while, an increase in the domestic gross domestic product (GDP) deteriorates the trade balance, and an increase in foreign GDP improves it in the long-run.

Keywords: Exchange rate, Trade balance, J-curve, symmetry, Panel data.

Introduction:

The fluctuations in exchanges rate have long been identified as apprehension for an economy's macroeconomic dynamics. However, with the onset of the generalized floating period, the area of attention has shifted significantly. Exchange rate fluctuations affect both exports and imports of a country, therefore affecting its trade balance. According to international trade theories, a currency devaluation or depreciation would make imports expensive and exports cheaper and, thus improve the country's trade balance, the currency of which is depreciated. However, improvement in the country's trade balance is expected not to take place immediately. Because prior contracts or purchases for export and import quantities stay unaltered during the period of depreciation, price adjustments have an immediate effect. As a result, a decline in the value of export profits results in an increase in the value of import payments, worsening the trade balance in the short term. However, when modifications to quantity and pricing are made over time, an improvement is shown. This brief worsening in the trade balance of a country followed by an improvement resulting from currency depreciation/ devaluation is commonly referred to as the "J-curve" effect in the economic literature.

Exchange rate theoretically impacts the balance of trade that may be examined with regard to the condition of Marshall-Lerner (M-L) and the "J-curve" effect. As stated by Marshall and Abba

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Learner, the former says that if the summation of demand elasticity for imports and exports is greater than one currency, depreciation/ devaluation will improve the trade balance. On the one hand, if the amount is exactly equal to one, the trade balance will remain unchanged in the case of depreciation (devaluation). On the other hand, if the demand elasticities of imports and exports are less than one, meaning that the Marshall Learner condition does not hold, depreciation (devaluation) will worsen the trade balance. However, scholars (Arize, 1990; Warner and Kreinin., 1983) have consistently demonstrated that the Marshall-Learner requirement is easily fulfilled; hence, in the long run, depreciation or devaluation improves an economy's trade balance. Additionally, the "J-curve" effect posits that, due to the intrinsic character of individuals, there will be an initial deterioration of the balance of trade in the short run following currency devaluation (depreciation), but will show improvement in the long-run.
In this context, this study tries to examine the movements of exchange rate on the balance of trade of Brazil and it top eight trading partners China, U.S, Argentina, Chile, Netherland, South Korea, Singapore, and Mexico from 1999 to 2020. The Auto-regressive distributed lag model (ARDL) will be used. The existing paper will not confine the potential of a symmetric relationship to exchange rates and trade balances only but will also investigate the influence of other factors such as domestic and foreign income growth symmetrically.

Literature review:

Professionals in international finance agree that actual exchange rate fluctuations affect the trade balance over the long run by Bahmani-oskooee, Parray et al., (2022) (1992, 2001); Himarios (1989); Rawlins and Praveen, (2000); Hasan and Khan, (1994); Bahmanii-oskooe and Ratha, (2004); Waliullah et al., (2010); Bhat and Bhat (2020) and Shahbaz et al. (2011). In particular, evidence implies that currency devaluation/depreciation improves the trade balance in the long run Baharumshah (2001,2002), Bahmani-oskooee (2001), Lal and Lowinger (2003), Tochitskaya (2005) and Onafowora (2003).

Linda and Daniel (2019) examine the trade balance in post-liberalisation Ghana, using both symmetric and asymmetric models to analyse data from 1984 to 2015. Both specifications demonstrate the absenteeism of the "J-curve" effect and the M-L condition. However, after applying the asymmetric model, Bhat Sajad and Bhat Javed (2020) presented no evidence of "J-curve" In the Indian case. Moses et al. (2020) investigates the symmetric and asymmetric effect of real exchange rate on Kenya's balance of trade by using quarterly data from 2006(Q1) to 2018 (Q4) with its 30 major trading partners. The results show that the "J-curve" effect is evident in 13 cases.

Doojav (2018) uses a VECM model to investigate the impact of the currency exchange rate on Mongolia's trade surplus or deficit. The results are consistent with the Marshal-Lerner condition, suggesting that a depreciation or devaluation of the Mongolian tugrik could lead to a net gain in trade surplus in the long run. The research indicates that a flexible exchange rate can be an effective tool for managing exchange rate risk and current account deficits.

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Additionally, Asteriou et al. (2016) used monthly data from 1995-2012 to examine the impact of exchange rate fluctuations on international trade for Indonesia, Mexico, Nigeria, and Turkey, employing the GARCH and ARDL techniques for short-run and long-run analysis, respectively. Except for Turkey, the findings indicate no long-term relationship between exchange rate volatility and foreign trade for the studied nations. On the other hand, in the short run, we find a robust causal correlation between volatility and international trade for Indonesia and Mexico, while for Nigeria, we find just a one-way causal relationship, from export demand to volatility.

Data and Econometric Methodology:

The balanced panel includes observations for the world's emergent economies namely Brazil and it top eight trading partners China, U.S, Argentina, Chile, Netherland, South Korea, Singapore, and Mexico from 1999 to 2020. The data set contains four variables: trade balance (TB), defined as export to import ratio, domestic GDP, world GDP (WGDP), and the exchange rate (E). Data on TB is obtained from the Direction of Trade and Statistics (DOTS), domestic GDP, and WGDP from World Development Indicators (WDI). The data on E is extracted from St. Louis Federal Reserve Bank (FRED). All four variables are transformed in natural logarithms, which gives direct elasticities for interpreting its estimated slope coefficients.

In accordance with Bahmani-Oskooee (1990 and Bhat and Bhat (2020), we employ the following model:

Trade Balance = f (Exchange rate, Domestic GDP, Foreign GDP) …… (A)

From (A), the estimable regression equation is specified as:

$$LTB_{it} = \alpha_0 + \alpha_1 LE_{it} + \alpha_2 LGDP_{it} + \alpha_3 LWGDP_{it} + \mu_{it}$$

Where L is the natural logarithm, TB is the trade balance defined as the export to import ratio is the dependent variable. α_0 is a constant term. $\alpha_{1,}$ $\alpha_{2,}$ and α_3 represent the elasticity coefficients; 't' signifies the time and 'i' is the cross-sectional unit. E_{it} is exchange rates, GDP is domestic gross domestic product and WGDP is world gross domestic product. μ_{it} is an error term.

We procced with estimating the above equation by using Panel autoregressive distributed lag model (PARDL). This methodology can be used when there is the existence of unit root or mixed order of integration I(0), I(1) of not more than I(1). We proceed with ARDL. However, we cannot apply ARDL when variables are I(2). The ARDL estimation approach works well, as is the case in this study, for small samples. In the empirical literature, the Mean Group (MG) estimator and the Pooled Mean Group (PMG) estimator are two popular approaches for analysing heterogeneous panels. The Hausman test is used to determine whether the estimators differ systematically. If the test rejects H_0 implying that a systematic difference exists across estimators, then the mean group is suitable. Concurrently, if we lack sufficient information to reject H_0 then the PMG estimator is appropriate. The PARDL enables the estimation of the short-run and long-run coefficients.

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The PARDL model is used in our analysis to examine the relationship between trade balance and other explanatory variables by assuming symmetrical response of trade balance to changes in the E, GDP and WGDP. The panel ARDL model is given as:

$$\Delta lnTB_{it} = \delta_{0i} + \delta_1 lnTB_{it-1} + \delta_2 lE_{it-1} + \delta_3 lGDP_{it-1} + \delta_4 lWGDP_{it-1} + \sum_{j=1}^{n1} \beta_1 \Delta \ln TB_{it-j} + \sum_{j=0}^{n2} \beta_2 \Delta lE_{it-j} + \sum_{j=0}^{n2} \beta_3 \Delta lGDP_{it-j} + \sum_{j=0}^{n2} \beta_4 \Delta lWGDP_{it-j} + \mu_i + e_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where lTB is the log of the trade balance for each economy í over a period of time t. lE, lGDP, lWGDP are log of exchange rate, Gross Domestic product, and world Gross Domestic Product respectively. μ_i is the group specific-effects. β_{0i} captures the country-specific effects.

To analyse the long run characteristics of panel data, estimation techniques like unit root and Cointegration are employed. The results and discussion are divided into three parts. First, we find the order of integration of variables, TB, E, GDP, and WGDP. The second step is to examine the relationship between variables, both in the short and long run. Third the PARDL model is estimated to examine the symmetric relationship between the variables.

Stationarity test results:

Our analysis starts with the panel unit root to ascertain the variables' stationarity properties. On all four variables, the panel unit root test is employed on both the levels and at the first difference. This paper uses numerous methods for determining the panel unit root mentioned in table 1. Results of panel unit root are shown in table 1. We find that the variables are a mixture of I(0), I(1), and none variable is I(2), and therefore it assures applicability of PARDL model

Table 1: Panel unit root analysis

Test method	Variables			
	LTB	LGDP	LWGDP	LE
Null hypothesis: assume Common unit root process				
Levin, Lin and Chu t*	-11.88**b	-3.68**a	-3.53***a	-15.87*b
Null hypothesis: assume individual unit root process				
LM, Pesaran and Shin W stat	-1.65**a	-2.35**a	-2.99**b	-12.13**b
Fisher ADF Chi-square	17.56***a	16.32**b	19.25**b	124.56*b

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Fisher PP chi-square	29.54**a	14.01**a	23.65**b	139.42*b

Source: Own Calculations

*Note: 'a' and 'b' represent the stationary at level and first difference respectively, while * is significant at 1%, ** denote significant at 5%, and *** denote statistical significance 10%.*

Panel Cointegration:

After confirming that all variables are either I(0), and I(1) or mixture, the study examines whether there is a long-run Cointegration relationship among the variables. Padroni's (1999, 2004) residual-based panel Cointegration test is estimated. Pedroni (1999, 2004) developed (Phillips-Perron test, Modified Phillips-Perron test, and Augmented Dickey-Fuller test). Table 2 reveals that two out of three test statistics contained in Pedroni (1999, 2004) tests show evidence. When the Cointegration among variables is examined. Consequently, we conclude that the variables are having long-term cointegration.

Table 2: Pedroni test of Cointegration

Test method	Statistic	P-Value
H_0: There is no cointegration. H_1: All the panels are cointegrated.		
Modified Phillips- Perron t	0.833	0.196
Phillips-Perron t	-2.231*	0.001
Augmented Dickey-Fuller t	-2.214*	0.010

Source: Own calculations

*Note: * denotes statistical significance at 5% level.*

Results and Discussion:

Having established the presence of Cointegration, as depicted in table 2, there exists a long-run relationship among the variables since Phillips-Perron-t and Augmented Dickey-Fuller t are statistically significant at 1% significance level.

First, we use the Hausman test to choose the appropriate estimator that is mean group (MG) and pooled mean group (PMG). The acceptance of H_0 implies adopting the pooled mean group estimator, while non-acceptance implies the adoption of the mean group estimator. Our study shows insufficient information to reject H_0, which indicates the appropriateness of the PMG estimator. Table 3 shows that PMG is the efficient estimator, in this paper, only the recommended estimator's results are reported and discussed.

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Panel ARDL results are depicted in table 3, which shows the short-run and long-run effects of E, GDP, and WGDP on the country's trade balance. To begin with the impact of exchange rate changes on the trade balance in short-run Table 3 highlights that the exchange rate exerts a negative but insignificant effect on TB. The negative sign shows deterioration of trade balance followed by an increase in the exchange rate. The impact of domestic GDP is statistically significant implying increase in domestic GDP will improve trade balance in the short run, I,e increase in GDP will encourage exports more than imports. however, the impact of foreign GDP is insignificant so left undiscussed. Significant error correction term (-0.446) with negative sign indicates a stable long-run relationship, suggesting that disequilibrium is corrected by 44.6% per year.

In the long run, the results from table 3 shows that the exchange rate's impact is positive and significant. The positive sign on the exchange rate variables indicates that, currency depreciation improves the trade balance and appreciation deteriorates it in the long run. This is consistent with the findings of (Aziz 2008, Sund Chu 2010 and Bhat and Bhat 2020). The outcome of this study does not provide an indication of 'J-curve' phenomena in Brazil and its top trading partners. The impact of domestic GDP is negative and statistically significant. This implies that as the economy grows, the demand for imported goods increases, as predicted by theory. The easing of import restrictions has resulted in the emergence of a new generation of domestic customers. Import demand responds far more positively to GDP growth than export demand does to exchange rate depreciation. Thus, the net effect on the trade balance is negative. This conclusion is consistent with the Keynesian idea that as income rises, imported products' consumption grows, affecting the trade balance. Finally, the impact of foreign GDP is positive and significant. A 1% increase in WGDP will improve the trade balance by 0.175%. The positive reaction of the trade balance to a growth in international GDP is consistent with Keynesian theory, in which an increase in later stimulates exports to the rest of the world, assuming that import demand remains the same. Our results show that exchange rate depreciation and an increase in foreign GDP enhance the trade balance in the long run.

Table 3: Panel ARDL Results;

Variable	Coefficient	Standard Error	P-Value
Long-run results			
lE	0.799	0.023	0.001
lGDP	-0.347	0.045	0.000
lWGDP	0.175	0.043	0.000

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Short-run results			
D.lE	-1.252	0.853	0.142
D.lGDP	0.488	0.192	0.011
D.lWGDP	-0.390	0.490	0.427
Constant	1.522	0.437	0.001
ECM	-0.446	0.128	0.001
Hausman test	1.79		0.781

Source: Own calculations

Conclusion:

A plethora of studies has been conducted to enlighten the association between exchange rate and trade balance. This study discusses the symmetrical influence of exchange rate movements on the trade balance across Brazil and its top trading partners for the period ranging from 1999 to 2020. The results of our estimated model demonstrate clear long run cointegration. Using panel ARDL exchange rate is statistically insignificant but is having an appropriate sign in the short-run. However, currency depreciation improves whiles as appreciation deteriorates the balance of trade in the long-run. The outcome of this reflects no evidence of J-Curve phenomena across Brazil and its trading partners. Similarly, the impact of domestic GDP is negative and statistically significant in short run but is positive in the long run, implying an increase in domestic GDP will improve trade balance in the long-run. Finally, the short-run impact of foreign GDP is negative and statistically insignificant. However, in the long-run, an increase in foreign GDP will improve the trade balance.

The findings of this paper suggest some crucial policy implications. It is imperative that countries prioritise export promotion and implement policies that will increase exports. It is also important to increase exports and reduce reliance on foreign markets by substituting imported goods with domestically produced ones, a strategy that can be accomplished through expanding domestic production capacity and boosting productivity. Finally, excessive exchange rate fluctuations should be limited to prevent exchange rate misalignments and an unfavourable position in the balance of trade account.

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