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Exchange Rate and Service Exports from India: A Nonlinear ARDL Analysis

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Abstract

Using linear and nonlinear autoregressive and distributed lag (ARDL) models we examine the relationship between real exchange rate and service exports from India by incorporating goods exports, financial development, FDI inflows, world demand and economic globalization during 1975-2015. Linear ARDL results indicate that 1 percent currency appreciation results in a reduction of the service exports by 0.01 percent in the long run. The net effect in the short run is negative and not significant. On the other hand, nonlinear ARDL results show the absence of any significant asymmetric impact of real exchange rate variations on service exports from India both in the short and long run. This implies that the J-curve effect between real exchange rate and service exports does not exist in the Indian context. Our results also show that the impact of supply augmenting factors (such as FDI inflows, financial development, and globalization) and demand-side factors (such as world demand) is more dominant than price effects on service exports.

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1. Introduction

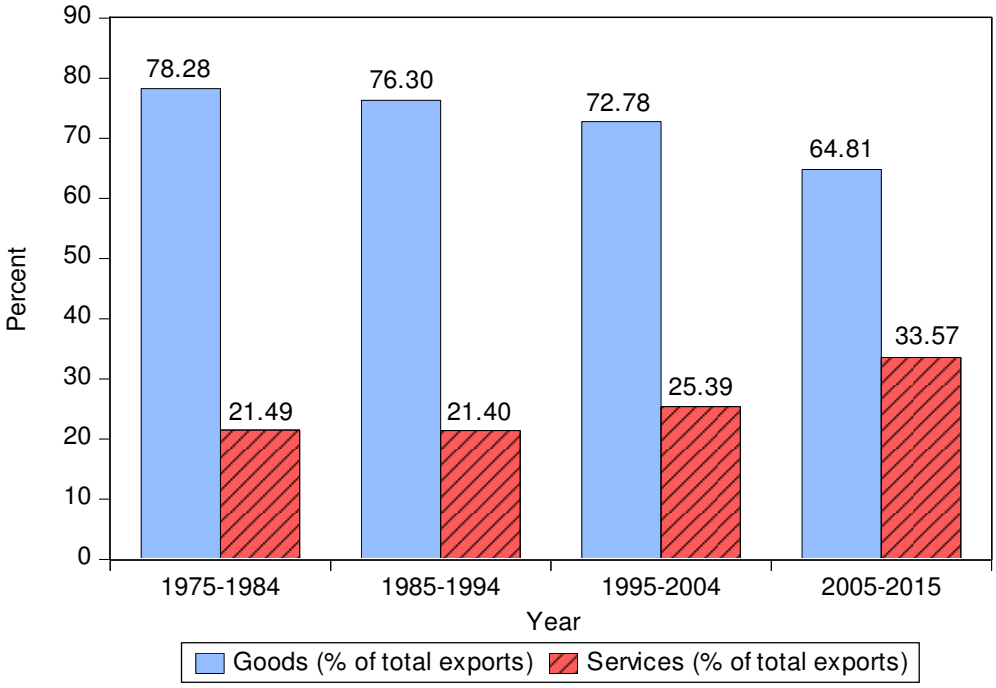
It is well recognized that economic growth can be generated not only by the increased participation of labour and capital in production but also by expanding trade through exports to wider international markets. This increasing importance of international trade has led to the adoption of export-led growth strategies by emerging economies (Pradhan, 2010). Following the success of East Asian economies, India followed the export-led growth strategy in the 1990s as a part of its structural adjustment program comprising of liberalization, privatization and open economy policies (Sahoo and Dash, 2014). India has also registered significant improvements in the services exports in the last two decades (See Figure 1). While the growth of goods export from India shows a decreasing trend, there is a significant rise in the service exports after the economic reforms of the 1990s. The service exports have increased from 15.27 percent of total exports in 1975 to 32.16 percent in 2014 (World Development Indicators, 2016). It is evident that India has been facing continuous deficits in its goods trade balance, which has led to recurring deficits in the current account. However, this is being adjusted by the rising surpluses in her services trade (Sahoo *et al*., 2016a, b), which has acted as a cushioning effect on the balance of payments.

Given the rising importance of exports on economic growth, many of the theoretical and empirical studies have found the adverse impact of exchange rate movements on exports growth (Thanh and Kalirajan, 2005; Dincer and Kandil, 2011; Cheung and Sengupta, 2013; Paudel and Burke, 2015). One of the major theoretical argument is the famous Mundell-Fleming (M-F) model. The basic argument of M-F model is that in a small open economy, given the nominal wages to be constant, an exchange rate appreciation adversely affects the exports and positively affects the imports of goods and services (Abeysinghe and Yeok, 1998). Further, Magee (1973) showed that devaluation or depreciation of exchange rate of a country deteriorates its trade balance initially and improves it later. This reflects the asymmetric effect of exchange rate on the trade balance. This is popularly known as the J-curve hypothesis (Bahmani-Oskooee *et al*., 2016). Against this backdrop, the main purpose of this paper is to investigate both symmetric and asymmetric impact of exchange rate movements on services exports from India. This assumes relevance due to the growing importance of services exports in the correction of India's balance of payments. Further, the past research also found that along with the price effect, the demand and the supply side factors play an important role in determining the goods and services exports (Sahoo and Dash, 2014; Eichengreen and Gupta, 2013). This prompts us to examine the role of demand-side factors such as world demand for services and the supply side factors such as foreign direct investment inflows, financial development, and globalization in the growth of service exports from India.

Our study differs from the existing literature on several grounds. *First*, we use a longer time series data for the period 1975 to 2014.[1] *Second,* we recognize that the Indian economy might have experienced structural breaks at different time points during the period of study, and as a result, we test for structural breaks in the integrating properties of the variables, without which the time series properties of the variables under investigation would tend to be biased. *Third,* we investigate both the symmetric as well as the asymmetric impact of real exchange rate on the service exports from India. In other words, the present study tries to capture both the linear as well as the nonlinear impact of the explanatory variables on the service exports from India.

[1] The time period used in this study is dictated by the availability of data for India.

Figure 1: Trend in goods exports and services exports, 1975-2015 (Decadal Average)



Source: Data used from the World Development Indicators (WDI) of World Bank

The remainder of the paper is structured as follows. Section 2 reviews some of the past studies related to the effects of exchange rates on trade flows. Section 3 describes the data and variables. Section 4 explains the econometric methodology. Section 5 presents the results and discussions. Section 6 concludes with some policy implications.

2. Review of Literature

Although majority of studies focus on the impact of exchange rate movements on total trade flows (Kodongo and Ojah, 2013; Asteriou *et al*., 2016; Bahmani-Oskooee *et al.* 2016; Bahmani-Oskooee and Aftab, 2017), the literature on the relationship between services exports and exchange rate, particularly in the Indian context, is limited. Barcenilla and Molero (2003), by investigating the determinants of services exports for 15 European countries for the period of 1976-2000, found that the variables such as foreign income, price, and exchange rate are the major determinants that influence the service exports in these economies. Kimura and Lee (2006), on the other hand, assessed the factors influencing service trade relative to the goods trade for 10 OECD member countries during 1999-2000. By using the standard Gravity model the authors found that geographical distance, cost of transport and economic liberalization are the important factors for services trade.

Recently, Sahoo and Dash (2014) investigated the determinants of modern services exports in India for the period of 1980-2011. Their results showed that human capital, physical infrastructure stocks and financial development along with world demand, exchange rate, and goods exports are the major determinants of the modern service exports (MSEs). They found that the software and communication exports depend more on human capital, telecommunication, FDI and quality of institutions than world demand, infrastructure, and real exchange rate. Eichengreen and Gupta (2013) surveyed India's experience with exporting services. The authors seek to show that the country's experience is unique, that modern tradable services have a significantly larger share of GDP than in other countries at comparable levels of economic development. They showed that in addition to the major economic reforms, other factors such as overall economic development, communications

infrastructure, access to foreign technology, and spillovers between the merchandise and service exports are important to affect the service exports from India. Lancheros and Demirel (2012), on the other hand, examined the role of finance in determining the exporting decisions and the levels exported by service firms in India. Their study found that while finance is not a significant determinant of Indian service firms' exporting activity, firm size, total factor productivity (TFP) and technology investments are significant factors motivating the exporting decisions and the level of exports of Indian service firms. Further, Bahmani-Oskooee and Mitra (2009) disaggregated the trade data between India and the U.S. at the industry level and use trade data from 38 industries to test for the short-run effects of the real depreciation of the Rupee as well as its long-run effects on the trade balance of the 38 industries during the period of 1962-2006. The authors found that while there were 22 industries responding significantly to the real value of the Rupee in the short run, only in eight industries did the J-Curve receive support.

From the above review, it emerges that majority of the studies are cross-sectional and basically focusing on examining the determinants of goods and services exports and not emphasizing on exchange rate which is, theoretically, expected to be a major determinant of exports and imports (Abel and Bernanke, 2001). Further, to the best of our knowledge, there are only a few studies examining the importance of exchange rate movements in explaining the services exports particularly in India (Eichengreen and Gupta, 2013; Sahoo and Dash, 2014). Further, these studies have tried to examine only the linear relationship, overlooking the existence of any nonlinear relationship. We attempt to fill this gap by emphasizing the impact of exchange rate movements on the service exports from India by incorporating the other potential explanatory variables in both linear and nonlinear models.

3. Data Sources and Variables

The present study uses annual time series data for the period of 1975 to 2015. The data is sourced from the World Development Indicators (WDI) of World Bank and Handbook of Statistics on Indian Economy published by the Reserve Bank of India (RBI). The description of variables is given in Table 1.

Table 1: Summary Statistics for Key Variables, 1975-2015.

Variable	Definition	Mean	Std. Dev.	Min.	Max.	Source
TSE	Total services exports as % GDP	3.435	2.619	0.839	8.664	WDI
REER	Real effective exchange rate (36-currency trade based index)	122.524	28.026	92.750	172.673	RBI
GEXP	Total goods exports as % of GDP	8.673	4.279	4.001	17.127	WDI
FINDEV	Financial development (measured by domestic credit to private sectors as % of GDP)	30.416	11.791	14.676	52.254	WDI
FDI	Net inflows of FDI as % of GDP	0.708	0.856	-0.029	3.546	WDI
SIMP	World services import net of India as % of world GDP	4.715	0.804	3.688	6.542	WDI
GLOBAL	Economic globalisation	37.989	10.058	25.746	51.642	Dreher (2006)

4. Econometric Methodology

We use the linear autoregressive and distributed lag (ARDL) bounds testing approach developed by Pesaran *et al*. (2001) and the nonlinear ARDL (NARDL) cointegration test developed by Shin *et al.* (2014) to examine both linear and nonlinear relationship between the variables, respectively. The main advantage of the ARDL model is that it will give efficient results even if the variables are integrated of the mixed order but no variable is integrated of order two i.e. I(2) (Pesaran *et al.*, 2001).

To find the long-run relationship between variables, the following ARDL model is estimated:

$$\begin{aligned}\Delta TSE_t = {} & \alpha_0 + \alpha_1 TSE_{t-1} + \alpha_2 REER_{t-1} + \alpha_3 GEXP_{t-1} + \alpha_4 FINDEV_{t-1} + \alpha_5 FDI_{t-1} + \alpha_6 SIMP_{t-1} \\ & + \alpha_7 GLOBAL_{t-1} + \sum_{i=1}^{m} \alpha_{8i} \Delta TSE_{t-i} + \sum_{i=0}^{m} \alpha_{9i} \Delta REER_{t-i} + \sum_{i=0}^{m} \alpha_{10i} \Delta GEXP_{t-i} + \sum_{i=0}^{m} \alpha_{11i} \Delta FINDEV_{t-i} \\ & + \sum_{i=0}^{m} \alpha_{12i} \Delta FDI_{t-i} + \sum_{i=0}^{m} \alpha_{13i} \Delta SIMP_{t-i} + \sum_{i=0}^{m} \alpha_{14i} \Delta GLOBAL_{t-i} + D_t + \mu_t\end{aligned} \tag{1}$$

where m is the optimal lag length and Δ is first difference estimator in Model 1. $\alpha s'$ represent the parameters and μ_t is the error term. D_t is a dummy variable that is used to capture the impact of the structural break date (t), which is determined by the unit root test developed by Zivot and Andrews (1992). First and second parts of the above equation represent the long-run relationship between the series and the error correction dynamics, respectively. To test the existence of the long-run relationship, F-test is employed. Finally, the computed F-statistics are compared with the critical values of Narayan (2005) because alternative lower and upper bounds critical values are more appropriate than that of Pesaran *et al*. (2001) for small sample sizes. A decision about the existence or non-existence of the cointegration among the variables can be inferred if the computed F-statistic falls outside the upper or lower bounds critical values, respectively. Further, if the computed F-statistic value falls within the upper and lower bounds critical values, then the result will be inconclusive. The optimal lag order is selected on the basis of Akaike Information Criterion (AIC). The minimum AIC of the model implies optimal lag length.

However, Pesaran *et al.* (2001) co-integration test gives the evidence of a linear relationship between variables. Following the earlier literature (Baum *et al.,* 2004), the effect of changes in the real exchange rate might not be symmetric if the service exports respond differently to exchange rate appreciation and depreciation. To examine this potential issue, we follow Bahmani-Oskooee and Fariditavana (2016) and generate changes in the real exchange rate which includes positive and negative changes. We then generate two new series, one representing appreciation (denoted by POS) and the other one representing depreciation (denoted by NEG). The former is defined as the partial sum of positive changes and the latter as the partial sum of negative changes, which are as follows:

$$\begin{aligned}\mathrm{POS}_t &= \sum_{i=1}^{t} \Delta REER_i^{+} = \sum_{i=1}^{t} \max(\Delta REER_i, 0) \\ NEG_t &= \sum_{i=1}^{t} \Delta REER_i^{-} = \sum_{i=1}^{t} \min(\Delta REER_i, 0)\end{aligned} \tag{2}$$

The NARDL proposed by Shin *et al.* (2014) represents the asymmetric error correction model as follows:

$$\begin{aligned}\Delta \mathrm{TSE}_t = {} & \sigma_0 + \rho TSE_{t-1} + \theta_1^+ REER_{t-1}^+ + \theta_2^- REER_{t-1}^- + \theta_3^+ FINDEV_{t-1}^+ + \\ & \theta_4^- FINVDEV_{t-1}^- + \theta_5^+ FDI_{t-1}^+ + \theta_6^- FDI_{t-1}^- + \theta_7^+ SIMP_{t-1}^+ + \theta_8^- SIMP_{t-1}^- + \\ & \theta_9^+ GLOBAL_{t-1}^+ + \theta_{10}^- GLOBAL_{t-1}^- + \sum_{i=1}^{p} \sigma_1 \Delta TSE_{t-i} + \sum_{i=0}^{q} \sigma_2 \Delta REER_{t-i}^+ + \\ & \sum_{i=0}^{q} \sigma_3 \Delta REER_{t-i}^- + \sum_{i=0}^{q} \sigma_4 \Delta FINDEV_{t-i}^+ + \sum_{i=0}^{q} \sigma_5 \Delta FINDEV_{t-i}^- + \sum_{i=0}^{q} \sigma_6 \Delta FDI_{t-i}^+ + \\ & \sum_{i=0}^{q} \sigma_7 \Delta FDI_{t-i}^- + \sum_{i=0}^{q} \sigma_8 \Delta SIMP_{t-i}^+ + \sum_{i=0}^{q} \sigma_9 \Delta SIMP_{t-i}^- + \sum_{i=0}^{q} \sigma_{10} \Delta GLOBAL_{t-i}^+ + \\ & \sum_{i=0}^{q} \sigma_{11} \Delta GLOBAL_{t-i}^- + D_t + \varepsilon_t \end{aligned} \tag{3}$$

In Eq. (3), σ_i denotes short-run coefficients, while θ_i denotes long-run coefficients with $i = 1 \ldots ..11$. Recall that a short-run analysis is intended to access the immediate impacts of exogenous variables' changes on the dependent variable. By contrast, a long-run analysis is used to measure the reaction time and speed of adjustment towards an equilibrium level. We apply the Wald test to check the long-term asymmetry ($\theta = \theta^+ = \theta^-$) and short-term asymmetry ($\sigma = \sigma^+ = \sigma^-$) for all variables. p and q represent the optimal lags for the dependent variable (TSE_t) and independent variables $(REER_t, FINDEV_t, FDI_t, SIMP_t, GLOBAL_t)$, respectively, which will be determined by the Akaike Information Criteria (AIC).

5. Results and Discussions

Checking stationarity properties of variables is a precondition for investigating cointegration among them. For this reason, we use unit root tests such as Augmented Dickey-Fuller (ADF, 1979), Phillips-Perron (PP, 1988) and Zivot-Andrews (ZA, 1992) to investigate the order of integration of the variables, and also to ensure that none is integrated at order 2 or $I(2)$. The results of the unit root tests are presented in Table 2. The evidence reported by the ADF, PP and ZA tests show that all the variables under study are stationary at their first difference or I(1).

Table 2: Unit root test results.

Variables	ADF		PP		ZA	
	Level	1st Diff.	Level	1st Diff.	Level	1st Diff.
TSE_t	-1.759	-6.985*	-1.759	-6.979*	-2.716 (1993)	-8.022* (2007)
REER_t	-0.793	-4.689*	-0.896	-5.493*	-2.774 (1993)	-5.980* (1998)
GEXP_t	-2.865	-6.865*	-2.666	-10.830*	-2.683 (1987)	-7.279* (2009)
FINDEV_t	-1.728	-5.777*	-1.132	-5.988*	-3.059 (1996)	-7.994* (2001)
FDI_t	-2.864	-7.404*	-2.933	-7.284*	-3.012 (1989)	-7.742* (2008)
SIMP_t	-1.104	-6.138*	-2.170	-6.076*	-4.545 (1989)	-6.259* (1985)
GLOBAL_t	0.019	-7.406*	-0.506	-7.689*	-1.394 (2009)	-4.842** (2007)

Note: Figures in the parenthesis are the structural break years in the respective variable. The asterisk * and ** indicate significance at 1% and 5% levels, respectively.

In the next step, we examine the long-run equilibrium relationship between service exports and real exchange rate along with other explanatory variables in a linear ARDL framework. The results are presented in Table 3. Here, we have estimated two models. Model 1 includes goods exports as an explanatory variable, whereas Model 2 does not include goods exports in the model. This is because goods export is assumed to be correlated with the exchange rate that may cause multicollinearity problem in the model. So in order to check the consistency of our results, we estimated two different models. As it is well known that the ARDL approach is sensitive to the lag length selection in the model, we use the Akaike Information Criteria (AIC) to select the appropriate lag length. As reported by Lütkepohl (2006) the dynamic link between the series can be well captured with the appropriate selection of the lag length. The optimum lags are given in the square brackets in Table 3. For testing the existence of cointegration in different models, we used Narayan (2005) critical values. The bounds testing results show that the ARDL F-statistic (F_{PSS}) from Pesaran *et al.* (2001) is found to be greater than the upper bounds critical values of Narayan (2005) at 5% level of significance in both the models where total services exports (TSE_t) is used as the dependent variable. This shows that the linear ARDL bounds test confirms the long run relationship between the variables in India for the period 1975 to 2015.

Table 3: Linear ARDL model results.

Variables	Model 1: [3,2,3,2,0,3,3]			Model 2: [3,2,3,1,3,3]		
	Coefficient	t-statistic	Prob.	Coefficient	t-statistic	Prob.
Short run						
$\Delta REER_t$	-0.001	-0.023	0.982	-0.001	-0.187	0.854
$\Delta GEXP_t$	0.098	1.529	0.150	-	-	-
$\Delta FINDEV_t$	0.155*	4.300	0.001	0.192*	6.928	0.000
ΔFDI_t	0.649*	4.842	0.000	0.817*	5.952	0.000
$\Delta SIMP_t$	0.623	1.734	0.107	0.684***	1.952	0.070
$\Delta GLOBAL_t$	0.035	1.732	0.107	0.032	1.607	0.129
D_t	0.160	0.513	0.617	0.151	0.576	0.573
Trend	-0.219*	-6.311	0.000	-0.241*	-7.362	0.000
ECM_{t-1}	-0.737*	-3.414	0.002	-0.794*	-3.729	0.001
Long run						
$REER_t$	-0.005**	-2.856	0.014	-0.006*	-3.570	0.003
$GEXP_t$	0.022	0.841	0.415	-	-	-
$FINDEV_t$	0.152*	17.518	0.000	0.158*	25.356	0.000
FDI_t	0.228*	6.459	0.000	0.219*	4.645	0.000
$SIMP_t$	0.854*	7.865	0.000	0.847*	8.277	0.000
$GLOBAL_t$	0.070*	6.457	0.000	0.082*	6.158	0.000
D_t	0.056	0.512	0.618	0.054	0.574	0.575
Trend	-0.077*	-7.654	0.000	-0.086*	-8.217	0.000
Constant	-5.999*	-14.323	0.000	-6.083*	-20.136	0.000
Adj R-	0.998	-	-	0.997	-	-

squared						
LM	2.731	-	-	2.597	-	-
ARCH	2.715	-	-	0.584	-	-
RESET	2.197	-	-	2.056	-	-
NORMAL	0.497	-	-	0.286	-	-
F_{PSS}	5.525*	-	-	21.855*	-	-

Note: The asterisk *, ** and *** indicate significance at 1%, 5% and 10% levels, respectively. The optimal lag length appears in square brackets. The upper bound critical value of Narayan (2005) at 5% level of significance is 4.790 including unrestricted intercept and unrestricted time trend.

The long-run results, from Table 3, show that there is a negative and statistically significant relationship between real exchange rate and service exports from India in both the models. It is further noted that 1% appreciation of real exchange rate leads to 0.005-0.006% fall in the service exports. This finding is consistent with the findings of Cheung and Sengupta (2013). In terms of the impact of other variables, we found that goods exports have a positive and insignificant impact on the service exports, while financial development, FDI inflows, world demand and economic globalization have a positive and statistically significant impact on the service exports. This implies that while a rise in financial development, FDI inflows, world demand and globalization increases the service exports, the goods exports does not significantly increase it, indicating a weaker network impact of goods exports.[2] Lastly, we incorporated a dummy variable to account for the impact of economic reforms during the 1990s $\left(D_t=1993\right)$ in India. We find that the economic reforms have no significant impact on the service exports from India.

Although the study emphasizes the importance of long-run estimates, the short run results reported in the upper segment of Table 3 show that real exchange rate, goods exports, world demand and globalization do not significantly affect the service exports in short run. It also shows that financial development and FDI inflows show the positive and significant impact on service exports from India. The short-run deviations from the long run equilibrium are corrected by 74% in model 1 and 79% in model 2. This shows that the short-run correction towards the long-run equilibrium is stronger with the absence of goods exports in the model 2. This can be justified on two main grounds. First, we found that goods exports have no significant impact on the total service exports. Second, there is a high correlation (around 65%) between goods exports and real exchange rate which may lead to multicollinearity problems in the model.[3] Therefore, in the non-linear ARDL model, results reported in Table 5, we dropped goods exports as an explanatory variable. Finally, the diagnostic tests, reported in the lower part of Table 3, suggest that the error terms of our linear ARDL models are normally distributed; free from serial correlation and heteroscedasticity. It also supports the model stability.

Next, we estimate the nonlinear ARDL model to test the existence of any nonlinear impact of real exchange rate on the service exports from India. It is widely believed that the impact of exchange rate changes on the trade balance follows a J-curve. According to this phenomenon, depreciation or devaluation worsens the trade balance in the short-run and improves it in the long-run (Magee, 1973). This implies that exchange rate can have an asymmetric impact on the service exports, and the present study is trying to investigate such

[2] It is argued that an increase in goods exports, which includes mostly manufacturing exports, leads to higher demand for services, due to network effect (Sahoo and Dash, 2014).

[3] Correlation results are not reported here, but will be provided by the corresponding author upon request.

relationship to test the validity of the J-curve effect in the Indian context. Before applying the NARDL model, we apply the BDS test developed by Brock *et al.* (1987) to test the nonlinear properties of the individual series. The results of BDS test are presented in Table 4. The results show that all the variables exhibit significant nonlinear properties at a different order of embedding dimensions.

Table 4: Results of BDS statistics.

Dimension	BDS statistic						
	TSE	REER	GEXP	FINDEV	FDI	SIMP	GLOBAL
2	0.170*	0.180*	0.155*	0.171*	0.142*	0.156*	0.198*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
3	0.273*	0.310*	0.241*	0.275*	0.233*	0.249*	0.328*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
4	0.330*	0.400*	0.292*	0.331*	0.283*	0.307*	0.411*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
5	0.356*	0.455*	0.313*	0.355*	0.316*	0.343*	0.465*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
6	0.358*	0.490*	0.300*	0.349*	0.310*	0.355*	0.500*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Figures in the parenthesis are p-values, and the sample period is from 1975 to 2015.
* Indicates the nonlinear dependency at 1% level of significance

In the next step, we estimated the nonlinear ARDL model and the results of which are presented in Table 5. The results show that the calculated t-statistic (T_{BDM}) value developed by Banerjee *et al.* (1998) and the F-statistic (F_{PSS}) value from Shin *et al.* (2014) are significant at 1% level, which confirms the existence of asymmetric cointegration between the variables. This indicates that total service exports, real exchange rate, financial development, FDI inflows, world demand and economic globalization share a long run asymmetric association in the Indian economy. This finding confirms the importance of taking asymmetry into account while studying the relationship between the variables. Further, the long run results from Table 5 show that the real exchange rate, FDI inflows, world demand and globalization do not have either positive or negative significant impact on the service exports from India. On the other hand, financial development is found to have a positive and significant impact on the service exports. Similar results also found in the short run. Further, looking at the long run and short run asymmetry (presented at the lower portion of Table 5) between the explanatory variables and service exports, we found that in the long run only FDI inflows have a significant asymmetric relationship with the service exports while real exchange rate, financial development, world demand and globalization do not possess any significant long-run asymmetric relationship with the service exports. On the other hand, all the variables, except real exchange rate, are found to have a significant asymmetric relationship with service exports in the short run. Overall, our analysis which examines both the asymmetric as well as the symmetric impact of exchange rate on the service exports confirms that there is no J-curve effect of real exchange rate on the total service exports from India. In other words, the exchange rate appreciation or depreciation possess only an identical impact on the service exports in the Indian context.

Table 5: Nonlinear ARDL (2,2,2,2,2,2) model results.

Variables	Coefficient	t-statistic	Prob.	Coefficient	t-statistic	Prob.
	Short-run effect [+]			Short-run effect [-]		
Short run						
$\Delta REER_t$	-0.026	-0.550	0.607	-0.002	-0.140	0.894
$\Delta FINDEV_t$	0.268*	5.530	0.003	0.360	1.600	0.171
ΔFDI_t	-0.075	-0.240	0.818	0.581	1.920	0.112
$\Delta SIMP_t$	0.286	0.180	0.867	1.103	1.150	0.303
$\Delta GLOBAL_t$	0.098	1.920	0.113	-0.754	-1.660	0.158
Constant	1.257**	3.290	0.022	-	-	-
D_t	0.012	0.020	0.989	-	-	-
ECM_{t-1}	-0.855*	-5.986	0.000	-	-	-
	Long-run effect [+]			Long-run effect [-]		
	Coefficient	F-stat.	Prob.	Coefficient	F-stat.	Prob.
Long run						
$REER_t$	-0.021	0.314	0.599	0.002	0.020	0.894
$FINDEV_t$	0.219*	22.270	0.005	-0.294	2.592	0.168
FDI_t	-0.061	0.058	0.820	-0.475	3.440	0.123
$SIMP_t$	0.234	0.032	0.866	-0.902	1.280	0.309
$GLOBAL_t$	0.080	3.193	0.134	0.617	2.267	0.193
Adj R-squared	0.967	-	-	-	-	-
LM	27.110	-	-	-	-	-
ARCH	2.009	-	-	-	-	-
RESET	6.95	-	-	-	-	-
NORMAL	2.061	-	-	-	-	-
BDM test	-8.301*	-	-	-	-	-
PSS test	15.737*	-	-	-	-	-
	Long-run asymmetry			Short-run asymmetry		
	F-stat.	Prob.	-	F-stat.	Prob.	-
$REER_t$	0.270	0.625	-	1.943	0.222	-
$FINDEV_t$	0.124	0.739	-	19.110*	0.007	-
FDI_t	7.029**	0.045	-	4.219***	0.095	-
$SIMP_t$	0.107	0.757	-	5.629***	0.064	-
$GLOBAL_t$	2.509	0.174	-	7.337**	0.042	-

Notes: Dt represents dummy variable for the structural break in the dependent variable. *,** and *** imply significance at 1%, 5% and 10% levels, respectively. PSS denotes the Pesaran *et al.* (2001) *F*-test of the null hypothesis $\rho_i = \beta_i^+ = \beta_i^- = 0$ against the alternative of joint significance. BDM denotes Banerjee *et al*. (1998) t-test of the null hypothesis $\rho_i = 0$ against the one-sided alternative hypothesis $\rho_i < 0$. In both cases, the null hypothesis indicates the absence of a long-run level relationship. The relevant critical values tabulated for BDM t-test are -5.37 (1%), -4.60 (5%) and -4.19 (10%). The equivalent values for the PSS F-test are -5.13 (1%), -4.52 (5%) and -4.21 (10%).

6. Concluding Remarks

This study examines both the symmetric and asymmetric impact of real exchange rate on the service exports from India by incorporating financial development, FDI inflows, world demand and economic globalization into the service export model. The study covers the annual data period of 1975-2015. The symmetric nexus between the variables was investigated through the linear ARDL Cointegration approach developed by Pesaran *et al*. (2001). On the other hand, the asymmetric relationship between the variables was examined by using the nonlinear ARDL model developed by Shin *et al.* (2014). The results from both the linear and nonlinear ARDL models show that there exist long-run equilibrium relationship between the variables in the case of India. The linear estimation results show that while real exchange rate has a significant and negative impact on service exports, financial development, FDI inflows, world demand and economic globalization have a significant and positive impact on the service exports in the long run. Further, it is noted that though real exchange rate negatively and significantly affects the total service exports in India, the supply augmenting factors (such as FDI inflows, financial development, and globalisation) and demand-side factors (such as world demand for services exports) have stronger positive impact on the services exports during the study period.

The nonlinear estimation results, on the other hand, show that the real exchange rate does not possess an asymmetric impact on the service exports from India either in the short run or long run. Further, it is noted that while FDI inflows possess a significant asymmetric relationship with the service exports in the long run as well as in the short run, financial development, world demand, and economic globalization possess a significant asymmetric impact in the short run only. So the results of our study confirm the non-existence of J-curve effect of real exchange rate on service exports from India. This indicates that the policy of devaluation or depreciation of the domestic exchange rate might not be an efficient way to minimize the trade deficit in India in the long-run.

The results of our study possess important policy implications. The study shows that as compared to the price effect, the demand-side and supply-side factors play a more important role to affect the service exports from India. It is also noted that the real exchange rate does not have an asymmetric impact on the service exports. Therefore, to maintain price competition, exchange rate policies need to be complemented by suitable supply-side policies for the service sectors to sustain the rising services exports in the long run. In particular, more FDI inflows can be encouraged in the services sectors for the production of better and quality services which can encourage more demand from the rest of the world. Further, financial development and globalization can be given priority for the better channelization of resources and the free flow of goods and services among the economies, respectively.

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