Time Series Investigation of J-Curve of Pakistan with Saudi Arabia

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Abstract This study is focused in analyzing the existence of J-curve phenomenon of Pakistan with Saudi Arabia by using the time series data from 1973 to 2010. Order of integration of the variables is mix as some variables are I(0) and some are I(1). So, ARDL approach to cointegration is applied to find out the relationship between exchange rate and trade balance. Results in both models do not support the existence of J-curve. The conclusion which is drawn from these models is that depreciation is not useful tool in improving trade balance of Pakistan with Saudi Arabia. Pakistan has to fine some alternative way of improving trade balance with these countries.

Keywords: *Pakistan, Saudia, J-curve, ARDL, trade, Cointegarion*

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1. Introduction

Determining suitable exchange rate is one of the critical tasks for developing countries because exchange rate plays a vital role in the settlement of trade balance of any country in this regard exchange rate policy is used most frequently for correcting the BOT (Balance of Trade). The theory that explains the relationship of exchange rate depreciation and BOT is the theory of J-curve. (Xu and Bahmani-Oskooee, 2013).

The J-curve hypothesis specifies that after devaluation trade balance first deteriorates and then it improves afterward. Xu and Bahmani-Oskooee (2013) says that this effect is observed due to sticky prices of imported commodities. The standardized J-curve illustrates two effects; one is volume effect (VE) and other is price effect (PE). Price effect remains lower than volume effect. Gelan and Bahmani-Oskooee (2011) explained that normally trade volume does not show any short run change but long run changes. Trade balance improves by devaluation iff Marshal-Learner condition holds in long run which states that sum of Import and export elasticities should be greater than one, because at in such condition price effect is diminished that time and volume effect is dominant. When the marshal learner condition is fulfilled the exchange deterioration seems to be a favorable tool for improving trade balance in the long run. This state shows that exports of the country have the potential to compensate the imports. As a result the volume of imported commodities will decrease and export volume will increase as adjustments is made in the exchange rate. All this process will improve the trade balance.

Pakistan being a developing economy is facing persistent trade deficit her import bill has always been greater than her export earnings except two fiscal years i.e. 1951-52 and 1972-73. Two major attempts have been made in Pakistan to promote exports by devaluation; first in 1955-56 and second in 1971-72. Exchange rate is depreciating continuously with the dollar and is affecting the trade balance negatively. Now the question arises whether the J-curve hypothesis exists between these two variables or not. (Petrovic and Gligoric, 2010).

Rehman and Afzal (2003) suggested devaluation as an effective tool in correcting the trade balance when exchange rate with U.S dollar was Rs. 57.57. Contrarily, according to Khan and Aftab (2008) J-curve of Pakistan does not exist with Hong Kong, Germany, Italy, Spain and Netherland. (Hameed and Kanwal; 2010, Awan et al. 2012; Khan et al, 2012) drew the same conclusion that J-curve did not exist in the Pakistan economy. Literature shows conflicting views about the existence of J-curve for Pakistan economy. The basic objective of this study is to investigate if the J-curve hypothesis of Pakistan holds true with Saudi Arabia.

2. Materials and Methods

As this study is a time series analysis so to choose the suitable econometric technique of estimation first the order of integration for all the variables is checked. As a second step the ARDL cointegration is applied on both the models under concern after finding mix order of integration. The data is taken from the WDI and SBP for the period of 1973 to 2010.

The variables which are utilized in the study are as under:

LY,	Natural log of Income of Pakistan
LYS,	Natural log of Income Of Saudi Arabia
LTBS,	Natural log of Trade balance of Pakistan with Saudi Arabia
LRETS,	Natural log of Real bilateral exchange rate of Pakistan with Saudi Arabia

2.1. The Auto Regressive Distributed Lag (ARDL) Frame Work

ARDL approach is used for analysis as it does not care for the difference in order of integration of variables. This technique was introduced by Pesaran et al (2001). This is most flexible approach because it deals with the variables that having same or different orders of integration that is at level I (0) and first difference I (1) or mix.

The general form of the model:

$$Y_t = \delta + \delta_0 X_i + \delta_1 X_{t-1} + \ldots\ldots + \delta_p X_{t-p} + \theta_1 Y_{t-1} + \ldots\ldots + \theta_p Y_{t-p} + V_i$$

This technique was introduced by Pesaran *et al*. (2001). ARDL is applied to compute the cointegration association of TB with real bilateral exchange rate. The model constructed to analyze the existence of J-curve phenomenon is as follow:

$$LTBT_t = \alpha_1 + \sum_{i=1}^{p} \beta_i LTBT_{t-i} + \sum_{i=0}^{q} \gamma_i LY_{t-i} + \sum_{i=0}^{r} \delta_i LYT_{t-i} + \sum_{i=0}^{s} \varepsilon_i LRET_{t-i} + \mu_t$$

2.2. Error Correction Mechanism (ECM)

The idea underlying error correction mechanism is basically to establish that the part of the disturbance is corrected form short run to the long run in a given economic situation (Engle and Granger, 1987). The Granger provided the basis of error correction model (ECM). This theorem gives framework for analyzing the cointegrated series. The accuracy of ECM depends on the relationship of the variables in the long run.

The consistency of estimates is attained through the inclusion of long run effects and short run dynamics. The main advantage of ECM is that it includes the differenced terms. All the stationary terms included in the analysis and it ensures that no information on the levels of variables is ignored by the addition of the disequilibrium terms. The ECM eliminates the trend by adding the variables at first difference and in this way the problem of spurious regression is removed.

The General Form of Unrestricted ECM model in ARDL (p,q,r) formulation:

$$\Delta LTBT_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta LTBT_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta LY_{t-i} + \sum_{i=0}^{r} \delta_i \Delta LYT_{t-i} + \sum_{i=0}^{s} \varepsilon_i \Delta LRET_{t-i} + \theta_i LTBT_{t-i} + \theta_2 LY_{t-i} + \theta_3 LYT_{t-i} + \theta_4 LRET_{t-i} + \mu_t$$

The following ECM model in ARDL (p,q,r) formulation is estimated in this research.

$$\Delta LTBT_t = \gamma_1 + \delta_1 \left(ecm\right)_{t-1} + \sum_{i=1}^{p} \alpha_i \left(\Delta LTBT\right)_{t-i} + \sum_{i=0}^{q} \beta_i \left(\Delta LY\right)_{t-i} + \sum_{i=0}^{r} \varepsilon_i \left(\Delta LYT\right)_{t-i} + \sum_{i=0}^{s} \omega_i \left(\Delta LRET\right)_{t-i}$$

3. Results and Discussions

3.1. Model of Saudi Arabia and Pakistan

3.1.1. Results of the Unit Root Tests

Augmented Dickey Fuller (ADF) test is applied to find out the order of integration of variables in this research.

Null hypothesis underlies that the coefficient has a unit root. The results are reported in the Table 1. The unit root test(ADF test) reveals that some variables are stationary at 1st difference and one is at level.

Table 1. Unit Root Test for the Model

	Statistical value			
	At Level		**At 1st Difference**	
	Without trend	with trend	Without trend	with trend
LTBS	-1.6494	-2.3977	-6.7284*	-6.8835*
LY	-1.6654	-1.2679	-2.8580***	-3.2819***
LYS	-0.3250	-1.8736	-3.0617**	-2.9813
LRETS	0.6846	-3.9096*	-3.4028*	-3.4028*

Note*,**,***Indicates that variable is stationary at 1%, 5%, 10% level.

3.1.2. Estimation of the Cointegrating Vector

All the regressors are replaced as regress and to find out the number of cointegrating vectors in this model and the results are reported in Table 2.

Table 2. Lag Determination through bounds tests

Dependent variable	F-Statistics	Lag	F-critical value*		Conclusion
			I(0)	I(1)	
$F_{(Ltbs/ly,lys,lrets)}$	$F_{(4,7)}$= 16.9881	5	3.219	4.378	Cointegration
$F_{(ly/lys,ltbs,lrets)}$	$F_{(4,7)}$=1.2017	5	3.219	4.378	No Cointegration
$F_{(lys/ly,ltbs,lrets)}$	$F_{(4,7)}$=1.7382	5	3.219	4.378	No Cointegration
$F_{(lrets/ly,lys,ltbs,)}$	$F_{(4,15)}$=5.155	5	3.219	4.378	Cointegration

Note: There are two cointegrating vectors.

3.1.3. Results of Long Run Cointegrating Vector

Long run coefficients are estimated through ARDL model. ARDL (2,5,5,0) lags were selected based on Schwarz Bayesian Criterion. Dependent variable is log of

trade balance in Saudi Arabia. The long run results of the model are given in the Table 3.

Table 3. Results of Long run Relationship

Variables	Coefficients	Standard error	t-statistics	P-values
C	11.4648	4.9046	2.3356**	.045
LY	5.0399	1.3513	3.7297*	.002
LYS	-1.7893	1.0038	-1.7825***	.006
LRETS	-2.0964	0.6476	-3.2369*	.005

Note*,**,***Indicates that variable is significant at 1%, 5%, 10% level.

Result show that domestic income is positively related with trade balance with the value of elasticity equal to 5.03. The coefficient of LYS is negative and significant which indicates that when income of Saudi Arabia increases the trade balance of Pakistan with Saudi Arabia will be effected negatively. The real bilateral exchange rate has negative and significant sign. It indicates that the Marshall -Learner condition does not hold in the long run. The J-curve hypothesis does not hold in the long run. So depreciation will worsen the trade balance of Pakistan in case of Saudi Arabia.

3.1.4. Results of Error Correction Model

Results of error correction model are reported in Table 4.

Table 4. ECM Short Run Results

Variables	Coefficients	Standard error	t-statistics	Probability
ECM(-1)	-.81173	.1585	5.4938*	0.000
C	9.9867	6.4286	1.5535	.137
DLY	-9.8467	3.2909	2.9921**	0.007
DLYS	-2.8979	.9008	-3.2167*	0.005
DLRETS	-1.8261	.5413	-3.3734**	0.003
S.E. of Regression	.2187		R-squared	.8117
Durbin-W stat	2.3562		AdjustedR-squared	.6456
Durbin- h statistic	1.946		F-statistic	5.6382[.000]

Note*,**,***Indicate significance at 1%, 5%, 10% level.

The value of error correction term (-0.8117) is negative and significant statistically which means that the model is convergent in nature. Any disequilibrium arising in the short run will be adjusted in the long run within one year. 81.17% equilibrium will be restored in one year.

The intercept is positive and insignificant. It means when there is no change in other arguments the trade balance will improve by 9.98%. The domestic income has negative sign and significant at 5% level of significance. This will show that when the domestic income increases it will detorirates the trade balance by 9.84 percent. It means in the short run the people will purchase more. The coefficient of foreign income DLYS is negative and significant at 1% level of significance. It means when the income of Saudi Arabia increases it will deteriorate the trade balance 2.89%.

The coefficient of real bilateral exchange rate DLRETS is negative and significant at 5% level. It shows that when the depreciation done in the country the trade balance will deteriorate in the short run. The Marshall- Learner condition does not hold because the sign of DLRETS is negative, which is not according to the economic theory. The J-curve phenomenon holds in the short run because in the short run trade balance worse off and improves in the long run.

The combination of short run and long run findings gives no evidence of J-curve hypothesis. In the long run the Marshall -Learner condition does not hold. The sign does not go from negative to positive of LRETS real bilateral exchange rate. It shows that J-curve does not hold in the case of Pakistan with Saudi Arabia. The results are same as of Khan and Aftab (2008) interpreting that J-curve did not exist of Pakistan with these countries Hong Kong, Germany, Italy, Spain and Netherland. The inference is also parallel with the findings of Hameed and Kanwal (2009).

3.1.5. Generalized Impulse Response Functions

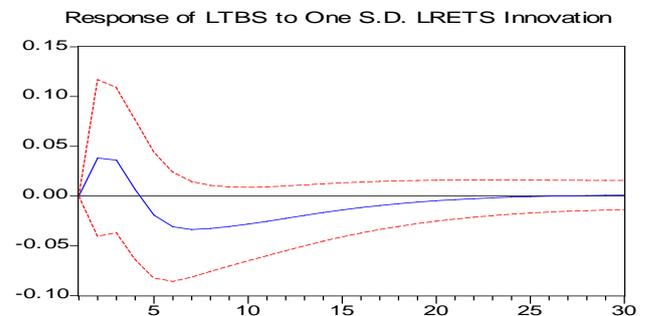Figure 1 shows that one S.D Innovation of LRETS has expansionary effect on trade balance of Pakistan.

Response of LTBS to One S.D. LRETS Innovation

Figure 1. Response of LTBS to One S.D. LRETS Innovation

3.1.6. Stability Test

CUSUM and CUSUM of Squares tests are applied in this study to check the structural stability of estimated parameters. Results of both tests show that estimated parameters are stable over the study time as the CUSUM stat in both cases is within upper and lower limits constructed under 95% confidence interval.
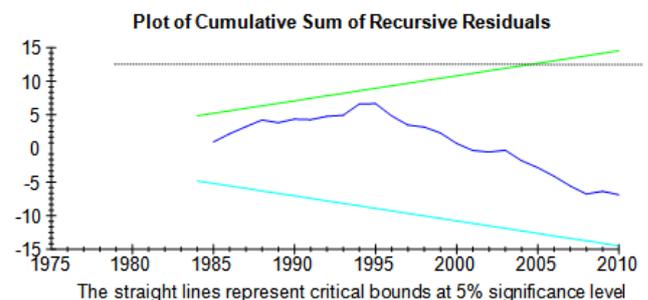

Plot of Cumulative Sum of Recursive Residuals

The straight lines represent critical bounds at 5% significance level

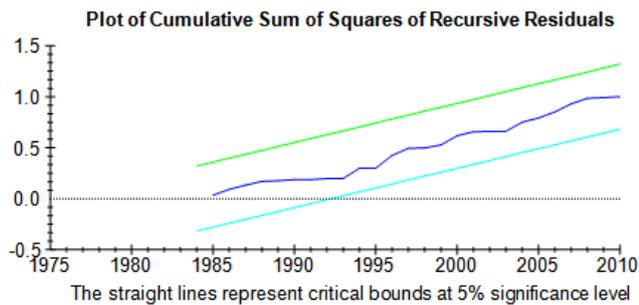**Figure 2.** CUSUM Test for Structural Stability

Figure 3. CUSUMSQ Test for Structural Stability

4. Conclusion and Policy Suggestions

Trade balance is now as in the era of globalization an important growth factor of the world economy. The countries that claim faster growth rate of GDP are considered successful and have been producing larger amount exports for the world economy. In developing countries the trade balance is helpful tool in achieving growth and development.

Empirical investigation of j-curve hypothesis showed that there exists no J-curve in Pakistan at least in case of Saudi Arabia. The possible reason for the non existence of J-curve is the nature of exports of Pakistan as she is not an exporter of finished goods. So to correct the trade balance of Pakistan devaluation has not been proved a suitable tool. Pakistan needs specialization in producing the finished type of exportable products for earning high from exports. Primary product exports have no proper justification to be increased. Government of Pakistan should focus on improving the quality of exports accompanied with the exchange rate stabilization because devaluation of exchange rate is proves unfavorable.

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