EXCHANGE RATE AND OIL PRICE:
ASYMMETRIC ADJUSTMENT IN PAKISTAN

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Abstract

By assuming asymmetric adjustments, this study investigates the long-run relationship and short-run dynamic relationship between real exchange rate and oil price in oil importing country Pakistan. Ender and Siklos (2001) suggested tests of cointegration, threshold autoregressive (TAR) and momentum-threshold autoregressive (MTAR) model, are employed to examine the likelihood of long-run relationship and asymmetric adjustment mechanism for two variables. Findings suggest that oil price has a long-run effect on real exchange rate. The real exchange rate adjusts faster for negative shocks than for positive deviations from long-run equilibrium. The short-run asymmetric dynamics show that real exchange rate and real oil price move in either direction. However, the real oil price appears weakly exogenous, it influences the real exchange rate in Pakistan but in an indirect way.

1. INTRODUCTION

In recent years, numerous challenges are faced by Pakistan's economy, which worsen country's economic indicators. High inflation, rising poverty, lesser employment opportunities, depreciating exchange rate, and low investment opportunities have affected the macro economic performance of the country. In addition to this, Pakistan has also witnessed a severe crisis in natural gas provision, power outages, oil and fuel which have worsened the internal economic situation of the country. Pakistan is heavily oil importing country where its oil imports account for more than 40 percent of the total imports. With flexible exchange rate system and large oil import bill, it is expected that the surprises in oil price have significant pressures on real exchange rate of Pakistan.[2]Likewise, it is expected that the negative and positive oil price oscillations from their equilibrium value may not influence the real exchange rate at constant rate. Thus, by assuming asymmetric adjustments, this study investigates the long-run relationship and short-run dynamic relationship between real exchange rate

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[2] Pakistan is managing flexible exchange rate regime but in practice, the system depends on interventions.

and oil price in Pakistan. Employing nonlinear cointegration tests, threshold [3] autoregressive (TAR) and momentum-threshold autoregressive (MTAR) model, we aim to investigate the likelihood of long-run linkages and asymmetric adjustment mechanism for two variables.

The TAR model was initially presented by Tong (1980), Tong and Lim (1980) and latter it was discussed by Tong (1990). With time, new developments in threshold modeling were observed that provided techniques for data to capture nonstationary and cointegration properties. It was witnessed that typical cointegration models such as error-correction models are based on assumption of linearity and symmetric adjustment (Engle & Granger, 1987). On the other front, threshold models offer a model specification which is now gaining strength as they model nonlinear behavior. In case, when symmetric adjustment is observed in the error-correction term, TAR reduces to the standard error correction model as pointed out in work of Balke and Fomby (1997), Enders and Granger (1998), Enders and Siklos (2001) and Hansen (1997) & Hansen and Seo (2002).

Research at macroeconomic level provides reasons that some economic variables show asymmetric adjustment and emphasizes the need to study such adjustments. It was noted by Sichel (1993) that the significance of such mechanism arises from a need to recognize facts about business cycles and economic variables. In addition to behavior. From time to time, various techniques are being followed to explore asymmetric adjustment in macro-economic literature.

Apart from Pakistan, the long-run relationship and short-run dynamics in real exchange rate and oil price have so far been studied for several oil importing and exporting countries. While determining the sources of real disturbances Zhou (1995), explained that oil price variations significantly provoke the real exchange rate movements. His conclusion was based on investigations of various real shock sources like productivity shocks, oil price and fiscal policy shocks. Similar relationship for Germany, Japan, and the US was investigated by Amano and VanNorden (1998a,b) while Chaudhuri and Daniel (1998) also examined it for 16 OECD countries; they all found that the real oil price is the long-run influential factor that determines real exchange rates in sample countries. Using a panel setup, Camarero and Tamarit (2002) showed long-run association between real oil prices and the real exchange rate (considering Spanish Peseta). Long-run relationship between real oil prices and real exchange rates for G7 countries was tested by Chen and Chen (2007) and they suggested that real oil price is a leading factor causing real exchange rate fluctuations, and also it has a strong ability to predict the real exchange rate in G7.

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[3]Threshold models became popular in applied economics as they model nonlinear behavior. The reason behind popularity is the observable pattern, followed by several Economic variables, and movement towards equilibrium (asymmetric adjustment).

The existence of long-run relationship between real exchange rate and real oil price was examined by Nikbakht (2010), and Mohammadi & Jahan-Parvar (2012). They also tested the validity of Dutch disease hypothesis in oil-exporting countries. Their findings also supported the existence of long-run relationship between real exchange rate and real oil price in oil-exporting regions.

Beside the discussion on relationship between oil-price and exchange rate, an empirical distinction is made by Chen and Goh (2013), they investigated that the negative and positive shocks in oil price have not affected real exchange rate in long-run. They showed that the negative and positive deviations in the long-run equilibrium of real exchange rate and oil price exhibit asymmetric adjustments; the negative and positive shocks in oil price affect differently the real exchange rate in Philippines. Ahmad and Hernandez (2013) checked the presence of long run relationship with asymmetric adjustment between real oil prices and real exchange rates. They considered twelve major world oil exporting and consuming countries by using the non-linear models; TAR and its alternative M-TAR model. The results confirm indication of cointegration in six countries while M TAR model for four of these countries show signs of asymmetric adjustments.

Some possible consequences and challenges existing in Pakistan's economy, due to elevated oil prices, are explored by Malik (2010). Pakistan is bearing major cost in importing oil and oil related products. Main usage of oil is in transport sector that consumes nearly 55 percent of the total oil products. However the calculated share of power sector is 29 percent while share of industry is 12 percent in terms of oil usage. The continuous rising trend in the oil prices in the international market negatively impacts Pakistan's foreign reserves.

Having empirical evidences from others, we observe that the assessment of long-run relationship between real exchange rate and oil price, and the asymmetries in the adjustments of negative and positive deviations remain an unexplored area in Pakistan. Thus, it motivates us to test these research questions to make contribution in empirical literature and to highlight policy suggestions for Pakistan. This research aims to assess the long run relationship between real exchange rate and real oil price and to explore the existence of asymmetric adjustments. The main objective of the study is to decompose the asymmetric adjustment if it exists. Engle-Granger test provide evidence and support on the long-run relationships, but its limitation is that it explains the adjustment is a linear process. Ender and Siklos (2001) suggested TAR and MTAR to decompose the nonlinear adjustment and this technique has been opted in this study.

The rest of study is organized as follows. Section 1 comprises of introduction. Section 2 discusses the exchange rate and oil price relationship. Specification of model and data description is presented in section 3. The results with detailed analysis are reported in section 4. Finally, section 5 presents conclusion and recommendations of the study.

2.   EXCHANGE RATE AND OIL PRICE RELATIONSHIP

Exchange rates have often been supposed to have impact on the import and export of goods and services. They are expected to influence the price of the products that are traded. At the same time energy, being an important variable, impacts production process in numerous ways. The use of oil, chemical, fuel and petroleum as inputs has increased over time in various key sectors, such as industrial, agricultural, and commercial sectors. Also, increased use of energy in thermal units, infrastructure and household has been observed. The prices of inputs (oil, fuel, petroleum, and chemicals) are expected to alter the prices of commodities, using these inputs, in production process. It is important to note that there are certain monetary (amount of foreign currency debt, inflation, foreign exchange reserves, and interest rate) and fiscal factors (weak capital account) which may affect exchange rate. Any increase in these factors may depreciate exchange rate.

As explained by Malik (2010) increase in oil prices influences income and demand in an economy. More of domestic output, at prevailing exchange rate, is needed to compensate for the same volume of oil imports. Due to the induced payment deficits, domestic currency may depreciate, reducing the purchasing power of domestic income for the imported goods. Aggregate supply is also reduced with rising oil prices, which increases intermediate input costs and reduces profits of the producer encouraging them to reduce output. Lower profits bring drop in investment spending and cause potential output to fall over prolonged periods.

Many researchers such as McGuirk (1983), Krugman (1983a, 1983b), Golub (1983) and Rogoff (1991) reviewed above suggested relationship, i.e. oil prices may have an important impact on exchange rates and tried to assess the possible role of oil prices in exchange rate movements. Their work indicated that oil price variations can aggravate real exchange rate movements in economy and real oil price is a leading long-run factor that determines real exchange rate. Amano and VanNorden (1998) illustrated the reasons due to which the real oil price captures terms-of-trade shocks exogenously. Further to this, they also explained why these types of shocks are essential in determining real exchange rates in the long run. Similarly, in this paper, we have tried to solve intermediate puzzle for Pakistan.

3.   DATA AND MODEL SPECIFICATION

Theoretically, following the model introduced by Chaudhri and Daniel (1998), a country's real exchange rate directly depends on real oil prices.

$$LnRER_t = \alpha_0 + \alpha_1 LnROP_t + \mu_t \qquad (1)$$

Where, RER is the real exchange rate and ROP denotes the real oil price.

Our major objective is to focus on analyzing the long-run equilibrium relationship between real exchange rate and oil price in Pakistan using nonlinear cointegration tests by assuming asymmetric adjustment. Using monthly data for the period 1982:01 to 2012:12, we estimate above equation to assess the symmetric and asymmetric

cointegration in next section. All data series are collected from *International Financial Statistics* (IFS).

Real Exchange Rate

The real exchange rate is constructed as national currency (Pak-Rupee) per US dollar at average period multiplied with consumer price index of the United States and divided by consumer price index of Pakistan.

Real Oil Price

Real oil price is obtained by multiplying the world crude oil price with national currency (Pak-Rupee) per US dollar for average period and dividing by consumer price index of Pakistan. This series is then multiplied with hundred.[4]

Finally, all variables used in this study i.e. real exchange rate and real oil price, are transformed into natural logarithm for estimation purpose. Real exchange rate indicates increasing trend of real exchange rate till 2001 and decreasing trend afterwards. Oil prices have shown decreasing trend at first and increasing trend after 1998. A sharp down turn is again observed in 2009 in oil prices. Our empirical results provide weak evidence of relationship between exchange rate and oil price. They support the hypothesis that there is an intermediate mechanism between two variables, not direct relationship.

4. ESTIMATION RESULTS

This section provides empirical findings of the relationship of real exchange rate and oil price. It explains TAR and M-TAR cointegration tests of Enders and Siklos (2001) along with the nonlinear ECMs within the context of the real exchange rate and real oil price. This approach is further utilized to investigate both short run and long run dynamics. First, we use the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to determine the stationarity and order of integration of real exchange rate and real oil prices. The null hypothesis is set for unit root i.e. when the null hypothesis is accepted the variable is nonstationary at level. If variable is found nonstationary at level, we move forward to test the hypothesis at first difference for corresponding variable. At first difference we reject null hypothesis as we conclude that corresponding variable is stationary at first difference and the order of integration is one. The Table A1 (Appendix A1) shows results of both tests.

The Schwarz Info Criteria (SIC) and Barlett Kernel method is used to select the optimal lag length for ADF and PP tests, respectively. Both tests reveal similar results that we accept the null hypothesis, and the real exchange rate and real oil prices are non-stationary at level. The null hypothesis is rejected at first difference where we conclude that all variables are stationary at first difference.

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[4] All over the world market crude oil priced in dollars.

4.1.   Symmetric Cointegration Test

Prior to testing the existence of symmetric and asymmetric cointegration in model, we conduct Engle–Granger two-step cointegration test. The first step is to pretest each variable to determine its order of integration. This step is already done in previous section where we have concluded that the order of integration of real exchange rate and real oil prices is one i.e. *I (1)*. The next step is to estimate the long-run relationship Equation (1) using OLS. From OLS regression, we extract the residuals (μ_t) and test it for stationarity. Since the μ_t values are the estimated values of the deviations from the long-run relationship, if these deviations are found to be stationary at level we infer that two variables are cointegrated. The estimated results of long-run regression Equation (1) are as follows:

$$LnRER_t = 3.53 \; + 0.122 \, LnROP_t + \mu_t \qquad\qquad (2)$$
$$ [35.351] \quad [3.572]^5$$

$$R^2 = 0.087 \, DW = 0.021$$

The long-run estimated results in Equation (2) are consistent with Chaudhri and Daniel (1998); the real oil prices have significant influence on the real exchange rate of Pakistan. These results are also theoretically sound because the rising real oil prices exert a depreciation pressure on real exchange rate. Further, from the estimated OLS regression Equation (2), we extract the residuals (μ_t) that will be examined for stationarity. We specify the equation of residuals for estimation as follow:

$$\Delta\mu_t = \rho\mu_{t-1} + \sum_{i=1}^{q} \vartheta_1 \, \Delta\mu_{t\text{-}1} + \nu_t \qquad\qquad (3)$$

With no intercept and trend, the ADF test confirms the stationarity of residuals $\hat{\mu}_t$ at level. However, we estimate Equation (3) also to confirm the stationarity of $\hat{\mu}_t$. The estimated results for residuals are:

$$\Delta\hat{\mu}t = -0.045\mu t - 1 \qquad\qquad (4)$$
$$\phantom{\Delta\hat{\mu}t =} [-3.592]$$
$$R^2 = 0.077 \, DW = 1.091$$

The t-statistics reported in square bracket rejects the null hypothesis of unit root at 5% level. It confirms the stationarity of residuals at level and validates the long-run relationship between exchange rate and oil price in case of Pakistan. Once the cointegration relationship is established between two variables, the next step is to move to evaluate an asymmetric cointegration test. To check the non-linearity or linearity in data Ramsey RESET test (1969) is also applied. Results of this test show nonlinearity at α=10%.

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[5]The value in brackets represents t-statistics.

4.2.   Asymmetric Cointegration Test

The Engle–Granger residuals specification in Equation (3) assumes that adjustment process in the long-run is symmetric. Enders and Siklos (2001) suggest that under asymmetric adjustment; the negative and positive deviations can adjust towards equilibrium at different rates. We employ threshold cointegration approach to test for a cointegrating relationship with asymmetric adjustment. We modify residuals specification in Equation (3) by splitting residuals into parts where one part is for above threshold values and the other is for below threshold values. To analyze asymmetric adjustment, we consider alternative specification TAR model and modify Equation (3) as follows:

$$\Delta\mu_t = I_t \rho_1 \mu_{t-1} + (1 - I_t)\rho_2 \mu_{t-1} + \sum_{i=1}^{P-1} \gamma_i \Delta\mu_{t-1} + v_t \qquad (5)$$

Where ρ_1, ρ_2 and γ_i are coefficients; v_t is a white-noise disturbance; p is the number of lags; and I_t is Heaviside indicator function such that:[6]

$$I_t = \begin{cases} 1 & if\ \mu_{t-1} \geq \tau \\ 0 & if\ \mu_{t-1} \leq \tau \end{cases} \qquad (6)$$

The above specification is set up for asymmetric adjustment. If the system converges to equilibrium, then the long-run equilibrium between them is given by $\hat{\mu}_t = \tau$, where τ is threshold parameter. To meet stationarity of $\hat{\mu}_t$, we require sufficient conditions $\rho_1 < 0$ and $\rho_2 < 0$ [Petrucelli and Woolford 1984]. Considering that if $\hat{\mu}_{t-1}$ is above its long-run equilibrium value, the adjustment at rate is ρ_1 and if $\hat{\mu}_{t-1}$ is below long-run equilibrium value, the deviations adjust at the rate ρ_2. The adjustment is likely to be symmetric if $\rho_1 = \rho_2$, otherwise using TAR model we can capture the asymmetry present in the model.

Enders and Siklos (2001) suggest another alternative specification to capture the asymmetry in adjustment of deviations i.e. MTAR model. The MTAR captures the previous periods change in $\hat{\mu}_t$ rather than identifying only the deviation from equilibrium in level. The Heaviside Indicator for MTAR is set as follows:

$$M_t = \begin{cases} 1 & if\ \Delta\mu_{t-1} \geq \tau \\ 0 & if\ \Delta\mu_{t-1} \leq \tau \end{cases} \qquad (7)$$

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[6] A dummy variable called Heaviside indicator function is used to determine the above and below threshold level.

Supplement to TAR model, the MTAR is a useful model that provides insight regarding speed of adjustments of negative and positive deviations from equilibrium. The values of ρ_1 and ρ_2 in MTAR model indicate speed of convergence towards the equilibrium above the threshold and below the threshold respectively. Along with Equation (5), the Equation (6) develops TAR model and the Equation (7) develops MTAR model.

Following Enders and Siklos (2001) who proposed cointegration joint test (F-statistics, ϕ), we assess whether asymmetric adjustment in error term is present. First the null hypothesis of no cointegration is tested that is $H_0 = \rho_1 = \rho_2 = 0$, if the null hypothesis is rejected, then we examine the null hypothesis of symmetric adjustment. The null hypothesis $H_0 = \rho_1 = \rho_2$ is set to determine the symmetric adjustment using standard F-equality.

The first row in Table A2 (Appendix A2) presents estimates of simple TAR model using the threshold value $\tau = 0$. Here estimates show that the F-Stat ϕ is 5.43, which is greater than 3.86 critical value at 5%. It suggests that we should reject the null hypothesis of no cointegration. We can conclude that the real exchange rate and oil price are cointegrated in long-run. The existence of cointegration allows us to further investigate whether the cointegration adjustment is asymmetric. The F-equality statistics at 2.448 is less than its critical value which indicates that we cannot reject the null hypothesis of symmetric adjustment at 5%.

Next, keeping aside the standard $\tau = 0$, the Chan's method (1993) is applied to search the optimal threshold value TAR-consistent which we found to be $\tau = -0.097$. Using this optimal threshold value, the cointegration joint test shows that ϕ is 5.861 that is higher than 3.89 at 5% critical value. Thus TAR-consistent value reveals cointegration between real exchange rate and oil price; the real oil price has long-run effects on real exchange rate in Pakistan. Examining the F-equality statistics in TAR-consistent model, we reject the null hypothesis of symmetric cointegration at 5% critical value. We conclude that real exchange rate and oil price have long-run relationship and the deviations adjustment process is asymmetric. The values of ρ_1 and ρ_2 in TAR-consistent Model suggests asymmetric convergence where negative deviations adjust more rapidly at the rate of ρ_2 than the positive deviations.

While analyzing MTAR and MTAR-consistent model with threshold values of $\tau = 0$ and $\tau = 0.018$ respectively, the values of ϕ are too high to reject the null hypothesis of no cointegration. So both models validate long-run equilibrium between real exchange rate and oil price. However, MTAR and MTAR-consistent models have too low F-equality values to reject the null hypothesis of symmetric cointegration. A similar study has been done by Ahmad and Hernandez (2013) whichfinds the long-run relationship and asymmetric adjustment between the real oil prices and the real

bilateral exchange rates of twelve major oil producers and consumers in the world. Another study done by Chen, Lee & Goh (2013) also shows similar type of relationship between exchange rate and oil price.

4.3 Asymmetric TAR-consistent Error Correction Model

After assessment of asymmetric cointegration between real exchange rate and oil price, we further estimate asymmetric error-correction model using the threshold value $\tau = -0.097$ in TAR-consistent. The error-correction model reveals short-run dynamics of deviations. In TAR-consistent we found asymmetries in the adjustments of negative and positive deviations; thus, here asymmetric error-correction model is developed to analyze short-run dynamics.

$$\Delta RER = c + \rho_1 I_t \mu_{t-1} + \rho_2 (1-I_t)\mu_{t-1} + A_{11}(L)\Delta RER_{t-1} + A_{12}(L)\Delta ROP_{t-1} + \varepsilon_{1t} \qquad (8)$$

$$\Delta ROP = c + \rho_1 I_t \mu_{t-1} + \rho_2 (1-I_t)\mu_{t-1} + A_{21}(L)\Delta RER_{t-1} + A_{22}(L)\Delta ROP_{t-1} + \varepsilon_{1t} \qquad (9)$$

We employ general to specific approach to specify the lag length of change in variables. Starting with a maximum lag of 8, we come up with three lags that affect the change in variables. The results of asymmetric error-correction model are reported in Table A3 (Appendix A3).

In Equation (8) we find weak evidence in favor (ρ_2 is marginally significant) of asymmetric adjustment of real exchange rate of Pakistan to the negative deviations in the spread approximately 1.1%. However, the real oil price is weakly exogenous as the error-correction terms are statistically insignificant. As the oil price appears weekly exogenous, it is concluded that oil prices influence the real exchange rate indirectly. There are certain monetary and fiscal factors which affect exchange rate through the indirect channel[7].

5. CONCLUSION AND POLICY RECOMMENDATIONS

The main objective of the paper is to decompose the asymmetric adjustment if it exists. Engle-Granger test provides evidence on the long-run relationships, but its limitation is that it shows the adjustment is linear process. Ender and Siklos (2001) suggested TAR and MTAR to decompose the nonlinear adjustment. The paper tries to see whether real exchange rate and oil price has long-run relationship in case of Pakistan, and further to investigate either the asymmetric mechanism embedded in their cointegration. Our findings suggest that real exchange rate and oil price have long-run relationship, and adjustment mechanism between two variables appears asymmetric in case of Pakistan. We also find evidence that real exchange rate asymmetrically adjusts to negative shocks in oil price. The real oil price appears

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[7]Monetary factors are debt, inflation, foreign exchange reserves, and interest rate. Any increase in these factors may depreciate exchange rate. Fiscal side factors include capital account. If capital account is weak then exchange rate depreciates.

weakly exogenous, and it influences the real exchange rate in Pakistan through indirect channel.

The instability observed in the relationship between oil price and exchange rate causes economic adversity, as the U.S. dollar and the oil price show the negative association. Any change in oil price has macroeconomic implications especially it affects the exchange rate and thus overall economic activity in the country. Pakistan is oil importing country and has heavy dependence on energy resources. Its industrial sector is energy intensive, while other sectors like commercial, infrastructure and households also need energy resources. Consequently, the country has to import oil in huge amount. The price of oil in Pakistan is fixed in US dollars per barrel therefore the massive import of oil (high import bill) affects local currency and causes depreciation of real exchange rate.

In a nutshell, the real oil price appears weakly exogenous, and it influences the real exchange rate in Pakistan but in indirect way. With an increase in the prices of tradable goods in country, price hikes may be observed. This causes a real depreciation of Pakistani rupee. When an oil price shock worsens the terms of trade, the home country has to raise the nominal exchange rate in order to improve country's competitiveness, which may lead to a further real depreciation of currency. Eventually, the price hike leads to change in production and consumption patterns.

Pakistan can adopt some cautious policy strategies. The foreign exchange policy should be fully considered while managing liquidity objective in country. As our exchange rate policy allows interventions, thus, State Bank's inflation control policy may consider the economic aspects of oil price hike and real exchange rate volatility as well, when revising monetary targets and open market operations. Such initiative will mitigate the adverse effects of the shocks on currency. Government may adopt a policy to restructure oil & gas sector and may also incentivize investment in this sector. To reduce import bills, focus of government should be on adoption of advance technological innovations to boost energy resources, research & development based sectoral growth and attracting investment to explore domestic resources.

For future research there is need of adding some other variables in model. This study has a limitation as it adopted two variables model and drew weak evidences, it may be useful in future to include monetary and fiscal factors which affect exchange rate.

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Appendix A1

Table A1.   Unit Root Tests

Variables	Level		First Difference	
	ADF	PP	ADF	PP
RER	-1.899	-2.376	-7.434	-7.406
ROP	-0.735	-0.873	-10.688	-10.245

Appendix A2

Table A2.   Estimates of TAR and MTAR Co-integration

Models	Coefficients				Threshold Values	F-Tests	
	ρ_1	ρ_2	γ_1	γ_2	τ	F-Stat ϕ	F-Equality
TAR	-0.005 [-0.776]	-0.017 [-3.193]**	0.279 [5.413]**	-0.091 [-1.778]*	0	5.43	2.448
TAR-Consistent	-0.003 [-0.634]	-0.018 [-3.357]**	0.279 [5.420]**	-0.091 [-1.81]*	-0.097	5.861	3.288
MTAR	-0.008 [-1.436]	-0.013 [-2.051]**	0.293 [5.750]**	-0.146 [-2.765]**	0	3.121	0.388
MTAR-Consistent	0.001 [0.067]	-0.011 [-2.683]**	0.294 [5.773]**	-0.15 [-2.843]**	0.018	3.483	1.12

*Note: The values in square bracket are t-statistics, * Significant at level of 10%, **Significant at 5%, ***Significant at 1%*

Appendix A3

Table A.3   TAR-consistent Asymmetric Error-Correction Model

Independents Variables	Dependent Variables			
	ΔRER		ΔROP	
	Coefficients	t-statistics	Coefficients	t-statistics
C	0.001	0.621	0.003	0.574
ρ_1	-0.004	0.632	0.015	0.385
ρ_2	-0.011	-1.752*	0.021	0.586
$A_{11}(L)$	0.285	5.491**	-0.292	-0.936
$A_{12}(L)$	-0.156	-2.903**	-0.063	-0.196
$A_{13}(L)$	0.127	2.487**	-0.467	-1.518
$A_{21}(L)$	0.014	1.524	0.326	6.157**
$A_{22}(L)$	0.013	1.435	-0.037	-0.672
$A_{23}(L)$	-0.015	-1.737*	0.005	0.103
F-Statistics (P-Value)	0.000		0.000	

**Significant at 5%, * Significant at 10%. Coefficient of ρ_2 is marginally significant.