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ASYMMETRIC CO-INTEGRATION ANALYSIS OF EXCHANGE RATES AND CRUDE OIL PRICES: EVIDENCE FROM INDIA

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Abstract

Using monthly data from January, 1980 to July 2013, the aim of the article is to find out whether there is cointegrating relationship between exchange rates and crude oil prices in India. The result indicates that there exists cointegration between the variables and speed of adjustment shows symmetric based on TAR model, while MTAR model exhibit asymmetric adjustment. The findings indicated that exchange rates have significant influence on crude oil prices in India and the adjustment to equilibrium when variables deviated is non-linear. The implication is that

Indian policy makers should focus more on their exchange rates dynamics in line with the persistent rises of crude oil prices that affects other macroeconomic variables specifically exchange rates that have significant influence on international trade considering the relevance of India in the international export market.

Keywords: Crude Oil Prices, Exchange Rates, Asymmetric, Cointegration, Error Correction Model, India

INTRODUCTION

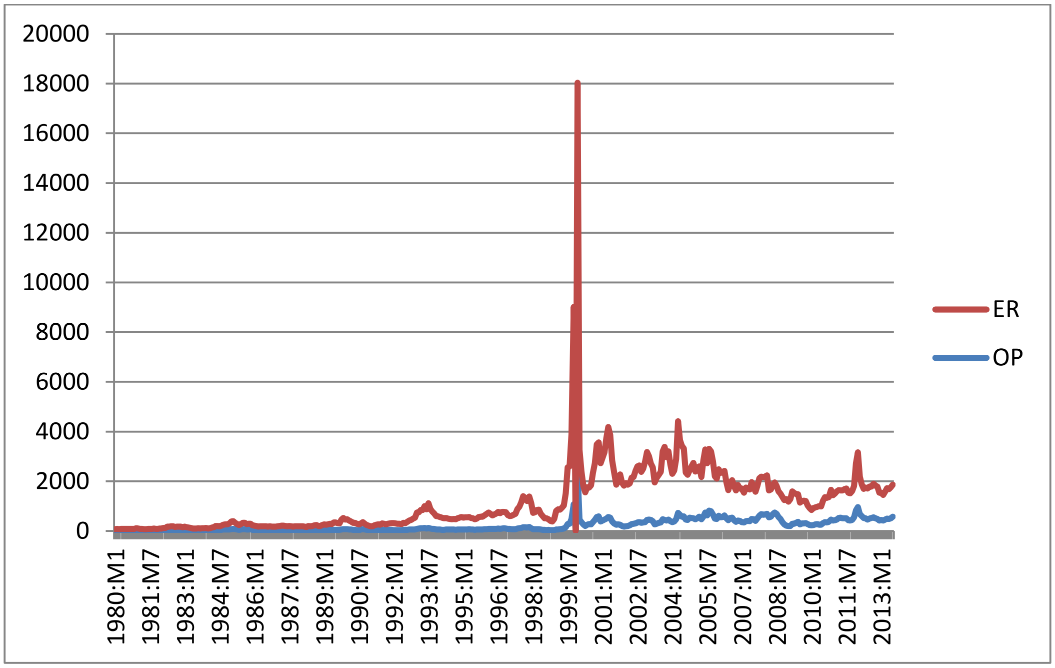
The first oil embargo of 1973 induces different finance and economic researchers to develop high interest in studying the links between oil prices and other macroeconomic variables. Considering its impacts on the global economy it almost affected all macroeconomic variables for example, inflation, output, terms of trade, employment, rate of interest etc. Investigating the links between global oil prices and exchange rates in India is important because the country is among the highest energy consumers in the world, therefore the impact of oil prices on its currency in relation to $USD will be an interesting topic to study more especially as we applied the new methodology to test and see whether the speed of adjustment is asymmetric or otherwise. Contrary to Engle-Granger symmetric adjustments analysis, various empirical studies exhibit asymmetric adjustments of the variables in the long-run. For details on studies that got asymmetric cointegration check Neftci, 1984; Falk, 1986; Terasvirta and Anderson, 1992; Beaudry and Koop, 1993; Ramsey and Rothman, 1996; Utkulu et al., 2004; Chen et al., 2005; Ewing et al., 2006; Narayan, 2007; Shen et al., 2007; and Yau and Nieh, 2008.

The present study empirically examined the impact of exchange rates on crude oil prices in India. This study is trying to answer the hypothesis that increase in the oil prices leads to depreciation of the country's currency in relation to $USD. Despite the importance of this relationship, very little studies applied asymmetric cointegration approach to address this issue in India. The rest of the paper is organized as follows; in section 2 both theoretical and empirical literatures are reviewed as well as an overview of the Indian economy, section 3 discussed about data and econometric methodology. Section 4 deliberated on the empirical findings and lastly section 5 concluded and proposes policy recommendations.

An overview of Indian Economy

India is the second largest populated country in the world with more than 1.21 billion people based on 2011 population census. It is ranked 10th in the world based on nominal GDP and third largest by purchasing power parity (PPP). The country is a member of G-20 major economies and also a member of BRICS economic union and it is among top 20 global players in terms of trade volume as recognized by world trade organisation (WTO). In 2014 the GDP growth rate of India is 5.5%, with $1,625 as its GDP per capita. With a consumer base of 1.2 billion people India has the large capacity of long term sustainable growth. The crude oil production in India for 2013-2014 production years was estimated at 37.788 million metric tonnes which surpass the previous year's output. In 2013-2014 the value of crude oil import was 189.238 metric tonnes which is about Rs.8, 64, 875 as against 184.795 metric tonnes for the previous year's valued at Rs.7, 84,652. Recently, the oil and gas sector is deregulated in India which gave more chances for private sector participation with little or no government participation. The trend below in figure 1 based on study data shows the relationship between oil prices and exchange rates for the study period.

Figure 1: Trends of Oil Prices and Exchange Rates in India (1980-2013)



Source: Author's construct based on study data

LITERATURE REVIEW

Oil price fluctuations was given due concern by both economists and econometricians during the mid-1970s, this is because of its influence on the business cycle volatilities. This gave an impetus to study, analyse and figure out on how oil price shocks influence other macro-economic variables, and to quantify such shocks on economic growth (See the detailed reviews by Jones and Leiby, 1996; Jones et al., 2004; Brown and Yücel, 2002). From the supply side effect point of view, increase in the oil prices will lead to decline in output as it result in the rises of the production inputs (See, among others, Brown and Yücel, 1999; Abel and Bernanke, 2001). As a result production cost will shut up this influenced the growth of output and productivity negatively. Increase in the price of oil may result in the rises of money demand, if the monetary authority failed to monitor the mechanism, interest rates will increase which will also impede economic growth (Brown and Yücel, 2002). An increase in oil prices could lead to more inflation, and this would result to price wages twists. The level of investment, consumption, and stock prices can also be affected negatively by increase in the oil prices, as such this depletes disposable incomes, and costs of production will be high. In the long run high cost of oil prices may lead to massive unemployment because excessive costs of production may lead to massive retrenchment as the firms profit will be adversely affected.

Several empirical studies were conducted about oil price shocks in relation to various macro-economic variables. For example, Zhang and Reed (2008) investigate the influence of global crude oil price on feed grain prices and pork prices in China for the period January 2000 to October 2007. The result indicated that the effect of crude oil price is insignificant over the period of the study. It also shows that the price of pork rises due to its demand and supply. Lardic and Mignon (2008) examined the relationship between oil price and economic activities proxied by GDP and concluded that though normal cointegration test was rejected, but there exist asymmetric cointegration between oil price and GDP in the US, G7, Europe and Euro area economies. Using annual data from 1970 to 2006, Greenidge and DaCosta (2009) investigate the factors that affect inflation in four Caribbean countries (Barbados, Jamaica, Guyana and Trinidad and Tobago) and concluded that there is significant effect of changes in oil price on inflation in both short run and long run. The relationship between oil prices, turkey's currency in relation to $USD exchange rate and agricultural products prices (wheat, maize, cotton, soybeans and sunflower) using monthly data from January, 1994 to March, 2010 and applied both Toda Yamamoto causality test and generalized impulse response function analysis. The finding based on impulse response analysis shows that agricultural prices do not respond to oil prices and exchange rates shocks in Turkey, and the long-run causality indicated that changes to oil prices and exchange rates volatility of the Turkey's currency are also not transferred to agricultural commodities prices in Turkey (Nazlioglu and Soytas, 2011).

Using generalized autoregressive conditional heteroskedasticity (GARCH) and exponential GARCH (EGARCH) Ghosh (2011) examined the relationship between crude oil price and exchange rates in India for the period of 2nd, July to 28th, November 2008. The finding shows that increase in oil price leads to the depreciation of Indian Rupees in relation to US Dollars. The finding also found no variation in the degree of both positive and negative effects of oil price shocks in India, also exchange rate instability and shocks of oil price have perpetual effect on exchange rate volatility.

Chen et al., (2013) used quarterly data from 1970Q1 to 2011Q4 of crude oil price and exchange rate for Philippine and concludes that the threshold auto regressive (TAR) model disclose that the two variables are non-stationary in the long run, they are however non-linearly adjusted using momentum autoregressive (MTAR) model. Tiwari et al., (2013) investigated the linear and nonlinear `Granger causalities among oil price and real effective exchange rate in India. When standard domain approach is applied there is no any causal relationship, the series are then decompose using wavelet technique and examine the nexus among decomposed series on scales basis. They also applied battery of non-linear causality test. After that the result shows both linear and non-linear relationship between oil price and real effective exchange rates at higher scales, but no causality exist at lower scale. Ibrahim and Chancharoenchai (2014) examined the relationship between oil price and other price indexes of Thailand using both symmetric and asymmetric co-integration and found that the main influence of oil price dynamics are on the energy price inflation, then transportation and communication inflation, and lastly the non-raw food and energy price inflation. Ali et al., (2015) applied asymmetric cointegration approach and examined the relationship between exchange rates and crude oil prices in South Africa using monthly data for the period of 1960-2013. Based on Engle-Granger technique the variables are cointegrated. However, when TAR and MTAR models are tested no any significant long-run relationship found and the speed of adjustment remained symmetric.

METHODOLOGY

Data

The data for the study obtained from two data bases, crude oil prices sourced from Western Texas intermediate (WTI), while exchange rates and Consumer Price Index (CPI) obtained from Data Stream International. Monthly data from January, 1980 to July, 2013 is used for the study. Real oil price is obtained by multiplying the world crude oil price with the country's local currency per US$ dollar at average period and divided by the country's CPI. Real exchange rate is obtained by taking each country's local currency per US$ dollar at average period multiplied with the Consumer price index of the United State and divided by the CPI of each country. Oil prices and exchange rates were both expressed in natural logarithms for normalization purposes.

Econometric Model Specification

$LER_t = \beta_0 + \beta_1 LOP_t + \mu_t$ (1)

LER refers to log of exchange rates and LOP is the log of oil prices, β_0 is the intercept and β_1 is the slope of the coefficient that explains the nexus between the two variables, and μ_t is the error term that may be serially correlated (Enders and Siklos, 2001). When the variables are stationary which will be shown by either Augmented Dickey–Fuller (ADF) or Phillips–Perron (PP) unit root tests, and then test to see if variables are co-integrated in the long-run by testing the residual as initiated by Engle and Granger (1987) method, as well as the Johansen (1988) and Johensen and Juselius (1990) Vector Auto Regressive (VAR) test.

EMPIRICAL RESULTS

Table 1: Results of the ADF and PP unit root tests for Exchange rates and Oil prices

Variables	ADF level	ADF First Difference	PP level	PP First Difference
$\mathbf{LER_t}$	-1.979 (0.296)	-5.707 (0.000)*	-2.648 (0.084)	-18.355 (0.000)*
$\mathbf{LOP_t}$	-1.335 (0.613)	-6.077 (0.000)*	-1.335 (0.613)	-6.077 (0.000)*

*NB: The ADF and PP test equations include both constant and trend terms. The Schwarz information criterion (SIC) is used to select the optimal lag order in the ADF test equation. The values in brackets are corresponding p-values. * Denote significance level at 1%, ** at 5%, and *** at 10% respectively.*

The null hypothesis cannot be rejected at level because all the p-values are insignificant at level. However the null hypothesis for both ADF and PP unit root tests was rejected at first difference because the p-values are significant at 5%. This signifies that all variables are non-stationary at levels but stationary at first difference and all integrated at order of 1 or I(1). Having established the stationarity among the variables we move further to conduct co-integration test for the two (2) countries under study.

Based on Engle-Granger test the residual must be moving together at level (Stationary), the residual estimation is shown below:

$$\Delta\mu_t = \rho\mu_{t-1} \sum_{i=1}^{q} \delta_1 \Delta X_{t-1} + v_t \quad (2)$$

The long-run estimated equation is presented below;

$LER_t = 2.21 + 0.86 LOP_t + \mu_t$

(0.095) (0.019)*

$R^2 = 0.83$, D.W = 0.02 (3)

The values in brackets are P-values, to obtain Engle-Granger values however we regress the residual using ADF at level without trend or intercept, the residual after estimation is as follows;

$\Delta\mu_t = 0.032\mu_{t-1}$

(-2.128)

$R^2 = 0.085, D.W. = 1.974$ (4)

Based on the t-statistics values of (-2.128) we reject null hypothesis at 5% which implies that residuals are stationary at level, means there exist cointegration between exchange rates and oil price, since the variables are cointegrated we then move to test for asymmetric cointegration to find out the speed of adjustment for the variables when deviated from the equilibrium.

The above mentioned tests assumed symmetry adjustment co-integrating relationship among variables. To test whether non-linear long-run relationship exists we apply the asymmetric cointegration tests initiated by Enders and Granger (1998) and Enders and Siklos (2001). As suggested by Eagle-Granger technique, the residuals of the equation 1 will be estimated using two steps to determine the long-run equilibrium of the equation between co-integrated series. It also concern with estimating equation (2) which depends on ρ and λ. To test for non-linear relationship between the variables equation 2 will be modified as follows:

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

The dummy variable known as Heaviside indicator function is used in order to determine above and below threshold (τ), in which:

$$T_t = \begin{cases} 1 \; if \; \mu_{t-1} \geq \tau \\ 0 \; if \; \mu_{t-1} < \tau \end{cases} \qquad (6a)$$

$$M_t = \begin{cases} 1 \; if \; \Delta\mu_{t-1} \geq \tau \\ 0 \; if \; \Delta\mu_{t-1} < \tau \end{cases} \qquad (6b)$$

Equation 5 and 6a refers to Threshold Auto Regressive (TAR) model, while equation 5 and 6b is Momentum Threshold Auto Regressive (M-TAR) model. Based on these models when $\mu_{t-1}$is above the threshold the coefficient for the adjustment is $\rho 1\mu_{t-1}$, while if the μ_{t-1} is below the threshold the adjustment coefficient is $\rho 2\mu_{t-1}$.

We need to test and see if the relationship between the variables is asymmetric by testing the null hypothesis of no cointegration as proposed by Enders and Siklos (2001), Ho: $\rho_1 = \rho_2 = 0$. If null is rejected, we then use F-equality values in order to determine asymmetric adjustment by testing the null hypothesis of Ho: $\rho_1 = \rho_2$.

Table 2: Estimation of the impacts for exchange rates on Oil prices: Engle –Granger, TAR and M-TAR cointegration

	Engle-Granger (1)	**TAR (2)**	**TAR-consistent (3)**	**M-TAR (4)**	**M-TAR-consistent (5)**
$\rho_1{}^a$	-2.128** (-1.941)	-0.012 (-1.124)	-0.008 (-0.824)	-0.024 (-2.544)	-0.062 (-4.136)
$\rho_2{}^a$	N/A	-0.016 (-1.649)	-0.0238 (-2.068)	-0.000 (-0.031)	0.000 (0.087)
Φ	N/A	0.833	1.063 [6.927]	2.571	13.101 [8.106]**
$\rho_1 = \rho_2$	N/A	1.9798	2.474 [6.914]	3.236	8.554 [7.910]**
τ		0	-0.465	0	0.041

N.B: t-statistics and critical values are given in round and squared brackets respectively. Monte Carlo simulation is used to obtain critical value at 5% significance level.

The Engle-Granger test signify the existence of cointegration among the variables as null hypothesis was rejected at 5% critical value, the threshold adjustment for TAR show that the variables are stationary and converge to equilibrium as shown by the negative signs for both coefficients except for M-TAR below threshold which shows positive sign possibly because of the nature of most commodities prices of persistence. The F-statistics and F-joint shows that we cannot reject null for TAR model. Moving to M-TAR model the null hypothesis was rejected at 5% which shows the variables were cointegrated asymmetrically using Enders and Siklos (2001) technique. Thus, based on our result the relationship between exchange rates and oil prices is symmetric shown by TAR, which implies that exchange rate and oil price are consistent in the long-run and the adjustment is linear. Using MTAR however, it shows the variables are non-linearly cointegrated, which implies friction in the relationship between exchange rate and oil price as shown by M-TAR model, means exchange rates have little or no effects on the oil prices in the long-run.

Since we got asymmetric cointegration in MTAR model we will now test for asymmetric error correction model based on our specified equation 5 above.

India Asymmetric error correction model estimated results

ΔER_t = 0.011 - 0.229Z^{+}_{t-1} - 0.884Z^{-}_{t-1} - 0.418ΔER_{t-1} - 0.176ΔER_{t-4} – 0.265ΔOP_t + ε_t

(0.079) (0.222) (0.001) (0.039) (0.049) (0.000)

Adj R^2 = 0.249

F-Stat= 11.92 (0.000)

We found that both exchange rates and oil prices shows some degree of convergence as signified that when the variables deviate upward (Z+) from its equilibrium path it persist and doesn't converge to its steady state, when it move down from the equilibrium it converge faster to its equilibrium path as shown by (Z-), therefore as hypothesized the adjustment of the variables are faster above the threshold. Though all the coefficients of lagged exchange rates are negative and significant at predictable level which signifies the variables convergence to the steady state when deviated. Above threshold real exchange rates adjust to equilibrium at about 22.9% which is assumed to be corrected in the subsequent month, while the below threshold adjusted at around negatively at around 88.4% and is significant at 5%. The interpretation remains that when oil prices increases it will invariably affect exchange rates in Indian economy, which exhibit that two variables were cointegrated.

CONCLUSION

The present study examined the effects of global crude oil prices on the exchange rates in India, the result shows an evidence of long-run relations between crude oil prices and exchange rates, and the speed of adjustment for the variables are asymmetrically cointegrated. Because of asymmetric adjustment it shows that the exchange rates are likely to increases faster due to increase in the oil prices. Based on this finding it become imperative for the policy makers in India to monitor the movement and adjust their currencies with regards to US dollars and rising crude oil prices in order to curb its external shocks on the exchange rates that may have adverse effects to the overall macroeconomic conditions in the country more especially as the government recently deregulated oil and gas sector that enhances private sector participation. Proper monitoring in line with sound policies on the oil and gas sector is paramount because of its direct and indirect effects on the general economy. Investigating the impact of oil prices on trade balance in India could be a very good study considering its stage in the global market as one of the vibrant export driven economy, therefore could be a good study and is suggested for future study in this area.

REFERENCES

A.B. Abel, B.S. Bernanke: Macroeconomics Addison Wesley Longman Inc. (2001).

Ali, H. S., Mukhtar, U., Tijani, B. A., & Auwal, A. M. (2015). Dynamic relationship of exchange rates and crude oil prices in South Africa: Are there asymmetries?. *Research Journal of Finance and Accounting*, *6*(6), 195-200.

Balke, N. S., & Fomby, T. B. (1997). Threshold cointegration: International economic review, 627-645.

Beaudry, P., & Koop, G. (1993). Do recessions permanently change output?. *Journal of Monetary economics*, *31*(2), 149-163 http://dx.doi.org/10.1016/0304-3932(93)90042-E.

Das, S., Bose, S., & Bhanumurthy, N. R. (2014). Oil Price Shock, Pass-Through Policy and its Impact on India. In *Market, Regulations and Finance* (pp. 231-253). Springer India.

Brown, S., & Yücel, M. K. (2002). Energy prices and aggregate economic activity: an interpretative survey. The Quarterly Review of Economics and Finance, 42(2), 193-208 http://dx.doi.org/10.1016/S1062-9769(02)00138-2.

Brown, S. P., & Yuecal, M. K. (1999). Oil prices and U.S aggregate economic activity: a question of neutrality. Economic and financial review-federal reserve bank of Dallas, 16- 23.

Chen, L. H., Finney, M., & Lai, K. S. (2005). A threshold cointegration analysis of asymmetric price transmission from crude oil to gasoline prices. Economics Letters, 89(2), 233-239 http://dx.doi.org/10.1016/j.econlet.2005.05.037.

Chen, J. E., Lee, C. Y., & Goh, L. T. (2013). Exchange rate and oil price: asymmetric adjustment. Applied Economics Letters, 20(10), 987-990 DOI:10.1080/13504851.2013.770118

Croushore, D. D., Abel, A. B., & Bernanke, B. S. (2001). Macroeconomics, Addison-Wesley.

Enders, W., & Granger, C. W. J. (1998). Unit-root tests and asymmetric adjustment with an example using the term structure of interest rates. *Journal of Business & Economic Statistics*, *16*(3), 304-311 DOI: 10.1080/07350015.1998.10524769

Enders, W., Siklos, P., 2001. Cointegration and threshold adjustment. Journal of Business and Economic Statistics 19, 166–176 DOI: 10.1198/073500101316970395

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276 http://www.jstor.org/stable/1913236,

Ewing, B. T., Payne, J. E., Thompson, M. A., & Al-Zoubi, O. M. (2006). Government expenditures and revenues: evidence from asymmetric modeling. Southern Economic Journal, 190-200 http://www.jstor.org/stable/20111882.

Falk, R. (1986). Conditional probabilities: insights and difficulties. In *Proceedings of the Second International Conference on Teaching Statistics* (pp. 292-297).

Ghosh, S. (2011). Examining crude oil price–Exchange rate nexus for India during the period of extreme oil price volatility. *Applied Energy*, *88*(5), 1886-1889 http://dx.doi.org/10.1016/j.apenergy.2010.10.043

Greenidge, K., & DaCosta, D. (2009). Determinants of inflation in selected Caribbean countries. Business Finance and Economics in Emerging Economies, 4(2).

Ibrahim, M. H., & Chancharoenchai, K. (2014). How inflationary are oil price hikes? A disaggregated look at Thailand using symmetric and asymmetric cointegration models. Journal of the Asia Pacific Economy, 19(3), 409-422 DOI:10.1080/13547860.2013.820470

Indian Petroleum and Natural Gas Statistics 2013-14. Government of India Ministry of petroleum & natural gas Economics and statistics division, New Delhi.

Jain, A., & Ghosh, S. (2013). Dynamics of global oil prices, exchange rate and precious metal prices in India. *Resources Policy*, *38*(1), 88-93 http://dx.doi.org/10.1016/j.resourpol.2012.10.001.

Jones, D. W., & Leiby, P. N. (1996). The macroeconomic impacts of oil price shocks: a review of the literature and issues. Oak Ridge National Laboratory http://www.jstor.org/stable/41323029

Jones, D. W., Leiby, P. N., & Paik, I. K. (2004). Oil price shocks and the macro-economy: what has been learned since 1996? The Energy Journal, 1-32 http://www.jstor.org/stable/41323029

Lardic, S., & Mignon, V. (2008). Oil prices and economic activity: An asymmetric cointegration approach. Energy Economics, 30(3), 847-855 http://dx.doi.org/10.1016/j.eneco.2006.10.010

Narayan, P. K. (2007). Are Nominal Exchange Rates and Price Levels Co-Integrated? New Evidence from Threshold Autoregressive and Momentum-Threshold Autoregressive Models Economic Record, 83(260), 74-85 DOI: 10.1111/j.1475-4932.2007.00377.x

Nazlioglu, S., & Soytas, U. (2011). World oil prices and agricultural commodity prices: evidence from an emerging market. Energy Economics, 33(3), 488-496 http://dx.doi.org/10.1016/j.eneco.2010.11.012

Neftci, Salih N. (1984). "Are Economic Time-Series Asymmetric Over the Business-Cycle? Journal of Political Economy 92:21 http://www.jstor.org/stable/1831389

Ramsey, J.B., & Rothman, P.(1996). Time irreversibility and business cycle asymmetry. *Journal of Money, Credit and Banking*, 1-21 http://www.jstor.org/stable/2077963

Shen, C. H., Chen, C. F., & Chen, L. H. (2007). An empirical study of the asymmetric cointegration relationships among the Chinese stock markets. Applied Economics, 39(11), 1433-1445 DOI: 10.1080/00036840600606302

Terasvirta, T., & Anderson, H. M. (1992). Characterizing nonlinearities in business cycles using smooth transition autoregressive models. *Journal of Applied Econometrics*, *7*(S1), S119- S136 DOI: 10.1002/jae.3950070509

Tiwari, A. K., Dar, A. B., & Bhanja, N. (2013). Oil price and exchange rates: a wavelet based analysis for India. *Economic Modelling*, *31*, 414-422 http://dx.doi.org/10.1016/j.econmod.2012.11.043

Utkulu, U., Seymen, D., & Arı, A. (2004, June). Export supply and trade reform: The Turkish evidence. International Conference on Policy Modelling, Paris June.

Yau, H. Y., & Nieh, C. C. (2009). Testing for cointegration with threshold effect between stock prices and exchange rates in Japan and Taiwan. Japan and the World Economy, 21(3), 292-300 http://dx.doi.org/10.1016/j.japwor.2008.09.001

Zhang, Q., & Reed, M. (2008, February). Examining the impact of the world crude oil price on China's agricultural commodity prices: the case of corn, soybean, and pork. In Proceedings of the Southern Agricultural Economics Association Annual Meetings, Dallas, TX.