IJEEP

INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY

EJ EconJournals ISSN: 2146-4553

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2015, 5(2), 574-579.

EJ EconJournals

Oil Price Volatility and Real Effective Exchange Rate: The Case of Thailand

Komain Jiranyakul*

School of Development Economics, National Institute of Development Administration, Bangkok, Thailand. *Email: jkomain@yahoo.com

ABSTRACT

The main objective of this study is to directly examine the relation between real oil price and real effective exchange rate in Thailand during July 1997 to December 2013. Under the floating exchange rate regime, bilateral exchange rates are expected to fluctuate more than under the fixed exchange rate regime. The monthly data of real effective exchange rate index and real oil price are used. The results from this study reveal that there is no cointegration and causality in levels of the two series. However, an increase in oil price volatility causes real exchange rate volatility to increase. This main finding gives some policy implications to policy makers.

Keywords: Oil Price, Real Exchange Rate, Bivariate Generalized Autoregressive Conditional Heteroscedastic, Volatility Spillover
JEL Classifications: C22, G40

1. INTRODUCTION

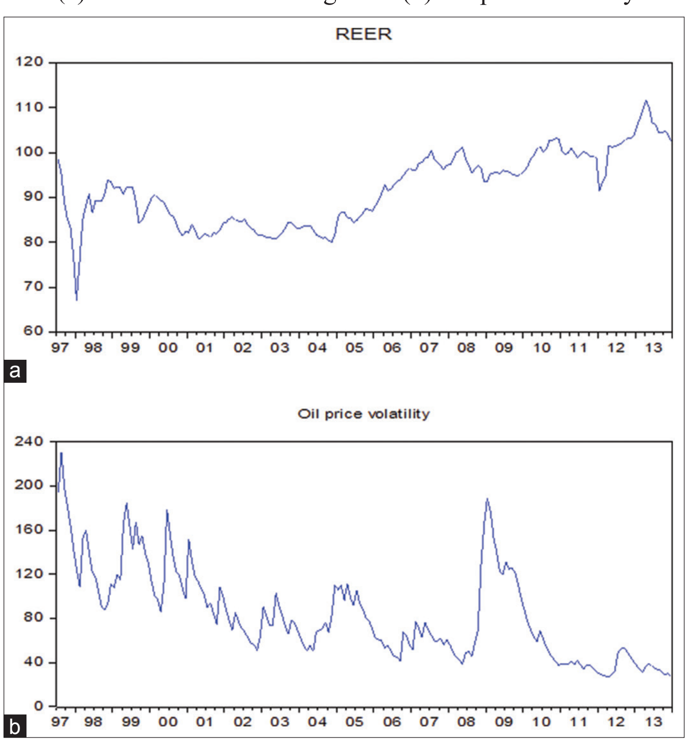
It is widely known in the economic literature that oil price shocks can impose economic impacts on both oil-exporting and oil-importing countries. In addition, there will be a wealth transfer from oil-importing to oil exporting countries due to an increase in the price of oil (Krugman, 1980). Many empirical studies have focused on the impact of real oil price on real exchange rate. However, previous results on the relationship between crude oil prices and exchange rates seem to be ambiguous. Amano and van Norden (1998) find that there exists a stable linkage between oil price shocks and the US real effective exchange rate over the post-Bretton Wood period. Their finding suggests that oil prices can be the dominant source of persistent exchange rate shocks. Chaudhuri and Daniel (1998) find the evidence showing that oil price is the main source of the US real exchange rate fluctuations. Akram (2004) finds a non-linear negative relationship between oil prices and the Norwegian exchange rate. An increase in the price of oil leads to an appreciation of the exchange rate. Chen and Chen (2007) find that there is a link between real oil prices and real exchange rates in the G-7 countries. A rise in oil prices leads to a real depreciation. In addition, real oil prices can forecast future real exchange rate movements. Huang and Guo (2007) find that real oil price shocks lead to minor appreciation of the long-term real exchange rate in China, a large Asian country that is dependent on imported oil. Lizardo and Mollick (2010) find that oil prices play an important role in the monetary model of exchange rates, i.e., oil prices significantly explain movements in the value of the US dollar against major currencies. Their results show that an increase in real oil prices causes a significant depreciation of the US dollar against net oil-exporting countries' currencies, but causes an appreciation of oil-importing countries' currencies. Hasanov (2010) employ error correction model and cointegration tests to examine the impact of real oil price on real exchange rate of Azerbaijan and finds that real oil price impose a positive impact on real exchange rate in the long run. In testing co-movements between oil price and exchange rate, Reboredo (2012) finds that co-movements between oil price and a range of currencies are generally weak. Ghosh (2011) examines the relationship between crude oil price and exchange rate using daily data for India and finds that an increase in oil price changes causes a depreciation of the rupee/US dollar. Turhan et al. (2013) find that a rise in oil prices causes an appreciation of emerging economies' currencies against the US dollar. Beckman and Czudaj (2013) use the trade-weighted US effective exchange rates and the prices of oil to examine the relationship between them. They employ

Markov-switching vector error correction model to test the link between oil prices and effective exchange rates (both nominal and real terms). One of their main findings is that both nominal and real effective exchange rates display a similar pattern to oil price shocks, i.e., an increase in real oil prices leads to an appreciation of the exchange rates. Using monthly data, Zhang (2013) finds the existence of long-run equilibrium relationship between real oil price and real effective exchange rate of the US dollar when structural breaks are taken into account.

Few empirical studies have focused on the impact of oil price volatility on exchange rates. Rickne (2009) finds that the co-movements between oil price and real exchange rates in the sample of 33 oil-exporting countries are conditional on political and legal institutions. Specifically, currencies in countries with strong bureaucracies are less affected by oil price variation. Englama et al. (2010) examine the relationship oil price and exchange rate volatility in Nigeria. They find that exchange rate volatility is positively influenced by oil price volatility. Ghosh (2011) also finds the result indicating that positive and negative shocks have similar effects on exchange rate volatility.

Thailand has switched from fixed to floating exchange rate regime since July 1997. The adoption of floating exchange rate regime has caused fluctuations in bilateral nominal exchange rates that are traded in the country. Therefore, the real effective exchange rate, the trade weighted index, has been substantially affected. Figure 1 shows the evolution of the real effective exchange rate and real oil price volatility. After the country has adopted the floating exchange rate regime, the behavior of real effective exchange rate appears to be independent of real oil price volatility (derived from the generalized autoregressive conditional heteroscedastic [GARCH] model in Section 2). The high volatility of real oil price during 2008 and 2009 did not seem to cause more fluctuations in the real effective exchange rate. Therefore, it should be expected that real oil price volatility might not affect the real effective exchange rate. However, the might exist volatility spillover from oil to foreign exchange markets.

Figure 1: Real effective exchange rate and real oil price volatility
(a) Real effective exchange rate (b) Oil price volatility



The main objective of this paper is to investigate whether oil price uncertainty affect the real effective exchange rate under the floating exchange rate regime. Monthly data of real effective exchange rate and real oil prices from July 1997 to December 2013 are used. The two-stage approach, which comprises a bivariate GARCH model and the standard Granger causality test, is adopted. The main finding is that real oil price volatility (uncertainty) does not cause real effective exchange rate of depreciate or appreciate, but real oil price volatility does cause real exchange rate volatility (uncertainty) to increase. Real exchange rate uncertainty can impose a significantly negative impact on the country exports and cause trade deficits. The present paper is structured as follows: Section 2 describes the data used in the analysis and econometric methodology pertaining to a bivariate GARCH model and causality test. Section 3 presents empirical results and findings. The last section gives concluding remarks.

2. METHODS

This section describes the data and estimation methods used in this study.

2.1 Data

Monthly data of consumer price index, the real effective exchange rate index, and crude oil price are used in this study. The real effective exchange rate index and consumer price index are obtained from the Bank of Thailand. The Brent crude oil price series expressed in dollar per barrel is obtained from Energy Information Administration. The data set covers the period from July 1997 to December 2013[1] with 198 observations.[2] Real oil price is calculated by multiplying crude oil price by the dollar exchange rate and deflating by consumer price index. Movements in real effective exchange rate (r^{REER}) and real oil price (r^{OP}) are the percentage rates of change of real effective exchange rate index and real crude oil price.

Summary statistics of real oil movements and real effective exchange rate changes are reported in Table 1. Average monthly rate of real exchange rate change is −0.038 whereas the average monthly oil price rate of change is 1.232. The Jarque-Bera normality test rejects the null of a normal distribution of both series, indicating that least squares estimation is not suitable.

The modified Dickey-Fuller (DF-GLS) test developed by Elliott et al. (1996) is used to determine stationarity property of the rates of change in real effective exchange rate and real oil price. This test is believed to be more powerful than the traditional unit root

1 This is the period of the floating exchange rate regime.
2 In fact, the size and significance of parameters in the conditional variance depend on the data frequency being used. Monthly data set allows for a longer time span and can capture the long-run impact of one variable on other variables.

Table 1: Descriptive statistics and unit root test

	r^{REER}	r^{OP}
Mean	−0.038	1.232
Standard deviation	2.623	9.080
Skewness	−1.016	−0.339
Kurtosis	18.671	3.583
Jarque-Bera statistic	2060.065 (*P*=0.000)	6.603 (*P*=0.037)
DF-GLS with constant	−5,136 (0) (*P*=0.000)	−8.299 (0) (*P*=0.000)

r^{REER} stands for the percentage change in real effective exchange rate, and r^{OP} stands for the percentage in real oil price. The number in parenthesis is the probability of accepting the null of normality

tests. The results show that the two series are stationary due to the rejection of the null hypothesis of the series contain unit root. The stationarity property of the two series enables one to perform the estimation of a bivariate GARCH model.

2.2 Methodology

Three procedures can be used to detect the linkages between real effective exchange rate and real oil prices. They are the followings.

2.2.1 Cointegration test

The existence of cointegration between real exchange rate and the price of oil implies that the price of oil adequately captures the dominant source of persistent real exchange rate movements. Pesaran et al. (2001) proposed an alternative procedure in testing for cointegration called a conditional autoregressive distributed lag (ARDL) model and error correction mechanism. The ARDL (:p, q) model is specified as:

$$\Delta L^{REER}{}_{t} = \mu + \sum_{i=1}^{p} \alpha_i \Delta L^{REER}{}_{t-i} + \sum_{j=1}^{q} \beta_i \Delta L^{OP}{}_{t-j} + e_t \tag{1}$$

where Δ denotes first difference, LREER is the log of real effective exchange rate index, LOP denotes the log of real oil price. The lag orders are p and q, respectively. They may be the same or different. To determine the optimal numbers of lagged first differences in the specified ARDL model, the grid search can be used to select a parsimonious model that is free of serial correlation. By adding lagged level of the two variables into Equation 1 as shown in Equation 2, the computed F-statistic for detecting cointegration can be obtained.

$$\Delta L^{REER}{}_{t} = \mu + \gamma_1 L^{REER}{}_{t-1} + \gamma_2 L^{OP}{}_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta L^{REER}{}_{t-i} + \sum_{j=1}^{q} \beta_i \Delta L^{OP}{}_{t-j} + e_t \tag{2}$$

The computed F-statistic is compared with the critical values. If the computed F-statistic is greater than the upper bound critical F-statistic, cointegration exists. If the computed is smaller than the lower bound F-statistic, cointegration does not exist. In case the computed F-statistic is between the upper and lower bound F-statistic, the result is inconclusive. Unlike other techniques that can be used to test for cointegration, re-parameterization of the model into the equivalent vector error correction is not required. Furthermore, the bounds testing an be applied to the mixed between I(0) and I(1) resulted from unit root tests, but not for I(2) series. The results from Table 1 show that the order of integration of the two series does not exceed one.

2.2.2 Non-causality test

Toda and Yamamoto (1995) develop the test for causal relationship between variables as an alternative to the standard Granger (1969) causality test. This non-causality test in a bivariate vector autoregressive (VAR) model having k lags can be conducted in their level of series. The optimal lag length (k) can be determined by Schwartz information criterion (SIC). The test is performed in a VAR model of order $k^* = k + d_{max}$, where d^{max} is the maximum anticipated order of integration of the series. Rambaldi and Doran (1996) indicate that the validity of the test using the modified Wald statistics for linear or non-linear restriction does not depend on the order of integration of the series, specifically the series can be I(0), I(1) or I(2). Whether the variables in the model Granger cause each other is tested in the joint restrictions where all coefficients are zero. The VAR model for non-causality test is specified as:

$$L^{REER}{}_{t} = a_0 + \sum_{i=1}^{k} \alpha_i L^{REER}{}_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \alpha_j L^{REER}{}_{t-j} + \sum_{i=1}^{k} \beta_i L^{OP}{}_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \beta_j L^{OP}{}_{t-j} + u_{1t} \tag{3}$$

and

$$L^{OP}{}_{t} = a_1 + \sum_{i=1}^{k} \gamma_i L^{OP}{}_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \gamma_j L^{OP}{}_{t-j} + \sum_{i=1}^{k} \delta_i L^{REER}{}_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \delta_j L^{REER}{}_{t-j} + u_{2t} \tag{4}$$

The error terms in the VAR model are assumed to be white noise. Since the extra lagged variables are included in the model, the causality test is conducted by testing for zero restrictions of the coefficients of all lag variables. Equation 3 is used to test whether real oil price (L^{OP}) Granger causes real effective exchange rate (L^{REER}) while Equation 4 is used to test whether real effective exchange rate (L^{REER}) Granger causes real oil price (L^{OP}). The main advantage of this test is that one does not need to know a priori whether the variables are cointegrated as long as the order of integration of series does not exceed the lag length of the specified VAR model.

2.2.3 The two-step approach

The two-step approach is employed to explain the relationship between oil price volatility and real exchange rate volatility. In the first step, a bivariate generalized autoregressive heteroskedastic model with constant conditional correlation (ccc-GARCH) model proposed by Bollerslev (1990) is employed to generate real exchange rate and oil price volatilities. In the second step, these generated series along with real effective exchange rate change and the rate of change in real oil price series employed in the standard Granger (1969) causality test. Pagan (1984) criticizes this procedure because it produces the generated series of volatility or uncertainty. When these generated series are used as regressors in Granger causality test, the model might be misspecified. However, the main advantage of the two-step procedure is that it provides room for the ability to establish causality between variables.[3] The system equations in a ccc-GARCH(1,1) model comprises the following five equations.

3 The current value of one variable might not affect the current value of another variable, but some of its lags might do.

$$r_t^{REER} = a_{1,0} + \sum_{i=1}^{p} a_{1,i} r_{t-i}^{REER} + \sum_{i=1}^{p} b_{1,i} r_{t-i}^{OP} + e_{1,t} \tag{5}$$

$$r_t^{OP} = a_{2,0} + \sum_{i=1}^{p} a_{1,i} r_{t-i}^{OP} + e_{2,t} \tag{6}$$

$$h_t^{REER} = \mu_1 + \alpha_{1,1} \varepsilon_{t-1}^{2,REER} + \beta_{1,1} h_{t-1}^{REER} \tag{7}$$

$$h_t^{OP} = \mu_2 + \alpha_{2,1} \varepsilon_{t-1}^{2,OP} + \beta_{2,1} h_{t-1}^{OP} \tag{8}$$

$$h_t^{REER,OP} = \rho_{12} (h_t^{REER})^{1/2} (h_t^{OP})^{1/2} \tag{9}$$

where r^{REER} is the rate of change in real effective exchange rate, and r^{OP} is the rate of change in real oil price, h^{REER} is the conditional variance of real effective exchange rate, h^{OP} is the conditional variance of real oil price, and $h^{REER,OP}$ is the conditional covariance of the two variables. The constant conditional correlation is ρ_{12}. The system equations can be estimated simultaneously.

The standard Granger causality test is performed in the following equation.

$$y_t = a + \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{1,t-i} + \sum_{i=1}^{k} \gamma_i x_{2,t-i} + \sum_{i=1}^{k} \varphi_i x_{3,t-i} + u_t \tag{10}$$

where y is a dependent variable, and x_1, x_2, and x_3 are independent variables. If any independent variable causes the dependent variable, there should be at least one significant coefficient of that lagged independent variable. This also indicates that the F-statistic in the standard causality test must show significance for each pair of variables. In the present study, the sequence of variables that will enter into a vector autoregression is (r^{REER}, r^{OP}, h^{REER}, h^{OP}), (r^{OP}, r^{REER}, h^{REER}, h^{OP}), (h^{REER}, r^{REER}, r^{OP}, h^{OP}), and (h^{OP}, r^{REER}, r^{OP}, h^{REER}). The optimal lag length is determined by SIC. It should be noted that all variables in the test must be stationary. An unrestricted VAR model is used to detect the sign of lagged variables.

3. EMPIRICAL RESULTS

The grid search for the parsimonious ARDL (p, q) model discovers that the ARDL(1,1) is free of serial correlation, resulting from using Lagrange multiplier (LM) serial correlation test. The chi-square statistic ($\chi^2_{(2)}$) of the LM test = 3.913 with $P = 0.141$ leads to the conclusion that the null hypothesis of no serial correlation in the residuals is accepted. By adding the lagged level of the pair of variables (LREER and LOP) to the ARDL(1,1) model, the computed F-statistic resulting from testing Equation 2 against Equation 1 is 2.092. This computed F-statistic is below the lower bound critical value at the 5% level of 4.94 in Table CI(iii) case III provided by Pesaran et al. (2001). Therefore, the null hypothesis of no cointegration is accepted. Therefore, there is no long-run relationship between real effective exchange rate and real stock price.

The non-causality test in a VAR model of Equations 3 and 4 using level of the two series is performed with the optimal lag of two determined by SIC plus the anticipated order of integration of one. The lag ($k + d_{max}$) is three. The results are reported in Table 2.

The results in Table 2 show that there are bidirectional positive causations between real oil price and real effective exchange rate. However, the level of significance is only at 10%. Further tests are conducted to examine the misspecification of the augmented VAR(3) model used in the analysis. The LM test statistic indicates the acceptance of the null hypothesis that there is no serial correlation in the residuals up to the third order of lags. Furthermore, the WH test shows that the null hypothesis of the presence of ARCH effect can be rejected at the 1% level of significance. However, the JB statistic shows that the residuals are not multivariate normal. Therefore, the augmented VAR(3) model is not suitable for non-causality test. In other words, the results in Table 2 are not reliable.

Table 2: Results of non-causality test between L^{REER} and L^{OP}

Null hypothesis	Modified Wald statistic	*P* value
L^{OP} does not cause L^{REER}	6.384 (+)	0.094
L^{REER} does not cause L^{OP}	6.641 (+)	0.084
Misspecification test for the VAR model		
	Test statistic	***P* value**
LM	2.286	0.683
JB	10.682	0.005
WH	175.006	0.000

L^{REER} stands for log of real effective exchange rate, and L^{OP} stands for log of real oil price. (+) indicates the positive sum of the coefficient of lagged variables, which is positive causation. LM is the Lagrange multiplier test for serial correlation up to the third order in the residuals, JB is the Jarque-Bera statistic for testing the null hypothesis that the residuals are multivariate normal, and WH is the White Heteroskedasticity test of the residuals

Up to this point, there is no long-run relationship between real effective exchange rate and real oil price, and there is unreliable non-causality test in the level of series. Therefore, it can be concluded that cointegration and non-causality tests cannot detect the impact of real oil price on real effective exchange rate. However, the two-step procedure can detect some aspects of the link between real oil price and real effective exchange rate. The results of the estimate of the bivariate GARCH(1, 1) model in the system equations, Equations 5-9, are reported in Table 3.

Assuming the conditional correlation (ρ_{12}) is constant, the model performs well.[4] The estimated conditional correlation is −0.136 which is significant at the 5% level. This correlation indicates that the two variables are interdependent with negative relationship. The standard Granger causality test is thus performed on four stationary series. The results are reported in Table 4.

The results in Table 4 show that real oil price change tends to cause the real effective exchange rate to decrease (appreciate), but tends to cause its volatility to increase. In addition, real oil price volatility tends to cause the real effective exchange rate to decrease or appreciate. However, these three results are not statistically significant. Finally, real oil price volatility positively causes real effective exchange rate volatility. This result is significant at the

4 The estimated parameters of ARCH (ε^2_{t-1}) and GARCH (h_t) terms are non-negative. Furthermore, the sum of the coefficients of the ARCH and GARCH terms is 0.884 for the conditional variance equation of the rate of change in real effective exchange rate and 0.970 for the conditional variance equation of the rate of change in real oil price. Therefore, the two conditional variance series are stationary. The system is also free of serial correlation because the Q(6) statistic has the *P* value that accept the null hypothesis of no serial correlation in the system residuals.

Table 3: Results from the bivariate GARCH (1,1) estimation

Mean equations:

$$r_t^{REER} = 0.122 + 0.441{*}{*}{*}\, r_{t-1}^{REER} - 0.226{*}{*}{*}\, r_{t-2}^{REER} - 0.012 r_{t-1}^{OP}$$
$$(1.259)\ (4.763)\qquad (-2.719)\qquad (-1.257)$$

$$r_t^{OP} = 0.690 + 0.144{*}\, r_{t-1}^{OP}$$
$$(0.287)\ (1.824)$$

(t-statistic in parenthesis)

Variance and covariance equations:

$$h_t^{REER} = 0.596{*}{*}{*} + 0.627{*}{*}{*}\, \varepsilon_{t-1}^{2,REER} + 0.257{*}{*}{*}\, h_{t-1}^{REER}$$
$$(4.424)\quad (3.201)\qquad (3.832)$$

$$h_t^{OP} = 2.124 + 0.117{*}{*}\varepsilon_{t-1}^{2,OP} + 0.853 h_{t-1}^{REER}$$
$$(0.852)\ (2.205)\qquad (14.481)$$

$$h_t^{REER,OP} = -0.136{*}{*}(h_t^{REER})^{1/2}(h_t^{OP})^{1/2}$$
$$(-1.694)$$

(t-statistic in parenthesis)

System diagnostic test:

Q (6) =30.434 (*P*=0.171)

r^{REER} and r^{OP} stands for the percentage rates of change in real effective exchange rate and oil price respectively. The conditional variances, hREER for real effective exchange rate and h^{OP} for real oil price. The conditional covariance is h^{REER}, OP. ***, ** and * denotes significance at the 1%, 5% and 10%, respectively. Q (k) is the Box-Pierce statistic test for the residuals obtained from system residual Portmanteau tests for autocorrelations

Table 4: Results of Granger causality test

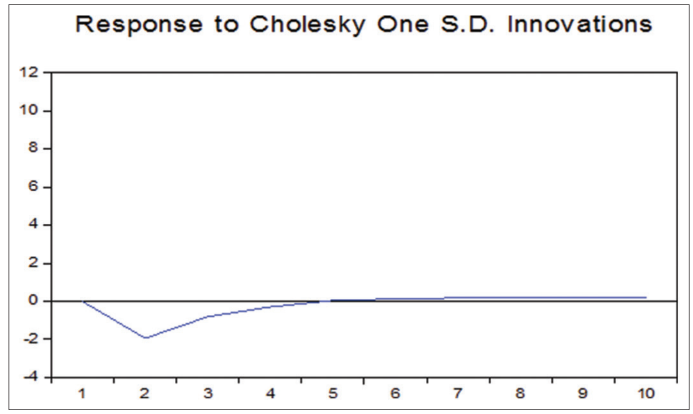
Hypothesis	F-statistic	*P* value
r^{OP} does not cause r^{REER}	1.828 (−)	0.164
r^{OP} does not cause h^{REER}	2.165 (+)	0.118
h^{OP} does not cause r^{REER}	1.185 (−1)	0.308
h^{OP} does not cause h^{REER}	3.131**(+)	0.046

r^{REER} and r^{OP} stands for the percentage rates of change in real effective exchange rate and oil price respectively. The conditional variances, h^{REER} for real effective exchange rate and h^{OP} for real oil price. **denotes significance at the 5% level

5% level. Therefore, it can be concluded that there is volatility transmission from real oil price to real effective exchange rate during the period of floating exchange rate regime. In other words, a rise in real oil price risk can cause an increase in real exchange rate risk and *vice versa*.

The impulse response in Figure 2 shows that real exchange rate volatility respond negatively to real oil price volatility in the 5 months period and respond positively to real oil price volatility afterward and never dissipate. In the events of rising real exchange rate volatility caused by real oil price volatility, the country's trade balance can be affected. If real exchange rate volatility adversely affects both exports and imports, the trade balance will be improved when the size of the impact of volatility on exports is relatively smaller than the size of the impact of volatility on imports. Otherwise, the trade balance will be harmed. Even though the central bank can implement sound monetary policy measures to stabilize some major currencies, such as the US dollar, Japanese yen, and Euro currency, fluctuations of nominal oil price cannot be controlled. Therefore, it seems necessary that policy makers should encourage firms to rely more on new energy

Figure 2: Response of real effective exchange rate volatility to oil price volatility



(hydroelectric and wind power) so that crude oil price will not be the main cause of real exchange rate volatility. In addition, some measures that will enhance competitiveness of exporting firms may deem necessary. Encouraging energy efficiency instead of energy intensity can reduce costs of production. Export diversification should also be implemented.

4. CONCLUDING REMARKS

This study employs three techniques of time series analysis to examine the relationship between real oil price and real effective exchange rate in Thailand, which is an emerging market economy. The results from cointegration test in a bivariate framework show that there is no long-run relationship between real oil price and real effective exchange rate. An alternative technique to examine the causal relationship between these two variables is the non-causality test that relies on an augmented VAR model. This approach allows for detecting causation between the levels of variables. However, the results from non-causality test fails to pass diagnostic tests. Therefore, the results should not be reliable.

The results from the two-stage approach show that there is no causality running from a change in real oil price to a change in real effective exchange rate. Additionally, real oil price volatility does not cause real effective exchange rate to appreciate as found in previous empirical studies. An important finding is that an increase in real oil price volatility causes an increase in real exchange rate volatility, which can harm the trade balance of the country. Policy makers should be aware of the volatility or uncertainty in the foreign exchange markets caused by uncertainty in the price of oil. It might be necessary to implement some measures that encourage firms to rely more on new energy (hydroelectric and wind power) so that crude oil price will not be the main cause of real exchange rate volatility. In addition, some measures that will enhance competitiveness of exporting firms may deem necessary. Encouraging energy efficiency instead of energy intensity can reduce costs of production. Export diversification should also be implemented to prevent the trade balance to deteriorate in the future.

REFERENCES

Akram, Q.F. (2004), Oil prices and exchange rates: Norwegian evidence. Econometrics Journal, 7(2), 476-504.

Amano, R.A., van Norden, S. (1998), Oil prices and the rise and fall of the US real exchange rate. Journal of International Money and Finance, 17(2), 299-316.

Beckman, J., Czudaj, R. (2013), Oil prices and effective dollar exchange rates. International Review of Economics and Finance, 27(C), 621-636.

Bollerslev, T. (1990), Modeling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model. Review of Economics and Statistics, 72(3), 498-505.

Chaudhuri, K., Daniel, B.C. (1998), Long-run equilibrium real exchange rates and oil prices. Economics Letters, 58(2), 231-238.

Chen, S.S., Chen, H.C. (2007), Oil prices and real exchange rates. Energy Economics, 29(3), 390-404.

Elliott, G., Rothenberg, T.J., Stock, J.H. (1996), Efficient tests for an autoregressive unit root. Econometrica, 64(4), 813-836.

Englama, A., Duke, O.O., Ogunleye, T.S., Ismail, F.U. (2010), Oil prices and exchange rate volatility in Nigeria: an empirical investigation. Central bank of Nigeria. Economic and Financial Review, 48(3), 31-48.

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.

Granger, C.W.J. (1969), Investigating causal relation by econometric and cross-sectional method. Econometrica, 37, 424-438.

Hasanov, F. (2010), The Impact of Real Oil Price on Real Effective Exchange Rate: the Case of Azerbaijan. DIW Berlin, Discussion Paper No. 1041.

Huang, Y., Guo, F. (2007), The role of oil price shocks on china's real exchange rate. China Economic Review, 18(4), 403-416.

Krugman, P. (1980), Oil and the Dollar. NBER Working Paper No. 554.

Lizardo, R.A., Mollick, A.V. (2010), Oil price fluctuations and U. S. dollar exchange rates. Energy Economics, 32(2), 399-408.

Pagan, A. (1984), Econometric issues in the analysis of regressions with generated regressors. International Economic Review, 25, 221-247.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationship. Journal of Applied Econometrics, 16(3), 289-326.

Rambaldi, A.N., Doran, H.E. (1996), Testing for Granger Non-causality in Cointegrated System Made Easy. Working Papers in Econometrics and Applied Statistics, No. 88, University of New England.

Reboredo, J.C. (2012), Modelling oil price and exchange rate co-movements. Journal of Policy Modeling, 34(3), 419-440.

Rickne, J.K. (2009), Oil Prices and Real Exchange Rate Movements in Oil-Exporting Countries: the Role of Institution, IFN Working Paper No. 810.

Toda, H.Y., Yamamoto, T. (1995), Statistical inferences in vector autoregressions with possibly integrated process. Journal of Econometrics, 66(1/2), 225-250.

Turhan, I., Hacihasanoglu, E., Soytas, U. (2013), Oil prices and emerging market exchange rates. Emerging Markets Finance and Trade, 49(S1), 21-36.

Zhang, Y. (2013), The link between the price of oil and the value of the US dollar. International Journal of Energy Economics and Policy, 3(4), 341-351.