Oil price shocks and domestic inflation in Thailand

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Abstract: This paper employ monthly data to examine the empirical relationship between oil price shocks and domestic inflation rate during 1993 and 2013. The results show that oil price, domestic or international, does not have the long-run impact on consumer prices. However, oil price shocks cause inflation to increase while oil price uncertainty does not cause an increase in inflation. Furthermore, inflation itself causes inflation uncertainty. The findings of this study encourage the monetary authorities to formulate a more accommodative policy to respond to oil price shocks.

Keywords: Oil shocks, inflation, bivariate GARCH, causality
JEL Classification: E31, Q43

1. Introduction

One of interesting topics on the relationship between oil shocks and macroeconomic variables is the impact of oil price shocks on domestic inflation rate. The rise of oil price can cause the costs of production of firms to increase. Therefore, the pass-through of oil price hike is reflected in an increase in the general price level of an economy. In addition, changes in oil price in the last five decades exhibit oil price volatility that can distort the decisions by economic agents. Lee and Ni (2002) find that oil price shocks affect economic performances via both demand and supply channels. Earlier studies by Mork and Hall (1980) and Mork (1989) point out that inflation induced by oil price shocks can reduce real balances, a measure purchasing power, in the economy and thus cause a recession. Bernanke et al. (1997) argue that the stagflation threat from the oil shocks in the 1970s should not be underestimated. The Federal Reserve adopted too high interest rate policy and thus did not respond to oil price shocks accurately. This resulted in decreased output or recession in the US. Hamilton (2003) indicates that oil shocks matter because they disrupt spending by consumers and firms on key sectors, and thus reduce output growth.

On the supply channel, oil price shocks can cause consumer prices to increase. This depends on the share of oil price in the price index. Hooker (2002) examines the effects of oil price changes on inflation in the US under a Phillips curve framework that allows for asymmetries, nonlinearities and structural breaks. The results show that oil price shocks seem to affect inflation through the direct share of oil price in consumer prices. Furthermore, monetary policy has become less accommodative of oil price shocks and thus prevents oil price changes from passing directly into core inflation. Ewing and Thompson (2007) find that oil prices lead the cycle of consumer prices in the US. The oil price pass-through into inflation in industrialized countries can decline due to some factors. De Gregono and Lanerretche (2007) find that the pass-through decline because of the fall in energy intensity while Chen (2009) indicates that a decline in the pass-through is due to a higher trade openness.

Huang and Chao (2012) examine the effects of international and domestic oil prices on the price indices in Taiwan using monthly data from January 1999 to December 2011. They find that changes in international oil prices have more crucial impacts on the price indices than changes in domestic oil prices. Chu and Lin (2013) find that oil price shocks have both long-term and short-term pass-through effects on Taiwan's producer price index. Gao et al. (2014) the degree of positive pass-through from oil price shocks to disaggregate US consumer prices is observed only in energy-intensive consumer price indices. In addition, the main causes of the pass-through are increases in the prices of energy-related commodity.

The main purpose of the present study is to investigate the impact of oil price shocks on domestic inflation in Thailand. Monthly data from January 1993 to December 2013 are used. This study does not use structural vector autoregression or other methods that capture the pass-through from oil price to consumer price as used in previous studies. In stead, the methods used are the bounds testing for cointegration and the two-step approach to detect the impact of oil price shocks on inflation and inflation uncertainty. The main findings are that oil price shocks, defined as movements in oil price, positively cause inflation to increase, but oil price uncertainty does not affect inflation. Furthermore, inflation itself causes inflation uncertainty in the Thai economy. The next section presents the data and estimation methods that are used in the analysis. Section 3 presents empirical results. Section 4 discusses the results found in this study. The last section gives concluding remarks and some policy implications based on the results of this study.

2. Data and Methodology

2.1 Data

The dataset used in this study comprises monthly data during 1993 and 2013. The consumer price index, industrial production index and the US dollar exchange rate (bath/dollar) series are obtained from The Bank of Thailand's website. The series of Brent crude oil spot price expressed in the US dollar per barrel is obtained from the US Energy Information Administration. The oil price series is international oil price. By multiplying the oil price series by the US dollar exchange rate, the domestic oil price series is obtained. All series are transformed into logarithmic series. The sample size comprises 252 observations.

The PP unit root tests proposed by Phillips and Perron (1988) are performed on first differences of the three series. The results are shown in Table 1.

Table 1 Results of PP tests for first difference of all variables: 1993M1-2013M12

Variables	Test A	Test B
Δcpi (changes in consumer price index)	-11.766 [1] (0.000)***	-11.929 [0] (0.000)***
$\Delta poil$ (changes in nominal oil pirce: domestic)	-12.926 [24] (0.000)***	-12.900 [25] (0.000)***
$\Delta poil$ (changes in nominal oil pirce: international)	-13.081 [0] (0.000)***	-13.065 [0] (0.000)***
Δip (changes in industrial production index)	-17.539 [3] (0.00)***	-17.866 [3] (0.000)***

Note: The levels of the three variables are expressed in the logarithmic series. Test A includes intercept only while Test B includes intercept and a linear trend. The number in bracket is the optimal bandwidth. ***, ** and ** denote significance at the 1, 5 and 10 percent level, respectively. The number in parenthesis is the probability of accepting the null hypothesis of unit root.

The results from unit root tests show that the degree of integration of all series does not exceed one because the null hypothesis of unit root is rejected at the 1 percent level of significance. This is suitable in performing the bounds testing for cointegration and the estimate of a bivariate GARCH model as well as the standard pairwise causality test described in the next sub-section.

2.2 Estimation Methods

2.2.1 Cointegration test

The existence of cointegration between nominal oil price, industrial production index and consumer price index implies that there is a long-run relationship between these variables. 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, r) model is specified as:

$$\Delta cpi_t = \mu + \sum_{i=1}^{p} \alpha_i \Delta cpi_{t-i} + \sum_{j=0}^{q} \beta_i \Delta poil_{t-j} + \sum_{k=0}^{r} \gamma_k \Delta ip_{t-k} + u_t \quad (1)$$

where *cpi* is the log of consumer price index, *poil* is the log of nominal oil price and *ip* is the log of industrial production.[1] The lag orders are p, q and r, 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.

$$\Delta cpi_t = \mu + \delta_1 cpi_{t-1} + \delta_2 poil_{t-1} + \delta_3 ip_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta cpi_{t-i} + \sum_{j=0}^{q} \beta_i \Delta poil_{t-j} + \sum_{k=0}^{r} \gamma_k \Delta ip_{t-k} + v_t \quad (2)$$

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 F-statistic 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-parameterizing the model into the equivalent vector error correction is not required. Furthermore, this procedure can an be applied to the mixed between I(0) and I(1) series resulted from unit root tests, but not for I(2) series. The results of unit root tests from Table 1 show that the order of integration of the two series does not exceed one.

2.2.2 The two-step approach

The two-step approach is employed to explain the relationship between nominal oil price and its uncertainty (or volatility) as well as inflation and its uncertainty. 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. It can be argued

[1] The inclusion of industrial production index can lead to the detection of interaction between the three variables in a multivariate cointegration test. This is similar to the model used by Chen (2009) who examines the oil price pass-through into inflation in industrialized countries.

that the main advantage of the two-step procedure is that it provides room for the ability to establish causality between variables.[2] The system equations in a ccc-GARCH(1,1) model comprises the following five equations.

$$p_t = a_{1,0} + \sum_{i=1}^{p} a_{1,i} p_{t-i} + \sum_{i=1}^{p} b_{1,i} op_{t-i} + e_{1,t} \quad (5)$$

$$op_t = a_{2,0} + \sum_{i=1}^{p} a_{1,i} op_{t-i} + e_{2,t} \quad (6)$$

$$h_t^p = \mu_1 + \alpha_{1,1}\varepsilon_{t-1}^{2,p} + \beta_{1,1} h_{t-1}^p \quad (7)$$

$$h_t^{op} = \mu_2 + \alpha_{2,1}\varepsilon_{t-1}^{2,op} + \beta_{2,1} h_{t-1}^{op} \quad (8)$$

$$h_t^{p,op} = \rho_{12}(h_t^p)^{1/2}(h_t^{op})^{1/2} \quad (9)$$

where p is the rate of change in consumer price index or inflation rate, and op is the rate of change in nominal oil price, h^p is the conditional variance of inflation rate, h^{op} is the conditional variance of nominal oil price change, and $h^{p,op}$ is the conditional covariance of the two variables. The constant conditional correlation is ρ_{12}. The system equations can be estimated simultaneously.

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

$$y_t = a + \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + \eta_t \quad (10)$$

where y is a dependent variable, and x is an independent variable. 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 sequences of variables that will be tested are {op,p}, {op, h^p}, {h^{op}, p}, {h^{op}, h^p}, {and p, h^p}. The optimal lag length is determined by SIC. It should be noted that all variables in the test must be stationary. An unrestricted vector autoregressive (VAR) model is used to detect the sign of lagged variables.

3. Results

The models expressed in equations (1) and (2) are used for testing the existence of level relationship between consumer price index, industrial production index and nominal oil price (both domestic and international) using parsimonious models. The results from bounds testing for cointegration are shown in Table 2.

Table 2 Results from bounds testing for cointegration: 1993M01-2013M12

Model	Computed F	ARDL model	$\chi^2_{(2)}$
a. cpi vs. op and ip	3.381	(1,1,1)	1.972 (p=0.373)
b. cpi vs. op and ip	3.659	(1,1,1)	1.343 (p=0.511)

Note: The LM test for serial correlation in the specified ARDL models is represented by $\chi^2_{(2)}$. Three variables: cpi, op and ip the logs of CPI, oil price and industrial production index, respectively. Op in (a) is domestic oil price and op in (b) is international oil price.

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

The results from bounds tests indicate that cointegration does not exist in both models. The computed F-statistics of 3.381 and 3.659 are smaller than the lower bound critical values of 4.94 and 4.04 at the 5 and 10 percent level of significance (Table CI (iii) Case III in Pesaran et al., 2001). Therefore, it can be concluded that there is no long-run equilibrium relationship between the price level and oil prices (domestic or international).

Before performing a bivariate GARCH estimate, the descriptive statistics for the full sample period are reported in Table 3.

Table 3. Descriptive statistics, 1993M1-2013M12

	p	op
Mean	0.276	1.214
Standard deviation	0.532	8.631
Skewness	-0.590	-0.308
Kurtosis	10.691	3.740
Jarque-Bera statistic	633.133	10.788
	(p-value=0.000)	(p-value=0.005)

Note: p stands for the percentage change in consumer price index, and op stands for the percentage change in domestic oil price as defined earlier. The number in parenthesis is the probability of accepting the null of normality.

The average monthly inflation rate is 0.276 percent, whereas the average monthly oil price change is 1.214 percent. The Jarque-Bera normality test rejects the null hypothesis of a normal distribution of the two series, indicating that the least squares estimation is not suitable.

The bivariate GARCH estimation for the system equations (5) to (9) to obtain volatilily or uncertainty series are reported in Table 4.

Table 4 Results from the bivariate ccc-GARCH(1,1) estimation

Mean equations:

$$p_t = 0.157^{***} + 0.151^{*} p_{t-1} + 0.010^{***} op_{t-1}$$
(4.259) (1.774) (3.446)

$$op_t = 0.373 + 0.154^{**} op_{t-1}$$
(0.430) (2.194)

(t-statistic in parenthesis)

Variance and covariance equations:

$$h_t^p = 0.030^{***} + 0.289^{***} \varepsilon_{t-1}^{2,p} + 0.628^{***} h_{t-1}^p$$
(2.759) (3.140) (6.551)

$$h_t^{op} = 3.353 + 0.235^{**} \varepsilon_{t-1}^{2,op} + 0.825^{***} h_{t-1}^{op}$$
(1.305) (2.289) (12.165)

$$h_t^{p,op} = 0.262^{***} (h_t^p)^{1/2} (h_t^{op})^{1/2}$$
(3.925)

(t-statistic in parenthesis)

System diagnostic test:

Q(4) =13.597 (p-value=0.629)

Note: op and op stands for the percentage rates of change in consumer price index and nominal oil price, respectively. The conditional variances, h^p for inflation rate and h^{op} for nominal oil price. The conditional covariance is $h^{p,op}$. ***, ** and * denotes significance at the 1, 5 and 10 percent, respectively. Q(k) is the Box-Pierce statistic test for the residuals obtained from system residual Portmanteau tests for autocorrelations.

The assumption of constant conditional correlation facilitates the simplicity of the system estimation. The model performs quite well in the dataset. The mean equation for domestic inflation rate is assumed to be dependent on the lag of domestic oil price change while the mean equation for domestic oil price change is assumed to be independent of inflation rate.[3]

The lags are chosen so that the system equations are free of serial correlation. Panels A and B contain the results of the conditional means and variances for inflation rate and oil price change, respectively. Referring to Panel A, the inflation rate is positively affected by the one-period lag of oil price change. In Panel B, oil price change is positively affected by its one-period lag. The coefficients in the two conditional variance equations are non-negative. Both conditional variance equations give significant ARCH and GARCH terms (α_1 and β_1). The sum of the coefficients of the ARCH and GARCH terms for inflation rate is 0.917 whereas the sum of coefficients for oil price change is 0.960. These results show that the GARCH variance series as measures of volatility or uncertainty is stationary. The constant conditional correlation in Panel C is 0.262, which is low and statistically significant.[4] The system diagnostic test using residual portmanteau test for autocorrelation accepts the null of no autocorrelation as indicated by Q(4) statistic. Therefore, the system equations are free of serial correlation. The volatility series are generated so as to examine their impacts on inflation and volatility in the standard Granger causality test. The results of pairwise Granger causality test are reported in Table 5.

Table 5 Results of pairwise Granger causality test

Hypothesis	F-statistic	P-value	Lag length
op does not cause p	7.415 ***(+)	0.007	1
op does not cause h^p	1.441 (+)	0.239	2
h^{op} does not cause p	1.696 (-)	0.168	3
h^{op} does not cause op	2.931** (-)	0.034	3
h^{op} does not cause h^p	1.690 (-)	0.187	2
p does not cause h^p	4.206*** (+)	0.001	5
h^p does not cause p	4.761*** (-)	0.000	5

Note: op and op stands for the percentage rates of change in consumer price index and nominal oil price, respectively. The conditional variances, h^p for inflation rate and h^{op} for nominal oil price. ***, ** and * denotes significance at the 1, 5 and 10 percent, respectively. The lag length in the pairwise causality test is determined by AIC.

The results in Table 5 show that oil price change tends to cause the inflation rate to increase, but tends to cause its volatility or uncertainty to decrease. The latter impact is insignificant. In addition, oil price volatility tends to cause the inflation rate to decrease, but is not statistically significant. Furthermore, oil price uncertainty does not cause inflation uncertainty. Finally, there exist bidirectional causality between inflation and inflation uncertainty. It is obvious that inflation causes higher inflation uncertainty while inflation uncertainty causes inflation to decline.

4. Discussion

Previous studies find that oil price shocks pass through domestic inflation. Furthermore, there is a non-linear adjustment between oil price changes and price indices. The present study reveals that domestic oil price shocks Granger cause domestic inflation and this result is

[3] The country is a small oil-importing country. Therefore, its inflation rate should not affect world oil price.
[4] This result shows that inflation and oil price change are positively correlated.

contradictory to the finding by Huang and Chao (2012) who find that international oil price plays more important role than domestic oil price on price indices. Even though oil price uncertainty does not affect inflation, inflation itself positive causes inflation uncertainty, which supports Friedman (1977) hypothesis. On the contrary, inflation uncertainty lowers inflation rate, which is contradictory to Cukierman and Meltzer (1986) hypothesis. However, the impact of oil price shocks on inflation might surpass the negative impact of inflation uncertainty on inflation. Therefore, the inflation induced by oil price shocks should not be ignored by the monetary authorities.

5. Concluding Remarks and Policy Implication

This study investigates the impact of oil price shocks on domestic inflation in Thailand. Monthly data from January 1993 to December 2013 are used. This study does not use structural vector autoregression or other methods that capture the pass-through from oil price to consumer price as used in previous studies. In stead, the methods used are the bounds testing for cointegration and the two-step approach to detect the impact of oil price shocks on inflation and inflation uncertainty. The main findings are that oil price shocks, defined as movements in oil price, positively cause inflation to increase, but oil price uncertainty does not affect inflation. Furthermore, inflation itself positively causes inflation uncertainty in the Thai economy. The implication based upon the results of this study is that besides inflation-targeting that has been implemented by the monetary authorities, monetary measures should also be designed to accommodate inflation induced by oil price shocks.

References

Bernanke, B. S., Gertler, M. and Watson, M. W., 1997. “Systematic monetary policy and the effects of oil price shocks,” Brooking Papers on Economic Activity, 1(1), 91-157.

Bollerslev, T., 1990. “Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model,” Review of Economics and Statistics, 73(3), 498-505.

Chen, S. S., 2009. “Oil price pass-through into inflation,” Energy Economics, 31(1), 126-133.

Chou, K-W. and Lin, P-C., 2013. “Oil price shocks and producer prices in Taiwan: an application of non-linear error-correction models,” Journal of Chinese Economic and Business Studies, 11(1), 59-72.

Cukierman, A. and Meltzer, A., 1986. “A theory of ambiguity, credibility, and inflation under discretion and asymmetric information,” Econometrica, 54(5), 1099-1128.

De Gregono, J. D. and Landerretche, C. N., 2007. “Another pass-through bites the dust? oil prices and inflation,” Working Paper, Central Bank of Chile.

Ewing, B. T. and Thompson, M. A., 2007. “Dynamic cyclical comovements of oil prices with industrial production, consumer prices, unemployment and stock prices,” Energy Policy, 35(11), 5535-5540.

Friedman, M., 1977. “Inflation and unemployment,” Journal of Political Economy, 85(3), 451-472.

Gao, L., Kim, H. and Saba, R., 2014. “How do oil price shocks affect consumer prices, Energy Economics, 45(C), 313-323.

Granger, C. W. J., 1969. “Investigating causal relations by econometric models and cross spectral methods,” Econometrica, 37(3), 424-438.

Hamilton, J. D., 2003. “What is an oil shock?,” Journal of Econometrics, 113(2), 363-398.

Hooker, M. A., 2002. “Are oil shocks inflationary? Asymmetric and nonlinear specification versus changes in regime,” Journal of Money, Credit, and Banking, 34(3), 540-561.

Huang, W-H. and Chao, M-C., 2012. “The effects of oil prices on the price indices in Taiwan: international or domestic oil prices matter?,” Energy Economics, 34(1), 730-734.

LeBlanc, M., and Chinn, M. D., 2004. “Do high oil prices presage inflation?: the evidence from G-5 countries,” Business Economics, 39(1), 38-48.

Lee, K. and Ni, S., 2002. “On the dynamic effects of oil price shocks: a study using industry level data,” Journal of Monetary Economics, 49(4), 823-852.

Mork, K. A., 1989. “Oil and the macroeconomy when prices go up and down: an extension of Hamilton results,” Journal of Political Economy, 97(3), 740-744.

Mork, K. A. and Hall, R. E., 1980. “Energy prices, inflation, and recession, 1974-75,” Energy Journal, 1(3), 31-63.

Pagan, A., 1984. “Econometric Issues in the analysis of regressions with generated regressors,” International Economic Review, 25(2), 221-247.

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

Phillips, P. C. B., Perron, P., 1988. “Testing for a unit root in time series regression,” Biometrika, 75(2), 335-346.