The effects of oil price and US economy on Thailand's macroeconomy: The role of monetary transmission mechanism

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The Effects of Oil Price and US Economy on Thailand's Macroeconomy: The Role of Monetary Transmission Mechanism

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ABSTRACT

This article investigates the channels of monetary transmission mechanism (interest rate, exchange rate, domestic credit and stock price) alongside oil price and the US industrial production, as two causes of recent crisis, during the pre-and post-crisis of 2007-2009 in Thailand. The channels of Monetary transmission barely have an effect on consumer price index and industrial production while oil price strongly affects both industrial production and consumer price index and the *US* industrial production robustly influences consumer price index during pre-crisis. However, oil price and the US industrial production greatly lose their effects on consumer price index and industrial production after the crisis period, the oil price is still mostly explains the variation of the consumer price index. The stock price is most effective conduit for monetary policy to industrial production during post-crisis period.

Keywords: Monetary transmission, external shocks, global financial crisis, oil price, US economy

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Any remaining errors or omissions rest solely with the author(s) of this paper.

INTRODUCTION

Although many studies dedicate to evaluate the channels of monetary transmission (interest rate, exchange rate, domestic credit and equity price), a limited number of them investigate this mechanism in the face of economic crises. Effectiveness of the monetary transmission channels becomes more pronounced when the economy is confronted with a crisis originating from external factors outside policy making decisions. In such circumstances, if a monetary transmission channel is in proper efficiency, it can reduce the negative effects caused by external crises and plays a more prominent and positive role against the negative role of external shocks. Global crisis of 2007-2009 that began in US and spread to other developed and emerging countries have left a deep economic recession during those years (Helbling *et al*., 2011).

This study considers the effectiveness of the channels of the channels of monetary transmission mechanism on output and prices, as measurements of monetary policy objectives of sustainable growth and price stability, in Thailand. The research seeks the effectiveness of this mechanism against external factors causing the crisis during pre-and post-crisis. Although investigation of the role of US economy as the source of the recent crisis is crucial, consideration of oil price, as the factor behind most of economic fluctuations, is also valuable (Cuñado and Pérez de Gracia, 2003; Hamilton, 1983, 2011), therefore the external variables include oil price and US output as a proxy of US economy (Ruiz and Vargas-Silva, 2010, p. 176). The co-movements of GDP growth and inflation of Thailand in Figure 1 with US growth and oil price confirms the important role of oil price and US output in domestic fluctuations.

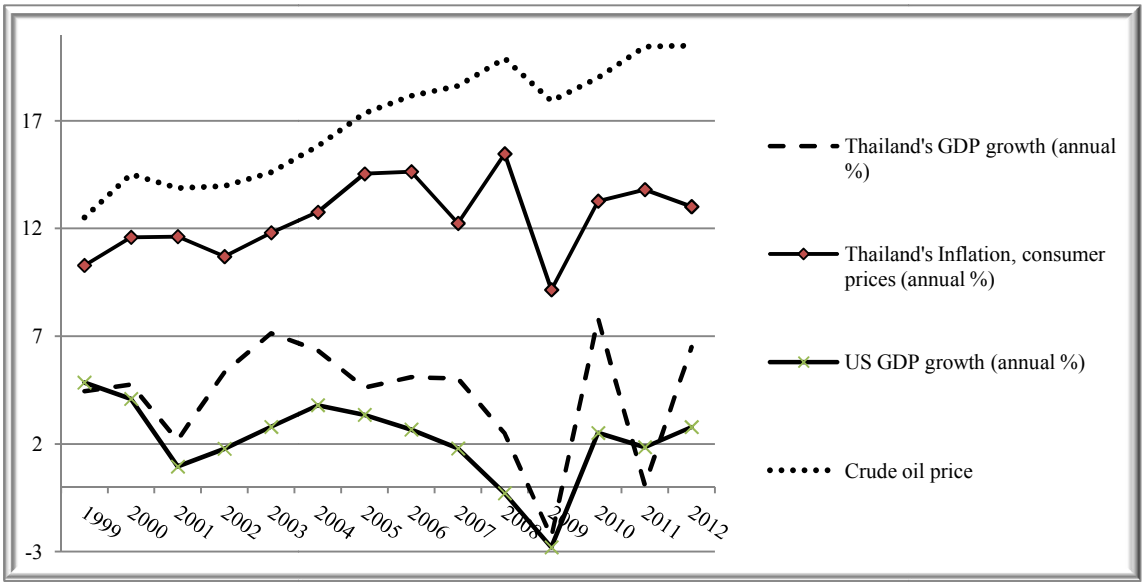

Figure 1: The coincidence between GDP growths, oil price and inflation

Notes: The data are collected from world bank (world development indicators)

This study utilizes the endogenous structural break test of (Zivot and Andrews, 1992) for splitting the sample into pre-and post-crisis. Zivot-Andrews test endogenously detects the most important time of the structural break on individual series so it can be determined whether the global crisis is the most important factor in a structural break of time series. Although few studies have explored the concurrency between structural break with the recession of 2007-2009 such as (Aly and Strazicich, 2011; Didier *et al*., 2012), recent studies have mostly considered a structural break during the recession of 1997-98 (Goh *et al.,* 2005; Loganathan *et al.,* 2012; Valadkhani and Chancharat, 2008). This study covers the gap in the literature by looking into structural break of the system variables during the global crisis of 2007-2009. The determination of the structural breaks in the different monetary and economic variables of this study provides a comprehensive assessment of the sensitivity of the economic variables to changes in global variables. This method indicates which variable is more sensitive to global changes and requires more attention.

This research investigates the monetary transmission channels with a new angle of view due to differences between recent crisis and other crisis, for instance this crisis was global, not regional. Evaluation of efficiency of the monetary transmission channels before and after the crisis specifies practical points about how to deal with global economic events.

Overall, this research is different with studies conducted in the monetary transmission mechanism, especially in Southeast Asian countries, in several ways. The majority of researches in the monetary transmission mechanism in the Asian countries have focused on investigating one or two channels of the monetary transmission mechanism, i.e. (Karim *et al.,* 2006; Wulandari, 2012) while this research investigates the efficiency of four channels of monetary transmission mechanism which includes: interest rate, exchange rate; credit and asset price (stock price). These four channels are well-known channels of monetary transmission mechanism (Mishkin, 1995, 1996, 2001; Taylor, 1995). Moreover, the evaluation of the efficiency of the monetary transmission channels concerning recent crisis has not been conducted in Asian countries. The consideration of the effect of the two factors causing the global crisis, oil price and US economy, in company with the channels of monetary transmission mechanism on economy demonstrates the strengths and weaknesses of the monetary transmission channels in the face of global crises.

This article seeks to achieve two fundamental questions. First, have the channels of the monetary transmission been able to protect the economy against fluctuations resulting from external crises before the crisis? Which channel has had the highest efficiency?

Second, have the roles of the monetary transmission channels increased against volatility caused by external shocks after the crisis? Have there been any improvements in the efficiency of the monetary transmission mechanism channels? In general, to what extent is the protective power of the channels of monetary transmission against external shocks?

LITERATURE REVIEW

Comparison between the monetary transmission mechanism before and after a specific economic event can help to employ optimal monetary policies. Evaluation of money and credit in both pre-and post-financial liberalization in Malaysia was the subject of (Azali, 2001; Azali and Matthews, 1999). (Çatik and Karaçuka, 2012) used TVAR methodology and monthly data from 1986 to 2010 to find the importance of the credit channel under pre-and post-inflation targeting regime in Turkey. The study statistically found the break date in inflation on 2003-M11 that was correspondent with the date of employing inflation targeting. The results showed interest rate channel and credit channel were strong in stabilizing the prices after the time of the inflation targeting; although the credit volume was not influenced by monetary shocks. Several researches considered monetary transmission mechanism before and after the Asian crisis of 1997-98 (Disyatat and Vongsinsirikul, 2003; Hesse, 2007; Raghavan, Silvapulle and Athanasopoulos, 2012).

(Cukierman, 2013) using the data of USA from 1999-M1 until 2012-M3 found the possibility of the relation between high inflation with rising rate of credit in economy. He concluded that the effects of the monetary transmission mechanism to prices during

time of crisis is weaker than that of the other times and it depends on the financial system status. The variables used in this article included industrial production, consumer price index, narrow money, interbank rate, total Volume of credit, oil price, US industrial production, federal fund rate and US$/Turkish Lira exchange rate. In an attempt to find the effectiveness of the monetary transmission over time (Weber *et al.,* 2011) employed VAR to find the changes in monetary transmission before and after the structural break in the euro area. The study discovered the break point at 1996 by using the quarterly data from 1980-Q1 until 2006-Q4 and split the data on two periods before and after 1996-Q1. The results indicated there were no differences in monetary transmission pre-and post-structural break according to the responses of variables to interest rate shocks. The data that were employed in this research include real GDP, GDP deflator, household housing wealth, interest rate, non oil commodity price, US interest rate. (Laopodis, 2013) discovered the relationship between federal fund rate and stock price by using the data from 1970 until 2005. The study tested the structural break and determined the relationship between interest rate and stock market by using VAR methodology and 6 variables. The study separated the data according to structural breaks in federal fund rate into in three samples; 1970-M1 until 1979-M8, 1979-M8 until 1987-M8 and 1978-M8 until 2005-M12. The purpose of dividing the data based on the interest rate was the classification according to the different monetary policy regimes. The results showed the asymmetric response of the stock market to monetary policy between two different periods.

RESEARCH METHODOLOGY

This study covers monthly data from 2002M1 to 2013M4. Vector of variables are defined as follows:

$y_t = [int \quad m2 \quad cpi \quad ip \quad oil \quad USip \quad dc \quad eer \quad sp]$

Where *int* represents interest rate, *m2* is broad money, *cpi* indicates consumer price index, *ip* symbolizes industrial production, *USip* is a sign of the US industrial production as a proxy of the US economy, *dc* stands for domestic credit and *sp* denotes stock price. More details about the variables are listed in Table 1. All variables except interest rate are used in logarithmic form and in level since this study is based on (Kim and Roubini , 2000) which built on Bayesian inference. According to (Sims , 1988) unit root test is not as important as it is in econometrics especially when Bayesian inference is employed. VAR in level is common in monetary policy studies, i.e. (Smets and Peersman, 2001 and Uhlig, 2005)

Table 1 Description of variables

Label	Descriptions
int	Interest rates: money market rate
m2	Broad money
oil	World commodity prices: crude oil
USip	US industrial production - total index
ip	Manufacturing production index
cpi	Consumer price index
dc	Depository corporations survey: claims on private sector
eer	Effective exchange rate
sp	Share prices, total

Source: The data are collected by Thomson DataStream

This study divides the sample into the periods before and after the crisis by testing the structural break of each variable according to (Zivot and Andrews, 1992) instead of joint variables. Zivot-Andrews test endogenously detects the most important time of the structural break on individual series so it can be determined whether the global crisis has

affected the variables of interest to the extent of undertaking the structural break. The study improves the performance of VAR by omitting observations with structural break during the economic crisis of 2007-2009. According to (Hassani *et al.,* 2009) the existence of a structural break in the series reduces VAR performance and diminishes quality of forecasting. Several studies split the sample based on tests of structural break of each series (Baek and Koo, 2010; Bayrak and Esen, 2013; Narayan, 2004; Okunev *et al.,* 2002; Pala, 2013). A similar process for splitting sample is carried out by (Gerlach *et al.,* 2006). Table 2 presents the results of three models of Zivot-Andrews test, intercept, trend and both intercept and trend (in this research the pre-crisis period ends with the first statistically significant date of structural break during 2007-2009 while post-crisis period starts with the last statistically significant date of structural break during 2007-2009). 2008:01 is the first statistically significant date of structural break and 2008:10 is the last one during 2007-2009 so the pre-crisis period starts from 2002-01 until 2007:12 and post-crisis 2008:11 until 2013:04.

Table 2 Zivot-Andrews test

variable	Intercept	Trend	Both (intercept and trend0
op	-5.75(2008:08)***	-3.95 (2007:11)	-5.68 (2008:08)***
USip	-6.44 (2008:08)***	-2.88 (2004:11)	-6.97 (2008:08)***
ip	-5.15 (2011:10)**	-4.69 (2008:01)**	-4.70 (2007:09)
cpi	-5.13 (2008:10)**	-3.74 (2008:02)	-5.11 (2008:10)**
M2	-2.40 (2010:10)	-3.94 (2009:08)	-4.71 (2008:01)
int	-4.58 (2008:10)*	-2.82 (2005:11)	-4.42 (2008:10)
eer	-3.12 (2006:06)	-2.57 (2004:07)	-3.41 (2006:01)
dc	-5.04 (2010:10)	-4.64 (2010:05)***	-1.89 (2010:01)
sp	-2.56 (2007:08)	-3.16 (2010:02)	-5.02 (2008:06)*

Notes: ***, ** and * show the significant level at 1% and 5% and 10%, break dates are in blankets

The central part of monetary transmission research is considering the response of economic variables to monetary policy shocks so the VAR models are especially useful to find the reply of real variables to exogenous shocks. In spite of all the benefits of the

VAR approach in economic research, the independence property of VAR to economic theory leads to the emergence of structural VAR approach. Once the restrictions are successfully done, the SVAR model is able to map out the systematic dynamics to shocks and identify the relationship between variables, and then it transmits the shocks of monetary policy to other variables in the system. The wide-ranged theoretical restrictions in SVAR make this model well-matched to different economic theories (Gottschalk, 2001). The SVAR models are also preferable to VAR in monetary transmission studies because the identification of Choleskey decomposition in the VAR models based on partial identification (Elbourne, 2008).

This research employs the (Kim and Roubini, 2000) model to achieve its objectives. Besides the suitability of SVAR (Kim and Roubini, 2000) for small open economies and solving the puzzles of VAR models, the objective of considering external shocks causing the crisis alongside monetary transmission channels in this study is in agreement with the model of (Kim and Roubini, 2000). One of the goals of this study is to investigate the monetary transmission channels before and after the crisis that caused by impacting of external variables on the economy. The contemporaneous relationship between external and internal variables in structural VAR of (Kim and Roubini, 2000) gives the possibility to evaluate the effectiveness of the channels of monetary transmission mechanism in the face of another similar crisis. It also allows evaluating policies in times of crisis. If policies implemented in time of crisis are successful in decreasing the sensibility of the internal variable to external shocks, the economy should not show strong reactions to shocks in exogenous variables after structural break.

Equation (1) represents the reduced form of vector autoregressive.

$$\mathcal{A}_0 X_t = \mathcal{A}(L)\, X_{t-1} + \nu_t \quad (1)$$

X_t : Vector of endogenous variables

X_{t-1} : Vector of lagged valued

v_t : Vector of error terms

Value for parameters is impossible. The reduced form of VAR can be estimated as:

$$X_t = \mathcal{C}(L)\, X_{t-1} + u_t \quad (2)$$

$\mathcal{C}$(L) $=\mathcal{A}_0^{-1}\mathcal{A}(L)$ matrix of coefficient of lagged variables, $u_t = \mathcal{A}_0^{-1}\varepsilon_t$ vector of residuals that are connected to the structural shocks and is observed so

$$\varepsilon_t = \mathcal{A} u_t \quad (3)$$

Equation (3) is employed for deriving the relationship between variance-covariance of u_t that is observed and ε_t that is not observed.

$$\Omega=\begin{bmatrix} {\sigma_1}^2 & \sigma & . & . & . & . & \sigma_{1n} \\ \sigma_{21} & {\sigma_2}^2 & . & . & . & . & \sigma_{2n} \\ \sigma_{31} & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ \sigma_{n1} & \sigma_{n2} & . & . & . & . & {\sigma_n}^2 \end{bmatrix} \quad (4)$$

Each factor of Ω can be calculated as; $\sigma_{ij} = 1/\mathrm{T} \sum_{t=1}^{T} u_{it}\, \sigma_{jt}$.The above variance-covariance contains (n^2+n)/2 distinct elements, $\mathcal{A}$ contains $n^2 - n$ unknown values and $var\varepsilon_{ij}$ contains n unknown so $n^2 - n + n = n^2$ unknown and (n^2+n)/2 known therefore $n^2 - \frac{n^2+n}{2} = \frac{n^2-n}{2}$ restrictions on the system. The model of 9 variables of this research must include at least 36 restrictions to be identified.

The following matrix demonstrates the restrictions imposed on the system based on $\varepsilon_t = \mathcal{A} u_t$.

$$\begin{matrix} \varepsilon_{oil} \\ \varepsilon_{usip} \\ \varepsilon_{ip} \\ \varepsilon_{cpi} \\ \varepsilon_{m} \\ \varepsilon_{int} \\ \varepsilon_{dc} \\ \varepsilon_{eer} \\ \varepsilon_{sp} \end{matrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{41} & 0 & \alpha_{43} & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \alpha_{53} & \alpha_{54} & 1 & \alpha_{56} & 0 & 0 & 0 \\ \alpha_{61} & 0 & 0 & 0 & \alpha_{65} & 1 & 0 & 0 & 0 \\ \alpha_{71} & 0 & \alpha_{73} & 0 & 0 & \alpha_{76} & 1 & 0 & 0 \\ \alpha_{81} & \alpha_{82} & \alpha_{83} & \alpha_{84} & \alpha_{85} & \alpha_{86} & \alpha_{87} & 1 & 0 \\ \alpha_{91} & \alpha_{92} & \alpha_{93} & \alpha_{94} & \alpha_{95} & \alpha_{96} & \alpha_{97} & \alpha_{98} & 1 \end{bmatrix} \begin{bmatrix} u_{oil} \\ u_{usip} \\ u_{ip} \\ u_{cpi} \\ u_{m} \\ u_{int} \\ u_{dc} \\ u_{eer} \\ u_{sp} \end{bmatrix} \quad (5)$$

The first two variables, *oil* and *USip,* are exogenous variables that are included for two reasons, disconnecting the supply side shocks from monetary policy shocks and their role on global crisis. The industrial production of the US as a proxy of the US economy is included because of the high trade relationship between two countries and the role of the US economy in recent crisis of 2007-2009.

cpi and ip are supply and demand that illustrate the equilibrium in commodity markets. The production is not affected by prices due to the unavailability of monthly inflation data, but the oil price as a factor influencing on inflation expectation impact on industrial production and *CPI* within a month. An Increase or decrease in production during the month affects the price. The high trade volume between Thailand's economy as small open country and the US causes the US output affect the Thailand industrial production at any point in time.

m and int indicates the money demand and money supply. Money demand is affected by short-run interest rate, inflation and output as the theory indicates. Money and oil price enter inflation targeting reaction function of Thailand instead of production and

inflation because of unavailability of the information about inflation and production within the month these variables go through the monetary reaction function.

$dc,$ Domestic credit, contemporaneously reacts to the shocks of industrial production (Wulandari, 2012), inflation and policy rate. The real cost of credit (real interest rate) is an important factor for borrowers.

eer and SP are effective exchange rate and stock market index. Similar to Kim and Roubini the exchange rate is an arbitrage equation that shows the financial market equilibrium. The forward looking property of exchange rate and asset price makes them sensitive to the news so all the variables in the system affect them; however, the research assumes the one way contemporaneous effect of exchange rate on asset price. The study of (Li *et al.,* 2010) is an example in which the stock price is contemporaneously affected by shocks of other variables. (Wongbangpo and Sharma, 2002) found the impact of exchange rate on the stock returns in ASEAN countries. (Liang *et al.,* 2013) achieved the same results by reexamining the relationship between stock index and exchange rate in ASEAN-5 countries.

RESULTS AND DISCUSSION

Before proceeding, it should be noted that the VAR model consists of three lags for pre-crisis period and two lags for post-crisis period. These results rooted in outcomes of AIC, BIC and LR test and least serial correlation in residuals. Such a procedure is applied in the studies of (Buckle *et al*., 2007) and (Voss, 2002) for finding the lag length (refer to Table A1-A4 in appendix for more information).

The contemporaneous coefficients of the relationship between the variables of the system in Table 3 indicate the contemporaneous effect of oil price on *cpi* of pre-crisis. *m2* of pre-crisis period positively and interest rate of post-crisis period negatively impact on exchange rate that denotes the efficiency of monetary policy on exchange rate. Domestic credit of post-crisis period significantly and negatively affects this variable too. The contemporaneous correlation between variables shows the positive and significant effect of *m2*, industrial production, domestic credit and exchange rate as well as negative and significant effect of interest rate on stock price during pre-crisis period. The oil price and domestic credit significantly affect stock price during post-crisis period. The bigger values of exchange rate for both periods show that the exchange rate is an important factor affecting stock price and does not lose this property by crisis. The likelihood ratio of over-identifying restrictions (Chi-Squared) are not rejected for both periods.

Table 3 Contemporaneous coefficients in structural VAR: Thailand

Dependent variable	Independent variable	Pre-crisis	Post-crisis
int	*m2*	-16.771	25.480
		(25.735)	(19.556)
	oil	-0.117	-0.214
		(0.380)	(0.542)
m2	*int*	0.055	-0.112
		(0.050)	(0.103)
	cpi	-0.533	2.128
		(0.390)	(1.359)
	ip	0.035	-0.047
		(0.055)	(0.047)
cpi	*ip*	0.032	0.000
		(0.025)	(0.007)
	oil	0.025***	0.007
		(0.007)	(0.007)
ip	*oil*	-0.068	0.000
		(0.048)	(0.195)
	USip	-0.248	2.824
		(0.655)	(2.232)
USip	*oil*	-0.033***	0.033*
		(0.011)	(0.013)
dc	*int*	-0.000	-0.003
		(0.012)	(0.006)
	ip	0.040	0.028***
		(0.071)	(0.009)
	oil	0.020	0.007
		(0.019)	(0.009)
eer	*int*	-0.012	-0.027*
		(0.012)	(0.017)
	m2	0.359*	0.252
		(0.211)	(0.263)
	cpi	0.177	-0.482
		(0.442)	(0.728)
	ip	-0.099	0.011
		(0.064)	(0.029)
	oil	-0.021	0.0178
		(0.024)	(0.028)
	USip	0.203	0.272
		(0.253)	(0.351)
	dc	-0.094	-1.312 ***
		(0.155)	(0.479)
sp	*int*	-0.118*	0.075
		(0.064)	(0.058)
	m2	2.082**	0.962
		(1.019)	(0.908)
	cpi	1.900	2.006
		(2.387)	(2.214)
	ip	0.623*	0.033
		(0.369)	(0.103)
	oil	0.164	0.232**
		(0.134)	(0.095)
	USip	-1.665	-1.230
		(1.272)	(1.086)
	dc	1.696**	2.308
		(0.828)	(1.722)
	eer	2.641***	1.757***
		(0.854)	(0.601)
Chi-Squared		8.166	3.702
		[0.417]	[0.882]

Notes: ***, ** and * show the significant level at 1%, 5% and 10%, break dates are in blankets

Figure 2 represents the responses of price index of Thailand to positive shock to each of the four variables of monetary transmission and foreign variables. Significant changes in *cpi* to positive shock in each of the four channels of monetary transmission except stock price before the crisis period is small compared to the after the crisis period. Following a positive shock in interest rate and exchange rate, the price is reduced during post-crisis period. The prices rise in response to a positive shock to credit and stock index during post-crisis. Price responses to positive shocks in exogenous variables indicates the efficiency of oil price changes on domestic prices during both periods, while the US industrial production loses its impact on prices after the crisis period. Responses of price are positive whether the increase occurs in the US industrial production or in oil price.

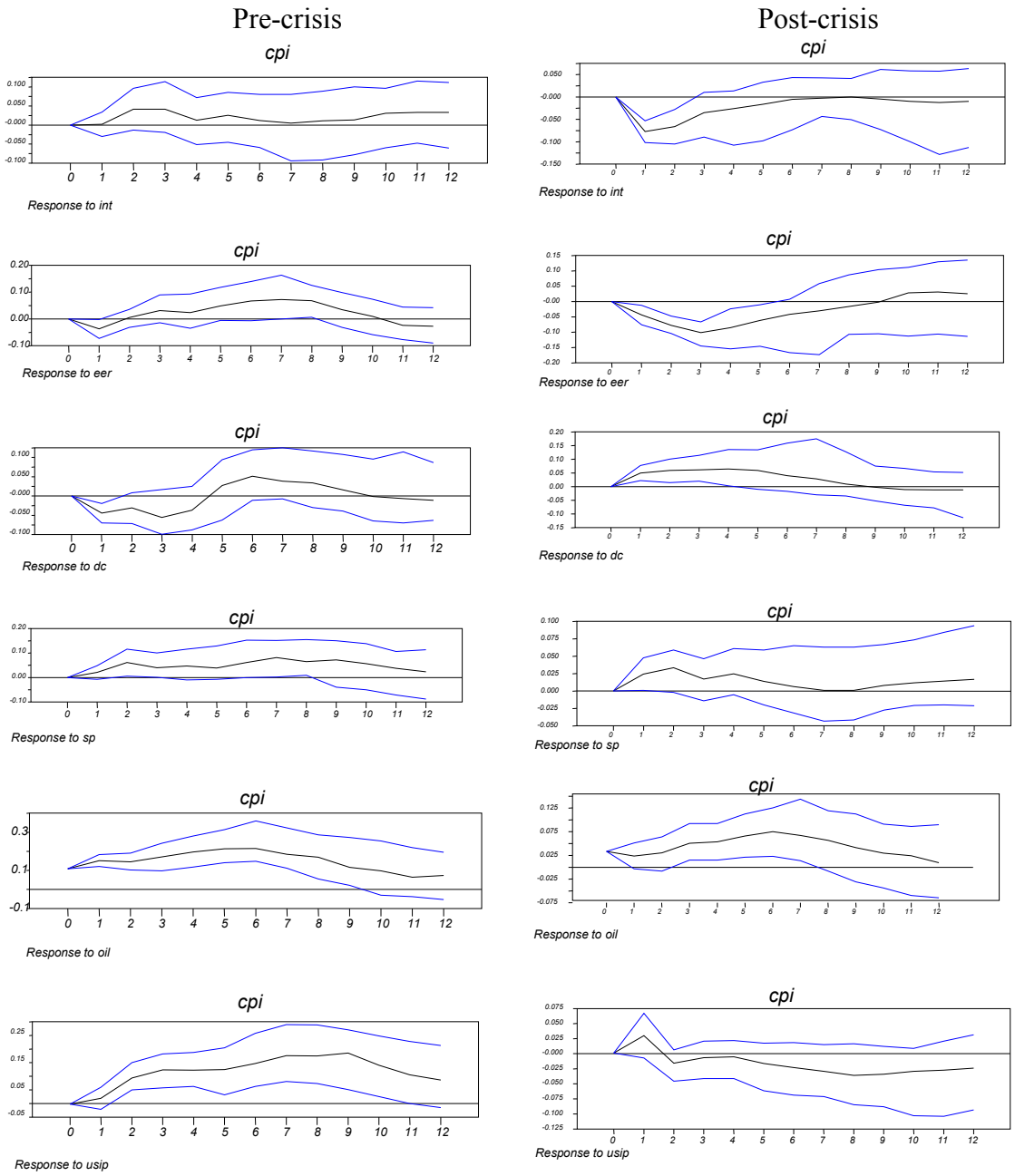

Figure 2 Responses of *cpi* to the shocks of internal and external variables

Variance decomposition in Table 4 demonstrates that before the crisis period, domestic variables did not substantially at all give impact on the prices while exogenous variables explained up to 60% of the price volatility. After the crisis period, there is a significant

increase in impacting of the variables of monetary transmission mechanism except stock price on consumer price index; although a considerable reduction in the impact of exogenous variables on prices is also noticeable. However, the share of oil price in price volatility has dropped after crisis period compared to before crisis period, it is still an effective factor on domestic prices. Oil price accounts maximum 24% of price fluctuations after the crisis. Overall, the results suggest that policy maker can use the monetary transmission channels to restrain the prices after crisis period. Interest rate and exchange rate are the two instruments that can be effective in lowering the prices.

Table 4 Variance decomposition of *cpi*

Month	Pre-crisis						Post-crisis					
	int	*eer*	*dc*	*sp*	*oil*	*USip*	*int*	*eer*	*dc*	*sp*	*oil*	*USip*
0	0.00	0.00	0.00	0.00	21.89	0.01	0.00	0.00	0.00	0.00	3.47	0.00
1	0.00	1.05	1.54	0.33	26.72	0.27	11.58	4.39	4.01	1.05	3.44	1.47
3	1.26	0.84	2.11	2.05	29.84	8.13	15.05	17.21	11.84	2.24	6.22	0.77
6	0.95	1.92	1.96	2.30	41.04	12.12	11.91	20.43	19.93	1.78	17.37	0.87
9	0.76	3.12	1.96	3.62	40.62	18.47	12.03	18.75	20.49	1.19	23.35	1.24
12	1.13	2.90	1.81	3.59	39.95	20.92	13.52	17.89	19.68	0.97	24.05	1.91

Industrial production in response to a positive shock to each of the domestic variables significantly increases for only one or two months during pre-crisis period in Figure 3. The fall in significant responses of industrial production to increases in interest rate and exchange rate and the rise to domestic credit and stock price happen as it is expected during post-crisis period. These results for responses to interest rate and stock price occur in initial months while to effective exchange rate and domestic credit in middle months. Both external variables influence the industrial production in the period zero; however the response to *USip* is statistically meaningless for the rest of the year. Industrial production in response to a rise in oil price, after the immediate reduction, begins to increase until the second month and thereafter declines during pre-crisis. There

is a similar move after crisis; although the response is significant only for the first and third months.

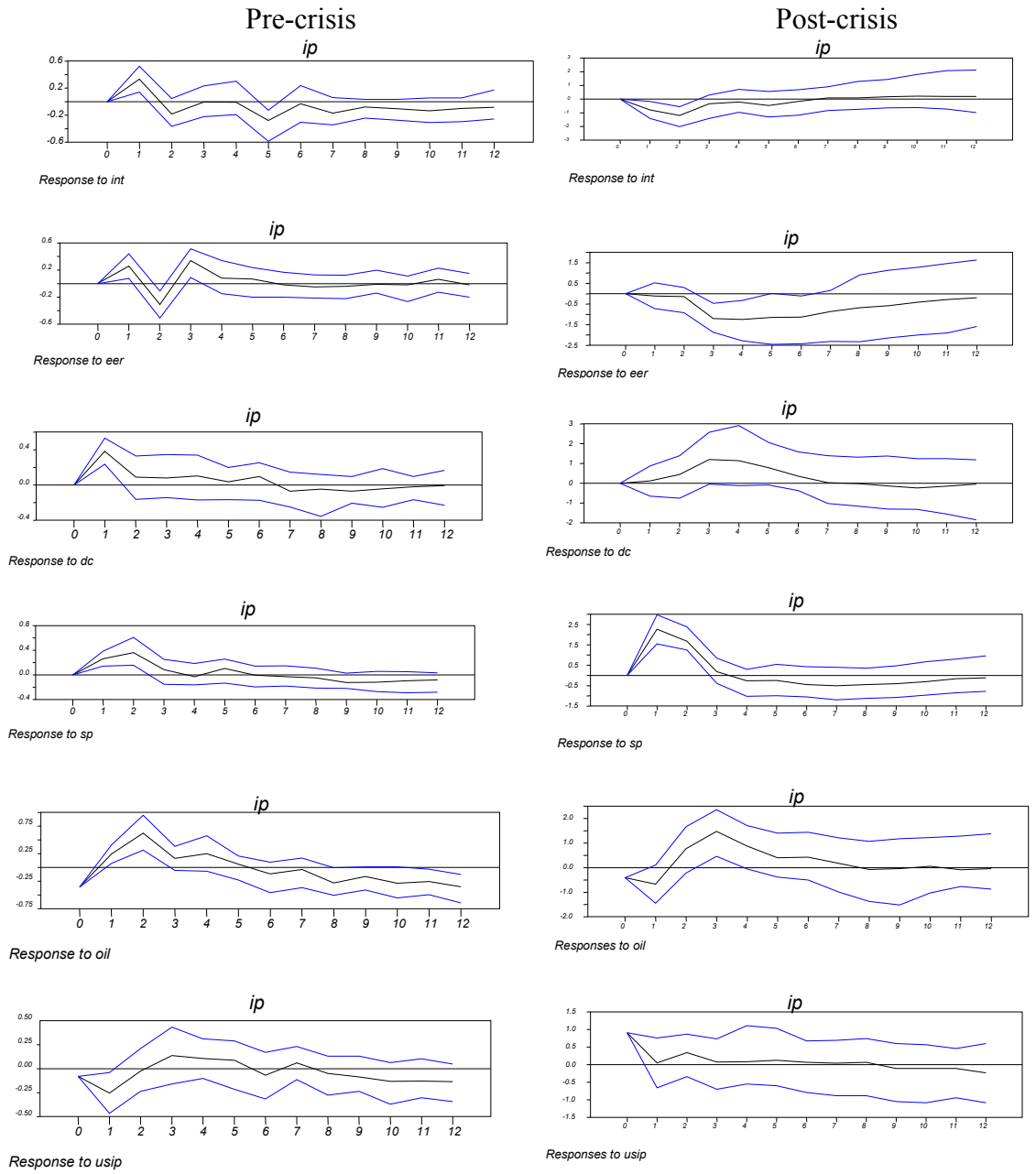

Figure 3 Responses of industrial production to the shocks of internal and external variables

The variance decompositions in Table 5 indicate the more important role for exchange rate among variables of monetary transmission in explaining *ip* fluctuations; although

the values of stock price and interest rate are close to exchange rate during pre-crisis period. The maximum decomposition of variance for each of the four channels is between 6-8%, so none of them can be considered as an effective factor among domestic variables during pre-crisis period. Oil price with accounting for maximum 24% of fluctuation in industrial production before the crisis period is foremost factor affecting production. After crisis, the stock price explains 17% of the volatility for industrial production at the peak in the third month, and is the most important factor affecting the production between all internal and external variables.

Table 5 Variance decomposition of industrial production

Month	Pre-crisis						Post-crisis					
	int	*eer*	*dc*	*sp*	*oil*	*USip*	*int*	*eer*	*dc*	*sp*	*oil*	*USip*
0	0.00	0.00	0.00	0.00	7.34	0.37	0.00	0.00	0.00	0.00	0.98	1.75
1	4.53	2.70	6.01	2.79	7.63	2.88	1.07	0.09	0.11	14.17	2.48	1.84
3	4.17	7.83	4.69	6.18	18.24	2.97	2.59	1.59	1.39	17.47	4.58	1.56
6	6.23	7.85	4.40	6.09	18.94	3.18	2.49	4.73	3.67	15.40	6.11	1.73
9	6.97	7.48	4.23	6.10	20.44	3.12	2.47	7.36	4.07	14.80	5.82	1.83
12	7.12	6.66	3.76	6.09	24.13	3.67	2.34	9.02	4.41	14.52	5.58	1.88

CONCLUSION

The purpose of this paper is to investigate the monetary transmission channels in Thailand with regard to the recent economic crisis of 2007-2009. This article studies the monetary transmission channels against oil price and the US industrial production, as the international two factor stressors, during pre-and post-crisis of 2007-2009. The comparison between the monetary transmission channels and external factors affecting the prices reflects the high impact of oil price and the US industrial production versus slight effect of monetary transmission channels on prices during pre-crisis period. After the crisis, while there is a significant reduction in the effects of external variables and increase in the effect of internal variables excluding the stock price on prices, oil price is

still a determining factor on price volatility. Monetary transmission mechanism via interest rates, exchange rate and domestic credit can impact on prices during post-crisis period. In the case of industrial production, such as the prices, oil price plays essential role in the fluctuation of industrial production while the role of transmission channels of monetary policy and the US industrial production is not significant before the crisis period. After the crisis, the monetary transmission channels are capable of affecting industrial production through stock price and the impact of oil price greatly reduces.

As a general conclusion from the results of post-crisis period, monetary policymakers in Thailand can take advantage of stock price and exchange rate to affect production and prices. The results imply, on one hand, the stock price as effective channel on industrial production which connects positively with the response of industrial production and on the other hand, exchange rate and oil price positively and contemporaneously influence stock price. The monetary authority must be aware of the positive relationship between domestic exchange rate and stock price because of the reduction in domestic currency with the aim of increasing production can be also be linked a negative impact on industrial production due to decrease in stock price. Since exchange rate mostly affect consumer price index with negative relationship and according to impulse response the effect of exchange rate on industrial production is not very significant, appreciation of domestic exchange rate can reduce the prices and increase the industrial production through stock price. The monetary authority of Thailand can also make the use of positive effect of domestic credit on price index. The decrease in domestic credit can be in line with the decrease in price index.

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APPENDIX

Table A1 VAR lag selection: pre-crisis

AIC	SBC/BIC	HQ	LR
-2163.41	-2144.01	-2155.93	0
-3268.47*	-3103.9*	-3223.18*	1299.33
-3153.68	-2918.65	-3145.12	154.01
-2939.92	-2762.06	-3095.82	182.78*
-2520.04	-2646.44	-3087.47	223.73
-1587.24	-2600.38	-3148.69	293.30

Table A2. Serial correlation: multivariate portmanteau statistic for pre-crisis

lags	1	3
1	61.66478	50.09724
	(0.94594)	(0.99726)
2	145.8971	94.12192
	(0.81293)	(1.00000)
3	231.8042	163.8094
	(0.68634)	(0.99997)
4	326.3356	268.6118
	(0.45315)	(0.98891)
5	407.3605	341.5393
	(0.45771)	(0.99021)
6	527.6758	458.0678
	(0.09315)	(0.8386)
7	634.0761	538.3151
	(0.02631)	(0.80143)
8	709.2878	612.7702
	(0.04747)	(0.83604)

Table A3. VAR lag selection for post-crisis

lags	AIC	SBC/BIC	HQ	LR
0	-1667.82	-1651.03	-1661.68	0
1	-2456.8437*	-2330.3884*	-2436.94	996.2368
2	-2309.73	-2194.37	-2396.82	180.859655*
3	-1971.64	-2137.08	-2435.42	259.5747
4	-893.219	-2174.14	-2568.3794*	353.935

Table A4. Serial correlation: multivariate portmanteau statistic for post-crisis

lags	1	2	4
1	80.13744	56.82392	183.2091
	(0.50621)	(0.98107)	(6.95427e-010)
2	163.77982	130.05221	310.91886
	(0.44610)	(0.96922)	(1.85186e-011)
3	252.5975	228.27055	432.22455
	(0.32279)	(0.74271)	(9.01340e-013)
4	355.2829	323.14021	520.01328
	(0.11172)	(0.50303)	(2.66284e-011)
5	449.0272	428.36703	645.18866
	(0.06458)	(0.20353)	(2.88899e-013)
6	528.5849	510.19354	769.29891
	(0.08864)	(0.21629)	(3.84824e-015)
7	602.97940	590.32048	890.93474
	(0.14314)	(0.24104)	(8.11868e-017)
8	697.2831	669.66347	994.57958
	(0.08785)	(0.26972)	(4.32967e-017)