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The Response of Macro Variables of Emerging and Developed Oil Importers to Oil Price Movements

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Abstract

This paper assesses the impact of crude oil price movements on two macro variables—the gross domestic product (GDP) growth rate and consumer price index inflation rate—in the developed economies of the United States and Japan, and an emerging economy, the People's Republic of China (PRC). These countries were chosen for this research because they are the world's three largest oil consumers. The main objective of this study is to see whether these economies are still reactive to oil price movements. The results obtained suggest that the impact of oil price fluctuations on the GDP growth of the developed oil importers is much lower than on the GDP growth of the emerging economy. The main reasons for this lie in fuel substitution (higher use of nuclear energy, gas, and renewables), a declining population (for Japan), the shale gas revolution (for the United States), and strategic oil stocks and government-mandated energy efficiency targets in developed economies. All of these factors make developed economies more resistant to oil shocks. On the other hand, the impact of oil price movements on the PRC's inflation rate was found to be milder than in the two developed countries that were examined. The main cause for this is that the PRC experiences a larger forward shift in its aggregate supply due to higher growth, which allows it to avoid a massive increase in price levels following oil price shocks.

JEL Classification: Q43, E31, O57

Contents

1. INTRODUCTION

More than 40 years have passed since the first oil price shock of 1973. During this period, global demand for oil has risen drastically, while at the same time new energy-related technologies and new energy resources have made global consumers more resistant to oil shocks. Since the oil shocks of the 1970s, emerging economies have come to play a much larger role in global energy consumption. The share of the People's Republic of China (PRC), for example, is 5 times larger than it was in the 1970s. On the other hand, the shares of the two largest developed oil consumers, the United States (US) and Japan, decreased from about 32% and 10%, to 21% and 5%, respectively.

After the oil crises of the 1970s and the economic recessions that followed, several studies found that oil price shocks played a significant role in the economic downturns. In recent years, both the sharp increase in oil prices that began in 2001 and the sharp decline that followed in 2008 following the subprime mortgage crisis have renewed interest in the effects of oil prices on the macro economy. Most recently, the price of oil has more than halved in a period of less than 5 months since September 2014. After nearly 5 years of stability, the price of a barrel of Brent crude oil in Europe fell from $117.15 on 6 September 2014, to $45.13 on 14 January 2015.

In this study, we will assess and compare the impact of oil price fluctuations on the gross domestic product (GDP) growth rate and consumer price index (CPI) inflation in the three largest crude oil consumers: the developed economies of the US and Japan, and an emerging economy, the PRC. We will answer the question of whether these economies are still elastic to oil price movements, or whether new, energy-related technologies and resources, like renewables and shale gas, have completely sheltered them from shocks. If these economies are still elastic, are they influenced to the same degree?

For this analysis, we chose to examine the period during the subprime mortgage crisis of 2008. Following the financial crisis of 2007–2008, crude oil prices dropped from $133.11 in July 2008 to below $42.01 in December 2008, due to decreased global demand. Shortly after this drop, however, they started to rise sharply again. We selected our analysis subperiods to be before and after this event and will compare the results of these two subperiods.

This paper is structured as follows: In the next section, we present an overview of oil and energy in the PRC, Japan, and the US. In the Section 3 we explain our model and in Section 4 we describe our empirical analysis. Section 5 contains this paper's concluding remarks.

2. OVERVIEW OF OIL AND ENERGY IN THE PEOPLE'S REPUBLIC OF CHINA, JAPAN, AND THE UNITED STATES

2.1 People's Republic of China

The PRC has quickly risen to the top ranks in global energy demand over the past few years. It is the world's second-largest oil consumer behind the US and became the largest global energy consumer in 2010. The country was a net oil exporter until the early 1990s, and became the world's second-largest net importer of crude oil and petroleum products in 2009. The PRC's oil consumption growth accounted for one-third of the world's oil consumption growth in 2013 and 43% of the world's oil consumption growth in 2014. Despite the PRC's slower oil consumption growth in the past few years, the United States Energy Information Administration (EIA) projects the PRC will account for more than a quarter of global oil consumption growth in 2015.

Natural gas use in the PRC has also increased rapidly in recent years, and the country has sought to raise natural gas imports via pipeline and liquefied natural gas (LNG). Coal supplied the majority (nearly 66%) of the PRC's total energy consumption in 2012 and the country is the world's top coal producer, consumer, and importer, and accounts for approximately half of global coal consumption, an important factor in world energy-related carbon dioxide emissions. Rising coal production is the key driver behind the country becoming the world's largest energy producer in 2007. In line with its sizeable industrialization and swiftly modernizing economy, the PRC also became the world's largest power generator in 2011 (EIA 2014a).

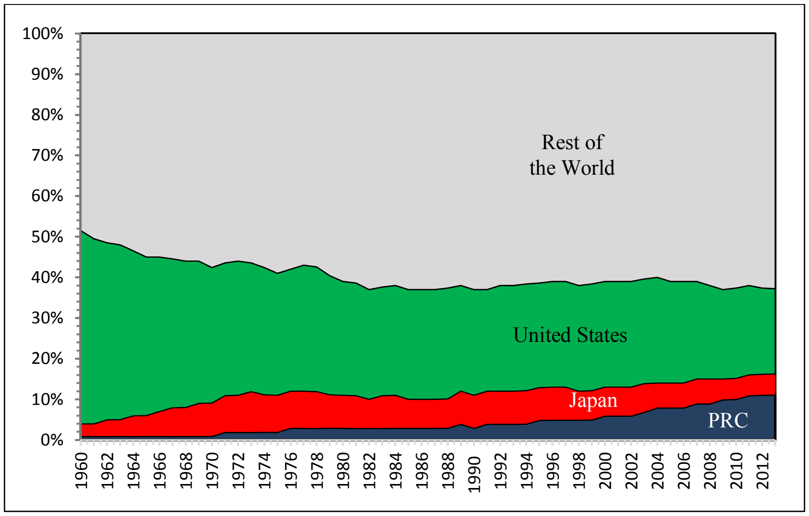
According to the Institute of Energy Economics of Japan's (IEEJ) *Asia/World Energy Outlook 2013* (IEEJ 2014), the PRC's oil consumption will almost double over the coming 30 years, reaching 866 million tons of oil equivalent (Mtoe) by 2040.[1] During this period, the PRC will replace the US as the world's largest oil consumer. Driving the increase will be the transportation sector, including road transportation. With the PRC's great potential to expand its vehicle market from its current 7% vehicle ownership rate, the number of vehicles in the country is expected to increase to 360 million in 2040, meaning that the transportation sector will double its oil consumption. The PRC's share of global gasoline consumption will expand from its current 8% to 18%, exceeding its share of the global population. This projection continues by saying that by 2040, the PRC will have the world's largest nuclear power generation capacity, and will account for half of the increase in global nuclear generation capacity between 2011 and 2040. Renewable energy will account for 9.7% of the PRC's primary energy consumption in 2040.

2.2 Japan

Japan is one of the world's largest energy consumers—it is the world's largest liquefied natural gas (LNG) importer, the second-largest coal importer, and third-largest net oil importer. Japan's domestic energy sources provide less than 15% of its own total primary energy use. Figure 1 shows the share of the world's three major oil consumers: The US, Japan, and the PRC. As the figure clearly shows, the US and Japan's shares are decreasing and the shares of the PRC and the rest of the world are on the rise.

[1] Equal to about 6,186 million barrels of oil equivalent (Mboe).

Figure 1: Share of Three Major Oil Consumers in Global Oil Consumption, 1960–2013



PRC = People's Republic of China.

Source: Annual statistical bulletin of the Organization of the Petroleum Exporting Countries (OPEC 2014).

In March 2011, a 9.0 magnitude earthquake struck off the coast of Sendai, Japan, triggering a large tsunami. The damage to Japan resulted in an immediate shutdown of about 10 gigawatts of nuclear electric generating capacity. Between the 2011 Fukushima disaster and May 2012, Japan lost all of its nuclear capacity as a result of scheduled maintenance and lack of government approvals to return to operation. Japan replaced the significant loss of nuclear power with generation from imported natural gas, low-sulfur crude oil, fuel oil, and coal. This caused the price of electricity to rise for the government, utilities, and consumers. Increases to the cost of fuel imports have resulted in Japan's top 10 utilities losing over $30 billion in the past two years. Japan spent a total of $250 billion on fuel imports in 2012, a third of the country's total import spending. Despite strength in export markets, the yen's depreciation and soaring natural gas and oil import costs due to a greater reliance on fossil fuels continued to deepen Japan's recent trade deficit throughout 2013. In the wake of the Fukushima nuclear incident, oil is still the main energy carrier in Japan, although the share of oil consumption in the total energy consumption of Japan reduced from about 80% in the 1970s to 43% in 2011. Japan consumed over 4.7 million barrels per day of oil in 2012.

There are several reasons for the decline in oil demand in Japan, but the main reason is due to structural factors, such as fuel substitution, a declining population, and government-mandated energy efficiency targets. Japan consumes most of its oil in the transportation and industrial sectors, and is also highly dependent on naphtha and low-sulfur fuel oil imports (EIA 2013). According to the International Energy Agency,[2] the total strategic crude oil stock in Japan was 590 million barrels at the end of December 2012, 55% of which were government stocks and 45% commercial stocks.

2.3 United States

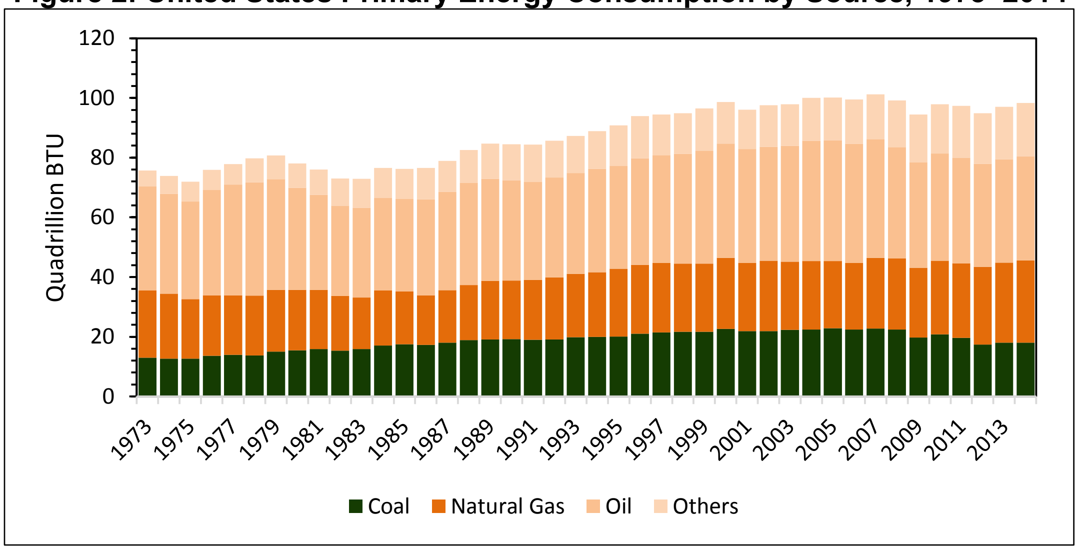
In 2014, the US consumed over 98 quadrillion British thermal units (BTU) of primary energy, making it the world's second largest energy consumer after the PRC.

[2] http://www.eia.gov/beta/international/analysis_includes/countries_long/Japan/japan.pdf

According to the latest available data, oil meets 35% of US energy demand, with 70% directed to fuels used in transportation—gasoline, diesel, and jet fuel. Another 25% is used in industry and manufacturing, 4% is used in the commercial and residential sectors, and less than 1% is used to generate electricity. Oil is the main mover of US national commerce and its use for transportation has increased connectivity. Almost all US transportation is dependent upon fuel in concentrated liquid form, with major sources of imported oil from Canada, Mexico, and OPEC, particularly Saudi Arabia, including 20% from the Persian Gulf. EIA estimates indicate US oil reserves to be about 23 billion barrels (EIA 2014b).

Figure 2 shows US primary energy consumption by source during 1973–2014. The share of crude oil decreased from 46% in 1973 to 35% in 2014, while the shares of natural gas (driven especially by the shale gas revolution), nuclear electric power, and renewable energy rose drastically.

Figure 2: United States Primary Energy Consumption by Source, 1973–2014



BTU = British thermal unit.

Note: Natural gas consumption excludes supplemental gaseous fuels.
"Others" includes nuclear and renewable energy.
Source: US Energy Information Administration, *Monthly Energy Review*, April 2015.

3. MODEL

The main objective of this research is to assess the impact of crude oil price movements on two macroeconomic variables, GDP growth rate and CPI inflation rate. In developing this model we used Taghizadeh-Hesary and Yoshino (2013) and Yoshino and Taghizadeh-Hesary (2015) as a reference. In their model, they assumed that oil price movements transfer to macro variables through either supply (aggregate supply curve) or demand channels (aggregate demand curve). In order to examine the effects of this transfer, they used an IS curve to look at the demand side and a Phillips curve to analyze inflationary effects from the supply side.

Using these aforementioned studies as inspiration, we chose to use the following variables in our survey: crude oil prices, natural gas prices, GDP, the consumer price index (CPI), money supply, and the exchange rate. We included the natural gas price because it is the main substitute energy source for crude oil. GDP and CPI are included in our variables mainly because their movements have an impact on the crude oil market (Taghizadeh-Hesary and Yoshino 2013, 2014; Yoshino and Taghizadeh-Hesary, 2014), and also because our objective is to assess the impact of oil price fluctuations on these two macro variables. The money supply and exchange rate are monetary policy variables that have an impact on the crude oil market (Taghizadeh-Hesary and Yoshino, 2014; Yoshino and Taghizadeh-Hesary, 2014). Taghizadeh-Hesary and Yoshino (2014) explain that oil prices accelerated from about $35/barrel in 1981 to beyond $111/barrel in 2011. At the same time, interest rates (the federal funds rate) subsided from 16.7% per annum to about 0.1%. By running a simultaneous equations model, they found that during the period 1980–2011, global oil demand was significantly influenced by interest rates, but the impact of exchange rate depreciations on oil demand was not significant in this period and supply actually remained constant. Aggressive monetary policy stimulates oil demand, while supply is inelastic to interest rates. The result is skyrocketing crude oil prices, which inhibit economic growth.[3]

To assess the relationship between crude oil prices, natural gas prices, GDP, consumer price index (CPI), money supply, and the exchange rate variables, we adopt the N variable structural vector autoregression (SVAR) model and start with following VAR model:

$$Y_t = A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + u_t \qquad (1)$$

where Y_t is a $(N \times 1)$ vector of variables. $A_{i\,(i=1,\ldots,p)}$ are $(N \times N)$ fixed coefficient matrices, p is the order of the VAR model and u_t is a $(N \times 1)$ vector of VAR observed residuals with zero mean and covariance matrix $E(u_t u_t') = \sum_u$. The innovations of the reduced form model, u_t, can be expressed as a linear combination of the structural shock, ε_t, as in Breitung et al. (2004):

$$u_t = A^{-1} B \varepsilon_t \qquad (2)$$

where, B is a structural form parameter matrix. Substituting Eq. (1) into Eq. (2) and following minor operations, we get the following equation, which is the structural representation of our model:

$$AY_t = A_1^* Y_{t-1} + \ldots + A_p^* Y_{t-p} + B\varepsilon_t \qquad (3)$$

where $A^*_{j\,(j=1,\ldots,p)}$ is a $(N \times N)$ matrix of coefficients; $A_j = A^{-1} A^*_{j\,(j=1,\ldots,p)}$ and ε_t are a $(N \times 1)$ vector of unobserved structural shocks, with $\varepsilon_t \sim (0, I_k)$. The structural innovation is orthonormal; the structural covariance matrix, $\sum_\varepsilon = E(\varepsilon_t \varepsilon'_t{}')$, I_N is the identifying matrix. This model is known as the AB model, and is estimated in the form below:

$$Au_t = B\varepsilon_t \qquad (4)$$

The orthonormal innovations ε_t ensure the identifying restriction on A and B:

$$A \sum A' = BB' \qquad (5)$$

Both sides of the expression are symmetric, which means that $N(N+1)/2$ restrictions need to be imposed on $2N^2$ unknown elements in A and B. At least $2N^2 - N(N+1)/2$ additional identifying restrictions are needed to identify A and B. Considering the six endogenous variables that we

[3] Taghizadeh-Hesary and Yoshino (2014) used two monetary policy factors in their global crude oil model: real interest rate and the real effective exchange rate (REER). However, since in the second subperiod (August 2008–December 2013) the behavior of the Federal Reserve and other monetary authorities kept interest rates near zero, we added the money supply variable instead of the interest rate in our analysis.

have in our model: $M_t, X_t, P_{Gt}, P_{Ot}, P_{Qt}, Q_t$, which are money supply, exchange rate, natural gas price, crude oil price, CPI, and GDP, the errors of the reduced form VAR are: $u_t = u_t^M + u_t^X + u_t^{P_G} + u_t^{P_O} + u_t^{P_Q} + u_t^Q$. The structural disturbances, $\varepsilon_t^M, \varepsilon_t^X, \varepsilon_t^{P_G}, \varepsilon_t^{P_O}, \varepsilon_t^{P_Q}, \varepsilon_t^Q$, are money supply, exchange rate, natural gas price, crude oil price, CPI, and GDP shocks, respectively. This model has a total of 72 unknown elements, and a maximum number of 21 parameters can be identified in this system. Therefore, at least 51 additional identifiable restrictions are required to identify matrices A and B. The elements of the matrices that are estimated are assigned a_{rc}. All of the other values in the A and B matrices are held fixed at specific values. Since this model is over-identified, a formal likelihood ratio (LR) test is carried out in this case to test whether the identification is valid. The LR test is formulated with the null hypothesis that the identification is valid. Our system is of the following form:

Matrix A Matrix B

$$\begin{array}{c} \\ M_t \\ X_t \\ P_{Gt} \\ P_{Ot} \\ P_{Qt} \\ Q_t \end{array} \begin{array}{c} \begin{array}{cccccc} M_t & X_t & P_{Gt} & P_{Ot} & P_{Qt} & Q_t \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ 0 & a_{32} & 1 & 0 & 0 & 0 \\ 0 & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & 0 & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \end{array} \begin{bmatrix} u_t^M \\ u_t^X \\ u_t^{P_G} \\ u_t^{P_O} \\ u_t^{P_Q} \\ u_t^Q \end{bmatrix} = \begin{array}{c} \begin{array}{ccccc} M_t & X_t & P_{Gt} & P_{Ot} & P_{Qt} \end{array} \\ \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} \end{bmatrix} \end{array} \begin{bmatrix} \varepsilon_t^M \\ \varepsilon_t^X \\ \varepsilon_t^{P_G} \\ \varepsilon_t^{P_O} \\ \varepsilon_t^{P_Q} \\ \varepsilon_t^Q \end{bmatrix} \quad (6)$$

The first equation represents the money supply as an exogenous shock in the system.[4] The second row in the system specifies exchange rate responses to money supply shocks.[5] The third row represents natural gas real price responses to exchange rate shocks. The forth equation allows crude oil prices to respond contemporaneously to exchange rate and natural gas price shocks. The fifth equation exhibits CPI responses to money supply, exchange rate, and crude oil price shocks. The last equation depicts GDP as the most endogenous variable in this system. Money supply, exchange rate, natural gas price, crude oil price, and CPI are variables that have an impact on GDP (see, for example, Taghizadeh-Hesary and Yoshino 2013, Taghizadeh-Hesary et al. 2013). The main purpose of this paper is to measure and compare a_{54} and a_{64}, which are the impacts of crude oil prices on CPI and GDP for the PRC, Japan, and the US. In order to accomplish this, we need to run this system for each of these three countries separately.

[4] For more information about exogeneity tests in structural systems with monetary application, please see Revankar and Yoshino (1990)

[5] For the impact of money supply on the exchange rates, please see Yoshino, Kaji, and Asonuma (2012)

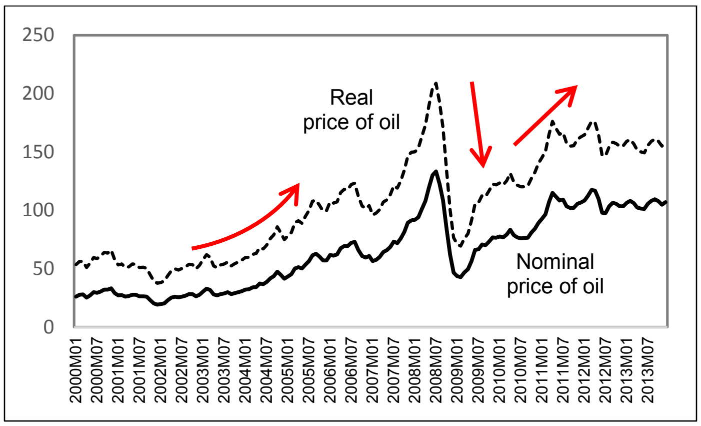
4. EMPIRICAL RESULTS

As mentioned earlier, the increase in oil prices that began in 2001, the sharp decline that followed the 2008 subprime mortgage crisis, and the immediate recovery that was experienced shortly after, have renewed interest in the effects of oil prices on the macroeconomy. For this reason, we selected a period that covers the significant fluctuations mentioned above. We ran regressions for our SVAR for each of these three countries during the two subperiods, January 2000–July 2008 and August 2008–December 2013, and compared the findings.

Figure 3 shows the crude oil price movements during the entire period covered by this paper. Following the financial crisis of 2007–2008, due to the decline in global demand for crude oil, prices dropped from $133.11 in July 2008 to below $42.01 in December 2008, and then started to increase again sharply.

Figure 3: Crude Oil Price Movements, January 2000–December 2013

($)



Note: Oil prices are a simple average of the Dubai crude oil prices in the Tokyo market; Brent crude oil prices in the London market; and WTI crude oil prices in the New York market. Real crude oil prices were obtained by deflating crude oil prices using the United States consumer price index (2005=100).

Source: The Energy Data and Modeling Center (EDMC) database of the Institute of Energy Economics, Japan (IEEJ) and International Financial Statistics (IFS) 2013.

In order to reach a more realistic analysis, we use all variables in real terms. Crude oil prices are obtained using a simple average of Dubai crude oil prices in the Tokyo market; Brent crude oil prices in the London market; and West Texas Intermediate (WTI) crude oil prices in the New York market, all in constant US dollars. Natural gas prices are in constant US dollars obtained using a simple average of three major natural gas prices: US Henry hub, United Kingdom National Balancing Point (NBP), and Japanese imported LNG average prices. The GDP of all three countries is in constant US dollars, at fixed purchasing power parity (PPP), and seasonally adjusted.[6] All of the three data series above were deflated by the US consumer price index (CPI), as most crude oil and natural gas markets are denominated in US dollars and the amount of GDP for each country was also in US dollars. For the exchange rate in PRC SVAR we used the yuan real effective exchange rate (REER), for Japan we used the yen REER, and for the US we used the US dollar REER (2005=100). As for the money supply, we used the M2 of the PRC, Japan and the US for each country's SVAR. From now on, whenever we refer to the price of crude oil, natural gas, or GDP, unless otherwise stated, we refer to their real values. The sources of the data are the International Energy agency (IEA) 2013, International Financial

[6] The original data was quarterly, but since our work file is on a monthly basis, we converted the data to monthly data and did exponential smoothing on the released data.

Statistics (IFS) 2013, the Energy Data and Modeling Center (EDMC) database of the Institute of Energy Economics, Japan (IEEJ), Monthly Energy Review of the US Department of Energy (DOE), and the Bank of Japan (BOJ) database.

In order to evaluate the stationarity of all series, we used an Augmented Dickey–Fuller test. The results found imply that, with the exception of US M2 and PRC GDP, which were stationary at the log level, all other variables are non-stationary at the log level. However, when we applied the unit root test to the first differences of the log-level variables, we were able to reject the null hypothesis of unit roots for each of the variables. These results suggest that the M2 of the PRC and Japan, the exchange rates of all three countries, Japanese and US GDP, crude oil prices, and natural gas price variables all contain unit roots. Once the unit root test was performed and it was discovered that the variables are non-stationary in level and stationary in first differences, they were integrated of order one. Hence they will appear in the SVAR model in first-differenced form. This means that instead of CPI we will have CPI growth rate or the inflation rate, and instead of GDP we will have the GDP growth rate. For other variables, we will have their growth rates in our regressions.

In order to test whether the identification is valid, the LR test was run for each country's SVAR. The LR test does not reject the under-identifying restrictions at the 5% level, implying that the identification is valid.

Table 1: Empirical Results

Country	January 2000–July 2008		August 2008–December 2013	
People's Republic of China	$-a_{64}^{CN}$ = - 0.26	S.E.= 0.07**	$-a_{64}^{CN}$ = -0.27	S.E.= 0.39
	$-a_{54}^{CN}$ = 0.02	S.E.= 0.02	$-a_{54}^{CN}$ = 0.02	S.E.= 0.02
Japan	$-a_{64}^{JP}$ = 0.03	S.E.= 0.005**	$-a_{64}^{JP}$ = -0.1	S.E.= 0.02**
	$-a_{54}^{JP}$ = 0.03	S.E.= 0.007**	$-a_{54}^{JP}$ = -0.01	S.E.= 0.007
United States	$-a_{64}^{US}$ = -0.06	S.E.= 0.002**	$-a_{64}^{US}$ = -0.01	S.E.= 0.01
	$-a_{54}^{US}$ = 0.07	S.E.= 0.002**	$-a_{54}^{US}$ = 0.03	S.E.= 0.01*

S.E. = standard error.

Note: $-a_{64}^{i}(i = CN, JP, US)$ shows the impact of oil price fluctuations on GDP growth; $-a_{54}^{i}(i = CN, JP, US)$ shows the impact of oil price fluctuations on CPI inflation; the z-statistic is obtained by $-a_{64}^{i}(i = CN, JP, US)/S.E.$ and $-a_{54}^{i}(i = CN, JP, US)/S.E$. To get an interpretation of the contemporaneous coefficients, the sign of A matrix is reversed; this follows from Eq. (13). * indicates significance at 5%, ** indicates significance at 1%.

Source: Authors' compilation.

The signs, sizes, and significance of the contemporaneous impacts of crude oil price movements on GDP growth rates and on CPI inflation rates deserve discussion because they have important policy and theoretical implications.

The PRC's elasticity of GDP growth rate and inflation rate to oil price movements did not change after the 2008 financial crisis. Before the crisis, the elasticity of the country's GDP growth rate and inflation rate to crude oil price changes was –0.26 (significant) and 0.02 (non-significant) respectively, and after the crisis they were –0.27(non-significant) and 0.02 (non-significant). The main cause for this is the appreciation of the yuan. Shortly after the sub-prime mortgage crisis, oil prices started to increase sharply. This happened because of a mild recovery in the global economy and huge quantitative easing policies of the US and other countries' monetary authorities (Yoshino and Taghizadeh-Hesary 2014). At the same time, the yuan appreciated compared to other currencies, meaning that the price of crude oil in the PRC's domestic market did not fluctuate much. The result is that both before and after the crisis, the impact of crude oil prices on the PRC's economy (GDP and inflation) was almost constant.

Japan's elasticity of GDP growth rate to oil price fluctuations became negative after the 2008 financial crisis, at –0.1 (significant). The reason for this is that since the Fukushima nuclear incident in March 2011, oil has remained the largest source of primary energy in Japan. The disaster made the country fully depended on the imports of fossil products, especially crude oil. Japan spent $250 billion on total fuel imports in 2012, a third of the country's total import charge. Our results show that during the second subperiod, August 2008–December 2013, an increase in the real growth rate of crude oil prices by 100 basis points would have reduced Japanese real GDP growth rate by 10%. Before the crisis, in the first sub-period, the elasticity of the Japanese GDP growth rate to crude oil price movements was positive, at 0.03 (significant). This is in line with Taghizadeh-Hesary et al. (2013), who found positive elasticity for Japanese GDP to crude oil prices during Q1 1990–Q4 2011. This positive elasticity exists due to several reasons, such as increased energy efficiency, accumulating huge strategic reserves of crude oil, declining crude oil demand stemming from structural factors like fuel substitution (use of nuclear electric power and natural gas), and population decline. Another reason is that in the first sub-period, although crude oil prices saw huge increases, because of the appreciation of the yen, resulting from accumulated foreign reserves in Japan, energy prices in the domestic market did not rise so much.

As for the elasticity of the Japanese CPI inflation to crude oil price growth rates, in the first subperiod the value was 0.03 (significant), but after the crisis it became negative (-0.01 non-significant). The reason for this negative impact on prices is that in Japan, aggregate supply is almost constant. Higher energy prices mainly affect the demand side of the economy. This is clearly evident in the second subperiod, shortly following the uncertain situation that occurred in the country after the Fukushima nuclear disaster. This uncertainty caused domestic consumption to shrink, resulting in price deflation.

The absolute value of the US elasticity of GDP growth rate to oil price growth rate was reduced following the 2008 financial crisis because of lower aggregate demand in the country, which was caused by the recession that the economy entered. Moreover, the impact of higher oil prices on inflation decreased in the second period because of lower aggregate demand.

The impact of oil price fluctuations on US and Japanese GDP is much milder than for the PRC. On the other hand, however, the PRC's CPI sees smoother rates of inflation in oil shocks compared to the US and Japan because of the higher growth rate its economy, which shifts the AS curve forward and avoids higher prices in oil shocks. In Japan's case, the AS curve has been almost constant recently, and in the US it is seeing only a small forward shift.

5. CONCLUSIONS

In this paper, we analyzed the impact of oil price fluctuations on two macro variables for two developed countries and one emerging country. The purpose is to compare these two groups' impacts and to see whether economies are still reactive to oil price fluctuations. For our analysis, we selected a period that includes the most recent financial crisis, the subprime mortgage crisis of 2007–2008. This means that we simultaneously compare these impacts in the period January 2000–July 2008 with the period following the crisis. August 2008– December 2013.

Our results show that the impact of oil price fluctuations on GDP growth rates in developed oil importers (US and Japan) is much milder than on an emerging economy's (PRC). An increase in the crude oil price growth rate by 100 basis points changes the PRC's GDP growth rate by –26% to 27%; the Japanese GDP growth rate by –10 to 3%, and the US GDP growth rate by –6 to –1%. The reasons for the difference between the impacts on these two groups are high fuel substitution (higher use of nuclear electric power, gas and renewables), a declining population (for the case of Japan), the shale gas revolution (for the US), greater strategic crude oil stocks and government-mandated energy efficiency targets in developed economies compared to emerging economies, which made them more resistant to oil shocks. On the other hand, the impact of higher crude oil prices on PRC CPI inflation is milder than in the two advanced economies. The reason for this is that a higher economic growth rate in the PRC results in a larger forward shift of aggregate supply, which avoids large increases in price levels after oil price shocks.

By comparing the results of these two subperiods, we conclude that in the second subperiod, the impact of oil price fluctuations on the US GDP growth rate and inflation rate was milder than in the first subperiod, because of lower crude oil and aggregate demand, resulting from a recession in the economy. For Japan, the second subperiod coincides with the Fukushima nuclear disaster that followed the massive earthquake and tsunami in March 2011, which raised the dependency on oil imports. Hence the elasticity of GDP growth to oil price fluctuations rose drastically. CPI elasticity reduced, however, because of diminished consumption due to uncertainty in the nation's future after the devastating disaster. The PRC's GDP growth and inflation rate elasticities to oil price fluctuations were almost constant in both subperiods. The main reason for this is the appreciation of the yuan. Shortly after the subprime mortgage crisis, oil prices started to increase sharply due to a mild recovery in the global economy and the huge quantitative easing policies of the US and monetary authorities in other countries. Simultaneously, the yuan appreciated compared to other currencies, meaning that the price of crude oil in the PRC's domestic market did not fluctuate as much. The result is that before and after the crisis, the impact of crude oil prices on the Chinese economy (GDP and Inflation) was almost constant.

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* The Asian Development Bank refers to China by the name People's Republic of China.