Discussion Paper Series

RIEB

Kobe University

DP2011-09

The impact of oil prices, real effective exchange rate and inflation on economic activity: Novel evidence for Vietnam*

Le Viet TRUNG

Nguyen Thi Thuy VINH

March 15, 2011

Research Institute for Economics and Business Administration

Kobe University

2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

The impact of oil prices, real effective exchange rate and inflation on economic activity: Novel evidence for Vietnam

Le Viet Trung

and

Nguyen Thi Thuy Vinh

Primary contact for the journal should be addressed to

Le Viet Trung

Address: Research Institute for Economics & Business Administration, Kobe University
2-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan

Phone: (81) 78 803 7031

Fax: (81) 78 803 7031

Email: trunglv@rieb-u.ac.jp

Nguyen Thi Thuy Vinh

Address: Graduate School of Economics, Kobe University
2-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan

Phone: (81) 90 6600 1310

Email: thuyvinh01@gmail.com

The impact of oil prices, real effective exchange rate and inflation on economic activity: Novel evidence for Vietnam

Abstract

The goal of this paper is to examine the impact of oil prices on Vietnam's economic activity using vector autoregressive (VAR) modeling and cointegration techniques. We use monthly data for the period 1995 – 2009 and include inflation and the real effective exchange rate as additional determinants of economic activity. We find evidence of a long-run relationship between oil prices, inflation, exchange rate, and economic activity. The results suggest that both oil prices and the real effective exchange rates have strongly significant impact on economic activity. An increase in oil price or depreciation may enhance economic activity. Vietnamese economic activity is influenced more by changes of value of Vietnamese currency than the fluctuations of oil prices. Inflation has a positive impact on economic activity however its impact is not highly significant. This suggests that moderate inflation is helpful rather than harmful to economic activity.

Keywords: Oil price, Economic activity, Vietnam
JEL Classification Number: E60, F41, O53, Q43, P20

1. Introduction

The Vietnamese economy, which for so long has been criticized for its heavy reliance on export of crude oil. The Vietnam's oil statistics show that the country has an estimated 2300 million tons of oil reserve. Vietnam exports about 16-18 million metric tons of crude oil per year, accounting for almost 20 percent of export earnings. Its contribution to GDP stands at about 18-20 percent and about 25-30 percent of government revenues per year. However, oil consumption in the country heavily relies on the import of refined petroleum products. Before 2009, the country imports almost all refined products for its local consumption. Vietnam opened its first oil refinery plant in February 2009. The refinery plant is designed to meet only about one-third of Vietnam's fuel demand. Thus, the country is still exposed to oil price shocks through massive importation of the refined petroleum products. As an oil exporter and importer of refined petroleum products, Vietnam is potentially vulnerable to oil price volatility.

The main purpose of this paper is to examine how Vietnamese economic activity is affected by changes in international oil prices. This paper applies vector autoregressive (VAR) modeling with cointegration techniques using monthly data for the period 1995:1 – 2009:3. We also consider the effect of inflation and real effective exchange rate on economic activity in the model. The Johansen cointegration test reveals one cointegrating equation using both the trace statistic and the maximum eigenvalue. Using the long-run vector coefficients we examine the sensitivity of economic activity in Vietnam to shock in international oil prices, inflation, and the real effective exchange rate. We find that oil prices and devaluation have strongly significant positive effect on economic activity. Inflation also has positive effect on economic activity. This suggests that depreciation and inflation are helpful rather than harmful to economic activity. Our findings show that Vietnam's economic activity increases more by depreciation of Vietnamese currency than oil prices or inflation increase.

There are several contributions of this study to the literature. First, Vietnam is an emerging country. Over the last 20 years, Vietnam's economic activity has grown rapidly. Despite the general recognition that oil plays as an important role in the Vietnamese economy, little research exists on the effects of oil prices on its macroeconomic dynamics. A study that examines the relationship between oil prices and economic activity through including the exchange rate and inflation variables will have direct relevance for policy. How these three variables affect the economic activity of an emerging economy will shed new light and will add to what is already known regarding the behaviour of emerging economy in responses to macroeconomic changes/shocks.

Second, although considerable empirical studies discover that oil price shocks have been an important source of economic fluctuation over the past three decades, most of the studies on the effect of oil prices are applied to the US case or OECD countries (e.g., Hamilton, 1983, 1988, 1996, 2000; Tatom, 1988; Mork, 1989, 1994; Kahn and Hampton, 1990; Hutchison, 1993; Hooker, 1996, 1999, 2002; Huntington, 1998; Lee et al., 2001; Rautava, 2004; Cunado and Gracia, 2005; Huang et al., 2005; Jin, 2008; Milani, 2009). Only few papers study the Asian developing countries. It is becoming more important to understand the macroeconomic behavior in Asian countries, as recognized by the 1997 crises and its impact on other economies. Hence, our study contributes to the literature on developing countries in general, and emerging markets (transitional market) likes Vietnam in particular.

Third, the relationship between oil prices, exchange rate, inflation and economic activity remains a controversial one in both theory and empirical findings. In a international context, oil prices may have a differential impact on each of the countries due to some different factors such as the sectoral composition, their differential tax structure and regulations or the country' s position as oil net importer or exporter. For instance, some studies suggest that the impact of oil price is only limited to the short-run (e.g., Cunado and Gracia, 2005) while the others suggest that the output is influenced significantly by fluctuations in oil price through both long-run and short-run (e.g., Rautava, 2004). As an oil importing country, an increase of world oil price should increase the production costs of the country, that retard its GDP growth, but this does not appear to be happening in the case of China (e.g., Du et al. 2010). Therefore, our findings may help to answer various questions which are still far from consensus in the literature.

Finally, in this study, we extend the modelling framework from a bivariate to a multivariate one by including two more variables, namely the real effective exchange rate and consumer price index variables. This is important, since in the applied economics literature it is argued that bivariate models give rise to omitted variable bias. It follows that our model is an advance over the ones used in the existing literature.

The remainder of this paper is organized as follows. Section 2 provides a literature review and theoretical background. Section 3 details the methodology for the study. Section 4 summarizes the main findings and discusses their implications, and Section 5 concludes our study.

2. Literature review and theoretical background

2.1. Impact of oil price on output

Oil price fluctuations receive important consideration for their presumed role on macroeconomic variables. Higher oil prices may reduce economic growth, generate stock exchange panics and produce inflation, which eventually lead to monetary and financial instability. It will also lead to higher interest rates and even a plunge into recession (McKillop, 2004). Sharp increase in the international oil prices is generally regarded as factors discouraging economic growth (Jin, 2008). Theoretically, there are different reasons why an oil price shock should affect macroeconomic variables. First, the oil price shock can lead to lower aggregate demand since the price rise redistributes income between the net oil import and export countries. Oil price spikes could curtail economic activity as a larger share of consumers' household incomes is diverted away from discretionary expenditures and toward energy consumption. Furthermore, the higher costs of production in many cases translated into higher prices for goods and services. Second, the supply side effects are related to the fact that crude oil is considered as a basic input to production process. A rise in the oil price reduces aggregate supply since higher energy prices mean that firms purchase less energy; consequently, the productivity of any given amount of capital and labor declines and potential output falls.

A large number of empirical studies have explored the relationship between oil price fluctuations and economic activity. From empirical point of view, oil price shocks are found to have significant effect on output. Hamilton (1983), the most influential article in the field, finds the existence of a negative relationship between oil prices and macroeconomic activity in the United States, indicating that a rise in oil price reduces output growth from 1948 to 1980. This result is confirmed by Hooker (1994) who shows that oil price variability exert influence on GDP growth between 1948 and 1972. Several authors introduce non-linear transformations into the models and Granger causality tests. Their findings confirm incidence of negative relationship between oil prices fluctuations and economic downturns as well as Granger causation from oil prices to growth before 1973, but oil prices fail to Granger cause macroeconomic variables when data sample is from 1973 to 1994 (e.g., Mork, 1989; Lee et al., 1995; Hamilton, 1996).

More recently, Lee and Ni (2002) analyze the effects of oil price shocks on demand and supply in various industries. They find that for industries that have a large cost share of oil, oil price shocks mainly reduce supply, but for other industries, oil price shocks mainly reduce demand. Huang et al. (2005) examine the effect of oil price change and its volatility on economic activities in the United States, Canada, and Japan. Their findings reveal that when oil price change and volatility exceed a threshold, they possess significant explanatory power for the outcome of economic variables such as industrial production and stock market returns. Milani (2009) estimates a structural general equilibrium model to investigate the changing relationship between the oil price and macroeconomic variables to fit the data on the United State using quarterly series for the 1960:1-2008:1 sample. His findings suggest that oil prices affect the economy through an additional channel, i.e., through their effect on the formation of agents' beliefs. The estimated learning dynamics indicates that economic agents' perceptions about the effects of oil prices on the economy have changed over time: oil prices were perceived to have large effects on output and inflation in the 1970s, but only milder effects after the mid-1980s.

Some recent comparative studies find evidence of the oil prices-macroeconomy relationship for some of the Asian countries. Cunado and Gracia (2005) find that oil prices have a significant effect on both economic activity and price indexes for some Asian countries (Japan, Singapore, South Korea, Malaysia, Thailand, and Philippines), although the impact is limited to the short-run and more significant when oil price shocks are defined in local currencies. They also find some differences among the responses of each of the Asian countries to oil price shocks. For example, the oil prices–macroeconomy relationship seems to be less significant for the case of Malaysia (the only oil-importing country in the sample) than for the rest of the economies.

Empirical results seem to suggest that the response of the oil-exporting countries may differ from that of oil importers. Jin (2008) finds that the oil price increase exerts a negative impact on economic growth in Japan and China and a positive impact on economic growth of Russia. This positive impact finding is similar with findings of Rautava (2004) for Russia and Aliyu (2009) for Nigeria. Du et al. (2010) investigate the relationship between the world oil price and China's macro-economy based on a monthly time series from 1995:1 to 2008:12, using the method of multivariate vector autoregression (VAR). The results show that the world oil price significantly affects the economic growth and inflation of China.

Only few studies investigate the impact of oil price shocks on Vietnam's macro-economy. Narayan and Narayan (2010) is the first study to model the impact of oil prices on Vietnam's stock prices using daily data for the period 2000–2008 and include the nominal exchange rate as an additional determinant of stock prices. They find that stock prices, oil prices and nominal exchange rates are cointegrated, and oil prices have a positive and significant impact on stock prices.

2.2. Impact of exchange rate on output

Traditional views such as the elasticities, absorption, and the Keynesian approaches assert that devaluation has positive effect on output. The elasticities approach states that devaluation will improve trade balance as long as the Marshall Lerner condition is satisfied. According to the absorption approach, through its expenditure switching and expenditure reducing effects, a devaluation will generate an increase in real output (Guitian, 1976; Dornbusch, 1988). The Keynesian approach, in which output is assumed to be demand determined and the economy operates below its potential – full employment condition – states that devaluation will have a positive impact on output and employment. The monetary approach, however, argues that exchange rate changes influence real magnitudes mainly through the real balance effect in the short-run but leave all variables unchanged in the long-run (Domac, 1997). While the traditional view indicates that currency depreciation is expansionary, other theoretical developments stress some negative effects, including the differ in the marginal propensity to save from profit and wages, nominal rigidities in the economy, balance-sheet effects, capital account problems, weakening confidence, and associated economic policies (Krugman and Taylor, 1978; Domac, 1997; Kamin and Rogers, 2000; Berument and Pasaogullari, 2003). Kandil (2004) introduces a macroeconomic model that incorporates exchange rate fluctuation. This model theoretically demonstrates that the effect of real depreciation is contractionary via the effect of the supply side. However, the effects on demand side make the final outcome inconclusive.

As for the effort of studying the impact of real exchange rate on output, some econometric studies use pooled time-series cross-country data with a large sample of countries. The empirical results are quite mixed. For instance, while Nunnenkamp and Schweickert (1990) survey forty-eight developed countries from 1982-1987 and reject the hypothesis of contractionary devaluation, Sheehey (1986) analyzes sixteen Latin American countries and find that devaluations have a negative impact on output. Contractionary effects of devaluation that slow output growth also appear in the majority of twenty-two developing countries under the investigation by Kandil (2004). Edwards (1986) uses annual data for twelve developing countries for the period 1965-1980, on the other hand, concludes that devaluations have a negative impact on output in the short-run, however, they are neutral in the long-run. Using an error correction technique for investigating the effect of change in real exchange rate on output, Kamin and Klau (1998) estimate a regression linking the output to the real exchange rate for a group of twenty-seven countries and assert the same conclusion. This study does not find that devaluations are contractionary in the long-run.

To examine the effect of changes in the real exchange rate on output of a single country, Terence and Pentecost (2001) use a conditional error correction model for four central and eastern European emerging market economies. The reduced form estimation results show that devaluation is neutral in its effect on the long-run level of GDP in the Czech Republic and Hungary, but that a real appreciation leads to a persistent fall in output in Poland and a sustained rise in output in Slovakia. Rogers and Wang (1995) estimate a five-variable VAR (output, government spending, inflation, real exchange rate, and money growth) for Mexico. They find that most of the variation in Mexican output is attributable to its "own shocks," but devaluations lead to decline in output. Adopting the same methodology, Copelman and Werner (1996) report that positive shocks to the rate of exchange rate depreciation significantly reduce credit availability with a negative impact on the Mexican output. Surprisingly, they find that shock to the level of the real exchange rate has no effect on output. Vo et al. (2000) examine impact of real exchange rate on output in Vietnam by using monthly data for the period 1992-1999. They find that a real depreciation rate has a positive and significant impact on output growth, though the magnitude is very unstable. More recent study by Rautava (2004) finds that a 10 percent real appreciation (depreciation) of the ruble is associated with a 2.7 percent decrease (increase) in the level of GDP in the long-run in Russia. Jin (2008) discovers that an appreciation of the real exchange rate leads to a positive GDP growth in Russia and a negative GDP growth in Japan and China. Aliyu (2009) finds that the 10 percent appreciation in the level of real exchange rate only increases real GDP by 0.35 percent in Nigeria.

2.3. Impact of inflation on output

The issue on relationship between inflation and growth has generated an enduring debate between *structuralists* and *monetarists*. The structuralists believe that inflation is essential for economic growth. In contrast, the monetarists see inflation as detrimental to economic progress. There are two aspects to this debate: the first is the nature of the relationship if one exists and the second is the direction of causality. The inconclusive nature of the relationship between inflation and economic growth is succinctly summarized by Friedman (1973) as follows: "historically, all possible combinations have occurred: inflation with and without development, no inflation with and without development."

It is now widely accepted that inflation has a negative effect on economic growth. However, this negative effect was not detected in data from the 1950s and the 1960s. Based on those data, the view that prevailed in the economic studies was that the effect of inflation on growth was not particularly important. Until the 1970s, many studies found this effect to be nonsignificant, and in fact some found it to be positive. However, in general there have been, at best, mixed empirical studies presented, as to their precise relationship (e.g., Wai, 1959; Dorrance, 1963, 1966; Bhatia, 1960; Pazos, 1972; Galbis, 1979). The change in view came only after many countries experienced severe crises of high and persistent inflation in the 1970s and the 1980s. These high-inflation crises were usually associated with a general decline in the macroeconomic performance and with balance of payments crisis. As more data became available on these episodes, studies repeatedly confirm that inflation has a negative effect on economic growth. There are many studies that find support for negative effect on economic growth (e.g., Fischer, 1993; De Gregorio, 1991; Barro, 1996).

However, study by Levine and Zervos (1993) suggests that inflation was not a robust determinant of economic growth. Inflation's significance declined, as other conditioning variables are included. Paul et al. (1997) involving 70 countries (of which 48 are developing economies) for the period 1960-1989 find no causal relationship between inflation and economic growth in 40 percent of the countries; they report bidirectional causality in about 20 percent of countries and a unidirectional (either inflation to growth or vice versa) relationship in the rest. More interestingly, the relationship is found to be positive in some cases, but negative in others. Recent work by

Mallik and Chowdhury (2001) find evidence of a long-run positive relationship between GDP growth rate and inflation for all four Asian countries (i.e., Bangladesh, India, Pakistan, and Sri Lanka). The other cross-country studies (e.g., Sarel, 1996; Khan and Senhadji, 2001) mainly focus on the nonlinearities and threshold effects of inflation on growth. Khan and Senhadji (2001) estimate the threshold level of inflation by using a balanced panel that averages time-series data over nonoverlapping half decades. They estimate the threshold level of inflation, above which inflation significantly slows growth, to be between 0.89 percent and 1.11 percent for industrialized countries, and between 10.62 percent and 11.38 percent for developing countries.

3. Research methodology

Beside oil price, exchange rate, and inflation, there are a large number of macroeconomic variables which affect economic activity and may equally be considered such as investment, consumption and government expenditure, trade, foreign direct investment, and so forth. Including these variables into the specification increases the fit of the model, but also decreases the degrees of freedom. For this reason the model is restricted to only the three chosen variables. The economic activity is, therefore, regressed against the international oil price, consumer price index, and the real effective exchange rate. In this paper, the economic activity is proxied by industrial production index.

We use a measure of real effective exchange rate where bilateral exchange rates are weighed for their relative trade share. The real effective exchange rate index is defined in foreign currency term (an increase in its value indicates an appreciation of Vietnamese currency) and is estimated by the geometric mean method as per the following formulate:

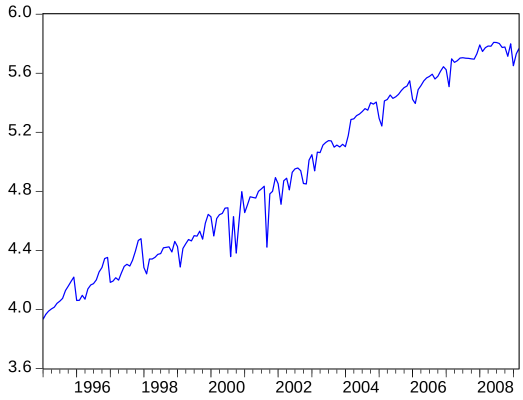
$$reer_t = \prod_{j=1}^{n} (e_{jt} \frac{P_t}{P_{jt}})^{w_{jt}} \qquad (3.1)$$

where $reer_t$ is the real effective exchange rate of Vietnam at time *t*; n is the number of trading-partner currencies in the trade basket; e_{jt} is the nominal bilateral exchange rate relative to currency *j*, measured as the number of units of currency *j* per unit of the domestic currency, and express as an index; w_{jt} is the weight assigned to currency *j* at time *t*, reflecting the contribution of the country of currency *j* to the Vietnam's foreign trade; P_t is the domestic price index at time *t* and P_{jt} is the price index of foreign country *j* at time *t*. The currency basket includes the twenty largest trading partners during the last 20 years: Japan, Singapore, China, US, Korean, Australia, Thailand, Germany, Hong Kong, Malaysia, France, Indonesia, UK, Netherland, Philippine, Italy, Switzerland, India, Spain, and Canada. Each selected trading partner accounted for at least 0.5 percent of Vietnam's total foreign trade during the last ten years. The basket covered about 80 percent of this total trade in every year since 1998. The trade weights are re-calculated annually.

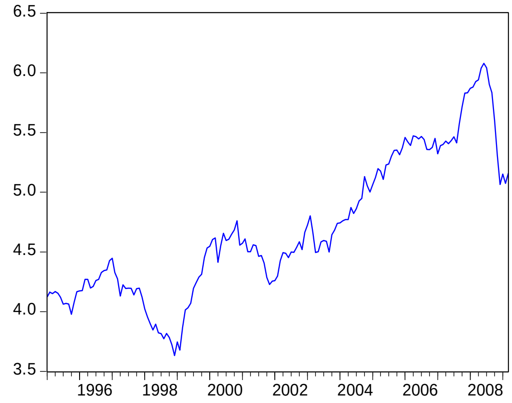
Monthly data from January of 1995 to March of 2009 is used for all variables in the country. Data of industrial production index is obtained from the Vietnam General Office Statistics (GSO). The world oil price is US dollar-basic oil price index that is an average of three spot price indices of Texas, U.K. Brent and Dubai and is taken from IMF International Financial Statistics (IFS). The real effective exchange rate and consumer price index are calculated or collected from the data base of IMF International Financial Statistics (IFS) and Direction of Trade Statistics (DOT).

The indices are created with the base index value of 100 in 2000. The analysis converts all variables into logarithmic form. Seasonal adjusted data are used for all variables to restrict the size of the model, i.e. no seasonal dummies are included. We consider real industrial production index (*lio*), consumer price index (*lcpi*), the real effective exchange rate (*lreer*), and the price of crude oil (*loil*). Plot of data series are provided in Figure 1. The observation from these data series suggests the existence of strong links among them.

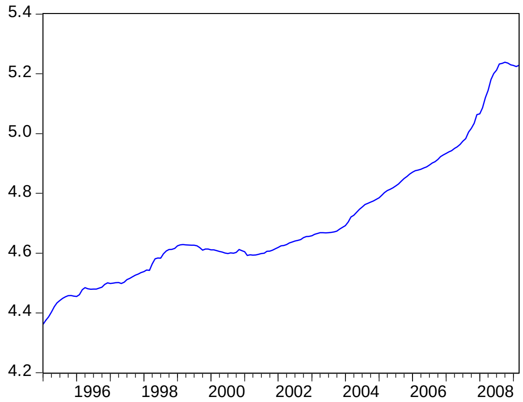
Figure 1. Vietnamese industrial production index, oil price, CPI, and real effective exchange rate



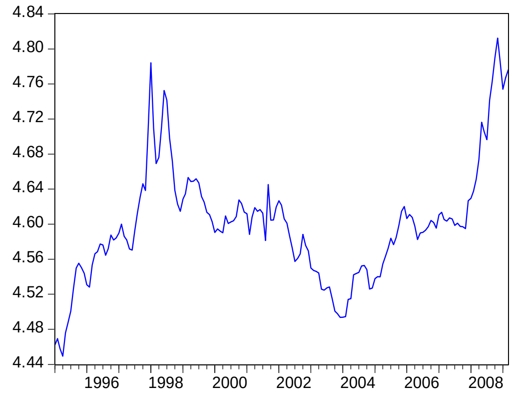
Industrial production index (*lio*)



Oil price index (*loil*)



CPI index (*lcpi*)



Real effective exchange rate (*lreer*)

The estimation strategy is as follows. First, we check for stationarity in each variable. Second, we analyze whether a long-run relation exists among the series by testing for cointegration among variables. Third, we study the short-run dynamic behavior between oil prices, real effective exchange rate, inflation, and economic activity.

The motivation for unit root testing and cointegration analysis arises from two key observations. First, the risk of spurious correlation precludes the study of long-run relationships among levels of non-stationary variables using ordinary estimation methods. Second, using only first differences of the variables, i.e. stationary I(0) series, runs the risk of losing relevant information. Thus, unit root tests are necessary to examine the time-series properties of the variables. If the series are found to be integrated of the same order, cointegration techniques should be applied to study the possible long-run dependencies among the variables, which are essential to understand the actual behavior of the variables. Economically speaking, cointegration of two variables indicates a long-term or equilibrium relationship between them, given by their stationary linear combination (called the cointegrating equation).

In this paper, the Augmented Dickey Fuller (ADF) test and the Dickey and Fuller generalized least squares (DF-GLS) test are employed to test for stationarity of the series to confirm the integrational properties of the data series in their levels and first differences. Most of lag length are determined by using Akaike Information Criteria (AIC). The null hypothesis in the ADF and DF-GLS tests is that the series is non-stationary or has a unit root. The series is stationary if the null hypothesis is rejected. If the series is not stationary in level but stationary in first difference, then it is said to be integrated of order one, I(1).

Since the main objective of this paper is to assess the short-run and long-run relationship among the variables, we apply two well-known approaches: the one developed by Engle and Granger (1987) and the other one by Johansen (1988) and Johansen and Juselius (1990). In addition, error correction model (ECM) was applied to see whether an economy is converging towards equilibrium in the long-run or not. The ECM also shows short-run dynamics.

The Engle–Granger test is a procedure that involves an OLS estimation of a pre-specified cointegrating regression between the variables. This was followed by a unit root test performed on the regression residuals previously identified. We applied the Engle-Granger two-step procedure by estimating equation (3.2) using OLS and then testing the level of stationarity of the residual term.

$$lio_t = \alpha_0 + \beta_1 loil_t + \beta_2 lcpi_t + \beta_3 lreer_t + \varepsilon_t \qquad (3.2)$$

Equation (3.2) shows that lio_t, which is the log of industrial production index is a linear function of $loil_t$ that is, log of oil price, $lcpi_t$, that is, log of CPI, and $lreer_t$, that is, log of real effective exchange rate. ε_t is the error term. The null hypothesis of no cointegration is rejected if it is found that the regression residuals are stationary at level. This procedure has some weaknesses, as the test is sensitive to which variable is used as a conditioning left-hand-side variable, which is problematic in the case of more than two variables.

There are few other techniques for testing for and estimating cointegrating relationships in the literature. Of these techniques, the Johansen (1988) and Johansen and Juselius (1990) maximum-likelihood test procedure is the most efficient as it tests for the existence of a cointegrating vector. Given that it is possible to have multiple long-run equilibrium relationship between economic activity and its proposed determinants, the technique described by Johansen allows one to determine the number of statistically significant long-run relationships. The Johansen approach to cointegration is based on a VAR model. The vector autoregression model of order *p* (VAR (*p*)) is constructed as a following equation.

$$\Delta y_t = \Phi_0 + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \qquad (3.3)$$

where y_t is a (4×1) vector of *lio*, *loil*, *lcpi,* and *lreer*. Φ_0 is the (4×1) intercept vector and ε_t is a vector white noise process. Γ_i denotes an (4×4) matrix of coefficients and contains information regarding the short-run relationships among the variables. The matrix Π conveys the long-run information contained in the data. If the rank of Π is r, where $r \leq n-1$, then Π can be decomposed into two $n\times r$ matrices α and β such that $\Pi = \alpha\beta'$ and β is the matrix of cointegrating vectors; the elements of α are known as the adjustment parameters in the vector error correction model. The Johansen-Juselius procedure is based on the maximum likelihood estimation in a VAR model, and calculates two statistics – the trace statistic and the maximum eigenvalue – in order to test for the presence of r cointegrating vectors. The trace test examines the null hypothesis that the number of cointegrating vectors in the system r, is less than or equal to r_0 where $r_0 < p$ and p is the number of variables in the system, whereas the alternative hypothesis is that the impact matrix is of a full rank. The maximum eigenvalue statistic also tests for r_0 cointegrating vectors against the hypothesis of r_0+1 cointegrating vectors.

In addition, in this paper, we also apply the dynamic ordinary least square procedure in order to check the results of long-run relationship.

4. Results and discussion

4.1. Unit root tests

As a first step in the empirical analysis, we perform unit root tests to confirm the integrational properties of the data series for all of the variables: oil prices, CPI, exchange rate, and economic activity. Table 1 shows the results of unit root tests for each of the variables.

Table 1. Unit root tests

Variable	*Level*				*First different*			
	ADF		*DF-GLS*		*ADF*		*DF-GLS*	
	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)
lio	0.04	-1.17	3.89	-0.82	-5.12***	-5.09***	-4.54***	-4.47***
loil	-1.13	-2.96	-0.42	-2.48	-4.79***	-4.76***	-3.42***	-4.25***
lcpi	0.50	-1.28	1.78	-1.63	-3.35***	-3.49**	-2.86***	-3.65***
lrer	-1.44	-1.55	0.41	-1.29	-10.21***	-10.18***	-8.84***	-9.78***

Notes. (i): with an intercept; (ii): with an intercept and a linear time trend. The number of the lags included was determined using the Akaike Information Criteria (AIC).

***and ** denote statistical significance at the 1% level and 5% level, respectively.

The results in Table 1 allow us to conclude that all the series are non-stationary at level under all tests. Taking the variables in their first difference, the results show that all are I(1) at the 1 percent level of significance. Therefore, oil prices, CPI, real effective exchange rate, and economic activity may be considered integrated of order one variables (i.e., the variables must be differenced once to be become stationary). The implication of this finding is that we can examine evidence for any possible cointegration (long-run) relationship between economic activity, oil prices, CPI, and exchange rate for Vietnam.

4.2. Long-run analysis: Cointegration tests

Having established the order of integration of our series in the preceding section, the next task is to determine the number of long-run equilibrium relationships or cointegrating vectors among the variables. Note that when series are found to be integrated of the same order, such as I(1) as in this case, it implies that an equilibrium relationship exists among the variables i.e., this could be that even though these variables are individually I(1), the combination of them is I(0). Since the main focus of the paper is to assess how economic activity in the long-run reacts to changes in oil price, CPI, and real effective exchange rate, we conduct a cointegration test in line with the Johansen test to determine the cointegrating rank, i.e., the number of cointegration vectors among variables.

Starting with twelve lags, the VAR system is reduced to a third-order VAR, i.e., three lags are used in the final estimation. Reduction is based on AIC information. After this specification, we proceed to examine whether stable long-run dependencies exist among the variables, i.e., whether the variables are cointegrated. Table 2 presents the test results for the number of cointegrating vectors i.e., β-vector. The results show that both the trace statistic and the maximum eigenvalue suggest the presence of one cointegrating equation among the four variables in the Vietnam economy at the 5% level. This unveils the existence of a long-run equilibrium relationship between economic activity and the variables used in the model. The next stage involves obtaining the long-run coefficients of the model using the Johansen procedure. Table 3 presents the normalized *(β)* of the variables in the model.

Table 2. Tests for the number of cointegration vectors

Rank	*Trace test*	*Max test*
None *	52.33**	33.83***
At most 1	18.50	14.24
At most 2	4.26	4.22
At most 3	0.05	0.05

Notes. The number of the lags included was determined using the Akaike Information Criteria (AIC).
*** and ** denote statistical significance at the 1% level and 5% level, respectively.

Table 3. Restricted cointegration estimation: long-run equations

β-coefficient	*Johansen procedure*		*Engle-Granger procedure*		*Dynamic OLS*	
	Equation	*Standard error*	*Equation*	*Standard error*	*Equation*	*Standard error*
lio	1.000		1.000		1.000	
loil	-0.181***	0.04431	-0.080***	0.02711	-0.137***	0.03802
lcpi	-0.373*	0.20241	-0.218*	0.12481	-0.220	0.15995
lreer	1.078***	0.25873	0.554***	0.14549	.880***	0.20181
trend	-0.009***	0.00065	-0.010***	0.00041	-0.010***	0.00050
constant	-6.059		-4.724***	0.45525	-5.969***	0.59933

Notes. The unit root tests have been carried out for the residuals of the dependent valuables estimated from the Engle-Granger (1987) two-step cointegration procedure and that from the Dynamic OLS model and in all cases we rejected the null hypothesis of unit root at the 1% level.
*** and * denote statistical significance at the 1% level and 10% level, respectively.

Thus, we can derive the cointegrating equation from the above results – with log of economic activity as the regressand while log of oil price, log of CPI and log of real exchange rate as regressors, as follows:

$$lio = 6.059 + 0.009 * trend + 0.181 * loil + 0.373 * lcpi - 1.078 * lreer \qquad (4.1)$$

Looking the significance level of the coefficients and their respective signs, the cointegrating equation (4.1) shows that a 10 percent permanent increase in the level of international crude oil prices will cause the level of economic activity to increase by 1.81 percent. Similarly, a permanent 10 percent increase in the level of CPI is associated with a 3.7 percent increase in economic activity. Regarding real effective exchange rate, a permanent 10 percent appreciation (depreciation) in the level of real exchange rate largely reduces (increases) economic activity by 10.78 percent.

All of the diagnostic tests support its inclusion of trend in the basic VAR and the long-run equation of economic activity. Thus, the trend can be interpreted as capturing the impact of Vietnam's modernization process, which involves the introduction of market reforms and the opening up of the economy. Assuming fixed oil prices, CPI and the real exchange rate, the parameter value of the trend variable, i.e., 0.009 per month, indicates that the underlying annual long-run growth rate of Vietnamese economic activity (i.e., industrial output) is about 10.8 percent.

From the point of view of income and output effect of oil price increase, higher oil price transfers income from oil importing countries to oil exporting countries and this results in improvements in the terms of trade and balance of payments position and hence accretion to foreign reserve. Hence the positive sign of the oil price variable is as expected. The output effect, all things being equal, is also expected to be positive for oil exporting countries largely because the scale of income transfer is enormous. In addition, although the Vietnamese economy relies so much on importation of refined petroleum products, both wholesale and retail prices of petroleum products are still controlled by the government. Therefore, the correlations between petroleum product prices and world oil market are still very low. Thus the coefficient of oil prices bears positive sign.

From the perspective of exchange rate depreciation, it is generally recognized that such would encourage exports and reduce imports. Therefore, the negative sign of the coefficient of real effective exchange rate is reasonable. Vietnam's economy relies heavily on exports of commodities, like rice, crude oil, and textiles. The weak Vietnamese dong could bring a competitive advantage for Vietnam's export and this could have positive effect on real GDP growth. The fact is that Vietnamese industries are highly imported dependent. Trade deficit is widened and the devaluation for the Vietnamese dong may allow the currency to weaken and help reduce the trade deficit.

Regarding the consumer price index (CPI), it is generally recognized that higher inflation would have a negative effect on economic activity. Therefore, the positive sign of the coefficient of CPI reported in equation (4.1) seems unreasonable. However, similar finding is reported by Mallik and Chowdhury (2001) for four South Asian countries (i.e., Bangladesh, India, Pakistan, and Sri Lanka). Recent study by Khan and Senhadji (2001) estimate the threshold level of inflation, above which inflation significantly slows growth, to be between 10.62 percent and 11.38 percent for developing countries. Vietnam is a developing country and over the past decade its economy grew at one of the highest rates in the world. Inflation was held relatively low in single digits after 1995, except 2008. Therefore, a moderate increase in inflation may be helpful rather than harmful to economic growth.

We also obtain the long-run relationship using the Engle-Granger (1987) two-step cointegration procedure (i.e., OLS procedure) and the Dynamic OLS model. The results are also reported in Table 3. We can derive the long-run equations from the Engle-Granger procedure and the Dynamic OLS model as follows.

$$lio = 4.724 + 0.010 * trend + 0.080 * loil + 0.218 * lcpi - 1.554 * lreer \quad (4.2)$$

$$lio = 5.969 + 0.010 * trend + 0.137 * loil + 0.220 * lcpi - 0.880 * lreer \quad (4.3)$$

The results from these two models show that the statistical significance and signs of oil price and real effective exchange rate variables do not change. Although the sign of the coefficient of the CPI does not change, it is statistically insignificant in the long-run even at the 10% level in the Dynamic OLS model. The other feature of the results when we compare the sizes of the coefficients in the three long-run equations in Table 3 is that while the sizes of the coefficients are somewhat different their order of sizes is the same i.e., the real effective exchange rate has the largest coefficient, followed by CPI, and oil price has the lowest coefficient. This shows that at the 1% significance level, Vietnam's economic activity increases more by exchange rate depreciation than oil price increase. This suggests that the impact of the internal and domestic factors were more dominant than the oil price on the Vietnam's economic activity. However, at the 5% significance level, CPI has no impact on economic activity in all three models.

4.3. Short-run analysis: an Error-Correction Model

To examine short-run fluctuations in the Vietnamese economic activity and the effects of oil prices, CPI and the real effective exchange rate on these fluctuations, we use an error-correction model. Of particular interest is whether the short-run dynamics are influenced by the estimated long-run equilibrium conditions, i.e., the cointegration vectors. In practice, we investigate if the coefficient of the error-correction terms implied by cointegration vectors for economic activity in the respective short-run equations is *negative* and *significant*. This coefficient also measures the speed of adjustment of economic activity to its equilibrium level.

We also discover the short-run dynamics for all previous three models: The Johansen procedure, the Engle-Granger procedure (Ordinary least square - OLS), and the Dynamic OLS procedure (DOLS). To investigate the effect of the 1997 Asian financial crisis on economic activity, we introduce a dummy variable (denoted *D97*) to represent the turmoil from 1997 August to 1999 July. The results from the ECM are reported in Table 4.

Table 4. Short-run Error Correction Model (ECM)

Variables	*Johansen procedure*		*Engle-Granger procedure*		*Dynamic OLS*	
	Coefficient	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*
EC term	-0.580***	0.10501	-0.577***	0.10202	-0.490***	0.09251
△lio(-1)	-0.052	0.09898	-0.053	0.09762	-0.111	0.09399
△lio(-2)	0.002	0.08208	0.014	0.08243	-0.020	0.08137
△loil	0.079	0.07377	0.037	0.07261	0.018	0.07324
△loil(-1)	0.016	0.07233	0.041	0.07189	0.027	0.07270
△loil(-2)	-0.011	0.07204	-0.002	0.07175	-0.020	0.07257
△lcpi	-1.267	1.13358	-0.213	1.12252	0.109	1.13919
△lcpi(-1)	0.608	1.20841	1.446	1.18686	1.705	1.19799
△lcpi(-2)	-1.077	1.11710	-0.335	1.10443	0.050	1.11822
△lreer	-0.934***	0.33627	-0.787**	0.33441	-0.803**	0.33787
△lreer(-1)	0.273	0.34834	0.156	0.34362	0.087	0.34608
△lreer(-2)	0.361	0.35557	0.346	0.35337	0.251	0.35464
Constant	0.012	0.00762	0.004	0.00782	0.033***	0.00836
D97	0.090***	0.02594	0.026	0.01923	0.004	0.01840
R-squared	0.354		0.359		0.346	
Adjusted R-squared	0.301		0.306		0.291	
Durbin-Watson stat	2.054		2.023		2.019	
F-statistic	6.588		6.733		6.348	

Notes. The lag length is selected using the Akaike Information Criteria (AIC).

*** and ** denote statistical significance at the 1% level and 5% level respectively.

We find that in the short-run neither the oil prices nor the consumer price index is statistically significant. The movements of exchange rate, however, do affect the economic activity. The dummy variable (*D97*) is statistically significant in the Johansen procedure but not significant in the Engle-Granger procedure and the dynamic OLS procedure. The positive coefficient of *D97* is inconsistent with our expectation. The possible reason is that in our sample the economic activity is proxied by industrial production index not by GDP growth. In fact, Vietnamese industrial sector is not strongly affected by the Asian financial crisis.

The one period lagged error correction term (*EC term*) is statistically significant and correctly signed at the 1% level. This implies that there is indeed a long-run relationship among economic activity, oil prices, CPI, and real effective exchange rates. A value of -0.58 for the coefficient of error correction term in the Johansen model (-0.577 in the OLS and -0.49 in the DOLS) suggests that Vietnamese economy will converge towards its long-run equilibrium level in a fairly high speed after an oil price shock or a fluctuation of the CPI or exchange rate. Eliminating, for instance, 99% of a shock to the oil price or CPI or real exchange rate would take about six months.[1]

5. Conclusions

In this paper, we use cointegration and error correction models to examine long-run and short-run dynamics of the relationship between economic activity and oil price for Vietnam. We examine this relationship by including the real effective exchange rate and inflation as additional determinants of economic activity. Our empirical analysis is based on monthly data for the period 1995-2009.

Amongst our main results, we find that economic activity, oil prices, inflation and real effective exchange rates are cointegrated; that is they share a long-run relationship. The Johansen cointegration test revealed one cointegrating equation at the 5% level using both the trace statistic and the maximum eigenvalue. We find that oil prices, devaluation and CPI have significant positive effect on economic activity. More precisely, over the long run, a 10 percent permanent increase (decrease) in international oil prices is associated with a 1.81 percent growth (decline) of economic activity. Similarly, a permanent 10 percent increase (decrease) in the level of CPI is associated with a 3.7 percent increase (decrease) in economic activity. In addition, a 10 percent real appreciation (depreciation) of the Vietnam dong is associated with a 10.8 percent decrease (increase) of economic activity in the long-run. This suggests that Vietnam's economic activity is affected more by depreciation of Vietnamese currency than an increase in oil prices or inflation.

Our findings have important policy implications and suggest that restraining the real appreciation of the Vietnamese currency may help support competitiveness and output growth. This supports for the current policies carried out by Vietnamese government on devaluation. In addition, contrary to the policy advice of the international lending agencies, attempts to reduce inflation to a very low level (or zero) are likely to adversely affect economic growth. Our findings suggest that moderate inflation is helpful to economic activity.

We also estimate long-run relationship using the ordinary least squares (OLS–the Engle-Granger procedure) and the dynamic OLS procedures. The results from these two procedures are consistent with the findings from the Johansen procedure in term of the signs of the coefficients, the order of sizes of effect (i.e., exchange rates have a largest coefficient, followed by CPI and oil prices respectively). However, the coefficient of CPI is only statistically significant in the long-run at the 10% level in the Johansen procedure model and OLS model, but it is not statistically significant even at the 10% level in the dynamic OLS procedure. Thus, our findings on the coefficient of CPI should be treated with caution.

Finally, we investigate the short-run dynamics and find that the coefficient of error term is correctly signed and statistically significant. This implies that long-run equilibrium condition influences the short-run dynamics. Real economy activity in Vietnam has an automatic adjustment mechanism and that the economy responds to deviations from equilibrium in a balancing manner.

References

Aliyu, S.U.R., 2009. Impact of oil price shock and exchange rate volatility on economic growth in Nigeria: an empirical investigation. Research Journal of International Studies 11 (July), 4-15.

Barro, R., 1996. Inflation and growth. Federal Reserve Bank of St. Louis Review 78 (3), 153-169.

Berument, H., Pasaogullari, M., 2003, Effects of the real exchange rate on output and inflation: evidence from Turkey. The Developing Economies 41 (4), 401-435.

Bhatia, R.J., 1960. Inflation, deflation, and economic development. IMF Staff Papers 8 (November), 101-14.

Copelman, M., Werner A.M., 1996. The monetary transmission mechanism in Mexico. International Finance Discussion Papers No 521, Board of Governors of the Federal Reserve System (U.S.).

Cunado, J., Gracia F.P., 2005. Oil prices, economic activity and inflation: evidence for some Asian countries. The Quarterly Review of Economics and Finance 45 (1), 65–83.

De Gregorio, J., 1991. The effects of inflation on economic growth: lessons from Latin America. IMF Working Paper WP/91.

Domac, I., 1997. Are devaluations contractionary? Evidence from Turkey. Journal of Economic Development 22 (2), 145-163.

Dornbusch, R., 1988. Open Economy Macroeconomics, 2 ed. New York.

Dorrance, G.S., 1963. The effect of inflation on economic development. IMF Staff Papers 10 (March), 1-47.

Dorrance, G.S., 1966. Inflation and growth. IMF Staff Papers 13 (March), 82-102.

Du, L., He, Y., Wei, C., 2010. The relationship between oil price shocks and China's macro-economy: An empirical analysis. Energy Policy 38 (8), 4142–4151.

Edwards, S., 1986. Are devaluations contractionary?. The Review of Economics and Statistics 68 (3), 501–508.

Engle, R.F., Granger, C.W.J., 1987. Co-integration and error correction: representation, estimation and testing. Econometrica 55 (2), 251-276.

Friedman, M., 1973. Money and Economic Development. Toronto: Lexington Books.

Fischer, S., 1993. The role of macroeconomic factors in economic growth. Journal of Monetary Economics 32 (3), 485-512.

Galbis, V., 1979. Money, investment and growth in Latin America, 1961-73. Economic Development and Cultural Change 27 (3), 423-43.

Guitian, M., 1976. The effects of changes in the exchange rate on output, prices, and the balance of payments. Journal of International Economics 6 (1), 65-74.

Hamilton, J., 1983. Oil and the macroeconomy since World War II. Journal of Political Economy 91 (2), 593–617.

Hamilton, J., 1988. A neoclassical model of unemployment and the business cycle. Journal of Political Economy 96 (3), 593–617.

Hamilton, J., 1996. This is what happened to the oil price–macroeconomy relationship?. Journal of Monetary Economy 38 (2), 215–220.

Hamilton, J., 2000. What is an oil shock?. NBER working paper 7755.

Hooker, M.A., 1994. What happened to the oil price-macroeconomy. Journal of Econometrics 31 (3), 307-27.

Hooker, M.A., 1996. What happened to the oil price–macroeconomy relationship?. Journal of Monetary Economics 38 (2), 195–213.

Hooker, M.A., 1999. Oil and the macroeconomy revisited [mimeo]. Federal Reserve Board.

Hooker, M.A., 2002. Are oil shocks inflationary? Asymmetric and nonlinear specifications versus change in regime. Journal of Money, Credit and Banking 34 (2), 540–561.

Huang, B., Hwang, M.J., Hsiao-Ping, P., 2005. The asymmetry of the impact of oil price shocks on economic activities: an application of the multivariate threshold model. Energy Economics 27(3), 455-476.

Huntington, H., 1998. Crude oil prices and U.S. economic performance: Where does the asymmetry reside? Energy Journal 19 (4), 107–132.

Hutchison, M.M., 1993. Structural change and the macroeconomic effects of oil shocks: Empirical evidence from the United States and Japan. Journal of International Money and Finance 12 (6), 587–606.

Jin, Guo, 2008. The impact of oil price shock and exchange rate volatility on economic growth: A comparative analysis for Russia Japan and China. Research Journal of International Studies 8 (November), 98-111.

Johansen, S., 1988. Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control 12 (2-3), 231-254.

Johansen, S., Juselius, K., 1990. Maximum likelihood estimation and inferences on cointergation – with applications to the demand for money. Oxford Bulletin of Economics and Statistics 52 (May), 169-210.

Kahn, G., Hampton, R., 1990. Possible monetary policy responses to the Iraqui oil shock. Federal Reserve Bank of Kansas City Economic Review 2 (November/December), 19–32.

Kamin, S.B., Klau, M., 1998. Some multi-country evidence on the effect of real exchange rate on output. International Finance Discussion Papers No 611, Board of Governors of the Federal Reserve System (U.S.).

Khan, M.S., Senhadji, A.S., 2001. Threshold effects in the relationship between inflation and growth. IMF Staff Papers Vol. 48 (1), 1-21.

Krugman, P.R., Taylor, L., 1978. Contractionary effect of devaluation. Journal of International Economics 8 (3), 183-227.

Kamin, S.B., Roger, J.H., 2000. Output and the real exchange rate in developing countries: an application to Mexico. Journal of Development Economics 61 (1), 85-109.

Kandil, M., 2004. Exchange rate fluctuations and economic activity in developing countries: theory and evidence. Journal of Economic Development 29 (1), 85-108.

Lee, B.R., Lee, K., Ratti, R.A., 2001. Monetary policy, oil price shocks and the Japanese economy. Japan and the World Economy 13 (3), 321–349.

Lee, K., Ni, S., Ratti, R.A., 1995. Oil shocks and the macroeconomy: The role of price variability. Energy Journal 16 (4), 39–56.

Lee, K., 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.

Levine, R., Zervos, S., 1993. What we have learned about policy and growth from cross-country regressions?. American Economic Review Papers and Proceeding 83 (2), 426-30.

Mallik, G., Chowdhury, A., 2001. Inflation and economic growth: evidence from four South Asian countries. Asia-Pacific Development Journal 8 (1), 123-133.

McKillop, A., 2004. Oil prices, economic growth and world oil demand. Middle East Economic Survey VOL. XLVII, No 35. Retrieved September 9, 2010 from http://www.gasandoil.com/goc/speeches/mckillop.htm.

Milani, F., 2009. Expectations, learning, and the changing relationship between oil prices and the macroeconomy. Energy Economics 31 (6), 827–837.

Mork, K., 1989. Oil and the macroeconomy when prices go up and down: An extension of Hamilton's results. Journal of Political Economy 97 (3), 740–744.

Mork, K., 1994. Business cycles and the oil market. Energy Journal 15 (Special Issue), 15–38.

Narayan, P.K., Narayan S., 2010. Modelling the impact of oil prices on Vietnam's stock prices. Applied Energy 87 (1), 356–361.

Nunnemkamp, P., Schweickert, R., 1990. Adjustment policies and economic growth in developing countries. Is devaluation contractionary?. Weltwirtschftliches Archive 126, 474-493.

Rautava, J., 2004. The role of oil prices and the real exchange rate in Russia's economy—a cointegration approach. Journal of Comparative Economics 32 (2), 315–327.

Rogers, J.H., Wang, P., 1995. Output, inflation and stabilization in a small open economy: evidence from Mexico. Journal of Development Economics 46 (2), 271-293.

Sarel, M., 1996. Nonlinear effects of inflation on economic growth. IMF Staff Papers 43(1), 199-215.

Sheeley, C.A., 1986. Unanticipated inflation, devaluation, and output in Latin America. World Development 14 (5), 665

-671.

Pazos, F., 1972. Chronic Inflation in Latin America. New York: Praeger.

Paul, S., Kearney, C., Chowdhury, K., 1997. Inflation and economic growth: a multi-country empirical analysis. Applied Economics 29 (10), 1387-1301.

Terence, C.M., Pentecost, E.J., 2001. The real exchange rate and the output response in four EU accession countries. Emerging Markets Review 2 (4), 418-430.

Tatom, J., 1988. Are the macroeconomic effects of oil price changes symmetric? Carnegie—Rochester Conference Series on Public Policy 28 (1), 325–368.

Vo, T. T., Dinh, H. M., Do, X. T., Hoang, V. T., Phan, C. Q., 2000. Exchange rate arrangement in Vietnam: information content and policy options. Individual Research Project, East Asian Development Network (EADN).

Wai, U.T., 1959. The relation between inflation and economic development: a statistical inductive study. IMF Staff Papers 7 (October), 302-17.

Footnotes

[1] The time required to dissipate *x*% of a shock is determined according to: $(1-\alpha)^t = (1-x)$, where t is the number of years and α is the absolute value of the speed of adjustment parameter.