Macroeconomic Impacts Of Oil Price Levels And Volatility On Indonesia

Marcel Gozali

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Abstract

This paper empirically examines the impact of oil price levels and volatility on key macroeconomic indicators of Indonesia. In particular, two measures of volatility – historical volatility and realized volatility – are utilized and compared for their different macroeconomic impacts. The relationships between oil price levels, the two volatility measurements, and macroeconomic indicators are explored with the Granger-causality test and the vector autoregressive system (VAR). Empirical analysis is done on two sets of data – one over the period between 1990 and 2008 and another between 1999 and 2008, following a structural break in the time series data during the Asian Financial Crisis in 1997-1998 (Rafiq, Salim and Bloch ,2008). Results from both sets of data show that realized volatility is a significant predictor of growth rates of GDP only when oil price levels is included in the VAR system. Another important result is that oil price levels has statistically meaningful impacts on government consumption and investment, and that the explanatory power of price levels to investment is strengthened when realized volatility is included in the time-series analysis.

Introduction

Policymakers are concerned with crude oil price levels and large movements in oil prices. This is because pioneering work by Hamilton (1983) found that all but one recession between the end of World War II and 1973 in the United States were preceded by a sharp rise in oil prices. The study paved the road for many others in investigating the macroeconomic impacts of oil shocks in developed economies (Burbridge and Harrison, 1984; Mork, Olsen and Mysen 1994; Ferderer, 1996; Guo and Kliesen, 2005). However, while many studied the macroeconomic impacts of oil price levels, few conducted analysis on the effect of oil price volatility while hardly any was done in the context of developing countries. In bridging this gap within the current literature, this paper attempts to analyze the impacts of both oil price levels and price volatility on the macroeconomy of Indonesia.

The contributions of this paper differ from previous research in three areas. Firstly, this paper remains one of the few that investigate the combined effects of oil price levels and price volatility – the two channels through which changes in oil prices affect aggregate economic activity. Secondly, empirical analysis is done in the context of Indonesia, on which no prior study of this type exists. Thirdly, this paper attempts to compare empirical results between two different measures of price volatility, namely historical volatility and realized volatility. Historical volatility is standard variance, which is used by earlier studies to measure oil price volatility (Burbidge and Harrison, 1984; Mork, Olsen and Mysen 1994; Ferderer, 1996). Realized volatility is a comparatively new measure of oil price proposed by Andersen et al. (2001a, 2001b, 2003) and Barndorff-Nielsen and Shephard (2001a, 2002) to be an unbiased and highly efficient estimator of volatility. Only two other studies on oil price volatility used this volatility measure (Guo and Kliesen 2005; Rafiq, Salim and Bloch, 2008).

Indonesia serves as an appropriate and interesting case for a few reasons. Firstly, the Indonesian domestic market is heavily dependent on oil. Oil makes up the largest portion of energy sources used domestically, accounting for 52 percent of the energy mix (Simbolon 2009). This is high relative to the global average of 36 percent, making the Indonesian economy particularly susceptible to oil price changes (International Energy Outlook 2009 – Chapter 1). When oil prices hit record prices in 2008, power generation became so costly that largest state-owned power company switched off its oil-fired power plants, causing rotating blackouts nationwide (Simbolon 2009). Secondly, no such studies on Indonesia exist. Finally, the time series data required for this study – daily oil prices and quarterly Indonesian macroeconomic indicators – are available and accurate.

The remainder of the paper is organized as follows. The Literature Review discusses the macroeconomic impacts of oil price levels and price volatility on the US and other countries, and the transmission channels through which both impact macroeconomic activities. Data Sources lists the definition of all variables used for empirical analysis, including the measurement of macroeconomic variables and price volatility, and the justifications for the use of a particular type of oil price. Details of the statistical methods used in this paper are under Empirical Methodology and empirical findings are discussed in Analysis Of Results before the Conclusion Of Results And Policy Implications is offered in the final section.

Literature Review

Oil price shocks and the US macroeconomy

In response to two consecutive oil shocks in the 1970s, Hamilton (1983) analyzed the correlation between oil prices and the output of the US economy over 1948-1981, and found that changes in oil price appeared to Granger-cause both real and nominal GNP, unemployment, domestic prices, wages, coal and metallic commodity indexes, interest rates, and high-grade bond yields. This result cast serious doubt on the proposition that the correlation between oil prices and the macroeconomy represented a mere coincidence. In particular, the correlation between oil price increases and real GNP becomes more negative for three quarters after an oil shock between the end of World War II and 1973, showing that every recession in that period had been preceded by a large increase in the price of crude oil with a lag of around nine months. Further work by Hamilton (1988, 1996, 2008) reinforced his conviction that statistically-significant correlations existed between oil prices and macroeconomic activities.

A number of studies confirmed Hamilton's results and made significant discoveries of their own. Gisser and Goodwin (1986) claimed that oil prices had significant impacts on output in the United States between 1961 and 1982, and that these impacts even exceeded the impacts of monetary and fiscal policy. The authors also proved that monetary and fiscal policy were unable to predict oil price changes, thereby concluding that oil price changes reflected the influence of exogenous events. A notable contribution in this study was related to the discovery that oil prices were determined by distinctively different factors before and after 1973. Before 1973, inflation, above all other variables, was a statistically-significant predictor of oil prices; after 1973, no such predictor could be identified. These results were consistent with the historical developments of oil pricing. The pre-1973 results supported the notion that the pricing of oil in the United States were dominated by regulatory bodies whose manipulation of supply conditions to meet demand were constrained by a need to keep inflation under control. The post-1973 results were suggestive of the domination of a post-1973 OPEC strategy based on a relatively broader array of indicators that was not strongly focused on any one variable.

Building on the work of Hamilton (1983) and Gisser and Goodwin (1986), Hooker (1996) indicated that the oil price shock of 1973, an effect of OPEC domination, had a large and significant impact on GDP growth in the United States, while that of 1979 was significant but incomplete in capturing the dynamics of the 1980-82 recession. In particular, an increase of 10% in oil prices led to a GDP growth which is 0.6% lower in the third and fourth quarters relative to the first and second quarters after the shock.

Asymmetric impact of oil price changes

Though agreeing with Hamilton, Mork (1989) observed that the author's study included only periods of oil price increases and excluded periods of oil price declines. In a check for robustness of Hamilton's results, the data set was extended to 1988 which included periods of oil price crashes, and real price increases and decreases were specified as separate variables and tested individually for statistical significance within the same econometric framework as specified by Hamilton (1983). The results showed that Hamilton's conclusions broke down after 1986 as Hamilton had implicitly assumed a symmetric effect of oil shocks: An increase (decrease) in oil prices reduced (increased) future GDP growth (Hooker 1996; Guo and Kliesen 2005). However, the effect could also be asymmetric, in which an oil price decrease might actually lower future GDP growth (Guo and Kliesen, 2005).

Oil price shocks in G10, European and Asian countries

Extending Hamilton's conclusions and incorporating Mork's discovery of asymmetric effects to G10, European and Asian countries was done by Mork and Olsen (1994), Lardic and Mignon (2006), and Cunado and Gracia (2005). Basing their work on seven OECD countries including the United States, Canada, Japan, Germany (West), France, the United Kingdom, and

Norway, Mork and Olsen (1994) examined the correlation between oil price changes and GDP growth between 1967 and 1992. Bivariate correlations between oil-price changes and GDP growth were carried out for each country in a fashion similar to Hamilton's Granger causality test, which refers to a regression equation with GDP growth as the variable on the left and lagged values of GDP growth and oil price changes on the right. Similar to Mork, real oil price increases and decreases were entered as separate variables to test for asymmetries for each country. The bivariate results showed a general pattern of negative correlations between GDP growth and oil price increases. Norway was the only country that showed a significantly positive correlation, which was not a surprise given the large Norwegian oil sector. Meanwhile, correlations with oil price decreases were positive which suggested that oil-price declines were associated with subsequent declines in overall growth. The overall differences between the estimated coefficients for oil price increases and decreases, respectively, were suggestive of asymmetric effects.

In a study of the long-term relationship between oil prices and economic activity in G7, Europe and Euro area countries, Lardic and Mignon (2006) found that rising oil prices slowed down economic activity more than falling oil prices stimulated it. The authors found evidence that their time-series data exhibited non-stationarity, leading to the rejection of standard cointegration. Building on Mork's discovery of asymmetric effects, the authors proceeded to find evidence of asymmetric cointegration between oil prices and GDP in most of the European countries in its data. Asymmetric cointegration involved the decomposition of a time series into its positive and negative partial sums, which was conceptually similar to Mork's specification of oil price increases and decreases as separate variables.

Cunado and Gracia (2005) examined the relation between oil price shocks and macroeconomic activities in six Asian countries, namely Singapore, South Korea, Malaysia, Japan, Thailand and the Philippines. Similar to Mork and Olsen (1994), Hamilton's Granger causality test was used and the asymmetric effect of oil price changes was accounted for. The paper's main contribution was the testing of the impact of expressing oil prices in different currencies, either local or the United States dollar (USD). The relationship between oil price shocks and economic growth rates was more significant when oil price shocks were defined in local currencies than when defined in USD. In testing for evidence of causality from oil price shocks to inflation rates, all six countries displayed evidence for causality when oil was priced in local currencies but only 3 did when oil was priced in USD.

Transmission channels through which changes in oil price impact macroeconomic activities

Changes in oil price can impact the macroeconomy through many transmission channels. First, since oil is a vital input, rising oil prices can lead to a classic supply-side shock that reduces potential output (Barro 1984; Brown and Yücel 1999). Consequently, the growth of output and productivity decreases. The decline in productivity growth lessens real wage growth and increases the unemployment rate at which inflation accelerates. If the higher oil prices are expected to be temporary, consumers will attempt to smooth out their consumption by saving less or borrowing more which boosts the equilibrium real interest rate. Declining output growth and higher real interest rate will result in a lower demand for real cash balances, leading to higher consumer spending and ultimately a greater rate of inflation. Therefore, rising oil prices reduce GDP growth and boost real interest rates and the measured rate of inflation. If wages are 'sticky' downward, the reduction in GDP growth will lead to increased unemployment and a further reduction in GDP growth – unless unexpected inflation increases as much as GDP growth falls (Koenig 1995; Brown and Yücel 2002).

Second, rising oil prices deteriorates the terms of trade for oil-importing countries and improves that for oil-exporting countries (Dohner 1981). This means that wealth is transferred from oil-importing nations to oil-exporting nations, diminishing consumer demand in oil-importing nations and increasing consumer demand in oil-exporting nations. Historically, the increase in demand in oil-exporting nations is less than the reduction in demand in the oil-importing nations. On net, the world consumer demand for goods diminishes, and the world supply of savings increases (Fried and Schulze 1975; Brown and Yücel 2002). The increased supply of savings puts downward pressure on real interest rates which can partially offset the upward pressure on real rates that comes from consumers in the oil-importing nations attempting to smooth their consumption. The downward pressure on world interest rates should stimulate investment that offsets the reduction in consumption and leaves aggregate demand unchanged in the oil-importing countries.

Third, monetary policy can determine the way an economy experiences an oil price shock. If the oil price shock leads to a higher real interest rate as mentioned, the velocity of money will increase. The national central bank can respond in one of three ways (Brown and Yücel 1999).. The first way is to hold the growth rate of nominal GDP constant through the implementation of contractionary policies to reduce the growth rate of monetary aggregate. The second way is to keep the growth rate of the monetary aggregate at a constant level. With an increasing velocity of money, the growth in nominal GDP will accelerate, and inflation will rise by more than GDP growth slows. The third way is to leave the real interest rate unchanged. This accelerates the growth of the monetary aggregate and increases the rate of inflation. Though the goal of a national central bank seeks is the pursuit of economic stabilization following oil price shocks, several studies argue that contractionary monetary policy accounts for much of the decline in aggregate economic activity following an oil price increase (Bohi 1989, 1991; Bernanke, Gertler and Watson 1997).

Bohi analyzed four countries after each energy shock in the 1970s and found no consistent relationship between industry activity and oil price shocks. He concluded that the obvious explanation of the negative impact of higher prices on output was tight monetary policy, which was implemented after a significant increase in oil prices. Bernanke, Gertler and Watson showed that the responses of the United States economy to an oil price shock were different when the federal funds rate was constrained to be constant relative to the case in which monetary policy was unconstrained. With a constant federal funds rate, the authors found that a positive oil price shock was correlated to an increase in real GDP. In the unconstrained case, a positive oil price shock was correlated to an increase in the federal funds rate and a decline in real GDP. The difference in the response of real GDP between the two cases showed that it was monetary policy's response to oil price shocks which accounted for the fluctuations in aggregate economic activity.

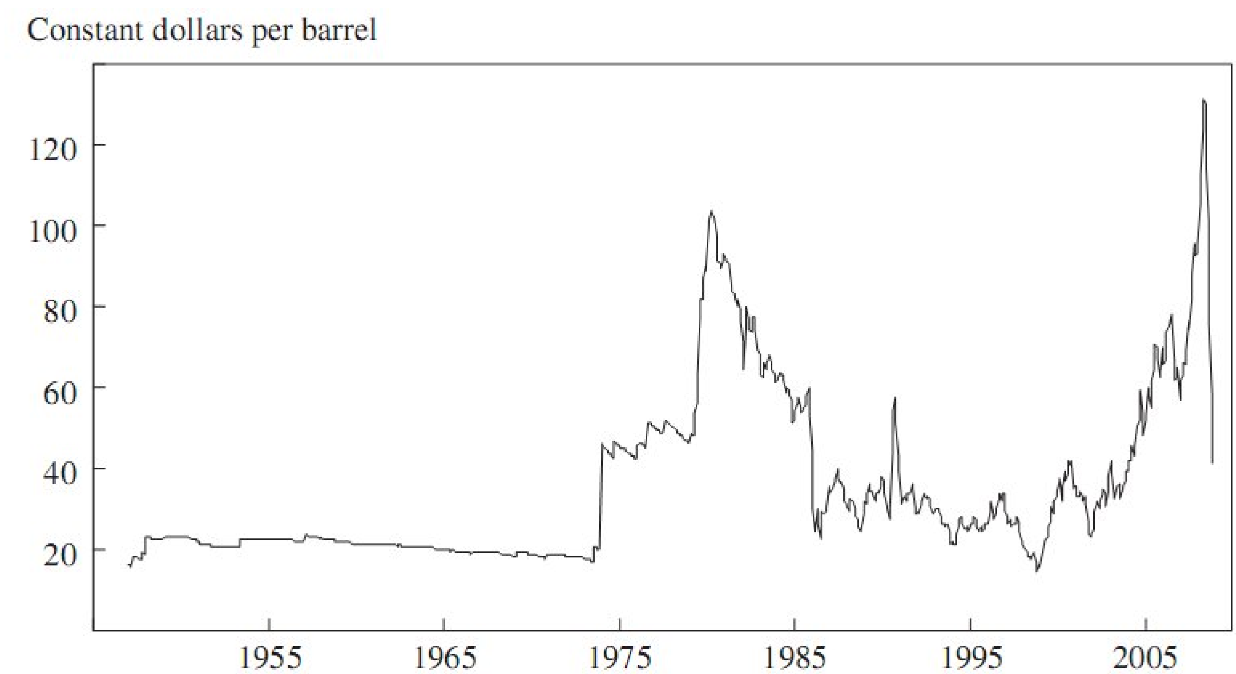
Fourth, as the demand of money rises in oil-importing countries to support the higher value of transactions initiated by rising oil prices, interest rate rises at a given supply of money and retards economic growth as a result (Pierce and Enzler 1978; Mork 1989).

Fifth, oil price shocks can lead to aggregate unemployment by inducing workers of adversely affected sectors to remain unemployed while waiting for conditions to improve in their own sectors rather than moving to positively affected sectors (Lilien 1982; Loungani 1986; Hamilton 1988). Aggregate unemployment rises with increased variability in the price shocks.

Macroeconomic influence of oil price volatility

In contrast to the above studies which focus on oil price shocks, previous research on oil price volatility and its macroeconomic impacts are very limited. Significant increases in oil price volatility began in mid-1980 and had persisted till today. Figure 1 below shows the trend of real crude oil prices between January 1947 and December 2008 (Hamilton 2008). Oil prices were characterized mainly by upward movements until 1980, after which large price increases and decreases reflected a substantial rise in oil price volatility.

Figure 1: Real crude oil prices, January 1947 to December 2008



Source: Energy Information Administration, Bureau of Labor Statistics

The change in the pattern of oil prices in mid-1980 prompted Hooker (1996) to discover the importance of oil price volatility and challenge the assumptions underlying the relationship between oil prices and the Unites States macroeconomy. Before Hooker's paper, the assumption was that a general pattern of negative correlations between the growth of the macroeconomy and oil price increases exist with oil prices having asymmetric impacts on macroeconomic variables.

The author found that the relationship was significantly altered through his discovery that oil prices Granger-cause a variety of macroeconomic variables in data up to 1973 but not in data up to 1994. Analysis indicated that the relationship had changed in such a way that could neither be described by a simple linear relation between oil prices and output nor by the asymmetric relation presented by Mork (1989). The author instead emphasized the importance of oil price volatility for the period after 1973. He discovered that between 1973 and 1994, changes in oil price levels could neither affect unemployment nor GDP growth. On the contrary, oil price volatility could predict GDP in the same period. This suggests that it is not the oil price *level* but its *volatility* that have a significant negative impact on economic activity in the period from 1973 to 1994.

Supporting Hooker's findings was conclusions from Lee and Ni (1996) who showed that the level of oil price alone was insufficient to explore the issue of causality of real oil price to the macroeconomy through 1992. Oil price volatility also had to be taken into account so that oil price could still be a predictor for growth in real GNP. To track oil price volatility, the authors included an innovative 'shock' variable as a measure of the degree of 'surprise' of the environment in which the oil price shock occurred. It indicated how different a given oil price movement was from its prior pattern and reflected both the unanticipated component of real oil price movement and the time-varying conditional variance of oil price change forecasts. Over a period between 1949 and 1992, the 'shock' variable was highly statistically significant in explaining GNP growth. This result was consistent with the view that the effect of a change in real oil price depends upon the degree of 'surprise' of the oil shock. Low volatility on the oil markets before a strong oil price increase could lead to a higher impact of the oil price shock on the macroeconomy than a highly volatile oil price environment.

Ferderer (1996) confirmed Hooker's findings as well. The author showed that oil price volatility exerted a stronger impact on output growth relative to oil price changes, though both oil price changes and oil price volatility had negative impacts on output growth. Both oil price variables also have a stronger and more statistically significant impact than do all of the monetary policy variables, namely the Federal Funds Rate and the industrial production. The fact that both the level and volatility of oil prices helped forecast output growth even when measures of monetary policy were included suggested that monetary tightening was not the sole cause of the recessionary effects of oil price shocks.

Utilizing impulse response functions and variance decomposition tests to extend the results of the Granger causality test, Ferderer (1996) indicated the duration of the impact of oil price shocks and oil price volatility on macroeconomic variables. An interesting contribution was the discovery that oil price volatility had a negative and significant impact on output growth that occurred immediately and then again for eleven months, while real oil prices required a year to have a significantly negative impact on output growth. In addition, Ferderer observed that oil price volatility strongly correlated with real oil price increases. This implied that the negative impact of price volatility on output growth could more likely be observed during periods of oil price increases relative to periods of oil price declines. Ferderer's results were consistent with the conclusions from prior studies, which emphasized the importance of oil price volatility over oil price changes on the United States macroeconomy.

In contrast, Hamilton (1996) claimed that oil price changes might be more important than oil price volatility in affecting the macroeconomy. Hamilton found that the majority of increases in oil prices since 1986 had been followed immediately by even larger decreases. In an attempt to smooth the effect of oil price decreases, Hamilton proposed to compare the current price of oil with the price level of the previous year rather than only compare it with the price level of the previous quarter by the use of a measure known as ‘net oil price increase’ (NOPI). In contrast to Hooker, Hamilton demonstrated that the relation between GDP growth and NOPI remained statistically significant using the same data set that Hooker had used, even when oil price volatility was included in the model in testing for impacts on macroeconomic variables. Thus, the author concluded that even if oil price increases seemed to have had a smaller macroeconomic effect after 1973, it was large oil price changes induced by oil supply disruptions, not oil price volatility, that had a major effect on macroeconomy.

Transmission channels through which oil price volatility impact macroeconomic activities

The well-established channels through which oil price volatility exert their impact macroeconomic activities are the uncertainty channel, that is a branch of business cycle theory, and the sectoral resource allocation channel. Bernanke (1983) offered a theoretical explanation about the uncertainty channel based on an important assumption, which is that the channel applied to only irreversible economic decisions, defined as activities that cannot be “undone” without the incurrence of high costs. When a firm faces increased uncertainty about the price of oil as a result of high oil price volatility, it is optimal for the firm to delay irreversible projects whose returns are closely related to oil prices and wait for the arrival of new information. Assuming that the new information is relevant to the estimation of the returns of the projects, the firm is more likely able to make a more well-informed decision by forgoing the returns from an early commitment.

In the uncertainty channel, the dynamics of investment are very sensitive to the timing of the arrival of new information. Bernanke showed that the interactions of investor learning and the optimal timing of investments gave rise to sharp fluctuations in the demand of goods like oil, resulting in higher price volatility that in turn reinforced the cycle. Thus, the uncertainty channel implies that volatility in oil prices is more important than the level of oil prices, as regular changes in oil prices increase the uncertainty of investment. Hence, as the level of oil price volatility increases, the returns associated with delays in investments increases and the incentive for immediate investment declines, which results in lower output levels for the entire macroeconomy (Ferderer 1996).

The sectoral resource allocation channel was first examined by Lilien (1982), whose focus was on labor allocation. In theory, even in periods of stable aggregate employment, continuous shifts of employment demand within the United States resulted in almost five percent of natural unemployment. This unemployment would always exist as separated workers would need time to be matched to new jobs. Economists theorized that the amount of such unemployment was small and fairly stable over time, thus having no impact on cyclical unemployment that made up the bulk of aggregate unemployment.

However, Lilien challenged the notion that natural unemployment was insignificant in explaining aggregate unemployment. Based on traditional theory, the quantity of unemployment depended on the speed with which workers were matched to new jobs. If workers were to have strong attachments to particular firms or industries due in part to firm- and industry-specific skills and to wage premiums associated with seniority, they would be reluctant to seek employment in other sectors of the economy. Thus the process of adjustment to sectoral shifts tended to be slow and typically involved significant unemployment before labor adjusted fully to new patterns of employment demand. The impact of such sectoral shifts on cyclical unemployment was assessed by constructing a dispersion index as a measure of labor reallocation. The dispersion index was then used as a proxy for employment demand and the relationship between the index and aggregate unemployment was assessed. Lilien argued that, given a standard definition of natural unemployment, as much as half of the variation in cyclical unemployment was attributed to the fluctuations of the natural rate brought about by the slow adjustment of labor to sectoral shifts of employment demand. This means that aggregate unemployment could be mostly explained by the dispersion of employment growth across industries. Another implication was that increasing variability in relative price shocks resulted in higher fluctuations of the natural rate of unemployment, which in turn led to higher aggregate unemployment.

Loungani (1986) built on Lilien's work on the sectoral resource allocation channel. Following Lilien in constructing a dispersion index to measure the magnitude of labor reallocation, Loungani decomposed the index into separate parts comprising the differential impact of oil price shocks across industries and residual dispersion. He presented two new results. First, Loungani showed that the dispersion of employment growth across industries was due to the differential impact of oil shocks across industries. Second and more importantly, once the dispersion of employment growth due to oil shocks was accounted for, the residual dispersion possessed no predictive power for unemployment. This result implied that if not for disruptions in the oil market, the process of labor reallocation would have been carried out without the generation of significant unemployment. However, Loungani also noted that his data included the dramatic oil price increases in the 1950s and 1970s, which could underlie the massive amount of labor reallocation. Thus, during periods without significant increases or decreases in oil prices, oil prices affect the economy through channels other than the process of labor reallocation.

Hamilton (1988) extended the works of Lilien and Loungani by demonstrating that volatility in the prices of primary commodities could lead to a reduction in aggregate unemployment by inducing workers of adversely affected sectors to remain unemployed while waiting for conditions to improve in their own sectors rather than moving to other positively affected sectors.

Data Sources

Macroeconomic variables of Indonesia

This paper uses quarterly data from 1990Q1 to 2008Q4 extracted from the International Financial Statistics (IFS) September 2009 database. Empirical analysis is confined within this period of time as data is not available for all the relevant macroeconomic variables prior to this period. The macroeconomic variables used in this study are as follows (short notations for each variable are in brackets):[1]

- growth rate of GDP (GGDP)
- investment, measured as gross fixed capital formation as a percentage of GDP (INV)
- private household expenditures, measured as household consumption as a percentage of GDP (PCON)
- government expenditures, measured as government consumption as a percentage of GDP (GCON)
- interest rate for working capital loans (IR)
- inflation rate, measured as the percentage change in the Consumer Price Index (INF)

[1] All data can be found in Appendix C.

- trade balance, measured as the difference between exports and imports as a percentage of GDP (TB)

Other variables used in this study include:[2]

- realized volatility (RV)[3]
- historical volatility (HV)[4]
- quarterly moving average of oil price levels (OILP).[5] A moving average is taken in an attempt to smooth price trends and decrease the impact of volatility on price levels

Measurement and justification of type of oil prices

The type of oil price chosen for empirical analysis is Light, Sweet Crude Oil, Cushing, Oklahoma Contract 4. It is the combined price for the highest grades of crude oil, defined as oil with low sulphur content and a high degree of viscosity. Examples of the varieties oil included in this price included West Texas Intermediate, which represents the global standard for crude oil prices. Contract 4 refers to the longest-dated crude oil future price that is available on the Energy Information Administration website.

Empirical research on oil prices often do not provide sufficient, if any, grounds for their use of particular oil prices. Of the 161 different types of oil that are traded around the world, it is suggested that the variety of oil chosen should most closely reflect the greatest degree of price discovery for the purposes of empirical research (Energy Intelligence Group). Price discovery is the process of uncovering an asset's full information or permanent value. At its most efficient

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[2] These data can be found in Appendix C.
[3] Computation of RV is outlined in the section 'Measurement of oil price volatility'.
[4] Computation of HV is outlined in the section 'Measurement of oil price volatility'.
[5] This is calculated from daily oil prices, which can be found in http://tonto.eia.doe.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RCLC4&f=D.

level, the process facilitates the attainment of equilibrium between buyers and sellers, and reflects the fundamental and technical factors underlying buyers' and sellers' decisions without the possibility of arbitrage. Important factors underlying price discovery include current supply and demand conditions such as valuation perceptions and the relative size of buyers and sellers; speculative expectations; market mechanisms that involve bidding and settlement processes; the abundance of liquidity; the amount, timeliness and reliability of information; and risk management choices including the availability of derivatives like futures and swaps.

Price discovery in oil prices is determined by three factors. The first factor is the variety of oil. Adelman (1984) concluded from performing correlation analysis on prices of major oil varieties that the "the world oil market, like the world ocean, is one great pool". Supporting his conclusions was a paper by Bachmeier and Griffin (2006). Utilizing daily prices for five geographically separated crude oils of varying quality characteristics within a vector error correction model, the authors showed that the world oil market is a single, highly integrated economic market. These results imply that prices for different varieties of oil tend to move in an integrated fashion. For this paper, the combined price for the highest grades of tradable oil is utilized to minimize the impact of illiquidity.

The second factor is spot or future prices of a particular tenor. Theoretical and empirical literature concluded that futures prices dominated price discovery relative to spot prices for light sweet crude oils (Schwarz and Szakmary, 1994; Gulen 1996; Silvapulle and Moosa, 1999). Of these studies, Gulen provided the most comprehensive coverage of the topic as he analyzed the crude oil trivariate system of spot-futures-posted prices in addition to bivariate spot-futures and spot-posted systems. In bivariate systems, both the futures price and the posted price are efficient predictors of the spot price as both spot-futures and spot-posted systems are found to be cointegrated. The analysis of trivariate systems shows that the futures price is superior to the posted price in predicting the spot price. Overall, futures prices provided a superior and efficient predictor of the spot price. In addition, long-dated futures reflect price discovery to a greater extent relative to short-dated futures because higher volatilities in short-dated futures contracts relative to long-dated contracts reflect transitory noises, which are unlikely to have any significant effect on investors' perceptions about the uncertainty of oil prices (Guo and Kliesen 2005).

The third factor is the settlement currency of the oil price. Empirical research on oil prices stick to one of two measures – either the USD world price of oil is used as a common indicator of the world market disturbances that affect all countries (Burbidge and Harrison, 1984; Cunado and Gracia, 2004), or this world oil price is converted into a specific currency by means of the market exchange rate (Mork, Olsen, & Mysen, 1994). The main difference between the two is that the specific currency in the second measure reflects expectations and actual conditions of exchange rate fluctuations and inflation levels in the underlying economy (Cunado and Gracia 2005).

However, a considerable amount of literature argues for the USD to be the ideal settlement currency. McKinnon (1979) suggested that the trading of homogenous commodities such as oil require the use of vehicle currencies because only vehicle currencies could provide a high degree of price transparency. Goldberg and Tille (2005) presented evidence that the USD is the best choice as a vehicle currency due to the central role of the United States in international trade. Krugman (1980) and Rey (2001) also suggested that only the currency of an economically dominant currency can serve as a vehicle currency.

Measurement of oil price volatility

Price volatility is traditionally measured as the square of simple standard deviation, otherwise known as historical variance, denoted as HV (Mork 1989; Lee and Ni 1995; Hooker 1996; Ferderer 1996). However, Andersen (2001a, 2001b, 2003) argued for the use of realized volatility, denoted as RV, as a relatively more accurate measure of volatility. Consider the following:

$$RV_t = \sum_{d=1}^{D_t} (P_{d+1} - P_d)^2$$

$$HV_t = \sum_{d=1}^{D_t} (P_d - \langle P \rangle)^2$$

where D_t is the total number of days in quarter *t*, P_d is the price of oil in day *d* of quarter *t* and <P> is the average of P within the period *t*.

If two sets of numbers, x and y, are given and their RV and HV measured,

x={1,2,3,4,5} y={5,3,4,2,1}

	Historical volatility (HV)	Realized volatility (RV)
x	10	4
y	10	10

The set of numbers in x represents a smooth trend with low volatility while that in y is characterized by relatively higher volatility. However, the table shows that historical volatility is not an accurate measure of volatility as it gives the same figure for both sets of numbers. Realized volatility is a relatively more accurate measure as it clearly shows that volatility in y is greater than that in x. As suggested by Andersen (2001b, 2003) and Barndorff-Nielsen and Shephard (2001a, 2002), the theory of quadratic variation suggested that, under appropriate conditions, realized volatility is an unbiased and highly efficient estimator of volatility of returns. In addition, papers by Zhang (2005) and Ait-Sahalia (2005) claimed that realized variance was a consistent and asymptotically normal estimator once suitable scaling is performed.

Empirical methodology

The econometric methods utilized in Rafiq, Salim and Bloch (2008) and Guo and Kliesen (2005) form the core of the empirical methodology in this paper. This study employs the Granger causality test to examine the causal relationship between oil price volatility, oil price levels and macroeconomic indicators of Indonesia. A variable, say X_t, Granger-causes another variable, say Y_t, when X_t provides statistically significant information about Y_t in a regression of Y_t on lagged values of Y_t and X_t. Vector auto-regression (VAR) of the following form is considered:

$$Y_t = \alpha_0 + \sum_{i=1}^{n} \beta_i Y_{t-i} + \sum_{i=1}^{n} \delta_i X_{t-i} + \mu_t \qquad (1)$$

$$X_t = \varepsilon_0 + \sum_{i=1}^{n} \phi_i Y_{t-i} + \sum_{i=1}^{n} \eta_i X_{t-i} + \upsilon_t \qquad (2)$$

where Y is a macroeconomic variable, X is a measurement of volatility such as HV or RV, *n* is the optimum lag length as specified by the Bayesian Information Criterion (BIC), μ and υ are vectors of disturbance terms, α and ε are vectors of constants, and the remaining Greek letters are coefficients of independent variables.

For each of the equations above, Wald χ^2 statistics are used to test for the significance of lagged values of an independent variable in forecasting values of the dependent variable while controlling for lagged values of the dependent variable. In addition, the Wald χ^2 statistics informs whether the dependent variables are endogenous or exogenous. For example, to test whether past values of GGDP (growth rate of GDP) predicts HV (historical volatility of oil prices), equation (1) can be used to set up two equations as follows (suppose that n=1):

$$HV_t = \alpha_0 + \beta HV_{t-1} + \mu_t \qquad (3)$$

$$HV_t = \varepsilon_0 + \phi HV_{t-1} + \delta GGDP_{t-1} + \upsilon_t \qquad (4)$$

Considering equation (3) as a restricted model where δ=0 and equation (4) as an unrestricted model where $\delta \neq 0$, the null hypothesis is set as δ=0 and the alternative hypothesis as $\delta \neq 0$. Should the null hypothesis be rejected, lagged values of GGDP correlate to HV, implying that GGDP Granger-causes HV. Residual sum of squares for each equation can be computed to derive a χ^2 test statistic that either rejects or fails to reject the null hypothesis. Next, equation (2) is used to set up another two equations where GGDP and HV switch sides. GGDP becomes the dependent variable and HV the independent variable. This was necessary since by definition, if GGDP Granger-cause HV, HV does not necessarily Granger-cause GGDP.

The above process is carried out with HV as the dependent variable and the macroeconomic indicators as the independent variables. Each macroeconomic indicator is tested for its significance in predicting HV. The block exogeneity Wald Test is then carried out to test for the joint significance for all macroeconomic indicators. The same process is then repeated with RV and OILP as the dependent variables. The results of the joint significance test inform whether volatility or oil price levels are endogenous variables, that is whether they have causal links from other variables in the model.

The next step involves the macroeconomic indicators as the dependent variables and HV as the independent variable. For each macroeconomic indicator, HV is tested for its significance in predicting values of the macroeconomic indicators. In addition, oil price levels are tested for its predictive significance as well. Using GGDP as an example and assuming that n=1, equations are set up as follows:

$$GGDP_t = \alpha_0 + \beta GGDP_{t-1} + \mu_t \qquad (5)$$

$$GGDP_t = \varepsilon_0 + \phi GGDP_{t-1} + \delta HV_{t-1} + \upsilon_t \qquad (6)$$

$$GGDP_t = \gamma_0 + \eta GGDP_{t-1} + \varphi HV_{t-1} + \lambda OILP + \theta_t \qquad (7)$$

The block exogeneity Wald Test is again used to test for the joint significance of both HV and OILP in predicting values of the macroeconomic indicators. The process is then repeated with RV as the independent variable. These tests reveal whether one variable – volatility *or* price levels – alone is sufficient in predicting values of macroeconomic indicators, or that both variables – volatility *and* price levels – are needed. Another possible result is that either variable may only be statistical significant predictors of macroeconomic indicators only when the other variable is included. For example, lagged values of HV may not correlate to GGDP in equation (6) above, but HV and GGDP may correlate when OILP is included in equation (7).

The Granger-causality framework based on standard VAR outlined above is only valid if the time series variables are stationary. A stationary time series is one whose statistical properties such as mean, variance and autocorrelation are all constant over time. In testing for stationarity, confirmatory data analysis, as proposed by Brooks (2002), is carried out. The procedure involves the use of standard unit root tests – the Augmented Dickey-Fuller (ADF) test, the Philips-Perron

(PP) test and the Kwiatkowaski-Philips-Schmidt-Shin (KPSS) test. These tests check for the presence of a unit root within the time series autoregressive model. The presence of a unit root implies a non-stationary time series. To illustrate the effect of a unit root, consider the following:

Given a first-order autoregressive model,

$$y_t = \alpha_0 + \beta y_{t-1} + \mu_t$$

For convenience, assume that α_0=0. The model has a unit root if β=1. The model is thus given by

$$y_t = y_{t-1} + \mu_t$$

By repeated substitution, the model can be written as

$$y_t = y_0 + \sum_{m=1}^{t} \mu_m \text{ where } \mathrm{Var}(y_t) = \sum_{m=1}^{t} \sigma^2 = t\sigma^2$$

Since the variance depends on t, the model with the unit root is thus non-stationary. If it is known that a series has a unit root, the series can be differenced to render it stationary.

However, Rafiq, Salim and Bloch (2008) suggested that the standard unit root tests may not be appropriate if the time series data were to contain structural breaks. Breaks in time series data can occur either instantaneously or gradually. Instantaneous change is modeled in the Additive Outlier (AO) model and changes that take place gradually are modeled in the Innovational Outlier (IO) model (Rafiq, Salim and Bloch, 2008). The authors further suggested the use of the IO model as “policy reforms at the macro level do not cause the target [macroeconomic] variable to respond instantaneously to the policy actions”. Using an IO model following Perron (1997) unit root test that allows for structural breaks, the authors found that the dates for the structural break congregated around the Asian Financial Crisis of 1997-1998 for the macroeconomic variables of Thailand. Since Indonesia and Thailand are well-known victims of the crisis, it is reasonable to assume that the time series macroeconomic variables of Indonesia share a similar structural break to those of Thailand. As a check for robustness, this paper employs two VAR systems – one for the entire time period between 1990Q1 and 2008Q4 and another for the time period after the structural break between 1999Q1 and 2008Q4.

A general form of the VAR system is as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{n} \beta_i Y_{t-i} + \sum_{i=1}^{n} \delta_{1i} X_{1t-i} + \sum_{i=1}^{n} \delta_{2i} X_{2t-i} + \ldots + \sum_{i=1}^{n} \delta_{pi} X_{pt-i} + \mu_t \qquad (8)$$

where *n* is the optimum lag length as specified by the Bayesian Information Criterion (BIC), *p* is the number of independent variables excluding the lagged dependent variable, μ is the disturbance term, α is a constant, and the remaining Greek letters are coefficients of independent variables. Each VAR equation is set up with a different variable as the dependent variable. To test for the significance of volatility and price levels in predicting values of macroeconomic indicators, the VAR equations are crafted in a fashion similar to equations (6) and (7). For the first VAR equation, volatility is first included and price levels excluded in the vector of lagged independent variables; for the second VAR equation, both volatility and price levels are included in the vector of lagged independent variables. This test is done for both the full and partial data set. The main difference between the VAR system and the Granger-causality test based on standard VAR is that the VAR system controls for all other independent variables, thus providing a closer approximation to reality compared to the Granger-causality test.

Analysis Of Results

First, we discuss the results of various statistical tests as applied to the entire data set. Section labels that begin with '1' denote analysis of the entire data set. Next, findings of the empirical analysis as applied to the data set from 1999Q1 are discussed and compared to those applied to the entire data set. Section labels that begin with '2' denote analysis of the partial data set.

1.1 Time-series properties of data

Since the core of the empirical methodology is the VAR Granger-causality test, it is imperative to first discuss the stationary properties of all variables. The unit root tests are applied to the level (original) series and first differences. The results of the ADF, PP and KPSS tests are as follows:

Table 1: Augmented Dickey-Fuller (ADF) test

(Null hypothesis: unit root present)

Legend

ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

Variable	Level series t statistics	Significance	First differenced t statistics	Significance
ggdp	-2.339	**	-7.711	***
inv	0.100		-13.705	***
pcon	-0.049		-8.268	***
gcon	-0.335		-8.462	***
ir	-0.685		-4.037	***
inf	-2.928	***	-5.983	***
tb	-0.438		-7.347	***
hv	0.052		-4.611	***
rv	-0.321		-5.362	***
oilp	-1.585		-5.506	***

Table 2: Philips-Perron (PP) test

(Null hypothesis: unit root present)

Variable	Level series t statistics	Significance	First differenced t statistics	Significance
ggdp	-1.605		-8.397	***
inv	8.432	***	-2.982	***
pcon	10.331	***	-1.303	
gcon	5.413	***	-5.841	***
ir	27.843	***	6.139	***
inf	6.503	***	-1.308	
tb	17.317	***	-2.356	**
hv	19.295	***	3.210	***
rv	24.506	***	3.970	***
oilp	23.952	***	2.017	**

Table 3: Kwiatkowaski-Philips-Schmidt-Shin (KPSS) test

(Null hypothesis: stationarity present)

Variable	Original series t statistics	Significance	First differenced t statistics	Significance
ggdp	0.091		0.048	
inv	1.233	***	0.064	
pcon	1.393	***	0.058	
gcon	0.856	***	0.139	
ir	1.448	***	0.082	
inf	0.111		0.023	
tb	3.048	***	0.078	
hv	0.789	***	0.483	*
rv	1.159	***	0.543	*
oilp	2.419	***	0.061	

Significance code

'***': rejection of null hypothesis at 0.10% critical level.

'**': rejection of null hypothesis at 1% critical level.

'*': rejection of null hypothesis at 5% critical level.

With the exception of two variables, results from the ADF and PP tests are relatively similar, showing that most variables are stationary at first differences. Findings from the KPSS test indicate that first differences for all but two variables are stationary. Since all variables are checked by at least one test to be stationary at first differences, a VAR in level or first differences makes no difference asymptotically (Sims, Stock and Watson, 1990). For convenience, level data is employed for this study.

1.2 Lag length selection, VAR Granger-causality and block exogeneity Wald test

According to the Bayesian Information Criterion (BIC), the lag length of VAR is identified to be 1. The following results are obtained from the VAR Granger-causality and block exogeneity Wald test carried out at lag 1 with HV, RV and OILP as dependent variables, and lagged values of macroeconomic indicators as independent variables.

Table 4: Test for exogeneity for HV

(Dependent variable: HV)

Legend

ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

Excluded variable	Chi square statistics	P-value	Significance
ggdp	0.452	0.502	
inv	0.275	0.600	
pcon	0.091	0.763	
gcon	0.009	0.924	
ir	1.864	0.172	
inf	0.004	0.948	
tb	1.629	0.202	
oilp	14.690	0.000	***
All (with oilp)	21.836	0.005	***
All (without oilp)	3.399	0.846	

Table 5: Test for exogeneity for RV

(Dependent variable: RV)

Excluded variable	Chi square statistics	P-value	Significance
ggdp	0.488	0.485	
inv	0.004	0.950	
pcon	0.251	0.616	
gcon	0.023	0.880	
ir	1.817	0.178	
inf	0.002	0.961	
tb	1.296	0.255	
oilp	15.776	0.000	***
All (with oilp)	21.788	0.005	***
All (without oilp)	3.949	0.786	

Table 6: Test for exogeneity for OILP

(Dependent variable: OILP)

Excluded variable	Chi square statistics	P-value	Significance
ggdp	0.167	0.683	
inv	1.260	0.262	
pcon	2.684	0.101	
gcon	0.047	0.829	
ir	2.481	0.115	
inf	0.373	0.542	
tb	3.837	0.050	*
hv	115.410	0.000	***
rv	82.150	0.000	***
All (with hv)	128.770	0.000	***
All (without hv)	7.720	0.358	
All (with rv)	83.970	0.000	***
All (without rv)	7.720	0.358	

Significance code

'***': rejection of null hypothesis at 0.10% critical level.

'**': rejection of null hypothesis at 1% critical level.

'*': rejection of null hypothesis at 5% critical level.

From Tables 4 and 5, the only significant variables are oil price levels and the joint significance of all variables inclusive of oil price levels. This shows that lagged values of oil prices correlate with both historical and realized volatility, implying that causal links may exist between the volatility measures and price levels. It is also interesting to observe that the joint significance of variables merits statistical importance only if price levels are included. Without price levels, results show that both volatility measurements can be treated as exogenous variables, implying that both HV and RV affect the macroeconomic variables without being affected by the same variables.

Table 6 confirms results from Tables 4 and 5 that causal links may exist between the volatility measures and price levels, since past values of both volatility measurements correlate with price levels and past values of price levels correlate with both volatility measurements as well. Results from the same table also show that the joint significance of variables is statistically important only if either HV or RV is included in the equations. Without volatility measurements, the joint significance of variables dwindles in importance in their prediction of price levels. This implies that oil price levels, similar to volatility measurements, is an exogenous variable, confirming the conclusions of a famous study by Gisser and Goodwin (1986) who concluded that oil price changes reflected the influence of exogenous events.

The following tables illustrate results from the VAR Granger-causality and block exogeneity Wald test carried out at lag 1 with the variables on opposite sides. Macroeconomic indicators are dependent variables, and lagged values of HV, RV and OILP are independent variables.

Table 7: Testing for significance of HV

(Independent variable: HV)

Legend

ggdp – growth rate of gdp	ir – interest rate
inv – investment	inf – inflation rate
pcon – private consumption	tb – trade balance
gcon – government consumption	

Dependent variable	Chi square statistics	P-value	Significance
ggdp	0.715	0.398	
inv	0.889	0.346	
pcon	0.006	0.936	
gcon	4.046	0.044	**
ir	0.970	0.325	
inf	0.251	0.617	
tb	1.476	0.225	

Table 8: Testing for significance of HV and OILP

(Independent variable: HV and OILP)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	1.916	0.384	
inv	0.934	0.627	
pcon	0.382	0.826	
gcon	4.320	0.115	
ir	1.912	0.384	
inf	0.263	0.877	
tb	4.494	0.106	

Table 9: Testing for significance of RV

(Independent variable: RV)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	0.174	0.677	
inv	0.682	0.409	
pcon	0.006	0.941	
gcon	3.434	0.064	*
ir	0.868	0.352	

inf	0.187	0.665	
tb	1.743	0.189	

Table 10: Testing for significance of RV and OILP

(Independent variable: RV and OILP)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	1.002	0.606	
inv	0.769	0.681	
pcon	0.309	0.857	
gcon	3.661	0.160	
ir	2.476	0.290	
inf	0.209	0.901	
tb	7.611	0.026	**

Table 11: Testing for significance of OILP

(Independent variable: OILP)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	0.035	0.851	
inv	0.253	0.615	
pcon	0.143	0.706	
gcon	3.274	0.070	*
ir	0.000	0.992	
inf	0.071	0.790	
tb	0.051	0.821	

Significance code

'***': rejection of null hypothesis at 0.10% critical level.

'**': rejection of null hypothesis at 1% critical level.

'*': rejection of null hypothesis at 5% critical level.

In Table 7, lagged values of HV are observed to be statistically significant in predicting values of government consumption (GCON). This result is however not observable in Table 8, in which lagged values of both HV and OILP are tested for their joint significance. It appears that the inclusion of price levels weakens the explanatory power of HV to GCON. RV displays relatively similar results as well in Tables 9 and 10. Past values of RV are statistically significant in predicting GCON, but display different results when joint significance with price levels is tested for. In particular, the joint significance of RV and OILP is statistically important in the prediction of values of trade balance (TB). In summary, both volatility measures appear to have causal links to government consumption, but these links weaken with the inclusion of price levels. Another implication of the findings in this section is that different types of volatility measurement do produce varying statistical results. While the joint significance of HV and OILP does not produce statistically meaningful results, the joint significance of RV and OILP is useful in predicting trade balance.

Table 11 shows that lagged values of price levels correlate with values of government consumption. The comparison of results from Tables 8, 10 and 11 is interesting in that both measures of volatility appear to weaken causal links between price levels and GCON. Recall that in the previous paragraph the opposite is true as well, that is price levels weaken the explanatory power of volatility measurements to GCON.

1.3 VAR estimation

The results of the VAR(1) models for both HV and RV, with and without OILP, are presented in the following tables. Numbers in bold represent statistical significance at a 5% critical level or lower. SE in the tables represents standard error.

Table 12: VAR (1) output for HV without OILP[6]

Legend

ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

	hv	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	1.123E+00	-3.044E-04	2.920E-04	1.023E-04	1.062E-04	-1.305E-05	-1.124E-04	-6.715E-02
SE	6.799E-02	3.177E-04	2.151E-04	2.553E-04	6.979E-05	7.407E-05	2.250E-04	7.582E-02

Table 13: VAR (1) output for HV with OILP[7]

	hv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	8.383E-01	-5.716E-03	-1.023E-03	-1.722E-04	1.822E-04	-1.073E-05	8.446E-05	-2.480E-04	-3.355E-01
SE	9.105E-02	5.488E-04	4.644E-04	3.154E-04	3.851E-04	1.035E-04	1.106E-04	3.389E-04	1.054E-01
oilp (-1)	4.250E+01	1.310E+00	1.074E-01	6.939E-02	-1.195E-02	1.749E-02	-1.458E-02	2.027E-02	4.011E+01
SE	1.013E+01	6.109E-02	5.169E-02	3.510E-02	4.286E-02	1.152E-02	1.231E-02	3.772E-02	1.173E+01

[6] The complete set of results is given in Appendix A in Table 12 (Complete).
[7] The complete set of results is given in Appendix A in Table 13 (Complete).

Table 14: VAR (1) output for RV without OILP[8]

	rv	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	1.097E+00	-2.875E-03	6.292E-03	1.497E-03	1.938E-03	-1.489E-04	-1.655E-03	-1.198E+00
SE	5.629E-02	5.928E-03	3.974E-03	4.741E-03	1.296E-03	1.375E-03	4.180E-03	1.408E+00

Table 15: VAR (1) output for RV with OILP[9]

	rv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	8.116E-01	-1.090E-01	-1.711E-02	-3.294E-03	3.095E-03	-8.675E-04	2.520E-03	-4.669E-03	-8.249E+00
SE	8.587E-02	1.318E-02	9.911E-03	6.644E-03	8.113E-03	2.177E-03	2.319E-03	7.142E-03	2.155E+00
oilp (-1)	2.116E+00	1.364E+00	1.056E-01	7.109E-02	-1.186E-02	2.080E-02	-1.980E-02	2.235E-02	5.230E+01
SE	5.149E-01	7.903E-02	5.943E-02	3.983E-02	4.864E-02	1.306E-02	1.390E-02	4.282E-02	1.292E+01

[8] The complete set of results is given in Appendix A in Table 14 (Complete).
[9] The complete set of results is given in Appendix A in Table 15 (Complete).

Table 16: VAR (1) output for OILP without HV and RV[10]

	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
oilp(-1)	8.359E-01	2.263E-02	5.512E-02	3.150E-03	1.660E-02	-7.579E-03	-2.813E-04	1.231E+01
SE	6.612E-02	3.550E-02	2.331E-02	2.844E-02	7.635E-03	8.193E-03	2.509E-02	8.353E+00

[10] The complete set of results is given in Appendix A in Table 16 (Complete).

In Table 12, lagged values of HV do not correlate with any macroeconomic indicators. When price levels are included in VAR(1), results in Table 13 indicate that lagged values of both HV and OILP correlate with the growth rate of GDP (GGDP) and trade balance (TB), while lagged values of OILP alone correlate with investment. Since the inclusion of OILP in Table 13 uncovered more significant results relative to its exclusion in Table 12, OILP appears to augment the explanatory power of HV in predicting the values of GGDP and TB. This result is confirmed by the Granger-causality test in Tables 7 and 8. Tables 7 and 8 show decreases in p-values for both GGDP and TB when price levels are included in addition to HV, implying that price levels augment the explanatory power of HV for GGDP and TB. This extent of increase in explanatory power, however, is not sufficient to merit statistical significance in Table 8. In contrast, the increase in explanatory power of HV merits statistical significance in Table 13.

When RV replaces HV, similar results are obtained. Table 14 shows no statistical significance between lagged values of RV and values of macroeconomic indicators. The inclusion of price levels in Table 15 suggests that lagged values of both HV and OILP correlate with the growth rate of GGDP and TB. This result is again confirmed by the Granger-causality test involving RV in Tables 9 and 10.

Table 16 shows that past values of price levels are significant in predicting values of investment (INV) and government consumption (GCON). However, Tables 13 and 15, with the inclusion of HV and RV respectively, shows that price levels are statistically meaningful predictors of INV but not of GCON. This shows that the volatility measurements weaken the explanatory power of price levels to GCON by a statistically meaningful extent.

2.1 Time series properties of data

Building on the findings of Rafiq, Salim and Bloch (2008) who found a structural break in the time series data during the Asian Financial Crisis at 1997-98, the above tests for the full data set are repeated for a partial data set that begins in 1999 as a check for the robustness of results obtained in previous sections. The unit root tests are applied to the level (original) series and first differences. The results of the ADF, PP and KPSS tests are as follows:

Table 17: Augmented Dickey-Fuller (ADF) test

(Null hypothesis: unit root present)

Legend
ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

Variable	Level series t statistics	Significance	First differenced t statistics	Significance
ggdp	-0.380		-5.899	***
inv	1.776	*	-1.102	
pcon	-1.136		-3.327	***
gcon	1.310		-2.946	***
ir	-0.316		-3.066	***
inf	-0.722		-4.365	***
tb	-0.545		-3.400	***
hv	-0.011		-3.157	***
rv	-0.197		-3.597	***
oilp	-1.395		-3.789	***

Table 18: Philips-Perron (PP) test

(Null hypothesis: unit root present)

Variable	Level series t statistics	Significance	First differenced t statistics	Significance
ggdp	-1.169		-4.281	***
inv	16.720	***	-1.375	
pcon	6.143	***	-1.848	
gcon	1.318		-4.947	***
ir	25.630	***	8.341	***

inf	0.845		-2.023	*
tb	4.254	***	-1.533	
hv	13.623	***	2.248	**
rv	16.911	***	2.673	**
oilp	13.906	***	1.525	

Table 19: Kwiatkowaski-Philips-Schmidt-Shin (KPSS) test

(Null hypothesis: stationarity present)

Variable	Original series t statistics	Significance	First differenced t statistics	Significance
ggdp	0.107		0.132	
inv	0.918	***	0.471	*
pcon	0.348		0.177	
gcon	0.923	***	0.124	
ir	0.822	***	0.407	
inf	0.108		0.070	
tb	0.230		0.149	
hv	0.700	**	0.448	
rv	0.924	***	0.471	*
oilp	1.699	***	0.064	

Significance code

‘***’: rejection of null hypothesis at 0.10% critical level.

‘**’: rejection of null hypothesis at 1% critical level.

‘*’: rejection of null hypothesis at 5% critical level.

Findings from the ADF and PP tests differ, though most variables are shown be stationary at first differences. With the exception of two variables, results from the KPSS test suggest that most variables are stationary at first differences. The unit root tests imply that level data can be used for further empirical analysis.

2.2 Lag length selection, VAR Granger-causality and block exogeneity Wald test

According to the Bayesian Information Criterion (BIC), the lag length of VAR is identified to be 3. The following results are obtained from the VAR Granger-causality and block exogeneity Wald test carried out at lag 3 with HV, RV and OILP as dependent variables, and lagged values of macroeconomic indicators as independent variables.

Table 20: Test for exogeneity for HV

(Dependent variable: HV)

Legend
ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

Excluded variable	Chi square statistics	P-value	Significance
ggdp	0.591	0.898	
inv	5.891	0.117	
pcon	0.306	0.959	
gcon	3.159	0.368	
ir	2.994	0.393	
inf	0.240	0.971	
tb	9.754	0.021	**
oilp	15.083	0.002	***
All (with oilp)	53.439	0.001	***
All (without oilp)	22.674	0.362	

Table 21: Test for exogeneity for RV

(Dependent variable: RV)

Excluded variable	Chi square statistics	P-value	Significance
ggdp	3.459	0.326	
inv	6.287	0.098	*
pcon	0.938	0.816	
gcon	1.866	0.601	
ir	3.056	0.383	
inf	1.404	0.705	
tb	8.701	0.034	**

oilp	24.774	0.000	***
All (with oilp)	94.749	0.000	***
All (without oilp)	31.556	0.065	*

Table 22: Test for exogeneity for OILP

(Dependent variable: OILP)

Excluded variable	Chi square statistics	P-value	Significance
ggdp	1.812	0.612	
inv	6.330	0.097	*
pcon	2.089	0.554	
gcon	4.930	0.177	
ir	3.479	0.324	
inf	1.716	0.633	
tb	5.141	0.162	
hv	51.830	0.000	***
rv	37.394	0.000	***
All (with hv)	151.370	0.000	***
All (without hv)	35.151	0.027	**
All (with rv)	118.210	0.000	***
All (without rv)	35.151	0.027	**

Significance code

'***': rejection of null hypothesis at 0.10% critical level.

'**': rejection of null hypothesis at 1% critical level.

'*': rejection of null hypothesis at 5% critical level.

Results from Table 20 suggest that TB and OILP have causal links to HV. However, the block exogeneity Wald Test shows that the joint significance of all other variables excluding price levels is not statistically sufficient to imply endogeneity for HV. We conclude that HV is an exogenous variable that affects the macroeconomic variables without being affected by the same variables. However, Tables 21 and 22 suggest a different story for RV and OILP. The block exogeneity Wald Test for RV and OILP shows that the joint significance of all other variables is statistically sufficient to imply endogeneity. This means that the values of RV and OILP may be determined by a particular functional relationship with the macroeconomic indicators. Recall that in the context of the full data set, RV and OILP are treated as exogenous variables.

The following tables illustrate results from the VAR Granger-causality and block exogeneity Wald test carried out at lag 3 with the variables on opposite sides. Macroeconomic indicators are dependent variables, and lagged values of HV, RV and OILP are independent variables.

Table 23: Testing for significance of HV

(Independent variable: HV)

Legend

ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

Dependent variable	Chi square statistics	P-value	Significance
ggdp	0.981	0.806	
inv	4.517	0.211	
pcon	0.169	0.982	
gcon	7.483	0.058	*
ir	11.457	0.009	***
inf	1.942	0.585	
tb	8.917	0.030	**

Table 24: Testing for significance of HV and OILP

(Independent variable: HV and OILP)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	6.193	0.402	
inv	7.799	0.253	
pcon	3.904	0.690	
gcon	8.255	0.220	
ir	31.071	0.000	***
inf	5.684	0.460	
tb	9.334	0.156	

Table 25: Testing for significance of RV

(Independent variable: RV)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	0.440	0.932	
inv	5.254	0.154	
pcon	0.408	0.939	
gcon	5.059	0.168	
ir	7.372	0.061	*
inf	0.666	0.881	
tb	6.116	0.106	

Table 26: Testing for significance of RV and OILP

(Independent variable: RV and OILP)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	9.1285	0.1665	
inv	8.805	0.1848	
pcon	4.5051	0.6087	
gcon	6.1442	0.4072	
ir	10.504	0.105	
inf	3.3623	0.7622	
tb	8.934	0.1773	

Table 27: Testing for significance of OILP

(Independent variable: OILP)

Dependent variable	Chi square statistics	P-value	Significance
ggdp	3.862	0.277	
inv	7.735	0.052	*
pcon	3.364	0.339	
gcon	5.811	0.121	
ir	5.554	0.136	
inf	1.646	0.649	
tb	5.690	0.128	

Significance code

'***': rejection of null hypothesis at 0.10% critical level.

'**': rejection of null hypothesis at 1% critical level.

'*': rejection of null hypothesis at 5% critical level.

Tables 23 shows that government consumption (GCON), interest rates (IR) and trade balance (TB) are Granger-caused by HV. Comparing Tables 23 and 24, the inclusion of price levels appears to strengthen the explanatory power of HV to interest rates (IR) and weaken that to GCON and TB. Table 25 shows that IR is Granger-caused by RV. A comparison between Table 25 and 26 shows that the inclusion of price levels appears to weaken the explanatory power of RV to IR. At this point it is interesting to observe that the statistical significance of RV and HV in predicting IR respond in opposite directions when price levels are taken into account. Table 27 shows that investments (INV) is Granger-caused by OILP. A comparison between Tables 24, 26 and 27 shows that the inclusion of either volatility measurement weakens the predictive power of price levels to INV.

2.3 VAR estimation

The results of the VAR(3) models for both HV and RV, with and without OILP, are presented in the following tables. Numbers in bold represent statistical significance at a 5% critical level or lower. SE in the tables represents standard error.

Table 28: VAR (3) output for HV without OILP[11]

Legend
ggdp – growth rate of gdp
inv – investment
pcon – private consumption
gcon – government consumption
ir – interest rate
inf – inflation rate
tb – trade balance

	hv	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	1.313E+00	-3.067E-04	2.614E-04	6.295E-04	1.323E-04	-1.095E-05	1.508E-04	-4.152E-01
SE	3.033E-01	5.369E-04	1.843E-04	4.708E-04	1.723E-04	6.454E-05	3.112E-04	2.823E-01
hv (-2)	-2.518E-01	-1.052E-03	1.509E-05	-8.965E-05	-2.858E-05	-4.680E-06	-7.455E-04	-1.779E-01
SE	4.172E-01	7.386E-04	2.535E-04	6.477E-04	2.370E-04	8.879E-05	4.281E-04	3.883E-01
hv (-3)	-4.991E-01	-8.790E-05	2.467E-05	6.753E-05	1.197E-03	1.924E-04	1.091E-03	1.471E+00
SE	8.761E-01	1.551E-03	5.324E-04	1.360E-03	4.978E-04	1.865E-04	8.989E-04	8.155E-01

Table 29: VAR (3) output for HV with OILP[12]

	hv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	8.835E-01	-3.468E-03	1.858E-04	-1.442E-05	-2.312E-04	1.211E-04	-1.566E-04	-6.825E-04	6.895E-01
SE	3.986E-01	1.908E-03	9.771E-04	2.533E-04	8.683E-04	2.816E-04	1.077E-04	4.532E-04	1.481E+00
hv (-2)	-8.633E-01	-7.414E-03	-3.561E-03	-2.756E-04	1.838E-03	-5.616E-04	2.174E-04	1.894E-04	1.324E-01
SE	9.112E-01	4.362E-03	2.234E-03	5.790E-04	1.985E-03	6.439E-04	2.462E-04	1.036E-03	1.174E+00
hv (-3)	2.281E-01	-1.386E-03	-2.363E-03	5.309E-04	2.863E-03	3.952E-04	2.661E-04	1.828E-03	6.895E-01
SE	1.150E+00	5.504E-03	2.819E-03	7.306E-04	2.505E-03	8.125E-04	3.107E-04	1.308E-03	1.481E+00
oilp(-1)	2.729E+01	8.921E-01	-2.099E-01	2.332E-02	2.313E-01	-1.943E-02	3.850E-02	1.948E-01	1.096E+02

[11] The complete set of results is given in Appendix B in Table 28 (Complete).
[12] The complete set of results is given in Appendix B in Table 29 (Complete).

SE	9.756E+01	4.670E-01	2.392E-01	6.199E-02	2.125E-01	6.894E-02	2.636E-02	1.109E-01	1.257E+02
oilp(-2)	2.870E+02	1.267E+00	4.594E-01	1.589E-01	-2.040E-01	9.881E-02	-3.029E-02	-6.261E-02	-9.122E+01
SE	1.615E+02	7.729E-01	3.958E-01	1.026E-01	3.518E-01	1.141E-01	4.363E-02	1.836E-01	2.080E+02
oilp(-3)	-1.845E+02	-4.925E-01	7.386E-02	-1.133E-01	-2.248E-01	4.619E-02	1.284E-03	-6.499E-02	1.096E+02
SE	9.755E+01	4.669E-01	2.391E-01	6.198E-02	2.125E-01	6.893E-02	2.636E-02	1.109E-01	1.257E+02

Table 30: VAR (3) output for RV without OILP[13]

	rv	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	2.142E+00	-1.841E-02	6.301E-03	2.060E-02	1.484E-02	-9.498E-04	4.533E-03	3.115E+00
SE	3.783E-01	1.369E-02	5.475E-03	1.392E-02	5.091E-03	1.886E-03	1.036E-02	1.024E+01
rv (-2)	-2.063E+00	3.075E-02	-8.246E-03	-3.165E-02	-2.612E-02	4.239E-03	-1.381E-03	-2.126E+01
SE	7.214E-01	2.610E-02	1.044E-02	2.655E-02	9.708E-03	3.596E-03	1.976E-02	1.953E+01
rv (-3)	3.868E-01	-8.048E-02	1.762E-02	4.509E-02	2.628E-02	-6.664E-03	-2.934E-02	1.407E+01
SE	6.558E-01	2.373E-02	9.490E-03	2.414E-02	8.825E-03	3.269E-03	1.797E-02	1.775E+01

Table 31: VAR (3) output for RV with OILP[14]

	rv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	1.326E+00	-5.062E-02	-4.327E-02	-5.672E-03	2.311E-02	1.155E-02	-4.990E-03	-1.785E-02	-3.191E+00
SE	3.285E-01	5.334E-02	1.558E-02	5.132E-03	1.949E-02	5.798E-03	1.595E-03	8.340E-03	1.293E+01
rv (-2)	-1.130E+00	-7.168E-02	5.459E-02	2.443E-03	-2.786E-02	-2.308E-02	8.457E-03	2.671E-02	-1.403E+01
SE	5.302E-01	8.609E-02	2.514E-02	8.282E-03	3.145E-02	9.357E-03	2.575E-03	1.346E-02	2.087E+01

[13] The complete set of results is given in Appendix B in Table 30 (Complete).
[14] The complete set of results is given in Appendix B in Table 31 (Complete).

rv (-3)	4.916E-02	-1.452E-01	-1.059E-01	1.083E-02	5.687E-02	1.914E-02	-1.079E-02	-4.845E-02	2.112E+00
SE	4.714E-01	7.653E-02	2.235E-02	7.362E-03	2.796E-02	8.318E-03	2.289E-03	1.196E-02	1.856E+01
oilp(-1)	6.141E+00	1.192E+00	1.143E-01	6.455E-02	5.602E-02	4.033E-03	2.093E-02	1.585E-01	2.202E+01
SE	1.630E+00	2.647E-01	7.730E-02	2.546E-02	9.670E-02	2.877E-02	7.915E-03	4.138E-02	6.418E+01
oilp(-2)	2.641E+00	5.421E-01	7.709E-02	9.468E-02	-8.378E-02	-1.476E-02	4.605E-03	-5.626E-02	-4.755E+01
SE	2.914E+00	4.732E-01	1.382E-01	4.552E-02	1.729E-01	5.143E-02	1.415E-02	7.398E-02	1.147E+02
oilp(-3)	-5.322E+00	-1.826E-01	8.669E-02	-8.404E-02	-1.103E-01	8.920E-02	1.915E-02	9.721E-02	1.549E+02
SE	2.203E+00	3.578E-01	1.045E-01	3.442E-02	1.307E-01	3.888E-02	1.070E-02	5.593E-02	8.675E+01

Table 32: VAR (3) output for OILP without HV and RV[15]

	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
oilp (-1)	1.325E+00	8.418E-02	4.348E-02	7.038E-02	2.965E-02	1.380E-02	1.458E-01	3.069E+01
SE	3.695E-01	1.154E-01	2.506E-02	8.990E-02	2.827E-02	1.099E-02	5.292E-02	5.567E+01
oilp (-2)	-1.088E+00	-2.859E-01	8.131E-02	1.219E-01	-1.679E-02	-1.481E-02	-1.850E-01	-1.967E+02
SE	5.255E-01	1.642E-01	3.564E-02	1.279E-01	4.021E-02	1.563E-02	7.526E-02	7.917E+01
oilp (-3)	-1.838E-02	8.432E-02	-6.213E-02	-1.106E-01	9.527E-02	1.692E-02	8.757E-02	1.852E+02
SE	5.662E-01	1.769E-01	3.840E-02	1.378E-01	4.332E-02	1.684E-02	8.109E-02	8.530E+01

[15] The complete set of results is given in Appendix B in Table 32 (Complete).

In Table 28, lagged values of HV correlate to values of government consumption (GCON) and trade balance (TB). However, the inclusion of price levels in Table 29 appears to weaken the predictive significance of HV to GCON and TB. In contrast, RV displays a completely different set of results. Recall that RV and HV produce the same results in section 1, in which the VAR model is applied in the context of the entire data set. Table 30 shows that past values of RV correlate to the growth rate of GDP (GGDP), investment (INV), private consumption (PCON), government consumption (GCON) and interest rate (IR). The inclusion of price levels strengthens the predictive significance of RV to GGDP, IR and the inflation rate (INF), and weakens that to INV. Lagged values of price levels correlate to values of INV, GCON, INF and TB in Table 32. When past values of HV are included in the VAR (3) model, the predictive significance of price levels to all macroeconomic variables weaken; when that of RV are included, the predictive significance of price levels to INV and IR strengthens, while that to INF and TB weakens.

Conclusion Of Results And Policy Implications

If volatility is measured as HV, volatility is treated as an exogenous variable for both sets of data. However, the results in both sections appear to be ambiguous. In the context of the full data set in section 1, past values of HV do not correlate to any macroeconomic indicators and the inclusion of price levels strengthens the predictive significance of HV to GGDP and TB. In the context of the partial data set in section 2, past values of HV correlate to GCON and TB and the inclusion of price levels weakens the predictive significance of HV to the same indicators. It seems that no common statistically significant results exist in the two sections. If volatility is measured as RV, volatility is treated as an exogenous variable in the context of the full data set and an endogenous variable in the partial data set. A common statistically significant result in both sections is that the inclusion of price levels significantly increases the predictive significance of RV to GGDP.

Results from both sections also show that oil price levels is a statistically significant predictor of GCON and INV. It is interesting to observe that in both sections the inclusion of RV increases the explanatory power of price levels to INV. The results from this paper show that both oil price volatility and price levels do impact the Indonesian macroeconomy, suggesting that for purposes of macroeconomic prosperity, policymakers should not only focus on stabilizing price levels for the long-run, but on controlling short-term, day-to-day fluctuations of oil prices as well.

The final set of common statistical results relates to the existence of causal links between both volatility measurements and price levels. This is consistent with the above results, which show that the inclusion of volatility or price levels does improve the predictive significance of the other variable to selected macroeconomic variables.

Further research

Future work on this topic should perhaps investigate on the possible causes of the transition from exogeneity to endogeneity for realized volatility and price levels. Though both are proven to be exogenous in the context of the entire data set, realized volatility and price levels appear to be endogenous for the more recent half. If endogeneity for realized volatility and price levels can be accounted for, further research is required to uncover the feedback mechanism by which the macroeconomy affect both variables. Another topic for future research also concerns a similar form of feedback that exists between price levels and volatility. This feedback may account for the vast improvement in predictive significance between each variable and the macroeconomic indicators when the other variable is included. It is perhaps also interesting to check whether a similar phenomenon exists for other emerging economies.

That oil price levels is a significant predictor of government consumption and investment is perhaps not surprising given Indonesia's heavy oil and electricity subsidies, a requisite for price stability and the protection of its citizens' purchasing power (Pasandran and Tisnabudi, 2010). It would be interesting for future research to look into the sensitivity of government expenditures, investment and national fuel subsidies to changes not only in oil prices, but also in prices for oil derivatives like diesel since diesel is also used by the country for electricity generation. Further work is also required to investigate into the channels by which price levels impact government consumption and investment. Previous research has established this for developed countries with free-market economies where little or no fuel subsidies exist. Perhaps a different form of channel exists for developing countries like Indonesia where fuel subsidies take up a substantial portion of the national budget.

Indonesia was a long-time oil exporter until 2006, during which it became a net oil importer. In 2009, its membership from OPEC was removed as a result of its declining oil exports. As future macroeconomic data becomes available, it would be interesting to compare time series results between the period when the country was a net oil exporter and that when it was a net oil importer. This comparison can only be carried out when sufficient data is available in the future to prevent low-power errors in time series analysis.

Appendix A

Table 12 (Complete): VAR (1) output for HV without OILP

	hv	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	1.123E+00	-3.044E-04	2.920E-04	1.023E-04	1.062E-04	-1.305E-05	-1.124E-04	-6.715E-02
SE	6.799E-02	3.177E-04	2.151E-04	2.553E-04	6.979E-05	7.407E-05	2.250E-04	7.582E-02
ggdp (-1)	3.174E+01	-4.962E-01	1.069E-01	2.292E-01	8.310E-02	-6.844E-02	-1.499E-01	3.301E+01
SE	3.667E+01	1.713E-01	1.160E-01	1.377E-01	3.764E-02	3.995E-02	1.214E-01	4.089E+01
inv (-1)	-9.174E-02	2.055E-01	4.786E-01	-3.376E-01	2.868E-03	1.257E-01	1.106E-01	-2.759E+01
SE	3.177E+01	1.484E-01	1.005E-01	1.193E-01	3.261E-02	3.461E-02	1.051E-01	3.543E+01
pcon (-1)	8.470E+00	-9.209E-02	-2.560E-03	6.375E-01	-4.232E-02	-9.711E-02	-7.687E-02	1.716E+01
SE	2.374E+01	1.109E-01	7.511E-02	8.912E-02	2.437E-02	2.586E-02	7.856E-02	2.647E+01
gcon (-1)	6.382E+01	-9.200E-01	2.760E-01	-3.201E-01	4.494E-01	-4.620E-01	-4.858E-01	-1.196E+02
SE	1.164E+02	5.440E-01	3.684E-01	4.371E-01	1.195E-01	1.268E-01	3.853E-01	1.298E+02
ir (-1)	-2.211E+01	-8.160E-02	-1.204E-01	1.221E-01	8.520E-03	8.544E-01	-7.674E-03	-7.338E+00
SE	2.875E+01	1.343E-01	9.096E-02	1.079E-01	2.951E-02	3.132E-02	9.514E-02	3.206E+01
inf (-1)	-4.851E+00	3.526E-01	-4.442E-02	8.073E-02	-1.154E-01	2.545E-01	6.459E-01	-4.305E+01
SE	4.096E+01	1.914E-01	1.296E-01	1.538E-01	4.204E-02	4.462E-02	1.356E-01	4.568E+01
tb (-1)	3.854E-02	2.089E-04	-6.904E-04	6.999E-05	-8.042E-06	-1.887E-05	1.052E-04	8.285E-01
SE	6.899E-02	3.224E-04	2.183E-04	2.590E-04	7.082E-05	7.516E-05	2.283E-04	7.694E-02
C	-7.790E+02	1.458E+01	1.566E+01	2.957E+01	6.638E+00	9.054E+00	7.345E+00	1.440E+03
SE	2.378E+03	1.111E+01	7.524E+00	8.927E+00	2.441E+00	2.590E+00	7.870E+00	2.652E+03

Table 13 (Complete): VAR (1) output for HV with OILP

	hv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	8.383E-01	-5.716E-03	-1.023E-03	-1.722E-04	1.822E-04	-1.073E-05	8.446E-05	-2.480E-04	-3.355E-01
SE	9.105E-02	5.488E-04	4.644E-04	3.154E-04	3.851E-04	1.035E-04	1.106E-04	3.389E-04	1.054E-01
oilp (-1)	4.250E+01	1.310E+00	1.074E-01	6.939E-02	-1.195E-02	1.749E-02	-1.458E-02	2.027E-02	4.011E+01
SE	1.013E+01	6.109E-02	5.169E-02	3.510E-02	4.286E-02	1.152E-02	1.231E-02	3.772E-02	1.173E+01
ggdp (-1)	1.116E+01	1.207E-01	-5.482E-01	7.330E-02	2.350E-01	7.463E-02	-6.138E-02	-1.597E-01	1.358E+01
SE	3.315E+01	1.998E-01	1.691E-01	1.148E-01	1.402E-01	3.769E-02	4.027E-02	1.234E-01	3.836E+01
inv (-1)	-3.961E+01	-6.368E-02	1.056E-01	4.141E-01	-3.265E-01	-1.340E-02	1.393E-01	9.170E-02	-6.490E+01
SE	2.993E+01	1.804E-01	1.526E-01	1.037E-01	1.266E-01	3.403E-02	3.636E-02	1.114E-01	3.463E+01
pcon (-1)	8.833E+00	2.331E-01	-9.117E-02	-1.967E-03	6.374E-01	-4.217E-02	-9.723E-02	-7.670E-02	1.751E+01
SE	2.122E+01	1.279E-01	1.082E-01	7.351E-02	8.975E-02	2.413E-02	2.578E-02	7.899E-02	2.456E+01
gcon (-1)	-8.788E+01	-6.958E-01	-1.303E+00	2.823E-02	-2.775E-01	3.870E-01	-4.100E-01	-5.582E-01	-2.628E+02
SE	1.102E+02	6.642E-01	5.620E-01	3.817E-01	4.660E-01	1.253E-01	1.339E-01	4.102E-01	1.275E+02
ir (-1)	2.437E+01	-1.213E-02	3.584E-02	-4.451E-02	1.091E-01	2.765E-02	8.384E-01	1.450E-02	3.654E+01
SE	2.799E+01	1.687E-01	1.427E-01	9.695E-02	1.184E-01	3.182E-02	3.400E-02	1.042E-01	3.239E+01
inf (-1)	4.007E+00	-4.247E-02	3.750E-01	-2.996E-02	7.824E-02	-1.117E-01	2.514E-01	6.501E-01	-3.468E+01
SE	3.668E+01	2.211E-01	1.871E-01	1.270E-01	1.551E-01	4.170E-02	4.456E-02	1.365E-01	4.244E+01
tb (-1)	-1.953E-01	-1.173E-03	-3.819E-04	-1.072E-03	1.357E-04	-1.043E-04	6.135E-05	-6.346E-06	6.078E-01
SE	8.315E-02	5.012E-04	4.241E-04	2.880E-04	3.517E-04	9.455E-05	1.010E-04	3.095E-04	9.622E-02
C	2.051E+02	-9.733E+00	1.707E+01	1.727E+01	2.929E+01	7.043E+00	8.717E+00	7.815E+00	2.369E+03
SE	2.139E+03	1.289E+01	1.091E+01	7.408E+00	9.045E+00	2.432E+00	2.598E+00	7.961E+00	2.475E+03

Table 14 (Complete): VAR (1) output for RV without OILP

	rv	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	1.097E+00	-2.875E-03	6.292E-03	1.497E-03	1.938E-03	-1.489E-04	-1.655E-03	-1.198E+00
SE	5.629E-02	5.928E-03	3.974E-03	4.741E-03	1.296E-03	1.375E-03	4.180E-03	1.408E+00
ggdp (-1)	1.302E+00	-5.058E-01	1.030E-01	2.304E-01	8.298E-02	-6.876E-02	-1.512E-01	3.298E+01
SE	1.636E+00	1.723E-01	1.155E-01	1.378E-01	3.769E-02	3.998E-02	1.215E-01	4.094E+01
inv (-1)	1.069E+00	1.940E-01	4.674E-01	-3.371E-01	1.009E-03	1.254E-01	1.100E-01	-2.659E+01
SE	1.431E+00	1.506E-01	1.010E-01	1.205E-01	3.294E-02	3.494E-02	1.062E-01	3.578E+01
pcon (-1)	6.657E-01	-9.140E-02	-1.806E-03	6.375E-01	-4.219E-02	-9.709E-02	-7.686E-02	1.709E+01
SE	1.059E+00	1.115E-01	7.475E-02	8.917E-02	2.438E-02	2.587E-02	7.862E-02	2.649E+01
gcon (-1)	1.691E+00	-9.192E-01	2.438E-01	-3.251E-01	4.409E-01	-4.617E-01	-4.802E-01	-1.144E+02
SE	5.211E+00	5.487E-01	3.679E-01	4.389E-01	1.200E-01	1.273E-01	3.870E-01	1.304E+02
ir (-1)	-1.253E+00	-7.375E-02	-1.117E-01	1.219E-01	1.007E-02	8.546E-01	-7.498E-03	-8.191E+00
SE	1.291E+00	1.359E-01	9.114E-02	1.087E-01	2.973E-02	3.154E-02	9.586E-02	3.229E+01
inf (-1)	-1.479E-01	3.544E-01	-4.465E-02	8.035E-02	-1.156E-01	2.545E-01	6.463E-01	-4.289E+01
SE	1.827E+00	1.924E-01	1.290E-01	1.538E-01	4.207E-02	4.462E-02	1.356E-01	4.570E+01
tb (-1)	2.183E-03	1.992E-04	-7.413E-04	6.421E-05	-2.056E-05	-1.885E-05	1.117E-04	8.360E-01
SE	3.170E-03	3.338E-04	2.238E-04	2.669E-04	7.300E-05	7.743E-05	2.354E-04	7.929E-02
C	-6.651E+01	1.471E+01	1.608E+01	2.961E+01	6.738E+00	9.056E+00	7.300E+00	1.381E+03
SE	1.063E+02	1.119E+01	7.502E+00	8.948E+00	2.447E+00	2.596E+00	7.890E+00	2.658E+03

Table 15 (Complete): VAR (1) output for RV with OILP

	rv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	8.116E-01	-1.090E-01	-1.711E-02	-3.294E-03	3.095E-03	-8.675E-04	2.520E-03	-4.669E-03	-8.249E+00
SE	8.587E-02	1.318E-02	9.911E-03	6.644E-03	8.113E-03	2.177E-03	2.319E-03	7.142E-03	2.155E+00
oilp (-1)	2.116E+00	1.364E+00	1.056E-01	7.109E-02	-1.186E-02	2.080E-02	-1.980E-02	2.235E-02	5.230E+01
SE	5.149E-01	7.903E-02	5.943E-02	3.983E-02	4.864E-02	1.306E-02	1.390E-02	4.282E-02	1.292E+01
ggdp (-1)	3.933E-01	9.375E-02	-5.511E-01	7.248E-02	2.355E-01	7.405E-02	-6.026E-02	-1.608E-01	1.052E+01
SE	1.486E+00	2.280E-01	1.715E-01	1.149E-01	1.404E-01	3.767E-02	4.011E-02	1.236E-01	3.728E+01
inv (-1)	-4.803E-01	-2.009E-02	1.167E-01	4.154E-01	-3.284E-01	-1.423E-02	1.399E-01	9.367E-02	-6.489E+01
SE	1.338E+00	2.054E-01	1.545E-01	1.036E-01	1.265E-01	3.394E-02	3.614E-02	1.113E-01	3.358E+01
pcon (-1)	6.551E-01	2.267E-01	-9.193E-02	-2.162E-03	6.376E-01	-4.229E-02	-9.699E-02	-7.697E-02	1.683E+01
SE	9.506E-01	1.459E-01	1.097E-01	7.354E-02	8.981E-02	2.410E-02	2.567E-02	7.906E-02	2.385E+01
gcon (-1)	-4.480E+00	-4.173E-01	-1.227E+00	3.649E-02	-2.905E-01	3.802E-01	-4.040E-01	-5.454E-01	-2.669E+02
SE	4.914E+00	7.542E-01	5.671E-01	3.801E-01	4.642E-01	1.246E-01	1.327E-01	4.087E-01	1.233E+02
ir (-1)	7.303E-01	-3.212E-02	2.522E-02	-4.508E-02	1.108E-01	2.957E-02	8.360E-01	1.346E-02	4.084E+01
SE	1.256E+00	1.927E-01	1.449E-01	9.714E-02	1.186E-01	3.184E-02	3.390E-02	1.044E-01	3.150E+01
inf (-1)	3.127E-01	-1.693E-02	3.774E-01	-2.918E-02	7.777E-02	-1.111E-01	2.502E-01	6.512E-01	-3.150E+01
SE	1.644E+00	2.523E-01	1.897E-01	1.272E-01	1.553E-01	4.168E-02	4.438E-02	1.367E-01	4.125E+01
tb (-1)	-7.329E-03	-7.896E-04	-2.753E-04	-1.061E-03	1.175E-04	-1.141E-04	7.014E-05	1.122E-05	6.009E-01
SE	3.668E-03	5.630E-04	4.234E-04	2.838E-04	3.466E-04	9.301E-05	9.904E-05	3.051E-04	9.204E-02
C	-3.491E+01	-1.387E+01	1.628E+01	1.714E+01	2.943E+01	7.048E+00	8.760E+00	7.634E+00	2.162E+03
SE	9.571E+01	1.469E+01	1.105E+01	7.404E+00	9.042E+00	2.427E+00	2.584E+00	7.960E+00	2.401E+03

Table 16 (Complete): VAR (1) output for OILP without HV and RV

	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
oilp(-1)	8.359E-01	2.263E-02	5.512E-02	3.150E-03	1.660E-02	-7.579E-03	-2.813E-04	1.231E+01
SE	6.612E-02	3.550E-02	2.331E-02	2.844E-02	7.635E-03	8.193E-03	2.509E-02	8.353E+00
ggdp (-1)	1.807E-01	-5.375E-01	7.511E-02	2.331E-01	7.474E-02	-6.227E-02	-1.571E-01	1.710E+01
SE	3.238E-01	1.738E-01	1.142E-01	1.393E-01	3.739E-02	4.013E-02	1.229E-01	4.091E+01
inv (-1)	1.298E-01	1.402E-01	4.199E-01	-3.326E-01	-1.303E-02	1.364E-01	1.001E-01	-5.354E+01
SE	2.909E-01	1.562E-01	1.026E-01	1.251E-01	3.359E-02	3.605E-02	1.104E-01	3.675E+01
pcon (-1)	2.445E-01	-8.914E-02	-1.626E-03	6.371E-01	-4.215E-02	-9.740E-02	-7.621E-02	1.817E+01
SE	2.074E-01	1.113E-01	7.311E-02	8.922E-02	2.395E-02	2.570E-02	7.871E-02	2.620E+01
gcon (-1)	7.876E-01	-1.038E+00	7.291E-02	-3.247E-01	3.898E-01	-4.319E-01	-4.938E-01	-1.757E+02
SE	1.052E+00	5.647E-01	3.708E-01	4.525E-01	1.215E-01	1.303E-01	3.992E-01	1.329E+02
ir (-1)	-3.540E-01	-2.531E-02	-5.481E-02	1.200E-01	2.701E-02	8.435E-01	-3.325E-04	1.648E+01
SE	2.683E-01	1.440E-01	9.459E-02	1.154E-01	3.098E-02	3.325E-02	1.018E-01	3.390E+01
inf (-1)	-1.159E-01	3.618E-01	-3.217E-02	8.058E-02	-1.118E-01	2.525E-01	6.469E-01	-3.899E+01
SE	3.583E-01	1.923E-01	1.263E-01	1.541E-01	4.137E-02	4.439E-02	1.360E-01	4.526E+01
tb (-1)	9.416E-04	-3.562E-06	-1.009E-03	6.833E-05	-1.003E-04	3.010E-05	8.540E-05	7.319E-01
SE	7.429E-04	3.989E-04	2.619E-04	3.196E-04	8.579E-05	9.207E-05	2.820E-04	9.386E-02
C	-1.600E+01	1.595E+01	1.708E+01	2.949E+01	7.031E+00	8.809E+00	7.543E+00	2.001E+03
SE	2.088E+01	1.121E+01	7.361E+00	8.982E+00	2.411E+00	2.587E+00	7.924E+00	2.638E+03

Appendix B

Table 28(Complete): VAR (3) output for HV without OILP

	hv	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	1.313E+00	-3.067E-04	2.614E-04	6.295E-04	1.323E-04	-1.095E-05	1.508E-04	-4.152E-01
SE	3.033E-01	5.369E-04	1.843E-04	4.708E-04	1.723E-04	6.454E-05	3.112E-04	2.823E-01
hv (-2)	-2.518E-01	-1.052E-03	1.509E-05	-8.965E-05	-2.858E-05	-4.680E-06	-7.455E-04	-1.779E-01
SE	4.172E-01	7.386E-04	2.535E-04	6.477E-04	2.370E-04	8.879E-05	4.281E-04	3.883E-01
hv (-3)	-4.991E-01	-8.790E-05	2.467E-05	6.753E-05	1.197E-03	1.924E-04	1.091E-03	1.471E+00
SE	8.761E-01	1.551E-03	5.324E-04	1.360E-03	4.978E-04	1.865E-04	8.989E-04	8.155E-01
ggdp (-1)	1.148E+02	-4.559E-01	-3.122E-02	-9.683E-03	2.146E-02	6.996E-02	1.862E-01	3.921E+02
SE	2.415E+02	4.275E-01	1.467E-01	3.749E-01	1.372E-01	5.140E-02	2.478E-01	2.248E+02
ggdp (-2)	-7.584E+01	-6.078E-01	2.370E-02	2.347E-01	-2.706E-01	6.406E-02	-2.047E-01	1.874E+02
SE	2.625E+02	4.648E-01	1.595E-01	4.076E-01	1.492E-01	5.587E-02	2.693E-01	2.444E+02
ggdp (-3)	5.097E+01	-5.079E-02	3.723E-02	-3.309E-02	-1.122E-01	4.983E-03	5.721E-02	5.504E+01
SE	1.039E+02	1.840E-01	6.315E-02	1.614E-01	5.904E-02	2.212E-02	1.066E-01	9.673E+01
inv (-1)	-5.530E+02	6.141E-01	5.156E-01	-8.379E-01	-2.679E-01	-1.101E-02	-3.801E-01	5.576E+02
SE	5.714E+02	1.012E+00	3.472E-01	8.872E-01	3.246E-01	1.216E-01	5.863E-01	5.319E+02
inv (-2)	4.024E+02	1.669E+00	-2.068E-01	-9.480E-01	-2.740E-02	2.007E-01	1.031E+00	-3.612E+02
SE	6.520E+02	1.154E+00	3.962E-01	1.012E+00	3.704E-01	1.388E-01	6.690E-01	6.069E+02
inv (-3)	2.058E+01	-1.126E+00	3.019E-01	1.184E+00	1.651E-01	-1.336E-01	-3.261E-01	-9.433E+01
SE	4.349E+02	7.699E-01	2.642E-01	6.752E-01	2.471E-01	9.255E-02	4.462E-01	4.048E+02
pcon (-1)	3.179E+02	1.651E-01	-1.290E-01	3.076E-01	-1.287E-01	9.660E-02	4.367E-01	2.087E+02
SE	3.001E+02	5.313E-01	1.824E-01	4.660E-01	1.705E-01	6.387E-02	3.079E-01	2.794E+02
pcon (-2)	-2.633E+02	-8.228E-01	1.008E-01	6.844E-01	-9.989E-02	-2.870E-02	-5.864E-01	-6.473E+01
SE	3.503E+02	6.202E-01	2.129E-01	5.439E-01	1.990E-01	7.455E-02	3.594E-01	3.261E+02
pcon (-3)	1.785E+02	7.184E-01	-1.565E-02	-6.174E-01	9.085E-02	-8.620E-02	9.108E-02	-2.267E+00
SE	2.428E+02	4.300E-01	1.476E-01	3.771E-01	1.380E-01	5.169E-02	2.492E-01	2.261E+02

gcon (-1)	-4.402E+02	-8.237E-01	5.280E-02	5.555E-01	4.788E-01	9.802E-02	5.307E-01	1.877E+02
SE	3.729E+02	6.602E-01	2.266E-01	5.790E-01	2.119E-01	7.937E-02	3.826E-01	3.471E+02
gcon (-2)	-4.326E+02	-1.492E+00	2.960E-01	7.557E-01	3.822E-01	-2.515E-01	-8.577E-01	5.549E+02
SE	3.620E+02	6.409E-01	2.200E-01	5.621E-01	2.057E-01	7.705E-02	3.714E-01	3.370E+02
gcon (-3)	1.122E+02	4.621E-01	-6.513E-02	-6.006E-01	-3.903E-01	-2.711E-01	-8.725E-01	3.121E+02
SE	4.562E+02	8.077E-01	2.772E-01	7.084E-01	2.592E-01	9.710E-02	4.681E-01	4.247E+02
ir (-1)	-1.535E+03	7.888E-01	-1.388E+00	-1.303E+00	6.488E-01	1.172E+00	4.963E-01	1.775E+03
SE	8.445E+02	1.495E+00	5.132E-01	1.311E+00	4.798E-01	1.797E-01	8.665E-01	7.861E+02
ir (-2)	6.812E+02	-3.694E+00	1.184E+00	3.151E+00	-1.345E+00	-5.372E-01	-1.627E+00	-7.963E+02
SE	1.093E+03	1.936E+00	6.643E-01	1.697E+00	6.212E-01	2.327E-01	1.122E+00	1.018E+03
ir (-3)	2.208E+02	2.783E+00	-2.311E-01	-2.035E+00	5.041E-01	2.384E-01	9.108E-01	-3.104E+02
SE	8.405E+02	1.488E+00	5.107E-01	1.305E+00	4.775E-01	1.789E-01	8.624E-01	7.824E+02
inf (-1)	6.504E+02	7.884E-01	1.708E-01	-6.887E-01	-5.061E-01	-7.789E-02	-5.186E-01	-5.002E+02
SE	3.147E+02	5.571E-01	1.912E-01	4.886E-01	1.788E-01	6.697E-02	3.229E-01	2.929E+02
inf (-2)	3.359E+02	1.335E+00	-5.577E-02	-1.252E+00	1.450E-02	1.597E-01	3.285E-01	-2.874E+02
SE	4.004E+02	7.089E-01	2.433E-01	6.217E-01	2.275E-01	8.522E-02	4.108E-01	3.727E+02
inf (-3)	3.687E+02	4.176E-02	1.257E-01	-3.496E-02	1.187E-01	9.384E-02	1.028E-01	5.642E+01
SE	2.359E+02	4.177E-01	1.434E-01	3.663E-01	1.341E-01	5.022E-02	2.421E-01	2.196E+02
tb (-1)	4.154E-02	-6.901E-04	2.273E-04	4.109E-04	2.728E-04	-1.257E-04	-3.982E-04	2.946E-01
SE	2.805E-01	4.966E-04	1.704E-04	4.355E-04	1.594E-04	5.970E-05	2.878E-04	2.611E-01
tb (-2)	7.967E-01	6.928E-04	-6.446E-05	-5.325E-04	-2.290E-05	-9.339E-05	9.089E-05	8.558E-02
SE	2.743E-01	4.856E-04	1.667E-04	4.259E-04	1.558E-04	5.838E-05	2.814E-04	2.553E-01
tb (-3)	-1.030E-01	5.801E-04	-1.862E-04	-9.346E-04	-4.108E-04	2.967E-05	-3.376E-04	2.774E-01
SE	3.310E-01	5.861E-04	2.012E-04	5.140E-04	1.881E-04	7.045E-05	3.396E-04	3.081E-01
C	-3.826E+03	-1.256E+01	1.560E+01	6.124E+01	2.186E+01	5.244E+00	1.560E+01	-2.907E+04
SE	1.811E+04	3.206E+01	1.100E+01	2.812E+01	1.029E+01	3.854E+00	1.858E+01	1.686E+04

Table 29(Complete): VAR (3) output for HV with OILP

	hv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	8.835E-01	-3.468E-03	1.858E-04	-1.442E-05	-2.312E-04	1.211E-04	-1.566E-04	-6.825E-04	6.895E-01
SE	3.986E-01	1.908E-03	9.771E-04	2.533E-04	8.683E-04	2.816E-04	1.077E-04	4.532E-04	1.481E+00
hv (-2)	-8.633E-01	-7.414E-03	-3.561E-03	-2.756E-04	1.838E-03	-5.616E-04	2.174E-04	1.894E-04	1.324E-01
SE	9.112E-01	4.362E-03	2.234E-03	5.790E-04	1.985E-03	6.439E-04	2.462E-04	1.036E-03	1.174E+00
hv (-3)	2.281E-01	-1.386E-03	-2.363E-03	5.309E-04	2.863E-03	3.952E-04	2.661E-04	1.828E-03	6.895E-01
SE	1.150E+00	5.504E-03	2.819E-03	7.306E-04	2.505E-03	8.125E-04	3.107E-04	1.308E-03	1.481E+00
oilp(-1)	2.729E+01	8.921E-01	-2.099E-01	2.332E-02	2.313E-01	-1.943E-02	3.850E-02	1.948E-01	1.096E+02
SE	9.756E+01	4.670E-01	2.392E-01	6.199E-02	2.125E-01	6.894E-02	2.636E-02	1.109E-01	1.257E+02
oilp(-2)	2.870E+02	1.267E+00	4.594E-01	1.589E-01	-2.040E-01	9.881E-02	-3.029E-02	-6.261E-02	-9.122E+01
SE	1.615E+02	7.729E-01	3.958E-01	1.026E-01	3.518E-01	1.141E-01	4.363E-02	1.836E-01	2.080E+02
oilp(-3)	-1.845E+02	-4.925E-01	7.386E-02	-1.133E-01	-2.248E-01	4.619E-02	1.284E-03	-6.499E-02	1.096E+02
SE	9.755E+01	4.669E-01	2.391E-01	6.198E-02	2.125E-01	6.893E-02	2.636E-02	1.109E-01	1.257E+02
ggdp (-1)	3.192E+02	1.113E+00	-1.929E-01	8.397E-02	-9.230E-02	7.836E-02	5.503E-02	1.754E-01	3.321E+02
SE	2.046E+02	9.794E-01	5.016E-01	1.300E-01	4.458E-01	1.446E-01	5.529E-02	2.327E-01	2.636E+02
ggdp (-2)	5.485E+01	3.504E-01	-3.140E-01	9.366E-02	6.214E-02	-1.864E-01	5.485E-02	-2.184E-01	1.924E+02
SE	2.136E+02	1.022E+00	5.235E-01	1.357E-01	4.652E-01	1.509E-01	5.771E-02	2.428E-01	2.751E+02
ggdp (-3)	8.193E+01	1.689E-01	1.780E-02	5.364E-02	-7.525E-02	-1.095E-01	-7.722E-03	7.237E-03	1.397E+01
SE	8.529E+01	4.082E-01	2.091E-01	5.419E-02	1.858E-01	6.027E-02	2.305E-02	9.698E-02	1.099E+02
inv (-1)	-1.346E+03	-3.823E+00	-4.451E-01	6.784E-02	-5.019E-01	-6.657E-01	-5.393E-02	-7.840E-01	3.760E+02
SE	5.185E+02	2.482E+00	1.271E+00	3.294E-01	1.129E+00	3.664E-01	1.401E-01	5.896E-01	6.679E+02
inv (-2)	2.281E+02	-1.200E+00	1.584E+00	-3.094E-01	-1.014E+00	-5.020E-02	1.969E-01	9.570E-01	-3.296E+02
SE	4.892E+02	2.342E+00	1.199E+00	3.108E-01	1.066E+00	3.457E-01	1.322E-01	5.563E-01	6.302E+02
inv (-3)	-2.660E+02	-1.170E-01	-2.051E+00	1.556E-01	1.817E+00	-2.239E-01	-1.748E-01	-5.501E-01	-4.430E+02
SE	4.273E+02	2.045E+00	1.047E+00	2.715E-01	9.308E-01	3.019E-01	1.155E-01	4.859E-01	5.504E+02
pcon (-1)	4.880E+02	2.597E+00	5.697E-01	-3.883E-02	5.870E-02	-3.478E-02	6.970E-02	3.511E-01	1.631E+02
SE	2.594E+02	1.241E+00	6.358E-01	1.648E-01	5.650E-01	1.833E-01	7.009E-02	2.949E-01	3.341E+02

pcon (-2)	-3.769E+02	-9.584E-01	-8.326E-01	3.215E-02	5.921E-01	-1.418E-01	-5.866E-02	-7.595E-01	-1.381E+02
SE	2.665E+02	1.276E+00	6.534E-01	1.693E-01	5.806E-01	1.883E-01	7.202E-02	3.031E-01	3.433E+02
pcon (-3)	-1.099E+02	-3.307E-01	4.112E-01	-1.802E-01	-5.642E-01	1.549E-02	-7.703E-02	4.925E-02	5.634E+01
SE	2.144E+02	1.026E+00	5.255E-01	1.362E-01	4.670E-01	1.515E-01	5.793E-02	2.437E-01	2.761E+02
gcon (-1)	-3.628E+02	-5.469E+00	-1.351E+00	1.148E-01	1.122E+00	2.650E-01	9.273E-02	5.695E-01	-4.289E+01
SE	3.456E+02	1.654E+00	8.472E-01	2.196E-01	7.528E-01	2.442E-01	9.339E-02	3.930E-01	4.452E+02
gcon (-2)	-4.768E+02	-2.904E+00	-2.649E+00	3.055E-01	1.848E+00	1.431E-01	-1.318E-01	-2.649E-01	6.638E+02
SE	4.980E+02	2.383E+00	1.221E+00	3.164E-01	1.085E+00	3.519E-01	1.346E-01	5.662E-01	6.414E+02
gcon (-3)	8.086E+02	8.448E-01	4.030E-01	3.569E-01	4.750E-02	-4.151E-01	-2.345E-01	-4.570E-01	1.372E+02
SE	4.349E+02	2.082E+00	1.066E+00	2.763E-01	9.474E-01	3.073E-01	1.175E-01	4.945E-01	5.602E+02
ir (-1)	-2.466E+03	-1.598E+01	-2.218E+00	-1.859E+00	8.090E-01	-2.116E-01	1.290E+00	8.852E-01	1.641E+03
SE	1.091E+03	5.221E+00	2.674E+00	6.930E-01	2.376E+00	7.707E-01	2.947E-01	1.240E+00	1.405E+03
ir (-2)	8.669E+02	6.202E+00	-3.761E+00	1.297E+00	3.365E+00	-1.426E+00	-5.620E-01	-1.667E+00	-9.977E+02
SE	8.255E+02	3.951E+00	2.024E+00	5.245E-01	1.798E+00	5.833E-01	2.231E-01	9.387E-01	1.063E+03
ir (-3)	9.274E+02	3.789E+00	4.716E+00	1.377E-01	-3.288E+00	1.152E+00	2.275E-01	9.869E-01	-1.358E+01
SE	8.275E+02	3.961E+00	2.029E+00	5.258E-01	1.803E+00	5.847E-01	2.236E-01	9.410E-01	1.066E+03
inf (-1)	5.817E+02	4.121E+00	1.065E+00	1.213E-01	-1.011E+00	-4.036E-01	-8.255E-02	-5.820E-01	-3.967E+02
SE	2.595E+02	1.242E+00	6.362E-01	1.649E-01	5.654E-01	1.834E-01	7.013E-02	2.951E-01	3.343E+02
inf (-2)	6.237E+02	3.531E+00	2.236E+00	9.012E-02	-1.883E+00	2.330E-01	1.005E-01	1.084E-01	-3.465E+02
SE	4.139E+02	1.981E+00	1.015E+00	2.630E-01	9.018E-01	2.925E-01	1.119E-01	4.707E-01	5.332E+02
inf (-3)	2.077E+02	1.353E+00	4.419E-01	1.622E-02	-5.606E-01	2.153E-01	5.148E-02	-1.694E-01	9.105E+01
SE	2.465E+02	1.180E+00	6.042E-01	1.566E-01	5.369E-01	1.742E-01	6.661E-02	2.803E-01	3.175E+02
tb (-1)	-1.823E-01	3.557E-04	-1.043E-03	1.024E-04	5.551E-04	1.215E-04	-1.494E-04	-5.599E-04	1.903E-01
SE	2.313E-01	1.107E-03	5.671E-04	1.470E-04	5.040E-04	1.635E-04	6.252E-05	2.631E-04	3.358E-01
tb (-2)	5.614E-01	1.564E-03	2.213E-04	-1.930E-04	-2.869E-04	-2.311E-04	-1.254E-04	-1.042E-04	-9.757E-02
SE	2.462E-01	1.178E-03	6.035E-04	1.564E-04	5.363E-04	1.739E-04	6.652E-05	2.799E-04	3.171E-01
tb (-3)	-2.733E-01	-2.733E-05	2.733E-04	-2.801E-04	-7.878E-04	-5.348E-04	1.505E-05	-4.431E-04	1.903E-01
SE	2.607E-01	1.248E-03	6.390E-04	1.656E-04	5.679E-04	1.842E-04	7.044E-05	2.964E-04	3.358E-01
C	2.931E+04	1.185E+02	4.619E+01	3.389E+01	3.358E+01	4.552E+01	8.017E+00	3.587E+01	-1.273E+04
SE	2.101E+04	1.006E+02	5.150E+01	1.335E+01	4.577E+01	1.484E+01	5.677E+00	2.389E+01	2.706E+04

Table 30 (Complete): VAR (3) output for RV without OILP

	rv	ggdp	inv	pcon	gcon	ir	inf	tb
rv (-1)	2.142E+00	-1.841E-02	6.301E-03	2.060E-02	1.484E-02	-9.498E-04	4.533E-03	3.115E+00
SE	3.783E-01	1.369E-02	5.475E-03	1.392E-02	5.091E-03	1.886E-03	1.036E-02	1.024E+01
rv (-2)	-2.063E+00	3.075E-02	-8.246E-03	-3.165E-02	-2.612E-02	4.239E-03	-1.381E-03	-2.126E+01
SE	7.214E-01	2.610E-02	1.044E-02	2.655E-02	9.708E-03	3.596E-03	1.976E-02	1.953E+01
rv (-3)	3.868E-01	-8.048E-02	1.762E-02	4.509E-02	2.628E-02	-6.664E-03	-2.934E-02	1.407E+01
SE	6.558E-01	2.373E-02	9.490E-03	2.414E-02	8.825E-03	3.269E-03	1.797E-02	1.775E+01
ggdp (-1)	2.771E+00	-3.031E-01	-7.456E-02	-1.280E-01	-7.480E-02	7.869E-02	1.906E-01	3.274E+02
SE	9.284E+00	3.360E-01	1.344E-01	3.417E-01	1.249E-01	4.628E-02	2.544E-01	2.513E+02
ggdp (-2)	-1.587E+01	-3.155E-01	-4.683E-02	-1.874E-02	-4.671E-01	9.686E-02	-1.820E-01	4.660E+01
SE	1.135E+01	4.108E-01	1.643E-01	4.178E-01	1.528E-01	5.659E-02	3.110E-01	3.073E+02
ggdp (-3)	-4.638E+00	-5.363E-02	2.718E-02	-7.218E-02	-1.568E-01	1.981E-03	4.428E-03	3.101E+01
SE	4.008E+00	1.450E-01	5.800E-02	1.475E-01	5.394E-02	1.998E-02	1.098E-01	1.085E+02
inv (-1)	-1.665E+01	1.742E+00	3.413E-01	-1.433E+00	-7.291E-01	1.041E-01	3.595E-02	1.372E+02
SE	2.476E+01	8.961E-01	3.584E-01	9.114E-01	3.333E-01	1.235E-01	6.785E-01	6.703E+02
inv (-2)	4.906E+00	3.243E-01	-3.273E-02	-3.977E-01	3.519E-01	6.686E-02	3.630E-01	-2.722E+01
SE	2.695E+01	9.753E-01	3.900E-01	9.919E-01	3.627E-01	1.344E-01	7.384E-01	7.295E+02
inv (-3)	1.412E+01	-2.069E-01	1.536E-01	8.561E-01	1.510E-01	-4.340E-02	2.963E-01	3.702E+01
SE	1.671E+01	6.046E-01	2.418E-01	6.149E-01	2.248E-01	8.329E-02	4.577E-01	4.522E+02
pcon (-1)	6.809E+00	8.988E-02	-1.491E-01	2.633E-01	-1.658E-01	8.181E-02	3.143E-01	2.198E+02
SE	1.123E+01	4.064E-01	1.625E-01	4.133E-01	1.511E-01	5.598E-02	3.077E-01	3.040E+02
pcon (-2)	-2.109E+01	-2.795E-01	1.474E-02	3.740E-01	-3.032E-01	3.317E-02	-3.711E-01	-2.027E+02
SE	1.496E+01	5.415E-01	2.166E-01	5.508E-01	2.014E-01	7.460E-02	4.100E-01	4.051E+02
pcon (-3)	1.782E+01	3.547E-01	6.415E-02	-3.555E-01	2.430E-01	-1.304E-01	-2.464E-02	7.989E+01
SE	1.047E+01	3.789E-01	1.515E-01	3.854E-01	1.409E-01	5.220E-02	2.869E-01	2.834E+02
gcon (-1)	-3.044E+01	-7.063E-01	1.364E-02	4.214E-01	3.241E-01	1.036E-01	4.637E-01	4.562E+01
SE	1.430E+01	5.176E-01	2.070E-01	5.265E-01	1.925E-01	7.131E-02	3.919E-01	3.872E+02

gcon (-2)	7.010E+00	-1.734E+00	3.532E-01	9.798E-01	5.911E-01	-2.657E-01	-8.157E-01	6.644E+02
SE	1.492E+01	5.399E-01	2.159E-01	5.491E-01	2.008E-01	7.437E-02	4.087E-01	4.038E+02
gcon (-3)	-8.225E+00	6.801E-01	-1.272E-01	-7.659E-01	-5.821E-01	-2.676E-01	-9.127E-01	1.669E+02
SE	1.698E+01	6.144E-01	2.457E-01	6.249E-01	2.285E-01	8.464E-02	4.651E-01	4.595E+02
ir (-1)	-4.480E+01	7.639E-01	-1.383E+00	-1.307E+00	6.210E-01	1.196E+00	5.110E-01	1.579E+03
SE	3.191E+01	1.155E+00	4.618E-01	1.174E+00	4.294E-01	1.591E-01	8.742E-01	8.637E+02
ir (-2)	1.796E+01	-2.151E+00	9.192E-01	2.282E+00	-2.084E+00	-4.028E-01	-1.190E+00	-1.383E+03
SE	4.519E+01	1.635E+00	6.539E-01	1.663E+00	6.081E-01	2.253E-01	1.238E+00	1.223E+03
ir (-3)	4.238E+00	1.548E+00	-1.984E-02	-1.341E+00	1.087E+00	1.172E-01	5.287E-01	2.249E+02
SE	3.509E+01	1.270E+00	5.078E-01	1.291E+00	4.722E-01	1.749E-01	9.614E-01	9.498E+02
inf (-1)	2.980E+01	6.922E-01	2.117E-01	-5.332E-01	-3.785E-01	-1.035E-01	-4.864E-01	-3.451E+02
SE	1.223E+01	4.425E-01	1.770E-01	4.501E-01	1.646E-01	6.096E-02	3.350E-01	3.310E+02
inf (-2)	4.520E+00	1.117E+00	-3.100E-02	-1.147E+00	1.118E-01	1.250E-01	2.204E-01	-1.383E+02
SE	1.570E+01	5.681E-01	2.272E-01	5.778E-01	2.113E-01	7.827E-02	4.301E-01	4.249E+02
inf (-3)	1.420E+01	-1.498E-01	1.639E-01	1.165E-01	2.610E-01	6.562E-02	7.386E-02	2.147E+02
SE	9.830E+00	3.557E-01	1.423E-01	3.618E-01	1.323E-01	4.900E-02	2.693E-01	2.661E+02
tb (-1)	2.941E-03	-8.596E-04	2.430E-04	4.794E-04	2.977E-04	-1.568E-04	-5.253E-04	3.555E-01
SE	1.061E-02	3.839E-04	1.535E-04	3.905E-04	1.428E-04	5.289E-05	2.907E-04	2.872E-01
tb (-2)	2.816E-02	6.853E-04	-5.282E-05	-4.750E-04	-3.129E-05	-1.213E-04	4.928E-05	1.239E-01
SE	1.022E-02	3.699E-04	1.479E-04	3.762E-04	1.376E-04	5.095E-05	2.800E-04	2.767E-01
tb (-3)	-2.250E-03	8.876E-04	-2.234E-04	-1.081E-03	-5.287E-04	6.181E-05	-2.123E-04	1.547E-01
SE	1.273E-02	4.608E-04	1.843E-04	4.687E-04	1.714E-04	6.348E-05	3.489E-04	3.447E-01
C	1.470E+02	-3.860E+01	2.136E+01	7.822E+01	3.454E+01	3.376E+00	1.039E+01	-2.134E+04
SE	7.463E+02	2.700E+01	1.080E+01	2.747E+01	1.004E+01	3.720E+00	2.045E+01	2.020E+04

Table 31 (Complete): VAR (3) output for RV with OILP

	hv	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
hv (-1)	1.326E+00	-5.062E-02	-4.327E-02	-5.672E-03	2.311E-02	1.155E-02	-4.990E-03	-1.785E-02	-3.191E+00
SE	3.285E-01	5.334E-02	1.558E-02	5.132E-03	1.949E-02	5.798E-03	1.595E-03	8.340E-03	1.293E+01
hv (-2)	-1.130E+00	-7.168E-02	5.459E-02	2.443E-03	-2.786E-02	-2.308E-02	8.457E-03	2.671E-02	-1.403E+01
SE	5.302E-01	8.609E-02	2.514E-02	8.282E-03	3.145E-02	9.357E-03	2.575E-03	1.346E-02	2.087E+01
hv (-3)	4.916E-02	-1.452E-01	-1.059E-01	1.083E-02	5.687E-02	1.914E-02	-1.079E-02	-4.845E-02	2.112E+00
SE	4.714E-01	7.653E-02	2.235E-02	7.362E-03	2.796E-02	8.318E-03	2.289E-03	1.196E-02	1.856E+01
oilp(-1)	6.141E+00	1.192E+00	1.143E-01	6.455E-02	5.602E-02	4.033E-03	2.093E-02	1.585E-01	2.202E+01
SE	1.630E+00	2.647E-01	7.730E-02	2.546E-02	9.670E-02	2.877E-02	7.915E-03	4.138E-02	6.418E+01
oilp(-2)	2.641E+00	5.421E-01	7.709E-02	9.468E-02	-8.378E-02	-1.476E-02	4.605E-03	-5.626E-02	-4.755E+01
SE	2.914E+00	4.732E-01	1.382E-01	4.552E-02	1.729E-01	5.143E-02	1.415E-02	7.398E-02	1.147E+02
oilp(-3)	-5.322E+00	-1.826E-01	8.669E-02	-8.404E-02	-1.103E-01	8.920E-02	1.915E-02	9.721E-02	1.549E+02
SE	2.203E+00	3.578E-01	1.045E-01	3.442E-02	1.307E-01	3.888E-02	1.070E-02	5.593E-02	8.675E+01
ggdp (-1)	7.083E+00	9.654E-01	-1.403E-01	2.227E-02	-2.048E-01	-5.815E-02	1.010E-01	2.626E-01	3.454E+02
SE	6.389E+00	1.037E+00	3.030E-01	9.979E-02	3.790E-01	1.127E-01	3.102E-02	1.622E-01	2.515E+02
ggdp (-2)	-7.454E+00	-2.185E-01	1.192E-02	9.592E-02	-1.098E-01	-4.107E-01	1.486E-01	7.112E-02	1.430E+02
SE	7.877E+00	1.279E+00	3.735E-01	1.230E-01	4.673E-01	1.390E-01	3.825E-02	1.999E-01	3.101E+02
ggdp (-3)	-3.672E+00	4.145E-02	-2.847E-02	4.763E-02	-8.153E-02	-1.574E-01	5.115E-03	1.288E-02	2.789E+01
SE	2.632E+00	4.273E-01	1.248E-01	4.111E-02	1.561E-01	4.644E-02	1.278E-02	6.680E-02	1.036E+02
inv (-1)	-3.338E+01	-3.664E+00	1.137E+00	3.921E-02	-1.251E+00	-8.137E-01	1.202E-02	-3.840E-01	1.473E+00
SE	1.707E+01	2.772E+00	8.096E-01	2.666E-01	1.013E+00	3.013E-01	8.289E-02	4.333E-01	6.721E+02
inv (-2)	-1.526E+00	-1.039E+00	3.557E-02	-2.148E-01	-2.061E-01	3.233E-01	3.070E-02	2.978E-01	-4.484E+01
SE	1.811E+01	2.941E+00	8.590E-01	2.829E-01	1.074E+00	3.196E-01	8.795E-02	4.598E-01	7.131E+02
inv (-3)	6.229E+00	1.936E+00	-1.110E+00	3.085E-02	1.249E+00	-1.655E-01	-2.004E-01	-5.163E-01	-5.192E+02
SE	1.301E+01	2.113E+00	6.172E-01	2.033E-01	7.720E-01	2.297E-01	6.319E-02	3.303E-01	5.124E+02
pcon (-1)	9.536E+00	2.515E+00	2.668E-01	-7.806E-02	1.611E-01	-1.274E-01	1.078E-01	4.061E-01	2.759E+02
	7.523E+00	1.222E+00	3.568E-01	1.175E-01	4.463E-01	1.328E-01	3.653E-02	1.910E-01	2.962E+02

pcon (-2)	-2.060E+01	-1.355E+00	-2.989E-01	3.939E-02	3.669E-01	-3.236E-01	2.699E-02	-4.285E-01	-2.454E+02
SE	9.747E+00	1.583E+00	4.622E-01	1.522E-01	5.782E-01	1.720E-01	4.733E-02	2.474E-01	3.837E+02
pcon (-3)	5.002E+00	2.656E-01	9.063E-02	-1.552E-01	-3.413E-01	2.597E-01	-1.668E-01	-1.892E-01	1.134E+02
SE	7.767E+00	1.261E+00	3.683E-01	1.213E-01	4.607E-01	1.371E-01	3.771E-02	1.971E-01	3.058E+02
gcon (-1)	-2.477E+01	-5.743E+00	-9.740E-01	6.217E-02	6.909E-01	1.704E-01	5.749E-02	2.902E-01	-2.047E+02
SE	9.848E+00	1.599E+00	4.670E-01	1.538E-01	5.842E-01	1.738E-01	4.782E-02	2.500E-01	3.877E+02
gcon (-2)	1.643E+01	-1.919E+00	-2.012E+00	3.635E-01	1.435E+00	4.382E-01	-3.025E-01	-7.921E-01	4.573E+02
SE	1.141E+01	1.852E+00	5.408E-01	1.781E-01	6.766E-01	2.013E-01	5.538E-02	2.895E-01	4.490E+02
gcon (-3)	1.617E+01	8.458E-01	1.010E+00	2.543E-01	-6.496E-01	-6.734E-01	-2.243E-01	-6.783E-01	1.397E+01
SE	1.271E+01	2.063E+00	6.025E-01	1.985E-01	7.537E-01	2.242E-01	6.169E-02	3.225E-01	5.002E+02
ir (-1)	-4.996E+01	-1.520E+01	-6.131E-01	-1.787E+00	-1.747E-01	2.108E-01	9.981E-01	-2.025E-02	9.958E+02
SE	2.690E+01	4.367E+00	1.275E+00	4.201E-01	1.596E+00	4.746E-01	1.306E-01	6.827E-01	1.059E+03
ir (-2)	3.099E+01	6.095E+00	-1.718E+00	1.180E+00	2.127E+00	-2.046E+00	-3.416E-01	-9.556E-01	-1.336E+03
SE	2.974E+01	4.829E+00	1.410E+00	4.645E-01	1.764E+00	5.249E-01	1.444E-01	7.549E-01	1.171E+03
ir (-3)	8.987E+00	2.992E+00	2.315E+00	1.915E-01	-1.889E+00	1.316E+00	2.324E-01	9.149E-01	5.682E+02
SE	2.417E+01	3.924E+00	1.146E+00	3.775E-01	1.434E+00	4.265E-01	1.174E-01	6.135E-01	9.515E+02
inf (-1)	2.273E+01	5.075E+00	8.136E-01	1.615E-01	-7.684E-01	-2.836E-01	-8.558E-02	-4.896E-01	-2.065E+02
SE	8.440E+00	1.370E+00	4.002E-01	1.318E-01	5.006E-01	1.489E-01	4.098E-02	2.142E-01	3.323E+02
inf (-2)	2.487E+00	3.301E+00	1.319E+00	4.266E-02	-1.427E+00	1.737E-01	1.476E-01	1.754E-01	-7.506E+01
SE	1.122E+01	1.821E+00	5.320E-01	1.752E-01	6.655E-01	1.980E-01	5.447E-02	2.847E-01	4.416E+02
inf (-3)	7.239E-01	1.850E+00	-2.156E-01	1.386E-02	-9.514E-02	3.361E-01	5.408E-02	-8.436E-02	3.168E+02
SE	7.206E+00	1.170E+00	3.417E-01	1.125E-01	4.274E-01	1.272E-01	3.499E-02	1.829E-01	2.837E+02
tb (-1)	-4.998E-03	1.161E-03	-1.190E-03	1.031E-04	5.844E-04	2.373E-04	-2.087E-04	-7.722E-04	2.542E-01
SE	7.445E-03	1.209E-03	3.531E-04	1.163E-04	4.417E-04	1.314E-04	3.615E-05	1.890E-04	2.931E-01
tb (-2)	1.729E-02	2.662E-03	2.633E-04	-2.046E-04	-4.029E-04	-1.178E-04	-1.925E-04	-3.499E-04	-3.813E-02
SE	7.436E-03	1.207E-03	3.526E-04	1.161E-04	4.411E-04	1.312E-04	3.611E-05	1.888E-04	2.928E-01
tb (-3)	-6.009E-03	-3.814E-04	6.691E-04	-2.834E-04	-1.006E-03	-5.869E-04	2.521E-05	-4.006E-04	5.227E-02
SE	8.418E-03	1.367E-03	3.992E-04	1.315E-04	4.994E-04	1.486E-04	4.088E-05	2.137E-04	3.314E-01
C	8.995E+02	6.006E+01	3.388E+00	3.607E+01	6.049E+01	4.428E+01	1.001E+01	4.038E+01	-5.336E+03
SE	6.002E+02	9.745E+01	2.846E+01	9.375E+00	3.560E+01	1.059E+01	2.914E+00	1.523E+01	2.363E+04

Table 32 (Complete): VAR (3) output for OILP without HV and RV

	oilp	ggdp	inv	pcon	gcon	ir	inf	tb
oilp (-1)	1.325E+00	8.418E-02	4.348E-02	7.038E-02	2.965E-02	1.380E-02	1.458E-01	3.069E+01
SE	3.695E-01	1.154E-01	2.506E-02	8.990E-02	2.827E-02	1.099E-02	5.292E-02	5.567E+01
oilp (-2)	-1.088E+00	-2.859E-01	8.131E-02	1.219E-01	-1.679E-02	-1.481E-02	-1.850E-01	-1.967E+02
SE	5.255E-01	1.642E-01	3.564E-02	1.279E-01	4.021E-02	1.563E-02	7.526E-02	7.917E+01
oilp (-3)	-1.838E-02	8.432E-02	-6.213E-02	-1.106E-01	9.527E-02	1.692E-02	8.757E-02	1.852E+02
SE	5.662E-01	1.769E-01	3.840E-02	1.378E-01	4.332E-02	1.684E-02	8.109E-02	8.530E+01
ggdp (-1)	-5.104E-01	-6.589E-01	2.291E-02	8.090E-02	-4.522E-03	5.921E-02	5.445E-02	2.409E+02
SE	1.596E+00	4.985E-01	1.082E-01	3.883E-01	1.221E-01	4.747E-02	2.285E-01	2.404E+02
ggdp (-2)	-1.540E+00	-8.501E-01	6.553E-02	3.540E-01	-2.288E-01	5.809E-02	-2.947E-01	8.465E+01
SE	1.702E+00	5.317E-01	1.154E-01	4.141E-01	1.302E-01	5.063E-02	2.437E-01	2.564E+02
ggdp (-3)	-8.050E-02	-9.170E-02	3.239E-02	-4.733E-02	-1.419E-01	-1.637E-03	-1.060E-02	1.419E+01
SE	6.835E-01	2.135E-01	4.636E-02	1.663E-01	5.229E-02	2.033E-02	9.788E-02	1.030E+02
inv (-1)	-1.425E+00	5.329E-01	1.635E-01	-9.560E-01	-4.987E-01	-1.003E-01	-7.457E-01	3.999E+02
SE	4.085E+00	1.276E+00	2.771E-01	9.940E-01	3.125E-01	1.215E-01	5.850E-01	6.155E+02
inv (-2)	1.721E+00	2.056E+00	-3.041E-01	-1.291E+00	-7.859E-02	2.418E-01	1.198E+00	-2.761E+01
SE	4.154E+00	1.298E+00	2.818E-01	1.011E+00	3.178E-01	1.236E-01	5.950E-01	6.259E+02
inv (-3)	4.316E+00	-7.491E-01	1.936E-01	1.038E+00	-1.535E-01	-1.880E-01	-4.382E-01	-2.080E+02
SE	3.173E+00	9.912E-01	2.152E-01	7.720E-01	2.428E-01	9.438E-02	4.544E-01	4.780E+02
pcon (-1)	1.214E+00	9.073E-03	-9.833E-02	3.085E-01	-1.360E-01	9.604E-02	3.204E-01	1.480E+02
SE	1.949E+00	6.089E-01	1.322E-01	4.743E-01	1.491E-01	5.798E-02	2.791E-01	2.937E+02
pcon (-2)	-1.432E+00	-9.669E-01	4.865E-02	7.173E-01	-1.232E-01	-5.822E-02	-7.413E-01	-1.645E+02
SE	2.325E+00	7.265E-01	1.577E-01	5.658E-01	1.779E-01	6.918E-02	3.331E-01	3.504E+02
pcon (-3)	1.759E+00	9.734E-01	-1.278E-01	-8.176E-01	8.482E-02	-7.675E-02	1.830E-01	1.876E+02
SE	1.680E+00	5.249E-01	1.140E-01	4.088E-01	1.286E-01	4.998E-02	2.406E-01	2.531E+02
gcon (-1)	-4.567E+00	-8.268E-01	4.419E-02	6.024E-01	2.161E-01	5.542E-02	3.353E-01	-9.639E+01
SE	2.579E+00	8.056E-01	1.749E-01	6.274E-01	1.973E-01	7.671E-02	3.693E-01	3.885E+02

gcon (-2)	7.965E-01	-1.015E+00	3.761E-01	8.863E-01	3.217E-01	-2.194E-01	-3.917E-01	6.510E+02
SE	2.802E+00	8.755E-01	1.901E-01	6.819E-01	2.144E-01	8.337E-02	4.014E-01	4.222E+02
gcon (-3)	-6.976E-02	4.886E-01	2.047E-01	-3.680E-01	-5.623E-01	-2.784E-01	-8.903E-01	-5.045E+01
SE	3.275E+00	1.023E+00	2.221E-01	7.968E-01	2.505E-01	9.741E-02	4.690E-01	4.934E+02
ir (-1)	-5.543E+00	1.716E+00	-1.693E+00	-1.487E+00	1.623E-01	1.137E+00	8.227E-01	1.864E+03
SE	6.289E+00	1.965E+00	4.266E-01	1.530E+00	4.812E-01	1.871E-01	9.008E-01	9.476E+02
ir (-2)	4.787E+00	-3.879E+00	1.227E+00	3.271E+00	-1.481E+00	-5.980E-01	-1.946E+00	-1.188E+03
SE	7.221E+00	2.256E+00	4.898E-01	1.757E+00	5.525E-01	2.148E-01	1.034E+00	1.088E+03
ir (-3)	-2.875E+00	2.242E+00	5.718E-02	-1.794E+00	9.493E-01	3.194E-01	1.047E+00	-1.691E+02
SE	5.726E+00	1.789E+00	3.884E-01	1.393E+00	4.381E-01	1.703E-01	8.200E-01	8.627E+02
inf (-1)	3.873E+00	8.396E-01	1.582E-01	-7.704E-01	-3.790E-01	-6.140E-02	-4.485E-01	-3.507E+02
SE	2.144E+00	6.698E-01	1.454E-01	5.216E-01	1.640E-01	6.377E-02	3.070E-01	3.230E+02
inf (-2)	-8.979E-02	8.990E-01	1.783E-03	-1.174E+00	6.861E-02	1.503E-01	6.748E-02	-4.347E+02
SE	2.681E+00	8.377E-01	1.819E-01	6.525E-01	2.052E-01	7.977E-02	3.840E-01	4.040E+02
inf (-3)	7.912E-01	-3.887E-02	3.647E-02	-1.772E-01	1.962E-01	9.649E-02	1.839E-02	1.829E+02
SE	1.682E+00	5.256E-01	1.141E-01	4.094E-01	1.287E-01	5.005E-02	2.409E-01	2.535E+02
tb (-1)	3.252E-03	-3.523E-04	1.107E-04	1.257E-04	1.264E-04	-1.357E-04	-4.309E-04	3.934E-01
SE	1.723E-03	5.383E-04	1.169E-04	4.193E-04	1.318E-04	5.126E-05	2.468E-04	2.596E-01
tb (-2)	4.122E-03	9.453E-04	-1.971E-04	-7.739E-04	-2.262E-04	-1.289E-04	-6.670E-05	4.777E-02
SE	1.802E-03	5.630E-04	1.222E-04	4.385E-04	1.379E-04	5.361E-05	2.581E-04	2.715E-01
tb (-3)	-7.635E-04	2.972E-04	-2.751E-04	-8.079E-04	-5.012E-04	-1.618E-05	-5.673E-04	5.953E-02
SE	2.187E-03	6.831E-04	1.483E-04	5.320E-04	1.673E-04	6.504E-05	3.131E-04	3.294E-01
C	-1.154E+02	-2.552E+01	3.209E+01	7.730E+01	4.166E+01	9.133E+00	3.183E+01	-2.397E+04
SE	1.448E+02	4.525E+01	9.824E+00	3.524E+01	1.108E+01	4.308E+00	2.074E+01	2.182E+04

Appendix C

Table 33: Time series data for all variables

	ggdp	inv	pcon	gcon	ir	inf	tb	hv	rv	oilp
Q1 1990	3.0500	20.7014	50.3303	10.1065	20.5667	1.5838	1326.0000	14.6919	5.2729	20.9759
Q2 1990	3.4509	17.4258	56.5980	8.8696	19.7333	2.2156	923.0000	31.5133	4.0359	19.3724
Q3 1990	6.1588	40.4338	58.5091	8.3150	20.4000	3.9690	924.0000	1312.9364	36.2786	25.3797
Q4 1990	-0.9168	33.4333	51.8690	8.7506	22.6000	1.8167	2179.0000	807.3312	76.4962	28.9949
Q1 1991	8.4158	28.9258	51.9860	9.5288	25.5333	1.1263	1089.0000	347.5226	61.6779	20.0900
Q2 1991	3.8397	27.5621	54.0408	8.4395	27.0000	2.2993	825.0000	22.6413	3.0937	20.6121
Q3 1991	6.3186	26.7079	56.3281	8.9615	24.6667	3.5980	1374.0000	7.0691	3.3892	21.3554
Q4 1991	-0.4641	29.1917	57.2933	9.6024	24.9333	2.2739	1513.0000	132.6809	4.0835	21.3197
Q1 1992	2.8966	26.3351	47.8849	9.9458	24.8333	1.3179	1199.0000	8.1588	4.5401	19.1744
Q2 1992	3.1872	27.3119	49.9280	8.8141	24.6333	1.7323	1345.0000	44.6329	3.0864	21.1743
Q3 1992	6.8465	26.6724	54.6173	8.9679	24.0000	0.8646	1849.0000	5.0840	1.4666	21.3671
Q4 1992	0.0585	28.6142	56.2286	10.3392	22.6667	0.9893	2629.0000	44.9225	2.2714	20.4871
Q1 1993	5.5308	25.8101	51.3418	9.1709	21.7600	5.3878	2163.0000	20.8825	3.1132	20.0519
Q2 1993	3.6722	24.8014	52.9783	9.0885	21.3800	1.9822	2250.0000	15.2352	1.2134	20.2711
Q3 1993	6.3321	25.8150	61.5628	8.7554	20.1733	1.1865	2241.0000	9.3034	3.9282	18.5008
Q4 1993	0.8372	28.5459	67.0965	9.0967	19.0333	1.3455	1577.0000	115.8362	3.8756	17.1784
Q1 1994	2.0165	25.2322	54.4289	8.3020	18.2633	3.1826	1309.0000	10.0377	3.7953	15.2157
Q2 1994	5.6934	27.2046	54.8318	8.1828	17.5533	1.6820	2075.0000	45.1281	3.9795	17.1402
Q3 1994	7.3364	26.2529	63.5377	7.8710	17.5667	2.4133	2462.0000	23.2357	3.3560	18.1994
Q4 1994	1.6361	31.2303	64.8926	8.1277	17.6567	2.0316	2055.0000	10.0407	2.2005	17.6584
Q1 1995	5.0275	27.4115	62.5560	8.2220	18.2400	2.7429	1447.0000	5.1990	1.2905	18.0119
Q2 1995	4.8103	27.1045	61.4831	7.4408	18.7867	2.9092	1418.0000	29.0117	2.6009	18.7287
Q3 1995	4.8823	29.1906	60.8581	7.2456	19.1100	1.3245	1414.0000	6.1761	1.3863	17.2738
Q4 1995	1.7614	29.8348	61.4962	8.4156	19.2700	1.5541	2254.0000	16.1940	0.9967	17.4925

Q1 1996	2.8083	26.7575	66.0606	8.5628	19.3033	4.4559	1166.0000	26.1020	3.5019	17.9348
Q2 1996	5.1547	27.6353	62.6236	7.4841	19.2433	0.4670	910.0000	7.9761	5.3966	18.9783
Q3 1996	6.2819	31.7964	60.6083	7.0732	19.1667	0.4447	1343.0000	81.2163	5.7492	20.6905
Q4 1996	5.3403	31.6922	60.6337	7.2643	19.1567	0.9022	2529.0000	27.0187	11.3939	23.1176
Q1 1997	1.0731	28.0993	61.6018	7.1817	18.9767	2.5872	1438.0000	118.8633	7.4031	21.9289
Q2 1997	2.4725	29.7023	61.1060	6.9542	18.7233	0.8684	3482.0000	34.0725	5.0714	20.0400
Q3 1997	9.2573	28.4960	58.8004	6.4452	23.3767	1.8688	2176.0000	9.6436	3.3913	19.9883
Q4 1997	3.6848	27.0744	65.0362	6.8366	26.1933	3.5685	2979.0000	71.0189	4.5374	20.1392
Q1 1998	25.0059	31.0481	58.6336	5.3678	26.3333	19.8298	4821.1400	41.7913	9.1153	16.7654
Q2 1998	5.3097	25.4123	65.6517	6.3220	32.1567	18.3356	4971.9200	22.6332	4.0305	16.1516
Q3 1998	18.6052	24.1120	69.3676	5.1002	34.9300	20.0639	5099.4900	26.1228	4.4899	14.9189
Q4 1998	-2.7083	22.1749	75.5253	6.0271	35.1967	4.7793	3536.2800	97.1265	6.0106	13.6759
Q1 1999	5.4919	20.3845	78.0736	5.9688	34.1133	4.7560	4039.4000	99.3348	5.1420	13.3492
Q2 1999	0.1364	19.8611	77.3749	8.2862	30.3367	-0.6632	4457.4400	31.7288	5.3940	17.3989
Q3 1999	2.1952	19.9890	73.9889	6.0636	24.5200	-2.2454	6343.0900	93.1536	4.9267	21.2411
Q4 1999	-0.7948	22.2642	76.5682	6.2131	21.6800	-0.0698	5803.5000	63.1099	12.5834	23.0762
Q1 2000	17.7518	19.0668	62.7871	6.2335	19.5833	2.4618	6264.5000	106.7901	18.5631	25.9879
Q2 2000	3.7263	19.5150	62.6742	7.3018	18.4633	1.0086	5744.6400	240.7483	16.0977	26.9159
Q3 2000	7.2756	19.6168	59.1641	6.0842	17.9767	2.2289	6168.0700	216.2851	21.5845	29.9235
Q4 2000	2.1223	21.0767	62.1507	6.5306	17.7967	2.8483	6864.8000	359.9979	31.4712	30.0071
Q1 2001	8.0111	20.6246	59.4274	5.8971	17.8500	2.9609	6179.3400	59.6119	17.6797	27.4846
Q2 2001	6.5638	19.5233	59.2223	6.4541	18.2633	2.6750	5492.9300	63.3066	11.3857	28.1481
Q3 2001	2.3175	17.7885	60.3187	6.8573	18.8767	3.7122	5644.6400	80.7914	20.3480	26.1673
Q4 2001	-1.2823	19.1015	67.7698	7.6629	19.2000	2.7396	5379.1800	137.8041	22.0065	21.1306
Q1 2002	4.8433	18.3570	66.6506	6.4480	19.3167	4.6955	5219.4500	235.9542	13.1252	22.0314
Q2 2002	2.4285	18.2454	67.2358	6.6140	19.1767	0.8963	6341.0100	37.3833	14.3398	25.7705
Q3 2002	4.5070	18.2008	65.6184	7.0828	18.8667	1.7005	6130.0100	104.5775	9.2005	27.3862
Q4 2002	-1.5094	19.2267	71.8326	8.1925	18.4200	2.6479	5822.7700	164.1450	12.3510	27.0348
Q1 2003	5.2964	18.6989	67.4407	6.6202	18.1967	2.2937	5837.3700	245.8860	23.3648	30.3956
Q2 2003	0.8312	18.7625	65.9558	7.4994	17.6767	0.2023	6113.5100	79.0690	15.0489	27.0435

Q3 2003	4.1163	19.2307	66.3561	8.1798	16.4367	0.8514	6439.5000	94.6127	12.3875	29.1333
Q4 2003	-2.2257	20.4402	69.7641	9.8071	15.4300	2.1032	6172.6900	81.8992	19.6540	30.0510
Q1 2004	4.8603	21.5844	67.8482	8.0400	14.7967	1.6486	3125.3500	109.5201	20.8523	33.1968
Q2 2004	5.1839	21.7810	66.7995	8.4359	14.2833	1.9716	5489.1800	222.3276	39.8173	37.2395
Q3 2004	5.4744	22.7818	65.0896	7.6758	13.8767	1.0672	5969.6900	467.1477	76.2936	42.6437
Q4 2004	0.6983	23.5198	67.4400	9.1083	13.5400	1.5504	5567.5800	792.3805	80.5480	47.7097
Q1 2005	5.4803	23.1456	66.1709	6.7516	13.3600	2.9381	3176.8500	1152.1201	43.2363	50.3206
Q2 2005	6.0324	23.7929	64.0816	6.9493	13.2900	1.8889	4056.5100	579.0134	70.7007	55.4260
Q3 2005	6.3424	23.5760	62.7969	8.1370	13.7767	1.7879	3501.5800	589.2254	83.0638	64.9795
Q4 2005	6.3780	23.9789	64.5748	10.2413	15.7767	10.3369	6798.6200	187.4193	61.3466	61.3119
Q1 2006	3.2009	23.7973	63.2282	7.0474	16.3367	2.1721	6692.5200	248.4758	72.5835	65.8419
Q2 2006	3.8311	24.1777	62.2901	8.6803	16.2300	0.6628	6985.7300	240.1979	71.5322	73.0959
Q3 2006	7.0845	23.9070	59.8036	8.3253	16.0033	1.2206	8595.7300	1580.7615	60.6116	73.1846
Q4 2006	0.3542	24.6098	65.3759	10.2943	15.3467	1.8678	7385.9800	100.9573	96.5527	63.7186
Q1 2007	5.2064	24.0209	63.2590	7.2455	14.7000	2.4679	7711.8300	845.3637	99.6454	61.0960
Q2 2007	4.9968	24.3117	63.2842	8.5746	14.0800	0.4273	8107.3000	143.1172	55.4757	68.0032
Q3 2007	6.8409	24.6960	61.8416	7.8174	13.5600	1.5380	7487.1800	515.1697	56.1541	73.7571
Q4 2007	0.3948	26.7061	65.8268	9.6510	13.1067	1.8244	9447.8300	1709.3185	170.8836	88.5760
Q1 2008	7.9934	26.0680	62.9694	6.8652	12.9433	2.8091	7535.9600	2082.3448	250.3359	96.3002
Q2 2008	10.0279	26.6463	60.0934	8.5385	12.9467	3.6081	5442.7700	8197.6760	457.1028	123.5511
Q3 2008	8.3658	27.7113	58.3183	7.9577	13.4967	3.2259	5771.4900	12806.3515	708.6770	118.5552
Q4 2008	-4.3699	29.9256	62.7553	10.1319	15.0067	1.3440	4165.8600	12513.5578	652.3560	61.9083

Bibliography

Adelman, M.A., 1984. International oil agreements. Energy J. 5 (3), 1–9.

Ait-Sahalia Y., Mykland P.A., Zhang L., 2005. How often to sample a continuous-time process in the presence of market microstructure noise. The Review of Financial Studies 18(2), 351–416.

Andersen, T.G., Bollerslev, T., Diebold, F.X., Ebens, H., 2001a. The distribution of realized stock return volatility. Journal of Financial Economics 61 (1), 43–76.

Andersen, T.G., Bollerslev, T., Diebold, F.X., Labys, P., 2001b. The distribution of realized exchange rate volatility. Journal of the American Statistical Association 96, 42–55.

Andersen, T.G., Bollerslev, T., Diebold, F.X., Labys, P., 2003. Modeling and forecasting realized volatility. Econometrica 71 (2), 579–625. Andersen, T.G., Bollerslev, T., Meddahi, N., 2004.

Bachmeier, L.J., Griffin, J.M., 2006. Testing for market integration crude oil, coal, and natural gas. Energy J. 27 (2), 55–71.

Barndorff-Nielsen, O.E., Shephard, N., 2001a. Non-Gaussian Ornstein–Uhlenbeck- based models and some of their uses in financial economics. Journal of Royal Statistical Society, Series B 63 (2), 167–241.

Barndorff-Nielsen, O.E., Shephard, N., 2002. Econometric analysis of realized volatility and its use in estimating stochastic volatility models. Journal of Royal Statistical Society, Series B 64 (2), 253–280.

Barro, R. J., 1984. Macroeconomics. New York: John Wiley & Sons.

Brown S., Yucel M., 1999. Oil Prices and US Aggregate Economic Activity: A Question of Neutrality. Federal Reserve Bank Of Dallas, 19992Q, 16-23.

Bernanke, B.S., 1983. Irreversibility, uncertainty, and cyclical investment. Quarterly Journal of

Economics 98 (1), 85.

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

Bohi, D. R., 1989. Energy price shocks and macroeconomic performance. Washington, D.C.: Resources for the Future.

Bohi, D. R., 1991. On the macroeconomic effects of energy price shocks. Resources and Energy, 13 (2), 145–162.

Brooks, C., 2002. Introductory Econometrics for Finance. Cambridge University Press, Cambridge.

Brown S., Yucel M., 2002. Energy Prices and Aggregate Economic Activity: An Interpretative Survey. Quarterly Review of Economics and Finance, 42(2), 193-208.

Burbidge, J., Harrison, A. 1984. Testing for the effects of oil-price rises using vector autoregression. International Economic Review, 25, 459–484.

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

Dohner, R.S., 1981. Energy prices, economic activity and inflation: survey of issues and results. In: Mork, K.A. (Ed.), Energy Prices, Inflation and Economic Activity. Ballinger, Cambridge, MA.

Energy Intelligence Group, The International Crude Oil Market Handbook, 2004, pp. E1, E287 and E313

Ferderer, J.P., 1996. Oil price volatility and the macroeconomy. Journal of Macroeconomics 18 (1), 1–26.

Fried, E. R., & Schultze, C. L., 1975. Overview in Fried & Schultze (Eds.), Higher Oil Prices and the World Economy. Washington, D.C.: The Brookings Institution.

Goldberg L. S, Tille C. Vehicle currency use in international trade. NBER Working Paper 11127. National Bureau of Economic Research, Inc: Cambridge, MA; 2005.

Gisser, M., Goodwin, T.H., 1986. Crude oil and the macroeconomy: tests of some popular notions. Journal of Money, Credit and Banking 18 (1), 95–103.

Gulen S.G., 1996. Efficiency in the crude oil futures market, Journal of Energy Finance & Development, Volume 3 (1), 13-21

Guo, H., Kliesen, K.L., 2005. Oil price volatility and US macroeconomic activity. Review — Federal Reserve Bank of St.Louis 57(6), 669–683.

Hamilton, J.D., 1983. Oil and the macroeconomy since World War II. Journal of Political Economy 91 (2), 228–248.

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

Hamilton, J.D., 1996. This is what happened to oil price–macroeconomy relation- ship. Journal of Monetary Economics 38, 215–220.

Hamilton, J.D., 2008. Oil and the macroeconomy. In: Durlauf, S., Blume, L. (Eds.), New Palgrave Directory of Economics, second ed. Palgrave McMillan Ltd

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

International Energy Outlook 2009. Energy Information Administration, Office of Integrated Analysis and Forecasting, US Department of Energy. May 2009

Koenig, E. F., 1995. Optimal monetary policy in an economy with sticky nominal wages. Economic Review, Federal Reserve Bank of Dallas (Second Quarter): 24–31.

Krugman P. Vehicle currencies and the structure of international exchange. Journal of Money,Credit and Banking 1980; 12 (3); 513-526.

Lardic S., Mignon V., 2006. The impact of oil prices on GDP in European countries: an empirical investigation based on asymmetric cointegration. Energy Policy 34 (18), 3910–3915

Lee, K., Ni, S., 1996. Oil shocks and the macroeconomy: the role of price variability. Energy Journal 16 (4), 39–56.

Lilien, D.M., 1982. Sectoral shifts and cyclical unemployment. Journal of Political Economy 90 (4), 777–793.

Loungani, P., 1986. On price shocks and the dispersion hypothesis. Review of Economics and Statistics 68 (3), 536–539.

McKinnon R. Money and international exchange: the convertible currency system. Oxford University Press: New York; 1979.

Mork, K.A., 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., Olsen, O., 1994. Macroeconomic responses to oil price increases and decreases in seven OECD countries. Energy Journal (15), 15–38.

Pasandran C., Tisnabudi I. "Oil Prices Seen Lifting Indonesia's Deificit". Jakarta Globe. January 12, 2010.

Pierce, J. L., Enzler, J. J., 1978. The effects of external inflationary shocks. Brookings Papers on Economic Activity, 1, 13–61.

Rafiq S., Ruhul S., Bloch H., 2008. Impact of crude oil price volatility on economic activities: An empirical investigation in the Thai economy. Resources Policy (34), 121-132.

Rey H. International Trade and Currency Exchange. Review of Economic Studies 2001; 68 (2); 443-464.

Schwarz, T.V., Szakmary, A.C., 1994. Price discovery in petroleum markets: arbitrage, cointegration, and the time interval of analysis. J. Futures Mark. 14 (2), 147–167.

Silvapulle, P., Moosa, I.A., 1999. The relationship between spot and futures prices: evidence from the crude oil market. J. Futures Mark. 19 (2), 175–193.

Simbolon, Johnnanes. “2009: New milestones in energy sector”. The Jakarta Post. December 22 2008.

Zhang, L., Mykland, P.A.,Aıt-Sahalia, Y.,2005. A tale of two time scales: determining integrated volatility with noisy high-frequency data. Journal of the American Statistical Association 100 (472), 1394–1411.