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Oil and Macroeconomy
The Case of Korea

Junhee Lee and Joonhyuk Song

8.1 Introduction

The world oil price reached a recorded high level in the summer of 2008 following its ascent from 2002. The increase in oil price is noticeable following a long stable period of oil price movements after the second world oil crisis of 1979 and 1980. Figure 8.1 shows the Western Texas Intermediate (WTI) oil price movements and the (shaded) recessions of the Korean economy since 1970. As we glance over the figure, we find that several of the Korean economic recessions coincide with episodes of world oil price hikes, particlarly for the periods of 1973 to 1974 and 1979 to 1980.

The recent increase in the world oil price did not induce much attention concerning the possibility of causing an economic recession. This is in contrast to previous episodes of the world oil price hikes, that many studies attributed as causes of economic recessions. The recent oil price hike began to stabilize after autumn 2008. However, it still raises questions concerning the relationship between world oil price hikes and macroeconomy; such as why the recent oil price hike did not cause a serious economic recession as it did previously. The macroeconomic impacts or nature of the oil price hike might have changed from the past.

Generally, an increase in oil price will affect econmic growth adversely both through consumption and procution channels. An increase in oil price will raise the consumers' cost of living and reduce overall consumption. In addition, it will add more uncertainties to consumers' future economic out-

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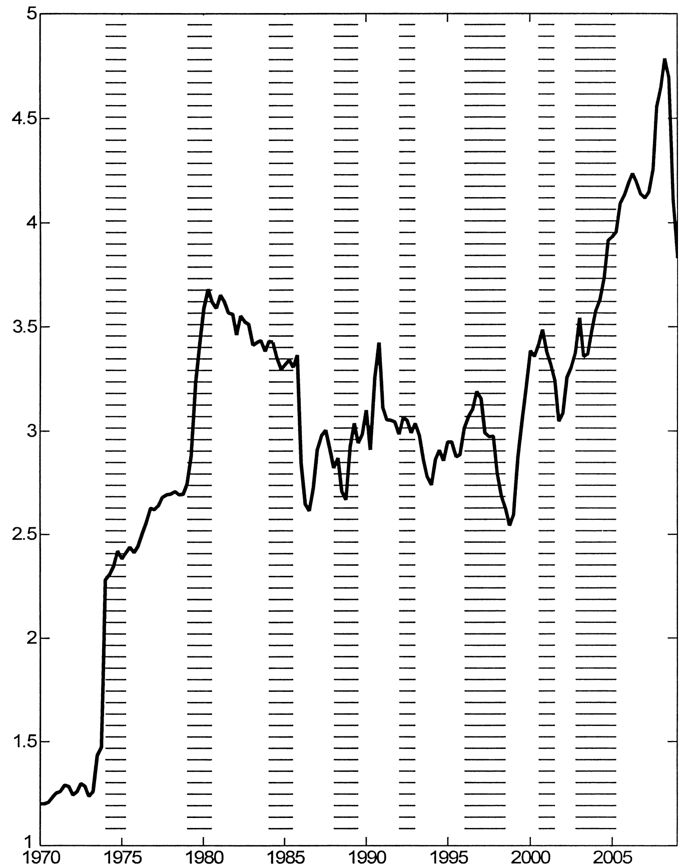

Fig. 8.1 Oil price and Korean economic recessions

looks and negatively affect the economy, as consumers will save more and spend less out of a precautionary motive facing the increased uncertainties. Hamilton (2005) stressed an indirect effect due to changes in the compositions of consumption expenditure. That is, changes in the compositions disturb sectoral allocations of resources and result in cutbacks in consumption, as well as increases in unemployment due to frictions in labor and capital markets. An increase in oil price will also affect economic growth adversely through production channels. An increase in oil price will raise production costs and increase uncertainties surrounding businesses and thus it will reduce productions.

In the past, large oil price hikes occurred following supply contractions due to geopolitical conflicts and uncertainties tied to oil-exporting countries. Hamilton (1996) showed that increases in oil prices preceded most U.S. recessions and that they were the main causes of the recessions. Using

New York Mercantile Exchange (NYMEX) crude oil futures data, Guo and Kliesen (2005) found that oil price volatilities had significant adverse effects on investment, consumption, and the unemployment rate.

The recent rise in oil price, however, can be viewed from a somewhat different perspective. In terms of the world oil market, oil demand recently increased substantially. For instance, China and India, new world economic powerhouses, have become huge consumers of crude oil. Other Asian economies have also increased their demands for crude oil as they recover from the financial crises of the late 1990s. In addition, developed countries also continued to grow during the period, supported by somewhat low interest rates. The recent hike in oil price thus might be viewed as endogenous movements along with the developments of strong oil market demands (or world economy), rather than exogenous movements stemming from supply-side contractions, as in the past.[1]

In terms of monetary policy, the recent oil price hike also reignites debates as to on which inflation measure the central bank should focus.[2] Oil price hike results in divergence between headline inflation and core inflation, which excludes energy and food inflation from headline inflation. The oil price increase may pass through to the price of nonenergy goods and services and lead to a dissociation between the headline and core inflation. The possible widening gap between two measures of inflation again raises the questions concerning the correct choice of inflation measure for conducting monetary policy.

In this chapter, we first analyze the nature of oil price hikes and their impacts on the Korean economy. We examine in detail whether the recent oil price hike is similar to or different from previous ones in terms of its origination. We further examine the impacts of the recent oil price hike on the Korean economy and compare them to previous experiences. We find the recent oil price hike originates endogenously from the demand side of world oil market, rather than exogenously from the supply side. The macroeconomic impact of the oil price hike is somewhat weakened compared to the previous oil price hikes, due to possible changes in macroeconomic structure.

We also discuss which inflation target would be more appropriate for the central bank to stabilize the economy. For this purpose, we built a dynamic stochastic general equilibrium (DSGE) model to examine the issue in a structural model. The model incorporates a Taylor-type monetary policy rule and monetary policy responds differentially to oil and nonoil prices, which correspond to noncore and core measures of inflation.

1. Kilian (2008) provide evidence that unanticipated crude oil supply shocks are far less important than shocks from the demand for crude oil.

2. Countries differ in their choice of an inflation measure for monetary policy. For example, the Bank of England and the Bank of Korea choose headline inflation as their policy target, while the U.S. Federal Reserve puts more emphasis on core inflation.

Previous literature generally tends to side with core inflation targeting rather than headline inflation targeting. Goodfriend and King (1997) suggest that monetary policy needs to focus on the sticky component of prices, rather than overall prices, implying core inflation to be the major target for conducting monetary policy. Aoki (2001) constructs a two-sector model, one with sticky price and the other with flexible price, and shows that complete stabilization of sticky price inflation is optimal in the model. Blinder and Reis (2005) provide evidences that core inflation predicts future headline inflation better than headline inflation itself.[3] Bodenstein, Erceg, and Guerrieri (2008) show that core inflation targeting in response to oil price shocks stabilize the economy better than headline inflation targeting in a DSGE model.

Conversely, Harris et al. (2009) criticize the policy recommendations from the aforementioned standard New Keynesian models in that these models assume the complete anchoring of inflation expectations. They show that longer-term consumer expectations on inflation respond to oil price shocks and suggest that the Fed should have put more weight on headline inflation. Hamilton (2008) shows that oil price shocks cannot be treated as merely transitory, discussing statistical characteristics of oil price shocks from historical data, and suggests that the central bank needs to pay more attention to the development of headline inflation including energy and food prices.

We find in an estimated DSGE model of the Korean economy that energy or oil price is relatively flexible compared to nonoil price and wage (but not completely flexible), and monetary policy would stabilize the economy better when it accommodates oil price inflation rather than fight against it.

The remainder of the chapter is organized as follows. In section 8.2, we describe basic findings from data. In section 8.3, we construct a five-variable structural vector autoregression (VAR) model and analyze the relationship between oil price and the Korean economy. In section 8.4, we present a DSGE model with oil sector and discuss monetary policy implications. Finally, section 8.5 concludes.

8.2 Data

In this section, we examine the properties of quarterly Korean data as well as world oil price; real gross domestic product (GDP), Consumer Price Index (CPI), and (real and nominal) interest rates together with world oil price (the WTI) as a preliminary step before formal analyses. We divide the data set into two subperiods, namely before and after the Korean currency crisis in 1998 and 1999 that is believed to have caused a structural break in

3. Cogley (2002) and Rich and Steindel (2005) also found the significant reversion of headline inflation to core inflation.

Table 8.1 **Summary Statistics**

	Pre-crisis		Post-crisis	
	Mean	Standard deviation	Mean	Standard deviation
Δ log WTI	1.45	12.08	3.08	15.64
Δ log CPI	2.39	1.96	0.76	0.44
Δ log CORE	2.06	1.75	0.70	0.31
Δ log RGDP	1.87	1.29	1.09	1.43
INTR	3.15	0.58	1.05	0.17
INTR-Δ log CPI	1.67	0.70	0.28	0.42

Notes: Measures in quarterly growth. Log difference from the previous quarter times 100.

the Korean economy.[4] The pre-crisis sample period is 1987:I to 1997:IV and post-crisis sample period is 2000:I to 2009:I. The division is also helpful to compare the effects of the recent oil price hike from the previous ones before the 1990s.

We first show the means and standard deviations of the log-difference data during the two subperiods in table 8.1. As we can see from the table, the standard deviations of the WTI and the real GDP log difference during the post-crisis period are somewhat higher than for the pre-crisis period. The standard deviations of headline and core CPI inflations and real interest rate during the post-crisis period are substantially lower than the pre-crisis period. We also report unit root tests on the variables in table 8.2. Interestingly, we find CPI-level data does not contain the unit root process and seems to be stationary during the post-crisis period from the tests, reflecting recent low inflation.

As a way to observe the dynamic impacts of oil price hikes on the macroeconomy, we provide the cumulative real GDP growth and CPI inflation during the two world oil crises and the recent oil price hike in figure 8.2. The series in figure 8.2 have four years duration each and the datings follow Blanchard and Gali (2007).[5]

The left-hand side of the figure depicts the cumulative real GDP growth and we observe that the negative effects on real GDP growth possibly induced by the oil price hike are most pronounced during the second world oil crisis, 1979:I to 1983:I. The real GDP growth shrank for almost two years before bouncing back to its trend growth. During the recent oil price hike, the real GDP growth seems to be little affected for at least one year after the

4. Much evidence supports the view that the Korean economy has experienced important and long-term changes during the periods. See Kim and Kang (2004), among others.

5. Blanchard and Galí (2007) identify four episodes of oil price shocks when the cumulative changes in (log) oil price are above 50 percent. We discard the third episode (1999:I to 2000:IV) as the period is close to the fourth period (2002:I to 2005:III).

Table 8.2 **Unit root tests**

	Pre-crisis					Post-crisis				
	PP test		ADF test		KPSS test	PP test		ADF test		KPSS test
	ρ	*t*-val	ρ	*t*-val	LM-stat	ρ	*t*-val	ρ	*t*-val	LM-stat
WTI	–0.03	–1.63	–0.04	–1.56	–0.24	–0.20	–1.85	–0.47	–3.15	0.13
CPI	–0.02	–1.92	–0.01	–1.89	0.24	–0.20	–2.31	–0.29	–2.06	0.08
CORE	–0.01	–1.78	–0.03	–2.46	0.11	–0.01	–1.53	–0.24	–3.07	0.08
RGDP	0.00	–0.15	–0.00	–0.41	0.31	–0.15	–1.73	–0.65	–2.87	0.09
INTR	–0.21	–2.09	–0.25	–2.18	0.15	–0.07	–1.74	–0.17	–2.03	0.14
Δ log WTI	–0.86	–9.75	–0.82	–5.76	0.08	–0.54	–3.52	–0.68	–2.30	0.09
Δ log CPI	–0.45	–6.03	–0.37	–4.14	0.11	–0.96	–5.71	–0.87	–2.84	0.06
Δ log CORE	–0.33	–4.79	–0.18	–2.24	0.12	–0.47	–3.54	–0.47	–2.66	0.10
Δ log RGDP	–0.83	–8.67	–0.75	–5.15	0.07	–0.93	–5.65	–1.03	–2.96	0.09
INTR- Δ log CPI	–0.75	–5.28	–0.57	–2.59	0.11	–1.04	–6.14	–0.75	–2.49	0.11

Notes: Asymptotic critical values for LM statistics are 0.216, 0.146, and 0.199 at 1%, 5%, 10%, respectively. PP = Phillips-Perron; ADF = Augmented Dickey-Fuller; KPSS = Kwiatkowski-Phillips-Schmidt-Shin; LM = Lagrange multiplier.

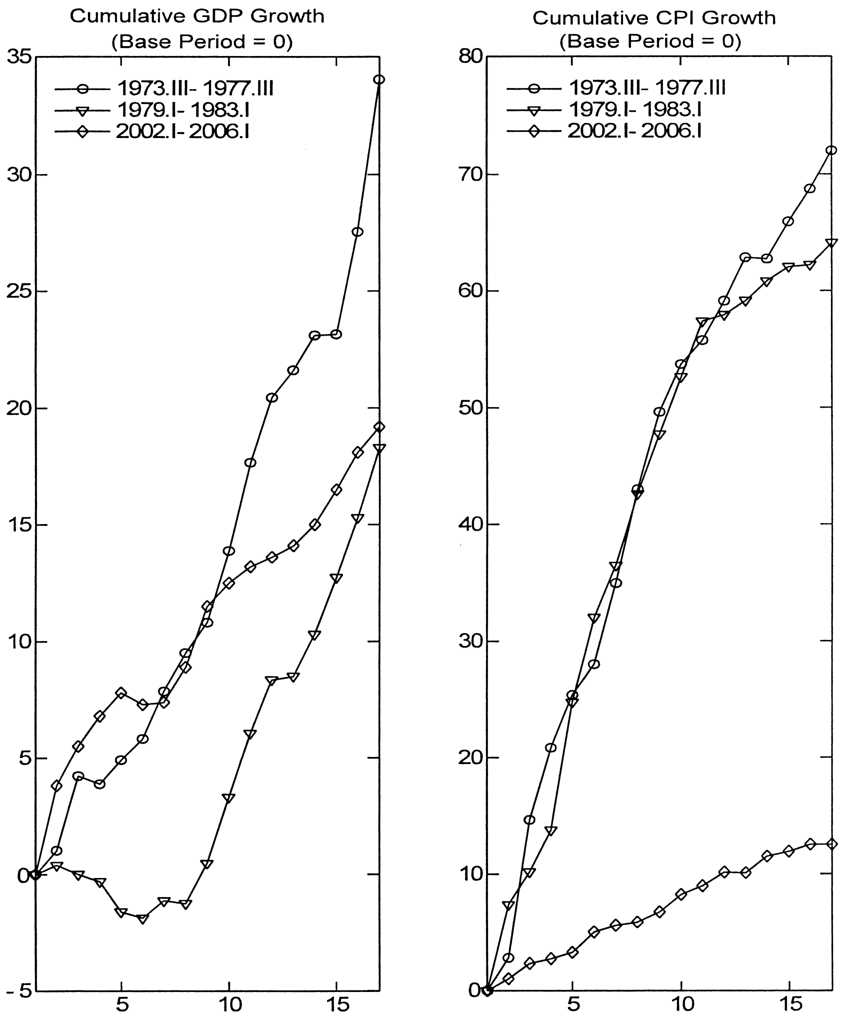

Fig. 8.2 Cumulative growth of GDP and CPI inflation

oil price hike and then it declined slightly later, but the contraction was not much pronounced.

The right-hand side of the figure illustrates the cumulative CPI inflation for the periods. The cumulative CPI inflation for the first and second oil crises look similar and the CPI inflation increased about 70 percent during both periods. However, the cumulative CPI inflation during the recent oil price hike shows different dynamics from the previous periods and the CPI inflation has risen about 12 percent over four years (i.e., 3 percent increase per annum). We may possibly conjecture that the macroeconomic effects of an oil price hike on inflation have diminished during the recent oil price hike.

As a simple way to compare the pre- and post-crisis macroeconomic responses to oil price hikes, we present nonparametric estimation results from regressing real GDP and CPI inflation on oil price in figure 8.3.[6] The left-hand side panel of the figure shows pre-crisis results and the right-hand panel shows post-crisis results. During the pre-crisis period, real GDP growth and oil price are negatively related and CPI inflation and oil price are not clearly related. During the post-crisis period, real GDP growth is almost flat to oil price changes and real GDP and oil price are not clearly related in contrast to the pre-crisis sample. In addition, CPI inflation and oil prices are not as clearly related as before.

In summary, the data indicate that the macroeconomic responses to oil price hikes may have changed in such a way that the Korean economy accommodates them better, which recently follows the Korean currency crisis from our simple preliminary examinations.

8.3 Dynamic Effects of Oil Price Hikes

8.3.1 A Structural VAR Model

In this section, we use a five-variable VAR model as our workhorse to quantify the responses of real GDP and inflation to oil price hikes. The results will be used to detect how the macroeconomic transmission mechanism of oil price hikes has changed before and after the Korean currency crisis.

We choose the log difference of oil price, export, real GDP, CPI price index, and real interest rate as our five variables for the VAR analysis. Corresponding to the five variables, we introduce five structural shocks that affect the Korean economy: oil price shock, export shock, local aggregate supply shock, local aggregate demand shock, and monetary policy shock. Because these structural shocks cannot be observed directly, we need to employ identifying restrictions to disentangle them. Our identification assumptions are based on both long-run and short-run restrictions. These will be discussed shortly. Let $\Delta z_t = [\Delta P_{o,t}, \Delta X_t, \Delta Y_t, \Delta P_t, i - \Delta P_t]'$ denote the vector of the five variables: the log difference of oil price, export, real GDP, price index, and real interest rate. We assume that Δz_t is a covariance stationary vector process suggested by the statistics in table 8.2. Each element of Δz_t is demeaned, hence it has a zero mean. The structural VAR with p lags can be expressed with the following representation

$$(1) \qquad A_0 \Delta z_t = A_1 \Delta z_{t-1} + A_2 \Delta z_{t-2} + \dots + A_p \Delta z_{t-p} + \omega_t,$$

6. In estimation, we use a Gaussian kernel regression with optimal bandwidth, suggested by Bowman and Azzalini (1997).

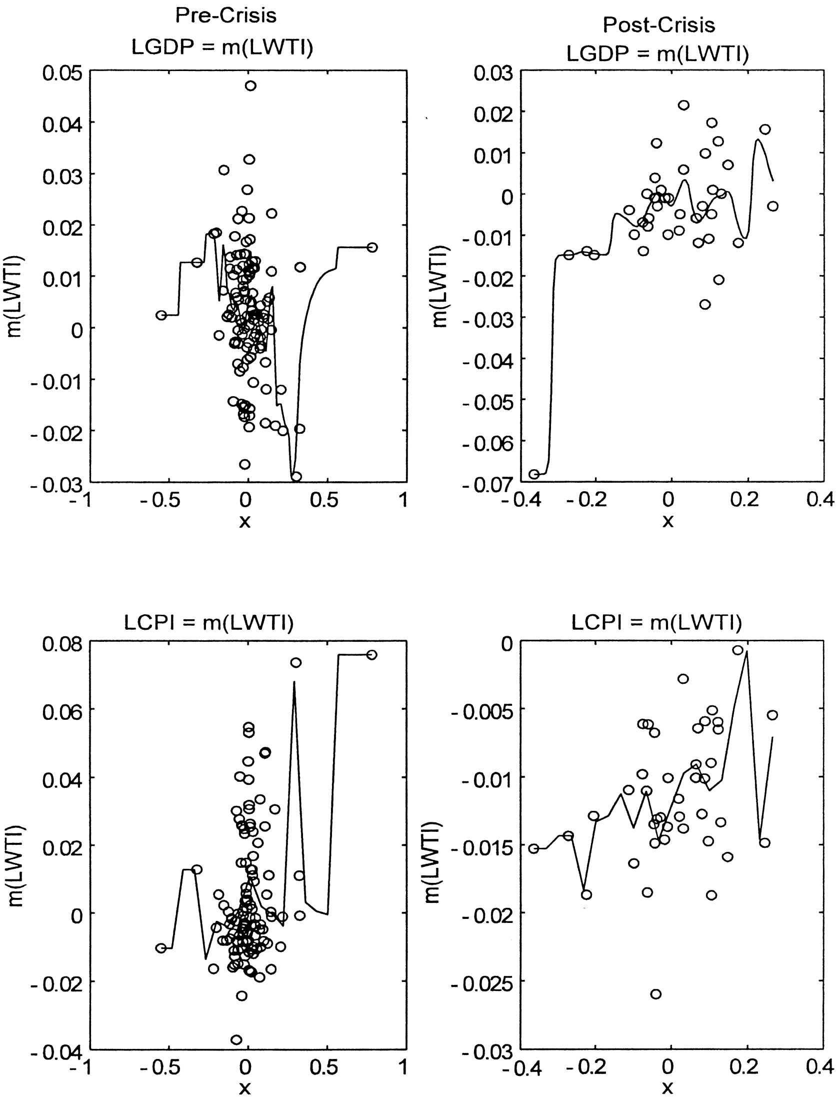

Fig. 8.3 Nonparametric GDP and inflation responses to oil price hikes

where A_0 is a 5×5 matrix restricting contemporaneous relations of the included variables; $\omega_t = [\omega_t^{OS}, \omega_t^{ES}, \omega_t^{LS}, \omega_t^{LD}, \omega_t^{MP}]'$ is a 5×1 column vector consisting of oil price shock (OS), export shock (ES), local aggregate supply shock (LS), local aggregate demand shock (LD), and monetary policy shock (MP), respectively, and $E[\omega_t] = 0$ and $E[\omega_t \omega_t'] = I_{5\times5}$. Alternatively, the structural VAR can be expressed as the following

$$(2) \quad \Delta z_t = B_1 \Delta z_{t-1} + B_2 \Delta z_{t-2} + \ldots + B_p \Delta z_{t-p} + C\omega_t = B(L)\Delta z_t + C\omega_t,$$

where $B_j = A_0^{-1}A_j$, $C = A_0^{-1}$ and $B(L) = B_1L + B_2L^2 + \ldots + B_pL^P$ and L is lag operator. If z_t is a stationary process, the VAR system can be rewritten as a VMA (Vector Moving Average) system according to the Wold representation theorem:

$$\Delta z_t = D(L)\omega_t \tag{3}$$

where $D(L) = (I - B(L))^{-1}$ and $D(L)$ is invertible. Once we have $D(L)$, we can recover expressions for the levels of the different variables in terms of current and lagged values of the structural disturbances by a straightforward transformation.

The reduced-form autoregressive representation of the VAR is given by

$$\Delta z_t = F(L)\Delta z_t + u_t, \tag{4}$$

where $E[u_t] = 0$ and $E[u_t u_t'] = \Omega$. Then, the reduced-form Wold moving average representation of Δz_t can be expressed as

$$\Delta z_t = G(L)u_t, \tag{5}$$

where $G(L) = (I - F(L))^{-1}$ and $G(L)$ is invertible and u_t is the vector of innovations in the elements of Δz_t. Comparing equation (2) and equation (4), the following condition holds

$$u_t = C\omega_t \tag{6}$$

for some 5×5 full rank matrix C. Equations (3), (5), and (6) imply that

$$D(L) = G(L)C. \tag{7}$$

Premultiplying both sides of equation (4) by C^{-1}, we can obtain the structural representation of Δz_t and the structural disturbance vector ω_t. The structural VAR can be identified to the extent that we introduce sufficient restrictions to determine twenty-five elements of matrix C. Given C, we can recover $D(L)$ by post-multiplying $G(L)$ in equation (7).

As the reduced-form variance-covariance matrix has fifteen elements, we need ten more restrictions to just identify the system. For this purpose, we introduce three long-run neutrality restrictions and seven short-run restrictions. Concerning the long-run restrictions, we assume that the growth in the oil price, expressed in WTI, is not affected by the local shocks, implying $D_{1,3}(1) = D_{1,4}(1) = D_{1,5}(1) = 0$.

The short-run restrictions are composed of two groups: one limits the contemporaneous effects of shocks; the other limits the contemporaneous effects of endogenous variables. Simply put, we introduce the short-run restrictions for both the matrix C and A_0. Concerning the restrictions on the matrix C, we assume no contemporaneous effects of local shocks on oil price. These imply the following three constraints on C

$$C_{1,3} = 0 \tag{8}$$

$$(9) \qquad C_{1,4} = 0$$

$$(10) \qquad C_{1,5} = 0.$$

We finally impose linear restrictions on the relationships between the contemporaneous variables, namely restrictions on A_0: (a) contemporaneous oil price does not affect export, (b) contemporaneous interest rate does not affect real GDP, (c) contemporaneous oil price does not affect real interest rate, and (d) contemporaneous export does not affect real interest rate. The restrictions imply

$$(11) \qquad A_{0,(2,1)} = 0$$

$$(12) \qquad A_{0,(3,5)} = 0$$

$$(13) \qquad A_{0,(5,1)} = 0$$

$$(14) \qquad A_{0,(5,2)} = 0.$$

Given $A_0^{-1} = C$, these restrictions can be mapped into four nonlinear constraints on the elements of C.

8.3.2 Empirical Results

Figure 8.4 displays the cumulative impulse response functions based on VAR estimates from the pre-crisis sample period. Each column in the figure represents impulse-response functions to one standard deviation of a structural shock.

In the first column, we show the impulse response functions to an oil price shock. The shock decreases both export and real GDP immediately. The decrease in export is due to the contraction of the world economy after a hike in oil price. Similarly, the domestic real GDP decreases due to contractionary effects after the oil shock. The positive standard deviation shock decreases real GDP permanently by 0.5 percent. The CPI decreases initially but climbs steadily up after the shock, resulting in 0.2 percent increase twenty quarters after the shock. Real interest rate decreases due to the increased inflation after the shock.

The second column represents the impulse response functions to an export shock. A positive foreign export shock raises export and real GDP permanently by 2.1 percent and 0.4 percent each. The shock has limited effects on oil price. The CPI increases for seven quarters after the shock and then decreases slowly. Real interest rate decreases due to the increase in inflation but slowly moves up, resulting in a long-run rise of 0.4 percent.

The third column represents the impulse response functions to a local aggregate supply (AS) shock. The local AS shock increases domestic output and decreases CPI as a textbook aggregate demand (AD)-AS analysis predicts. The initial deflationary impact raises the real interest rate. Export decreases somewhat after the shock. This is somewhat nonstandard. We

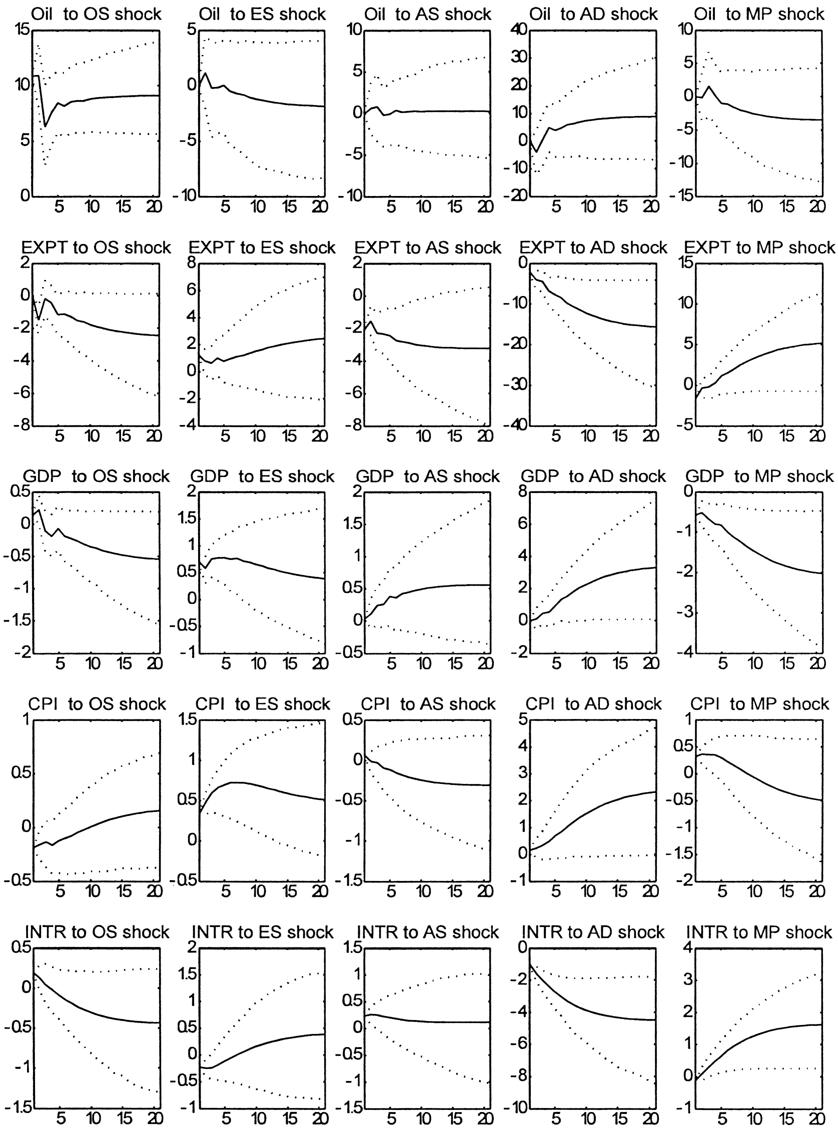

Fig. 8.4 Impulse responses, based on pre-crisis estimates

may interpret this as a switch from export to domestic absorption, given unchanged demand from abroad and increased domestic demand (output) after the shock.

The fourth column shows the impulse response functions to a local AD shock. In addition, as predicted by a standard AD-AS analysis, real GDP and CPI move up together in the same direction. The real interest rate goes down due to the increase in inflation. Export decreases somewhat given unchanged demand from abroad and increased domestic demand after the shock.

Finally, the fifth column provides the impulse response functions to a monetary policy shock. The monetary policy shock lowers real GDP and CPI as predicted. Contractionary effects of the shock reduce domestic demand and export increases accordingly. Real interest rate rises after the deflationary effect of the shock.

We next report the results from the post-crisis sample period in figure 8.5. As we discussed in the introduction, the purpose of the VAR analyses is to detect the nature of the oil shock that may originate from the supply or demand sides of the oil market. Thus, we focus on the impulse response functions to an oil price shock.

What stands out from the post-crisis sample is the impulse response function of export to an oil price shock and export increases after the shock in contrast to the pre-crisis sample. We interpret this as an oil shock in the post-crisis sample originating from the demand side of the oil market and the demand-side factor that drives the oil price up is a common factor that increases export. In the pre-crisis sample analysis, the export response to an oil price shock is negative and we interpret this as an oil price shock originating from the supply side of the oil market, and it reduces export due to its contractionary effects on the world economy. Real GDP shows similar movements in response to the oil price shock.

One might think that the different responses of real GDP and export to an oil price shock before and after the crisis stem from changed exchange rate regimes between the pre- and post-crisis period. If we review the history of the Korean foreign exchange system briefly, Korea introduced a multicurrency basket system in 1980 and the government tightly controlled foreign exchange rates until a market average exchange rate system was introduced in 1991. Since the adoption of the system, market forces played an increasingly important role in the determination of foreign exchange rates. Daily fluctuations in exchange rates were limited strictly in this system, however. After the outbreak of the crisis, Korea adopted a free floating exchange rate system and foreign exchange rates are freely determined by market forces. From this perspective, one may conjecture that an increase in oil price raises the exchange rate and spurs exports after the crisis, which would have been weak before the crisis, when exchange rates were strictly controlled by the government.

We find this argument unconvincing. We regress oil price on exchange rates and report the results in table 8.3. We find the regression coefficients are negatively (not positively) significant in the post-crisis sample, with their values ranging from –0.171 to –0.226; whereas those of the pre-crisis are distributed between –0.004 to 0.008—moreover, statistically insignificant.

These pictures can be understood as follows: the dynamic effects of the

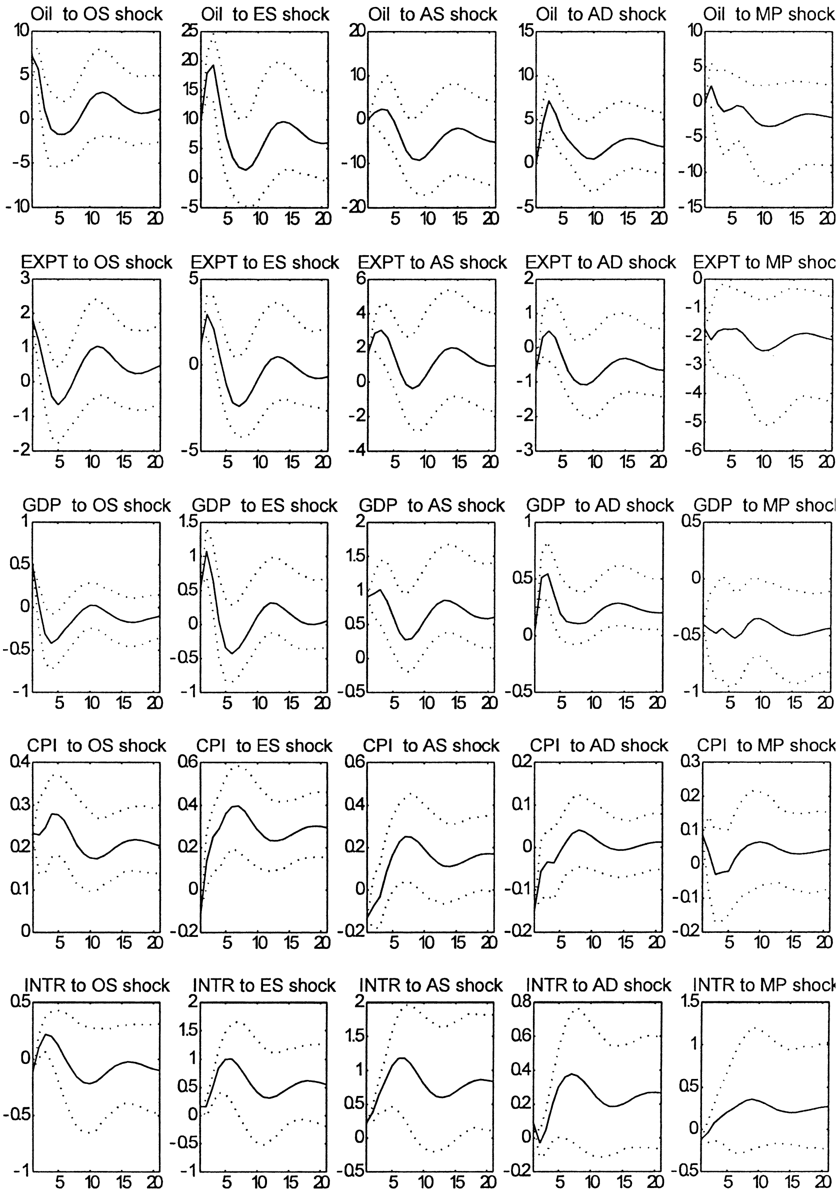

Fig. 8.5 Impulse responses, based on post-crisis estimates

oil price shock have changed after the crisis and the interactions between oil prices and macroeconomic aggregates build different patterns in the post-crisis sample period.

Turning from the impulse response functions to the other structural shocks, we report only the results in response to an AS shock to compare to

Table 8.3 **Regression estimates**

	Pre-crisis				Post-crisis			
	KRW/USD		REER		KRW/USD		REER	
WTI	–0.002	–0.004	0.007	0.008	–0.226	–0.241	–0.171	–0.197
	[–0.09]	[–0.17]	[0.20]	[0.22]	[–5.11]	[–4.84]	[–3.82]	[–3.98]
WTI(–1)		0.014		–0.008		0.035		0.062
		[0.56]		[–0.21]		[0.67]		[1.20]
Const.	4.576	4.446	2.175	2.158	3.505	3.204	2.650	2.111
	[3.87]	[3.71]	[1.25]	[1.23]	[1.30]	[1.16]	[0.97]	[0.77]
R^2	0.0001	0.0025	0.0006	0.0012	0.4272	0.4346	0.2943	0.3230

Notes: The t-values are reported in the parentheses. KRW/USD = South Korean won/U.S. dollar; REER = Real Effective Exchange Rate.

pre-crisis results. The impulse response functions to the rest of the structural shocks can be interpreted similarly. Figure 8.5 presents the impulse response functions to a local AS shock in the third column. The shock increases real GDP, as expected from a textbook AD-AS analysis. Although inflation decreases initially after the shock, it increases by 0.2 percent in the long run. The result is statistically insignificant, however, and we would not give much weight to it. Real interest rate increases due to the initial deflationary pressure and increased productivity. Export increases, given increased productivity after the shock.

8.3.3 Historical Simulation

To further examine the different impacts an oil price hike may have on the Korean economy before and after the crisis, we estimate dynamic correlations between real GDP and CPI in response to historical oil price shocks before and after the crisis. Thus, we first extract historical disturbances from the estimated structural VAR and eliminate all the shocks, other than oil price shocks, and then estimate the dynamic correlations. If the correlations are positive (negative), this can be interpreted as oil price shocks originating from the demand (supply) side of the oil market and having an aggregate demand (supply) nature in generating economic fluctuations.

The j-period-ahead dynamic correlation at time t can be written as follows:

$$
\begin{aligned}
Corr(\Delta \hat{Y}_{t+j}, \Delta \hat{P}_{t+j}|\Omega_t) &= \frac{(\Delta \hat{Y}_{t+j} - E[\Delta \hat{Y}_{t+j}|\Omega_t])(\Delta \hat{P}_{t+j} - E[\Delta \hat{P}_{t+j}|\Omega t])}{\sigma(\Delta \hat{Y}_{t+j}|\Omega_t)\sigma(\Delta \hat{P}_{t+j}|\Omega_t)} \\
&= \frac{\eta_{\Delta \hat{Y}_{t+j}} \eta_{\Delta \hat{P}_{t+j}}}{\sigma(\Delta \hat{Y}_{t+j}|\Omega_t)\sigma(\Delta \hat{P}_{t+j}|\Omega_t)}
\end{aligned}
$$

where $\eta_{\Delta\xi_{t,t+j}}$ is the j-period-ahead forecasting error of ξ ($= \Delta \hat{Y}_t, \Delta \hat{P}_t$) and Ω_t is information set up to time t. The hatted variables denote that the variables are disturbed by oil price shocks only.

Figure 8.6 presents the dynamic correlations in the pre- and post-crisis periods. In the short run, oil shocks work as demand factors; real GDP and CPI move in the same direction for both periods. However, comparing the magnitudes of the correlations, the post-crisis correlations are more than twice the pre-crisis correlations in the short run.

The difference with respect to the nature of oil price shocks between the two periods is more pronounced when medium or long-run correlations are compared. Medium or long-run correlations are around 0.4 in the post-crisis period, indicating that oil price shocks work as demand factors in the period. In contrast, medium or long-run correlations in the pre-crisis period are negative. The results imply that oil price shocks worked as aggregate supply factors in the period.

These findings, combined with the earlier impulse response analyses, lead

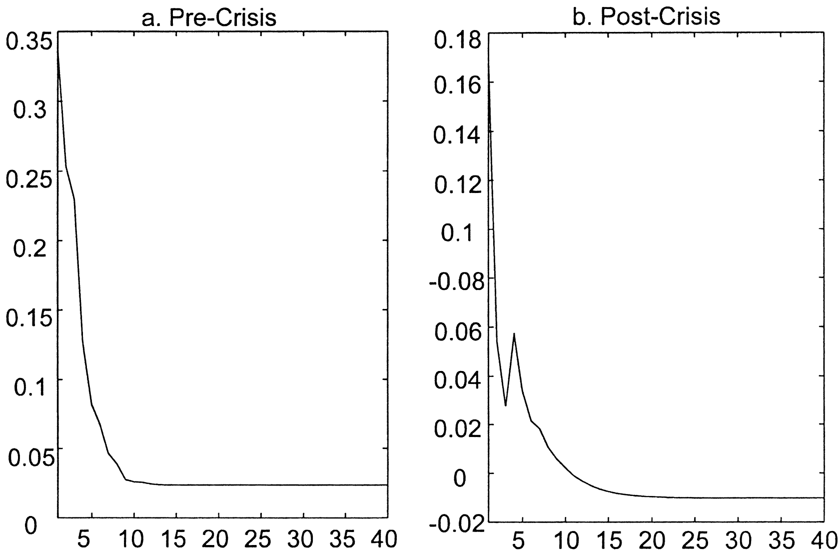

Fig. 8.6 Dynamic correlation between real GDP and CPI

to the following conclusion. The identified oil price shocks from the VAR in the pre-crisis period are mainly of aggregate supply nature and they affect domestic production adversely and raise CPI inflation by shifting the AS schedule to the left. In contrast, the oil price shocks in the post-crisis period largely work as aggregate factors and they increase export and domestic output, as well as CPI inflation, as they shift the AD schedule to the right.

In summary, the oil price changes, especially upward changes, have brought about many economic difficulties in the past. They may still be important macroeconomic factors but their impacts have been changed in recent years, as shown in our VAR evidence. We argue that the nature of oil price shocks have changed in recent years. In contrast to the previous oil price hikes, which were driven by supply disruptions, the recent oil price hike originated from an increase in the demand for oil. The demand-driven oil price hike has less, and diminished, adverse effects on the Korean economy compared to the previous oil price hikes.[7]

Thus far, we have examined the nature of oil price hikes and their macroeconomic impacts on the Korean economy with VAR analyses. We next construct a structural dynamic stochastic general equilibrium (DSGE) model to further consider economic and policy implications of the recent oil price hike. We especially consider which monetary policy rule would work better among Taylor-type rules in the face of oil price inflation based on the DSGE model.

7. See Kilian (2009) and Hamilton (2009) for related results.

8.4 Nominal Rigidities Model with Oil Consumption

We construct a small open economy nominal rigidities model, with oil and nonoil sectors, and extend the closed economy one sector models with oil usage, such as in Bodenstein et al. (2008).

We start with the production side of the nonoil sector. We denote the nonoil sector by subscript n and the oil sector by subscript o in the following equations. Firms produce final nonoil goods by aggregating intermediate goods. Namely,

$$y_{n,t} = \left[\int y_{n,t}(i)^{1/\mu_n} di \right]^{\mu_n}, \qquad \mu_n \geq 1, \tag{15}$$

where $y_{n,t}$ is the final good and $y_{n,t}(i)$ is the ith intermediate good in the nonoil sector. The final nonoil goods market is competitive and the final nonoil goods price ($P_{n,t}$) is

$$P_{n,t} = \left[\int P_{n,t}(i)^{1/(1-\mu_n)} di \right]^{1-\mu_n}, \tag{16}$$

where $P_{n,t}(i)$ is the ith intermediate nonoil good price. Demand for the ith intermediate good is

$$y_{n,t}(i) = y_{n,t} \left[\frac{P_{n,t}(i)}{P_{n,t}} \right]^{\mu_n/(1-\mu_n)}. \tag{17}$$

Production technology for the ith intermediate good is

$$y_{n,t}(i) = z_t (n_{n,t}(i))^{\alpha_n} (o_t(i))^{\alpha_o} \tag{18}$$

where $n_{n,t}(i)$ is labor input, $o_t(i)$ is oil usage, and z_t is the labor augmenting technology shock. This follows the law of motion given as

$$\ln z_t = z + \ln z_{z,t-1} + \zeta_{z,t} \tag{19}$$

$$\ln \zeta_{z,t} = \rho_{\zeta_z} \ln \zeta_{z,t-1} + \varepsilon_{z,t}, \qquad \varepsilon_{z,t} \sim N(0, \sigma_z). \tag{20}$$

Intermediate goods producers behave as monopolistic competitors and set prices using the Calvo mechanism. Namely, they set new prices with probability $1 - \theta_n$ or adjust prices just as much as the trend inflation rate with probability θ_n in each period. Thus, the ith intermediate good producer in the nonoil sector solves

$$\max_{P_{n,t}^N} E_t \sum_{s=0}^{\infty} (\beta\theta_n)^s \upsilon_{t+s} [\pi_n^s P_{n,t}^N y_{n,t+s}(i) - MC_{n,t+s}(i) y_{n,t+s}(i)] \tag{21}$$

subject to the demand for the ith intermediate good (see equation [17]). Variable π_n is the trend inflation rate in the nonoil sector, $P_{n,t}^N$ is the newly set price, $y_{n,t}(i)$ is the ith intermediate good, and $MC_{n,t}(i)$ is the nominal marginal cost in the nonoil sector given as

(22) $$MC_{n,t}(i) = \frac{W_t}{\alpha_n}\frac{n_{n,t}(i)}{y_{n,t}(i)},$$

where W_t is the nominal wage rate. The input ratio to minimize costs is

(23) $$\frac{o_t}{n_n} = \frac{\alpha_o}{\alpha_n}\frac{W_t}{P_{o,t}}$$

where $P_{o,t}$ is the final oil good's price. In addition, υ_t is the marginal value of a dollar to the household. The first-order condition with respect to $P^N_{n,t}$ is

(24) $$E_t \sum_{s=0}^{\infty} (\beta\theta_n)^s \upsilon_{t+s} y_{n,t+s}(i)\,[\pi^s_n P^N_{n,t} - \mu_n MC_{n,t+s}(i)] = 0.$$

The oil sector works similarly to the nonoil sector. Firms in the oil sector produce final oil goods by aggregating intermediate goods. Namely,

(25) $$y_{o,t} = \left[\int y_{o,t}(i)^{1/\mu_o}\, di\right]^{\mu_o}, \qquad \mu_o \geq 1$$

where $y_{o,t}$ is the final good and $y_{o,t}(i)$ is the ith intermediate good in the oil sector. The final oil good price ($P_{o,t}$) is given as

(26) $$P_{o,t} = \left[\int P_{o,t}(i)^{1/(1-\mu_o)}\; di\right]^{1-\mu_o}$$

where $P_{o,t}(i)$ is the ith intermediate oil good price. The demand for the ith intermediate good in the oil sector is

(27) $$y_{o,t}(i) = y_{o,t}\left[\frac{P_{o,t}(i)}{P_{o,t}}\right]^{\mu_o/(1-\mu_o)}$$

Production technology for the ith intermediate good is

(28) $$y_{o,t}(i) = z_t(cr_t(i))^{\alpha_{cr}}$$

where $cr_t(i)$ is the crude oil input imported from abroad. We abstract the labor input in the oil production for simplicity. Intermediate goods producers in the oil sector also behave as monopolistic competitors and set prices using the Calvo mechanism. The first-order condition is

(29) $$E_t \sum_{s=0}^{\infty} (\beta\theta_o)^s \upsilon_{t+s} y_{o,t+s}(i)\,[\pi^s_o P^N_{o,t} - \mu_o MC_{o,t+s}(i)] = 0.$$

Variable $MC_{o,t}$ is the nominal marginal cost given as

(30) $$MC_{o,t}(i) = \frac{P_{cr,t}}{z_t \alpha_{cr} cr_t(i)^{\alpha_{cr}-1}},$$

where $P_{cr,t} = S_t P^*_{cr,t}$ is the domestic crude oil price. This is the crude oil price in dollar terms, $P^*_{cr,t}$, times nominal exchange rate, S_t.

We also assume imported goods (other than crude oil) prices are sticky. Intermediate importers behave as monopolistic competitors and set prices using the Calvo mechanism. The first-order condition is

$$(31)\qquad E_t \sum_{s=0}^{\infty} (\beta\theta_m)^s \upsilon_{t+s} y_{m,t+s}(i)\,[\pi_m^s P_{m,t}^N - \mu_m MC_{m,t+s}(i)] = 0.$$

Variable $MC_{m,t}$ is the nominal marginal cost given as

$$(32)\qquad MC_{m,t}(i) = S_t P_t^*.$$

Next, we consider the household problem. The household i maximizes expected utility

$$(33)\qquad E_t\left[\sum_{s=0o}^{\infty} \beta^s (U(c_{t+s}) - V(n_{t+s}(i)))\right]$$

subject to the budget constraint

$$(34)\qquad P_{n,t}c_{n,t} + P_{o,t}c_{o,t} + P_{m,t}c_{m,t} + B_t \leq W_t(i)n_t(i) + \Pi_t + T_t + (1 + R_{t-1})B_{t-1},$$

where c_t is the final consumption good, n_t is the labor hours, B_t is the nominal savings, Π_t is the transfer from firms, T_t is the transfer from government, and R_t is the nominal interest rate. The final consumption good (c_t) is a composite of the domestically produced nonoil consumption good ($c_{n,t}$), oil consumption good ($c_{o,t}$), and imported consumption good ($c_{m,t}$) given as

$$(35)\qquad c_t(i) = \chi(c_{n,t}(i))^{1-w_o-w_m}(c_{o,t}(i))^{w_o}(c_{m,t}(i))^{w_m},$$

where $\chi = (1/w_o)^{w_o}(1/w_m)^{w_m}(1/(1-w_o-w_m))^{1-w_o-w_m}$ is a normalizing factor. The parameters w_o and w_m are the shares of the oil and imported consumption goods in total consumption. Variable $P_{n,t}$ is the domestically produced nonoil consumption good's price, $P_{o,t}$ is the oil consumption good's price, and $P_{m,t}$ is the imported good's price in the domestic currency. We drop subscript i, except for the household i's wage and labor supply assuming symmetric equilibrium.

First-order conditions, except for wage setting, are

$$(36)\qquad U_{c_n,t} = \upsilon_t P_{n,t}$$

$$(37)\qquad U_{c_o,t} = \upsilon_t P_{o,t}$$

$$(38)\qquad U_{c_m,t} = \upsilon_t P_{m,t}$$

$$(39)\qquad \frac{1}{1 + R_t} = \beta E_t \frac{\upsilon_{t+1}}{\upsilon_t}$$

where $U_{c_n,t}$, $U_{c_o,t}$, and $U_{c_m,t}$ are the derivatives of the utility function with respect to $c_{n,t}$, $c_{o,t}$, and $c_{m,t}$ respectively. We assume the utility function takes a form as

(40) $$U(c_t) = \zeta_{c,t} \ln c_t, \qquad V(n_t(i)) = \zeta_{n,t}\chi_n n(i)^2,$$

where $\zeta_{c,t}$ and $\zeta_{n,t}$ are the consumption preference shock and labor supply shock, respectively. They follow the laws of motion given as

(41) $$\ln \zeta_{c,t} = (1 - \rho_{\zeta_c}) + \rho_{\zeta_c} \ln \zeta_{c,t-1} + \varepsilon_{c,t}, \qquad \varepsilon_{c,t} \sim N(0, \sigma_c)$$

(42) $$\ln \zeta_{n,t} = (1 - \rho_{\zeta_n}) + \rho_{\zeta_n} \ln \zeta_{n,t-1} + \varepsilon_{n,t}, \qquad \varepsilon_{n,t} \sim N(0, \sigma_n).$$

In addition, χ_n is a normalizing factor that ensures the steady-state labor supply is one-third of available time.

Households set wages using the Calvo mechanism. Labor used for production is an aggregate of differentiated labor supply by households given as

(43) $$n_t = \left[\int n_t(i)^{1/\mu_w} di\right]^{\mu_w}, \qquad \mu_w \geq 1.$$

The wage associated with n_t is given as

(44) $$W_t = \left[\int W_t(i)^{1/(1-\mu_w)}\ di\right]^{1-\mu_w}.$$

Demand for the ith household's labor is

(45) $$n_t(i) = n_t\left[\frac{W_t(i)}{W_t}\right]^{\mu_w/(1-\mu_w)}.$$

In each period, household i sets a new wage with probability $1-\theta_w$, or adjusts its wage just as much as the trend inflation rate times the trend growth rate with probability θ_w. The household wage setting problem is then

(46) $$\max_{W_t^N} E_t \sum_{s=0}^{\infty} (\beta\theta_w)^s [-V(n_{t+s}(i)) + \upsilon_{t+s}(\pi_c \cdot z)^s W_t^N n_{t+s}(i)]$$

where π_c is the final consumption good's trend inflation rate and z is the economy-wide trend growth rate. The first-order condition with respect to W_t^N is given as

(47) $$E_t \sum_{s=0}^{\infty} (\beta\theta_w)^s n_{t+s}(i)\, \upsilon_{t+s}\left[-\mu_w \frac{V'(n_{t+s}(i))}{\upsilon_{t+s}} + (\pi_c)^s W_T^N\right] = 0.$$

Market-clearing conditions are

(48) $$y_{n,t} = c_{n,t} + S_t x^*_{n,t}$$

(49) $$y_{o,t} = o_t + c_{o,t}$$

(50) $$n_t = n_{n,t}$$

where $x^*_{n,t}$ is the nonoil goods export in dollar terms. We abstract the oil sector export for simplicity. We define the real GDP of the economy as

(51) $$y_t = c_t + \frac{P_{n,t}}{P_{c,t}} x_t - \frac{P_{cr,t}}{P_{c,t}} cr_t - \frac{P_{m,t}}{P_{c,t}} c_{m,t}.$$

Exogenous variables—detrended log nonoil goods export in dollar terms ($\tilde{x}^*_{n,t}$), detrended log real exchange rate ($\tilde{\xi}_t$) and detrended log relative price of crude oil to foreign price level ($\tilde{\gamma}^*_t$)—follow joint process given as

(52) $$F_0 \begin{bmatrix} \tilde{x}^*_{n,t} \\ \tilde{\xi}_t \\ \tilde{\gamma}^*_t \end{bmatrix} = F(L) \begin{bmatrix} \tilde{x}^*_{n,t-1} \\ \tilde{\xi}_{t-1} \\ \tilde{\gamma}^*_{t-1} \end{bmatrix} + \varepsilon^*_t, \qquad \varepsilon^*_t \sim N(0, \Sigma^*).$$

We assume $\tilde{\gamma}^*_t$ does not contemporaneously affect the other variables in equation (52). We thus identify the effects of oil price shocks (innovations in $\tilde{\gamma}^*_t$) using a recursive ordering scheme, so that F_0 is a lower triangle matrix.[8]

Monetary policy follows a Taylor-type interest rate rule given as

(53) $$R_t = \rho_R R_{t-1} + (1 - \rho_R)(\rho_{\pi_{\text{core}}} \pi_{\text{core},t-1} + \rho_{\pi_{\text{non}}} \pi_{\text{non},t-1} + \rho_y \tilde{y}_{t-1}) + \varepsilon_{m,t},$$

where $\tilde{y}_t$ is the output gap and $\varepsilon_{m,t} \sim N(0, \sigma_m)$. We also note that the final consumption good price ($P_{c,t}$) is given as

(54) $$P_{c,t} = P_{o,t}^{w_o} P_{m,t}^{w_m} P_{n,t}^{1-w_o-w_m}.$$

We define core CPI inflation as CPI inflation excluding oil price inflation. Then, we can define $\pi_{\text{core},t} = (w_m \pi_{m,t} + (1 - w_o - w_m)\pi_{n,t})$ and $\pi_{\text{non},t} = w_o \pi_{o,t}$.

We next estimate the nominal rigidities model constructed before using Bayesian methods, as in Smets and Wouters (2007). The sample period for the estimation is 2000:I to 2009:I, corresponding to the post-Korean currency crisis period.[9]

We fix some parameters by calibration and then estimate the remaining parameters by Bayesian methods. We set the subjective discount rate β as $0.98^{1/4}$. The nonoil sector production function parameters α_n and α_o are set as 0.448 and 0.062, respectively, using the shares of labor input and intermediate oil (petroleum) use in the total value-added plus intermediate oil use in the nonoil (nonpetroleum) sector, obtained from the 2005 Korean input-output table. We also set α_{cr} as 0.657, using the share of intermediate crude oil use in total value-added plus intermediate crude oil use in the oil (petroleum) sector from the input-output table. We set the price and wage markup parameters (μ_n, μ_o, μ_m, and μ_w) as 1.1 as in the literature. We calibrate the shares of oil (petroleum) and imported goods in total consumption, w_o and

8. The oil price shocks in equation (52) are identified in the context of the DSGE model and monetary policy assessments as in Bodenstein et al. (2008). They differ from the oil price shocks identified from the VAR analyses in the previous section to detect the differences in the nature of oil price hikes. The oil price shocks in equation (52) would resemble oil price shocks originating from the purely supply side of oil markets.

9. For the pre-crisis DSGE analysis, one may consult the working paper version of the paper, Lee and Song (2009).

w_m, as 0.021 and 0.390, respectively, using the shares of oil (petroleum) and imported goods in the GDP from the input-output table.

We use the log difference of real GDP, CPI inflation rate, CPI energy price inflation rate (as oil sector inflation rate), overnight call rate, linearly detrended log export in dollar (constructed as export in real GDP divided by the real exchange rate and then multiplied by core CPI and divided by CPI), linearly detrended log real effective exchange rate from Bank for International Settlements (BIS), and linearly detrended log WTI price divided by U.S. CPI (as the relative price of crude oil to foreign price level). We obtain the data from the Korean National Statistical Office, Datastream, and the BIS. The seven observable variables match seven structural shocks in the model and we can identify the model.

In addition, we estimate the exogenous VAR block equation (52) with the data and insert the estimated block in the model before the Bayesian estimations. We find that a VAR with lag length one is appropriate based on the Schwartz criterion.

We estimate parameters concerning price, as well as wage stickiness, shock processes, and monetary policy rule, using Bayesian methods after log-linearizing the model around the stationary steady states, as in Adolfson et al. (2007) and Smets and Wouters (2007).

We set the prior distributions of the price stickiness and wage stickiness parameters, θ_n, θ_o, θ_m, and θ_w, as uniform distributions on the interval [0, 1]. We set the prior distribution of the parameter concerning the weight on the nonoil inflation rate, $\rho_{\pi_{core}}$, as a normal distribution with a mean of 1.5 and a standard deviation of 0.4 and the prior distribution of the parameter concerning the weight on output gap, ρ_y, as a beta distribution with a mean of 0.125 and a standard deviation of 0.1 following the literature. We set the prior distribution of the parameter concerning the weight on the oil inflation rate, $\rho_{\pi_{non}}$, as a normal distribution with a mean of 0 and a standard deviation of 2. The zero prior mean and relatively large standard deviation reflect the lack of prior information concerning the monetary policy response toward oil price inflation. We set the prior distributions of shock persistence and monetary policy interest rate smoothing parameters, ρ_{ζ_z}, ρ_{ζ_c}, ρ_{ζ_n}, and ρ_R, as beta distributions with a mean of 0.7 and a standard deviation of 0.1. We set the prior distributions of all parameters concerning the shock standard deviation as an inverse gamma distribution with a mean of 0.2 and a standard deviation of 2. We also estimate the diagonal elements of Σ^* in the VAR block equation (52), which is the identity matrix by definition, and set the prior distributions of the diagonal elements of the matrix as inverse gamma distributions with a mean of 1 and a standard deviation of 2. We will denote the ith diagonal element of the matrix by Σ^*_{ii} in the following. Table 8.4 summarizes the prior distributions of the parameters.

Table 8.5 summarizes the estimated posterior distributions of the parameters. When we examine the estimated posterior distributions of the price

Table 8.4 Priors

Parameters		Priors		
		Type	Mean	Standard deviation
Nonoil price stickiness	θ_n	Uniform	0.5	$1/\sqrt{12}$
Imported goods price stickiness	θ_m	Uniform	0.5	$1/\sqrt{12}$
Oil price stickiness	θ_o	Uniform	0.5	$1/\sqrt{12}$
Wage stickiness	θ_w	Uniform	0.5	$1/\sqrt{12}$
Monetary policy nonoil inflation response	$\rho_{\pi_{core}}$	Normal	1.5	0.4
Monetary policy oil inflation response	$\rho_{\pi_{non}}$	Normal	0.0	2.0
Monetary policy output gap response	ρ_y	Beta	0.125	0.1
Interest rate smoothing	ρ_R	Beta	0.7	0.1
Aggregate tech. shock persistence	ρ_{ζ_z}	Beta	0.7	0.1
Consumption preference shock persistence	ρ_{ζ_c}	Beta	0.7	0.1
Labor supply shock persistence	ρ_{ζ_n}	Beta	0.7	0.1
Monetary policy shock standard deviation	σ_m	Inv. Gamma	0.02	2
Aggregate tech. shock standard deviation	σ_z	Inv. Gamma	0.02	2
Consumption preference shock standard deviation	σ_c	Inv. Gamma	0.02	2
Labor supply shock standard deviation	σ_n	Inv. Gamma	0.02	2
VAR cov. matrix diagonal elements	Σ^*_{ii}	Inv. Gamma	1	2

stickiness parameters, the posterior of the nonoil sector price stickiness parameter, θ_n, is estimated to be highest; its mode is 0.958. The posterior of the oil sector price stickiness parameter, θ_o, is estimated to be lowest amongst the price stickiness parameters; its mode is 0.492. We note the estimated degree of oil price stickiness differs from zero, as we can see from the tenth percentile of the posterior. The posterior mode of imported goods price stickiness, θ_m, is 0.843, between the modes of nonoil good's price stickiness and oil good's price stickiness. The posterior of the wage stickiness parameter, θ_w, is estimated to be lower than the posteriors of the price stickiness parameters; its mode is 0.210.[10]

Concerning the parameters of the monetary policy Taylor rule, the posterior mode of the monetary policy response to nonoil price inflation parameter, $\rho_{\pi_{core}}$, is 1.537, slightly higher than the prior mode. The posterior mode of the monetary policy output gap response parameter, ρ_y, is 0.003, lower than the prior mode. When we examine the posterior of the monetary policy response to oil price inflation, $\rho_{\pi_{non}}$, the mode is –0.120, the tenth percentile is –3.327, and the ninetieth percentile is 3.188. Thus, the monetary policy response toward oil price inflation is rather imprecisely estimated, including zero between the tenth and ninetieth percentile. The

10. The estimated wage stickiness parameter is relatively low compared to previous results, as in Adolfson et al. (2007). This might be because we do not utilize wage data in the estimation since we cannot obtain reliable Korean wage data.

Table 8.5 **Posteriors**

Parameters		Posteriors			
		Mode	Standard deviation	10th percentile	90th percentile
Nonoil price stickiness	θ_n	0.958	0.012	0.924	0.970
Imported goods price stickiness	θ_m	0.843	0.066	0.744	0.938
Oil price stickiness	θ_o	0.492	0.045	0.418	0.559
Wage stickiness	θ_w	0.210	0.053	0.136	0.325
Mon. policy nonoil response	$\rho_{\pi_{core}}$	1.537	0.313	1.268	2.320
Mon. policy oil response	$\rho_{\pi_{non}}$	–0.120	1.980	–3.327	3.188
Mon. policy output gap response	ρ_y	0.003	0.006	3.031e-6	0.015
Interest rate smoothing	ρ_R	0.698	0.091	0.563	0.833
Aggregate tech. shock per.	ρ_{ζ_z}	0.414	0.036	0.353	0.482
Cons. preference shock per.	ρ_{ζ_c}	0.835	0.046	0.710	0.883
Labor supply shock per.	ρ_{ζ_n}	0.974	0.011	0.946	0.985
Monetary policy shock standard deviation	σ_m	0.026	0.003	0.024	0.032
Aggregate tech. standard deviation	σ_z	0.352	0.065	0.268	0.475
Cons. preference shock standard deviation	σ_c	0.161	0.031	0.131	0.254
Labor supply shock standard deviation	σ_n	0.637	0.193	0.450	1.073
VAR cov. first diag. element	Σ^*_{11}	0.929	0.105	0.778	1.132
VAR cov. second diag. element	Σ^*_{22}	0.925	0.104	0.775	1.133
VAR cov. third diag. element	Σ^*_{33}	0.914	0.103	0.765	1.116
Marginal likelihood			375.9		

estimated mode represents less adverse or more accommodating policies toward oil price inflation than nonoil price inflation, as mentioned in Dhawan and Jestke (2007).

We can summarize our findings from the DSGE model based on the Korean data as follows. First, the degree of oil sector price stickiness is relatively lower than nonoil sector price stickiness, as in the literature. However, the oil sector price is not completely flexible differing to the theoretical models, as in Aoki (2001), in which optimal monetary policy is the complete stabilization of the core inflation rate. Second, the monetary policy response toward noncore CPI inflation is rather imprecisely estimated and the estimated posterior mode represents less strict policy toward noncore CPI inflation than core CPI inflation.

8.5 Monetary Policy Rules

In the following, we consider different degrees of monetary policy responses toward noncore oil price inflation in the Taylor-type rules equation (53) and examine the effects on CPI inflation and output gap volatilities

Table 8.6 **Monetary policy rules and volatilities**

Permanent tech. shocks			Preference shocks		
$\rho_{\pi_{non}}$	$S.D.(\pi_c)$	$S.D.(y)$	$\rho_{\pi_{non}}$	$S.D.(\pi_c)$	$S.D.(y)$
10th per.	0.0005	0.1491	10th per.	0.0065	0.6923
Mode	0.0005	0.1489	Mode	0.0067	0.6949
Zero	0.0005	0.1489	Zero	0.0067	0.6950
90th per.	0.0005	0.1487	90th per.	0.0068	0.6972
Labor supply shocks			Oil shocks		
$\rho_{\pi_{non}}$	$S.D.(\pi_c)$	$S.D.(y)$	$\rho_{\pi_{non}}$	$S.D.(\pi_c)$	$S.D.(y)$
10th per.	0.0413	0.5049	10th per.	0.0021	0.1575
Mode	0.0380	0.4343	Mode	0.0021	0.1582
Zero	0.0378	0.4319	Zero	0.0021	0.1582
90th per.	0.0350	0.3727	90th per.	0.0021	0.1593
Export shocks (1st shocks in VAR)			Real exchange rate shocks (2nd shocks in VAR)		
$\rho_{\pi_{non}}$	$S.D.(\pi_c)$	$S.D.(y)$	$\rho_{\pi_{non}}$	$S.D.(\pi_c)$	$S.D.(y)$
10th per.	0.0041	0.1041	10th per.	0.0022	0.1289
Mode	0.0043	0.1132	Mode	0.0022	0.1301
Zero	0.0043	0.1136	Zero	0.0022	0.1302
90th per.	0.0045	0.1231	90th per.	0.0022	0.1323

Note: S.D. = standard deviation.

in the DSGE model. It would also be necessary to consider different values for ρ_{π_o}, since its posterior distribution is imprecisely estimated.

We further consider cases separately when the model economy is perturbed by each structural shock to examine the different effects of monetary policy responses to the shocks. The other parameter values are set at their posterior modes.

We simulate the model by setting $\rho_{\pi_{non}}$ equal to –3.327, –0.120, 0.0, and 3.188, respectively. They are respectively the tenth percentile, the mode, zero response, and the ninetieth percentile of the posterior distribution of $\rho_{\pi_{non}}$. Table 8.6 reports the results.

When the model economy is simulated with oil shocks only, more accommodating policies toward oil price inflation works better, as we can reduce output gap volatilities without raising CPI inflation volatilities very much. This resembles the results from Dhawan and Jeske (2007). More aggressive monetary policies toward oil price inflation destabilize nonoil sector inflation and output through interest rate adjustments and lead to higher volatilities in overall CPI inflation and output gap.

The results for the other structural shocks are mixed. In response to technology shocks and labor supply shocks, more aggressive policy toward oil price inflation works better. In response to consumption preference shocks, more accommodating policy works better, as can be seen in table 8.6.

8.6 Conclusion

The price of crude oil has increased steadily since 2002. It started to increase very rapidly at the end of 2007. Facing the recent hike of the oil price, economists, as well as policymakers, became concerned with the difficulties the rising oil price might have on the Korean economy.

This chapter investigates the changing nature of oil price hikes and macroeconomic responses to them in the Korean economy. We also evaluate which monetary policy rule works better in the face of oil price shocks to stabilize the economy. We find that the recent run-up in oil price is induced by an increase in the demand for oil, and its effects on the Korean economy are weak from the VAR analyses. This is in contrast to the causes and effects of the previous two oil price hikes in the 1970s. In addition, we find monetary policy in Korea needs to be operated more or less accommodatingly to the oil price shocks to stabilize the economy given the shocks and frictions in the DSGE model.

Naturally, there are other possible explanations for the declining importance of oil price hikes. One may ascribe mild impacts of oil prices to the macroeconomy to declining shares of oil in consumption and production. We look into the time series for both consumption and production shares of oil but fail to find conspicuous changes in the shares. This is consistent with the findings in Kilian (2008).[11] We also investigate whether the wage inflation has shown any significant differences in the pre- and post-crisis periods, but persuasive results cannot be found, either.

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11. However, Blanchard and Galí (2007) find the decline in the share of oil in consumption and production results in quantitatively significant implication for the recent U.S. economy.

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Comment Tokuo Iwaisako

Lee and Song's chapter analyzes the effect of oil shocks on the Korean economy and examines the role of monetary policy in dealing with oil

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