Three Essays on Macroeconomics, Oil Price Fluctuations, and Credit Risks in Banking Systems

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Abstract

This dissertation is a collection of theoretical and empirical essays on oil price fluctuations, macroeconomics, and credit risks in banking systems. The dissertation consists of three papers organized as chapters: i) Chapter 1 evaluates the optimal monetary policy response to the underlying causes of oil price fluctuations under a Dynamic Stochastic General Equilibrium (DSGE) framework for small open oil-importing economies, ii) Chapter 2 examines the empirical dynamic effects of underlying shocks of oil price fluctuations on monetary policy response and macroeconomic aggregates across oil-exporting and oil-importing open economies, and iii) Chapter 3, however, examines the effect of the recent oil price slumps on credit risks and banking instability across Gulf Cooperation Council (GCC) region. Chapter 3 further examines the macro-financial linkages between the real economy and GCC banking systems.

Chapter 1 constructs a DSGE model for small open oil-importing economies to evaluate the optimal monetary policy response to the underlying causes of oil price fluctuations and its transmission channels to these economies. This chapter incorporates oil supply disruption shock, oil demand shock driven by world economic activities, and oil speculative demand shock. The model incorporates oil and non-oil goods in consumption and final good production, oil storage with competitive oil-speculative firms, exogenously determined oil supply, and endogenously determined real oil price. The model explores whether the origin of oil price shocks requires a different optimal monetary policy response with a central bank committed to stabilizing output-gap and inflation. The results demonstrate that central banks in small open economies should indeed identify these underlying causes of oil price fluctuations and respond to the ori-

gin of the oil shock. Therefore, an oil price hike (or slump) caused by world economic activities induces a tightening (or expansionary) optimal monetary policy response. An oil price hike (or slump), however, caused by oil supply disruption and speculative oil demand shocks induces an expansionary (or tightening) optimal monetary policy response. The oil price hike induced by oil supply disruption and speculative oil demand shocks brings unwanted economic consequences to small open economies and therefore a monetary policy with stabilizing objectives will have to accommodate these shocks.

Chapter 2 further constructs a Structural VAR model that jointly captures the interactions between macroeconomic aggregates, monetary policy and the underlying causes of oil price fluctuations. The structural model of Chapter 2 follows Kilian (2009) in identifying the underlying the oil price shocks and Kim and Roubini (2000) in identifying the monetary policy in open economies. The results indicate that the oil supply disruption shock tends to have a diminished effect across oil-importing open economies. The oil demand shock driven by world economic activity, however, tends to stimulate domestic economic activities across oil exporting and oil importing open economies. Both world oil demand and oil-specific demand shocks place an inflationary pressure on domestic CPI across these economies. The results report asymmetric interest rate responses to different oil shocks within and across these open economies. In Mexico, Norway, Japan, Thailand, and Denmark; the interest rate falls in response to oil supply disruption shock. The interest rate rises in response to world oil demand shock across oil importing economies. The monetary policies, however, responded differently to oil-specific demand shock. The interest rate rises in oil-importing economies such as Japan, the U.K., Thailand, Denmark, and Sweden and falls in oil-exporting economies such as Canada, Norway, and Mexico.

Chapter 3 assesses the effect of the recent 2014-2015 oil price slumps on the financial stability in the Gulf Cooperation Council (GCC) region. The first objective of Chapter 3 is to assess the oil price shock transmission channels, along with other macroeconomic shocks, to GCC banks' balance sheets. This part of Chapter 3 implements a System Generalized Method of Moments (GMM) model of Blundell & Bond (1998) and a Panel Fixed Effect Model to estimate the response of nonperforming loans (NPLs) to its macroeconomic determinants. The second objective of Chapter 3 is to assess any negative feedback effects between the GCC banking systems and the real economy. The second part of Chapter 3 implements a Panel VAR model to explore the macro-financial linkages between GCC banking systems and the real economy. The results indicate that oil price, non-oil GDP, interest rate, stock prices, and housing prices are major determinants of NPLs across GCC banks and therefore are major determinants of financial stability in the region. Credit risk shock tends to propagate disturbance to non-oil GDP, credit growth, and stock prices across GCC economies. A higher level of NPLs restricts banks' credit growth and can dampen economic growth in these economies. The results support the notion that disturbances in banking systems lead to unwanted economic consequences in the real sector. For policy makers with financial stability objectives, counter cyclical policies to fluctuations in international oil prices are needed to limit the GDP slowdown and smooth the potential spillover effects to banking systems. The GCC economies, however, accumulated large amount of oil stabilization buffers and have the fiscal space to limit any negative feedback to their financial sectors.

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Chapter 1

The Optimal Monetary Policy Response to the Underlying Causes of Oil Price Fluctuations in Small Open Economies and Its Transmission Channels

1.1 Introduction

The assumption of oil price exogeneity in macroeconomic models was the common approach in studying the dynamic of oil price fluctuations (see Kilian (2009)). Historically, the assumption of oil price exogeneity was largely justified by the dominant role of the supply side in international oil markets. In the 70s, the conflict in the Middle East, the rise of OPEC, and the Iranian Revolution were the main causes of oil price fluctuations. As a result, the literature ignored the underlying causes of oil price fluctuations and focused exclusively on the dynamic of an exogenous oil price assumption [see Hamilton (1983), Bernanke et al. (1997), Hamilton (2003)), and Blanchard & Gali (2007)]. The oil price hike in 2008-2009 and its recent slump in 2014-2015 bring various economic consequences to small open economies. The 2008-2009 oil price hike was caused by the demand side of international oil markets and mainly driven by strong economic growth in emerging markets. The recent 2014-2015 slumps of oil prices, however, are driven by a combined effect of slow economic growth in emerging markets and a massive increase in global oil production. This chapter highlights how does an oil price increase (or decrease) caused by disruptions in global oil production, world economic growth, or oil speculative demand shocks affect the small open economies and what are the optimal policy responses to these underlying causes of oil price fluctuations. Kilian (2009) argues that the existing macroeconomic models must consider the underlying causes of oil price fluctuations and rejects the common assumption of oil price exogeneity. The main theoretical premise behind this chapter is to examine the transmission channels of these underlying causes of oil price fluctuations on small open economies and whether the origin of the oil price shocks should determine the optimal monetary policy response. Chapter 1 constructs a Dynamic Stochastic General Equilibrium (DSGE) model for small open economies to evaluate the optimal monetary policy response to the underlying causes of oil price fluctuations and its transmission channels to these economies. This chapter incorporates oil supply disruption shock, oil demand shock driven by world economic activities, and oil speculative demand shock. The model explores whether the origin of oil price shocks requires a different optimal monetary policy response with a central bank committed to stabilizing output-gap and inflation. The results of this chapter show that central banks in small open economies should indeed identify these underlying causes of oil price fluctuations and respond to the origin of the oil price shock. Further, evidence for asymmetric monetary policy responses to different shocks of oil price fluctuations are discussed in Chapter 2. Hence, Chapter 2 complements the theoretical work of Chapter 1.

1.2 Literature Review

Economists disagree on the reasons behind the diminished effect of 2000s oil price shocks on macroeconomic aggregates, specifically inflation and output. Blanchard & Gali (2007) argue that the diminishing effect of the 2000s oil shocks is due to i) the decline in real wage rigidities ii) the higher credibility of monetary policies, and iii) the decline of oil share in productions. Kilian (2009) identifies, however, the underlying shocks of oil price fluctuations in international oil markets. He further argues that the effect of oil price shocks depends on these underlying causes of oil price fluctuations.

Bodenstein, Guerrieri, and Kilian (2012) are the first to examine appropriate monetary policy response to different oil shocks. From a welfare-maximizing perspective, Bodenstein, Guerrieri, and Kilian (2012) conclude optimal responses to oil shocks are asymmetric and note " no two structural shocks induce the same monetary policy response." Thus, for the U.S. Federal Reserve, they argue that the origin of the oil shocks should determine the policy response.

Plante (2009) calibrates a New Keynesian DSGE model for the U.S. and examines the optimal response of monetary policy to exogenous oil supply shock and productivity-driven demand shock. Under different policy rules, Plante (2009) finds that the nominal interest rate falls after an oil supply shock and rises after a productivity-driven demand shock. Plante (2009) finds that the optimal monetary policy response to exogenous oil supply shock and productivity-driven demand shock are asymmetric. In line with Bodenstein, Guerrieri, and Kilian (2012), Plante (2009) confirms that different oil shocks induce different optimal monetary policy responses.

Kilian (2009) structurally decomposes the oil price into i) oil supply disruption shocks, ii) oil demand shock driven by world economic activities, and iii) oil-specific demand shock driven by precautionary demand for oil. Kilian & Lewis (2011) find the Federal Funds rate rises in response to an oil price hike driven by world economic activities and oil specific-demand shocks. However, the Federal Funds rate falls in response to oil supply disruption shock. Chapter 2 provides a literature review on the empirical results of oil price shocks.

Bernanke et al. (1997) show that the endogenous tightening response of monetary policy to oil price hikes in the 1970s accounts for a large part of the "recessionary impact of oil price" on macroeconomic aggregates. The paper argues that the U.S. Federal Reserve could have avoided that recession by keeping interest rate constant and hence tolerated a higher inflation rate.

Bodenstein, Erceg, and Guerrieri (2011) introduce a two-country DSGE model that endogenously determines oil price with an incomplete financial market and calibrated the model for the U.S. economy. They report oil price shock leads to a reduction in U.S. non-oil consumption and an immediate depreciation effect on real exchange rate. Bodenstein, Erceg, and Guerrieri (2011) further indicate that oil shocks are significant in explaining the fluctuation of non-oil trade balance, which "reflects a strong interaction between oil imports and non-oil imports."

Under alternative monetary policy rules with a welfare-maximizing model, Bodenstein et al. (2008) explore the optimal response to an energy supply shock. The key result of their analysis is that the adverse energy supply shock leads to a persistent increase in core and headline inflation. The results further show that macroeconomic implications of a central bank responding to a forecast of core inflation are different than those implications due to responding to headline inflation. The results of Bodenstein et al. (2008) suggest that responding to a forecast of core inflation leads to a more stabilized economy.

Başkaya et al. (2013) examine the uncertainty of oil prices and its implications under small open DSGE framework. With oil price modeled as an exogenous variable, Başkaya et al. (2013) find two channels through which oil price affects small open economies: i) leads to a riskier marginal product of capital and more incentives to use less capital, and ii) leads to a higher level of demand for precautionary savings. Medina & Soto (2005) calibrate a small open DSGE model for the Chilean economy. The study finds that an increase of 13% in real oil price causes an increase in inflation and a decrease in GDP.

Unalmis et al. (2012) build on recent literature of commodity storage modeling to introduce speculative oil demand in a DSGE framework. The speculative oil firms enable the model to link the current oil price, future oil price, and oil inventory. Unalmis et al. (2012) indicate that the asymmetric effect of oil price increase is due to the endogenous monetary policy response.

Peersman & Stevens (2010) develop a structural DSGE model for the U.S. and a simplified oil producing economy. They claim that different oil shocks have different macroeconomic effects on the U.S. economy. The oil supply shock, their results indicate, explains more than 50% of the fluctuations of real oil price. As a result, the real oil price is exogenous to the U.S. macroeconomic aggregates. Peersman & Stevens (2010) argue that the significant role of oil supply shock in their results is due to the shift in power from oil producing economies to oil companies. The oil-specific demand shocks come second in explaining the fluctuations in the real price of oil.

1.3 Model

The model presented in this chapter extends the new Keynesian small open economy model of Kollmann (2002) and Kollmann (2001). The model incorporates oil and non-oil goods in consumption, oil and non-oil goods in final good production, oil storage with competitive oil-speculative firms, exogenously determined oil supply, and endogenously determined real oil price. The objective of the central bank is to stabilize output-gap and inflation. The household representative maximizes expected utility by choosing oil-consumption (C_t^o), non-oil consumption (C_t^n), capital (K_t), hours worked (L_t), and domestic bonds (A_t), and buying an international foreign bond (B_t). Under a monopolistic competition, the model takes nominal rigidity in pricing imported and domestic intermediate non-oil goods. The domestic economy exports non-oil intermediate goods, imports foreign intermediate non-oil goods, and imports crude oil. The real price of oil is endogenously determined as a result of oil market clearing.

1.3.1 Household

The household's budget constraint for period t is:

$$A_{t+1}+e_tB_{t+1}+P_t(C_t+I_t)=W_tL_t+R_tK_t+A_t(1+i_{t-1})+e_tB_t(1+i^f_{t-1})+\int_0^1\Pi^{\mathrm{n}}_{d,t}(s)ds+\int_0^1\Pi^n_{m,t}(s)ds \tag{1.1}$$

Incomplete market frictions in investment are integrated to account for adjustment costs in investment. The investment is specified as follows:

$$I_t = K_{t+1}+\psi(K_{t+1},K_t)-(1-\delta)K_t \tag{1.2}$$

The adjustment cost function is $\psi(K_{t+1},K_t)=\frac{\psi}{2}\left(\frac{K_{t+1}-K_t}{K_t}\right)^2 K_t$ and i_t is the interest rate on domestic currency bonds A_t . i^f_t is the interest rate on foreign currency bonds B_t. Schmitt-Grohé & Uribe (2003) and Mendoza (1991) found open economy models in absence of adjustment costs in investment are excessively volatile. For households, the utility function is specified as :

$$U_0 = E_0\sum_{t=0}^{\infty}\beta^t u_t\left(C_t,L_t\right) \tag{1.3}$$

$$U_t\left(C_t,L_t\right)=\frac{C_t^{1-\chi}}{1-\chi}+\frac{\left(1-L_t\right)^{1-\eta}}{1-\eta} \tag{1.4}$$

$$C_t=\left(\left(1-\omega_{oc}\right)^{\frac{1}{\gamma}}\left(C^n_t\right)^{\frac{\gamma-1}{\gamma}}+\left(\omega_{oc}\right)^{\frac{1}{\gamma}}\left(C^o_t\right)^{\frac{\gamma-1}{\gamma}}\right)^{\frac{\gamma}{\gamma-1}} \tag{1.5}$$

Following Bodenstein, Erceg, and Guerrieri (2011), the consumption basket (C_t) in household's budget constraint is produced by consumption distributors under perfect competition. The household representative maximizes the lifetime expected utility by choosing oil-consumption (C^o_t), non-oil consumption (C^n_t), capital (K_t), hours worked (L_t), domestic bonds (A_t), and buying an international foreign bond (B_t). γ is the elasticity of substitution between oil and non-oil consumption. χ is the inverse elasticity of inter-temporal substitution of consumption. η is the inverse of Frisch wage elasticity of labor supply.

Given the budget constraint, the representative household chooses $\{L_t, C_t, C_t^n, C_t^o, A_{t+1}, B_{t+1}, K_{t+1}\}_{t=0}^{t=\infty}$ that maximize the expected lifetime utility function. The following equations are the first order conditions for the representative household:

$$C_t^{-\chi} = \frac{(1-L_t)^{-\eta}}{W_t} \tag{1.6}$$

$$C_t^n = (1-\omega_{oc})\left(\frac{P_t^n}{P_t}\right)^{-\gamma} C_t \tag{1.7}$$

$$C_t^o = (\omega_{oc})\left(\frac{P_t^o}{P_t}\right)^{-\gamma} C_t \tag{1.8}$$

$$\frac{1}{(1+i_t)} = E_t\left(\rho_{t,t+\tau}\left(\frac{P_t}{P_{t+1}}\right)\right) = E_t\left(\left(\frac{\beta C_{t+1}^{-\chi}}{C_t^{-\chi}}\right)\left(\frac{1}{\Pi_{t+1}}\right)\right) \tag{1.9}$$

$$\frac{1}{\Upsilon_t(1+i_t^f)} = E_t\left(\rho_{t,t+\tau}\left(\frac{P_t}{P_{t+1}}\right)\left(\frac{e_{t+1}}{e_t}\right)\right) = E_t\left(\left(\frac{\beta C_{t+1}^{-\chi}}{C_t^{-\chi}}\right)\left(\frac{1}{\Pi_{t+1}^*}\right)\left(\frac{RER_{t+1}}{RER_t}\right)\right) \tag{1.10}$$

$$1+\psi\left(\frac{K_{t+1}}{K_t}-1\right) = \beta E_t\left(\left(\frac{C_{t+1}^{-\chi}}{C_t^{-\chi}}\right)\left(1-\delta+r_{k,t+1}+\frac{\psi}{2}\left(\frac{K_{t+2}^2}{K_{t+1}^2}-1\right)\right)\right) \tag{1.11}$$

The above equations are Euler conditions. (Π_t) is the domestic inflation, RER_t is the real exchange rate, and (Π_t^*) is the world inflation rate, which is exogenous. (Υ_t) is a stationary exogenous variable referred to as "UIP shock" as in Kollmann (2002) to account for uncovered interest parity (UIP) .

1.3.2 Final Good Production

Under a perfectly competitive market, the final good producer takes the final non-oil good (Z_t^{n}) and crude oil (Y_t^o), and converts them into a final good (Z_t). (Y_t^o) is imported from the rest of the world, and appears in the current account[1]. The final good is either consumed by households or invested in the economy.

$$Z_t = C_t + I_t \tag{1.12}$$

The final good production utilizes the following CES technology where $0 < \omega_j < 1, j = o,m$ are shares of imported oil and imported goods in production :

$$Z_t = \left((1-\omega_{op})^{\frac{1}{\bar{\nu}}} (Z_t^n)^{\frac{\bar{\nu}-1}{\bar{\nu}}} + (\omega_{op})^{\frac{1}{\bar{\nu}}} (Y_t^o)^{\frac{\bar{\nu}-1}{\bar{\nu}}} \right)^{\frac{\bar{\nu}}{\bar{\nu}-1}} \tag{1.13}$$

$$Z_t^n = \left((1-\omega_m)^{\frac{1}{\nu}} \left(Y_t^d\right)^{\frac{\nu-1}{\nu}} + (\omega_m)^{\frac{1}{\nu}} (Y_t^m)^{\frac{\nu-1}{\nu}} \right)^{\frac{\nu}{\nu-1}} \tag{1.14}$$

In the non-oil sector, under a perfectly competitive market, the final non-oil good producer takes a continuum of non-oil domestic intermediate goods and non-oil foreign intermediate goods to produce the final non-oil good. The CPI is a weighted average of domestic oil and non-oil prices as follows:

$$P_t = \left((1-\omega_{op}) (P_t^n)^{1-\gamma} + \omega_{op} (P_t^o)^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \tag{1.15}$$

The non-oil aggregate price is a weighted average of domestic and imported prices for non-oil goods as follows:

$$P_t^n = \left((1-\omega_m) \left(P_{d,t}\right)^{1-\nu} + \omega_m (P_{m,t})^{1-\nu} \right)^{\frac{1}{1-\nu}} \tag{1.16}$$

[1] See the Appendix for the detailed model setup

The first order conditions for the cost minimization problems for the final good producer and the final non-oil good producer yield the following:

$$Z_t^n = (1-\omega_{op})\left(\frac{P_t^n}{P_t}\right)^{-\bar{\nu}} Z_t \tag{1.17}$$

$$Y_t^o = (\omega_{op})\left(\frac{P_t^n}{P_t}\right)^{-\bar{\nu}} Z_t \tag{1.18}$$

$$Y_t^d = (1-\omega_m)\left(\frac{P_{d,t}}{P_t^n}\right)^{-\nu} Z_t^n \tag{1.19}$$

$$Y_t^m = (\omega_m)\left(\frac{P_{m,t}}{P_t^n}\right)^{-\nu} Z_t^n \tag{1.20}$$

1.3.3 Intermediate Goods Sector

The following technology is utilized to produce domestic goods and is specified as:

$$Y(j)_t = X_t K(j)^{\alpha} L(j)_t^{1-\alpha}, 0 < \alpha < 1 \tag{1.21}$$

X_t is an exogenous productivity shock. Given the price of labor (w_t) and the price of capital $(r_{k,t})$, the solution for the cost minimization problem leads to:

$$r_{k,t} = (\alpha)\frac{Y_t}{K_t} mc_t \tag{1.22}$$

$$w_t = (1-\alpha)\frac{Y_t}{L_t} mc_t \tag{1.23}$$

mc_t is the marginal cost of production. The marginal cost can be solved from the above F.O.C. and specified as:

$$mc_t = \left(\frac{r_{k,t}}{\alpha}\right)\left(\frac{K_t}{L_t}\right)^{1-\alpha}\left(\frac{1}{X_t}\right) = \left(\frac{r_{k,t}}{\alpha}\right)\left(\frac{\alpha w_t}{(1-\alpha)r_{k,t}}\right)^{1-\alpha}\left(\frac{1}{X_t}\right) \tag{1.24}$$

The domestic non-oil goods are either exported or domestically consumed in the final good production.

$$Y(j)_t = Y(j)_t^d + Y(j)_t^x \tag{1.25}$$

Note that $Y_t^i = (\int_0^1 Y_t^i(j)^{\frac{\theta}{\theta-1}} dj)^{\frac{\theta-1}{\theta}}$ with $\theta > 1$ and for $i = d,m$, where $Y_t^d(j)$ and $Y_t^m(j)$ are quantity indices of domestic and imported intermediate non-oil goods. θ is a constant elasticity of substitution between intermediate goods. Respectively, the price for domestic and imported intermediate goods are $P_{d,t} = (\int_0^1 P(j)_{d,t}^{\frac{\theta-1}{\theta}} dj)^{\frac{\theta-1}{\theta}}$ and $P_{m,t} = (\int_0^1 P(j)_{m,t}^{\frac{\theta-1}{\theta}} dj)^{\frac{\theta-1}{\theta}}$.

Given the the domestic output price $P_{d,t}$ and the domestic intermediate good price $P_{d,t}(j)$, competitive firm chooses $Y_t^d(j)$ that maximizes the following profit:

$$max_{Y_t^d(j)} \left[P_{d,t}Y_t^d - \int_0^1 P_t^d(j)Y_t^d(j)dj\right]$$

s.t.

$$Y_t^d = (\int_0^1 Y_t^d(j)^{\frac{\theta}{\theta-1}} dj)^{\frac{\theta-1}{\theta}}$$

The solution yields the demand function of the domestic intermediate producer $\left[Y_t^d(j) = \left(\frac{P(j)_{d,t}}{P_{d,t}}\right)^{-\theta} Y_t^d\right]$ and similarly yields the demand function of the intermediate good importer $\left[Y_t^m(j) = \left(\frac{P(j)_{m,t}}{P_{m,t}}\right)^{-\theta} Y_t^m\right]$.

The demand function for domestic exports is a function of real exchange rate and relative domestic price which is specified as follows:

$$Y(j)_t^x = \left(\frac{P_{d,t}}{RER_t}\right)^{-\xi} Y_t^* \tag{1.26}$$

ξ reflects the price demand-elasticity for domestic goods by foreigners and Y_t^* reflects the exogenous foreign demand caused by a shock to world real economic activities.

1.3.3.1 Intermediate Domestic Goods Firms

Under monopolistic competition, the market consists of a continuum of intermediate non-oil goods firms indexed by j belong to $[0,1]$. The firms take capital K(j) and labor L(j) to produce differentiated intermediate non-oil goods Y(j). Following Calvo (1983), the intermediate domestic firm is allowed to adjust its price with probability $(1-\phi)$ and the price remains unchanged with constant probability ϕ. The intermediate domestic non-oil goods producer maximizes the following discounted profit function:

$$\Pi_{d,t}^n = \left(P_{d,t}(j) - mc_t\right) Y_t^d(j)$$

Note that the the stochastic process discount factor is $\beta^\tau \lambda_{t+\tau}$ and $\lambda_{t+\tau}$ is the marginal utility of consumption in period $t+\tau$. The problem, then, can be written as a maximization of the discounted profit of the intermediate domestic firm:

$$\max_{P(j)_t} E_t \sum_{\tau=0}^{\infty} (\beta\phi)^\tau \left(\lambda_{t+\tau} \frac{\Pi_{d,t+\tau}^n}{P_{d,t+\tau}}\right) \tag{1.27}$$

s.t.

$$Y_t^d(j) = \left(\frac{P(j)_{d,t}}{P_{d,t}}\right)^{-\theta} Y_t^d$$

The F.O.C. for this problem is

$$E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} \left((1-\theta) \frac{P(j)_{d,t}^{-\theta}}{P_{t+\tau}^{1-\theta}} Y_{t+\tau}^{d} + (\theta) \frac{P(j)_{d,t}^{-(1+\theta)}}{P_{t+\tau}^{1-\theta}} mc_{t+\tau} Y_{t+\tau}^{d} \right) = 0$$

The price that the intermediate domestic firm chooses is $\left(P(j)_{d,t}\right)$, which is independent of τ and the solution can be written as:

$$P(j)_{d,t} = \left(\frac{(\theta)}{(\theta-1)} \frac{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} mc_{t+\tau} Y_{t+\tau}^{d} / P_{d,t+\tau}^{1-\theta}}{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} Y_{t+\tau}^{d} / P_{d,t+\tau}^{1-\theta}} \right) \tag{1.28}$$

1.3.3.2 Intermediate Imported goods Firms

Under monopolistic competition, the market consists of a continuum of intermediate non-oil goods importers indexed by j belong to [0,1]. The firm j imports at the world international price to produce a differentiated imported good $Y_{t,m}(j)$. The intermediate importer is allowed to adjust its price with probability $(1-\phi)$. Its price remains unchanged with constant probability ϕ .

$$\Pi_{m,t}^{n} = (P(j)_{m,t} - e_t P_t^{*}) Y_t^{m}(j)$$

The intermediate imported goods producer chooses the price that solves the following maximization problem:

$$\max_{P(j)_{m,t}} E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \left(\lambda_{t+\tau} \frac{\Pi_{m,t+\tau}^{n}}{P_{m,t+\tau}} \right) \tag{1.29}$$

s.t.

$$Y_t^{m}(j) = \left(\frac{P(j)_{m,t}}{P_{m,t}} \right)^{-\theta} Y_t^{m}$$

The price that the intermediate importer chooses is $(P(j)_{m,t})$, which is independent of τ and the solution can be written as:

$$P(j)_{m,t} = \left(\frac{(\theta)}{(\theta-1)} \frac{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} e_{t+\tau} P^{*}_{t+\tau} Y^{m}_{t+\tau} / P^{1-\theta}_{m,t+\tau}}{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} Y^{m}_{t+\tau} / P^{1-\theta}_{m,t+\tau}} \right)$$

1.3.4 Oil Storage Firms

There is a continuum of competitive oil storers or speculators indexed by m belong to [0,1] with no barriers to enter to the oil storage market[2]. At time t, the representative oil speculator buys (D_t) with oil spot price (P^o_t) and store that amount. At time *t+1*, the representative oil speculator sells (D_t) with oil spot price $\left(P^o_{t+1}\right)$ to make profits (Π^o_t) from the oil price difference between time t and *t+1*. Hence, the representative oil speculator influences the demand on oil by storing at time t and selling at time *t+1* to maximize the following profit:

$$\Pi^o_t = \frac{aE_t\left(P^o_{t+1} D_t\right)}{(1+i^*_t)} - P^o_t D_t \left(1 + \varsigma + \frac{\varphi}{2} D_t Sd_t\right) \tag{1.30}$$

The F. O. C. is

$$\frac{aE_t\left(\frac{P^o_{t+1}}{P_{t+1}}\pi_{t+1}\right)}{(1+i^*_t)} = \frac{P^o_t}{P_t}\left(1+\varsigma+\varphi D_t Sd_t\right) \tag{1.31}$$

As in Unalmis et al. (2012), the model in this chapter includes an oil storage market with competitive oil-speculative firms. This chapter further includes a shock to the demand of these oil speculative firms that mimics the speculative oil demand shock. $\varsigma + \varphi D_t Sd_t$ reflects storing cost of one unit of oil with Sd_t represents a shock to speculative demand in oil storage market. $\varsigma < 0$ is "convenience yield" and φ an increasing cost of storing one more unit of oil. $1-a$ is the "waste" due to storing oil, and this waste is assumed to be 1%.

[2]In this part, I follow Unalmis, Unalmis, and Unsal (2012) in modeling the oil speculators which was recently developed based on commodity storage literature.

1.3.5 Market Clearing Conditions

The market cleating conditions for the model are:

$$Z_t = C_t + I_t \tag{1.32}$$

$$L_t = \int_0^1 L_t(j)dj$$

$$K_t = \int_0^1 K_t(j)dj$$

The supplies of $L_t, and\, K_t$ are equal to the demands of intermediate producers. The rate at which the domestic household borrows in international bond market is equal to exogenous world interest rate plus a "spread"(see Kollmann (2001, 2002)).

$$\frac{(1+i_t^f)}{\pi^*} = \frac{(1+i_t^*)}{\pi^*} - \frac{\zeta\left(\frac{B_{t+1}}{P_t^*}\right)}{Y^x}, \zeta > 0$$

$\zeta > 0$ is the degree of capital mobility. With $\zeta = 0$, the country has a perfect capital mobility. In this chapter, oil supply is exogenously determined, real oil price is endogenously determined, and the oil market clearing condition is:

$$O_t^s + aD_{t-1} - D_t = O_t^d + C_t^O + Y_t^O \tag{1.33}$$

1.3.6 Exogenous Variables

$i_t^*, \pi_t^*, O_t^d, O_t^S, Sd_t, X_t, \Upsilon_t, Y_t^*$ are international interest rate, international price inflation, world oil consumption, world oil supply, speculative demand shock, productivity shock, UIP shock, and world economic activity shock respectively. These exogenous variables follow an AR(1) process specified as:

$$i_t^* = (1-\rho^{i^*}) + \rho^{i^*} i_{t-1}^* + \varepsilon_t^{i^*}$$

$$\pi_t^* = (1-\rho^{i^*}) + \rho^{\pi^*} \pi_{t-1}^* + \varepsilon_t^{\pi^*}$$

$$O_{t-1}^d = (1-\rho^{O^d}) + \rho O_{t-1}^{O^d} + \varepsilon_t^{O^d}$$

$$O_t^S = (1-\rho^{O^S}) + \rho^{O^S} O_{t-1}^S - \varepsilon_t^{O^S}$$

$$Sd_t = (1-\rho^{Sd}) + \rho^{Sd} Sd_{t-1} + \varepsilon_t^{Sd}$$

$$X_t = (1-\rho^X) + \rho^X X_{t-1} + \varepsilon_t^X$$

$$\Upsilon_t = (1-\rho^\Upsilon) + \rho^\Upsilon \Upsilon_{t-1} + \varepsilon_t^\Upsilon$$

$$Y_t^* = (1-\rho^{Y^*}) + Y_{t-1}^* + \varepsilon_t^{Y^*}$$

$\varepsilon_t^{i^*}$, $\varepsilon_t^{\pi^*}$, $\varepsilon_t^{O^{wc}}$, $\varepsilon_t^{O^S}$, ε_t^{Sd} , ε_t^X , ε_t^Υ $\varepsilon_t^{Y^*}$ are independent white noises with standard deviations $\sigma_t^{i^*}$, $\sigma_t^{\pi^*}$, $\sigma_t^{O^{wc}}$, $\sigma_t^{O^S}$, σ_t^{Sd} , σ_t^X , σ_t^Υ $\sigma_t^{Y^*}$.

1.3.7 The Central Bank

$$i_t = i + \Lambda_\pi \hat{\pi}_t + \Lambda_Y \hat{Y}_t + \Lambda_{RER} R\hat{E}R_t \tag{1.34}$$

The central bank implements short-term nominal interest rate, i_t, as its monetary policy instrument. The policy coefficients, $[\Lambda_\pi, \Lambda_Y, \Lambda_{RER}]$, determine the response of the central bank to steady-state deviations of output, inflation, and real exchange rate.

1.3.8 The Objective of the Central Bank:

The central bank objectives can be described as a quadratic period Loss Function (LF_t):

$$LF_t = \left[(\pi_t - \pi)^2 + \lambda_Y (Y_t - Y)^2 + \lambda_i var((\Delta i_t)\right] \tag{1.35}$$

λ_Y and λ_i are the relative weight on output-gap stabilization and interest rate smoothing. The inter-temporal loss function in each period t in the form of expected discounted future losses is:

$$\min_{\Lambda_\pi, \Lambda_Y, \Lambda_{RER}} E_t \sum_{j=0}^{\infty} \beta^j LF_{t+j} \tag{1.36}$$

The central bank is committed to setting $[\Lambda_\pi, \Lambda_Y, \Lambda_{RER}]$ at the values that minimize its expected discounted loss function, $\left(E_t \sum_{j=0}^{\infty} \beta^j LF_{t+j}\right)$. This chapter aims to find the optimal policy coefficients in order to analyze the optimal policy responses to the underlying causes of oil price fluctuations. First, this chapter derives an analytical country-specific steady-state solution. Second, it implements a central bank objective function to loop the entire model and find the values of the optimal monetary policy coefficients that minimize the Central Bank's loss function, $E_t \sum_{j=0}^{\infty} \beta^j LF_{t+j}$. The loss function includes the variance of $\Delta i_t = i_t - i_{t-1}$ to account for any high variation in interest rate.

1.3.9 Calibration

The parameters of this model are mostly borrowed from Kollmann (2002). The discount factor (β) is set to 0.99 and the capital depreciation rate is set to $\delta = 0.025$. The price elasticities of the aggregate imports and exports are set to $(\nu = 0.6, \xi = 0.8)$. The steady-state price-marginal cost markup factor for intermediate goods set to $\frac{(\theta)}{(1-\theta)} = 1.2$. The capital adjustment cost parameter is set to $\psi = 15$. The capital mobility parameter is set to $\zeta = 0.0019$. The parameter of Calvo price setting is set to $\phi = 0.75$. The the inverse elasticity of inter-temporal substitution of consumption is set to $\chi = 2$. The the inverse of Frisch wage elasticity of labour supply is set to $\eta = 1.5$. The elasticity of substitution in consumption basket is set to $\gamma = 0.3$. $\lambda_Y = 1.5$ and $\lambda_i = 0.5$ are the relative weight on output-gap stabilization and interest rate smoothing. The parameters of the exogenous shocks are set to $\sigma_t^{i^*} = 0.004$ with $\rho^{i^*} = 0.75$, $\sigma_t^X = 0.01$ with $\rho^X = 0.9$, $\sigma_t^{\pi^*} = 0.005$ with $\rho^{\pi^*} = 0.8$, $\sigma_t^\Upsilon = 0.033$ with $\rho^\Upsilon = 0.5$, $\sigma_t^{O^S} = 0.01$ with $\rho^{O^S} = 0.9$, $\sigma_t^{Y^*} = 0.01$ with $\rho^{Y^*} = 0.95$, and ,$\sigma_t^{Sd} = 0.01$ with $\rho^{Sd} = 0.98$.

1.4 Results

Under a calibrated small open DSGE model, the optimal policy coefficients are $\Lambda_Y = 1.4030$, $\Lambda_\pi = 0.0147$, and $\Lambda_{RER} = 1.9896$ with an the objective function of a central bank that minimizes the fluctuations in output gap and inflation. The results are robust with different relative weights on output-gap stabilization and interest rate smoothing. The results demonstrate the policy makers in small open economies should indeed respond to the underlying causes of oil price fluctuations and not to changes in oil price itself.

Figures 1.1-1.15 show the impulse responses of policy interest rate and several macroeconomic variables within the model to the underlying causes of oil price fluctuations. The model incorporates structural shocks in oil supply disruption, oil demand driven by world economic activities, and speculative oil demand. The macroeconomic variables under consideration are policy interest rate, domestic output, domestic exports, domestic consumption, domestic investment, domestic inflation, real exchange rate, oil consumption, domestic wages, and real oil price.

Under small open economy framework with a central bank committed to stabilizing output-gap and inflation, Figures 1.1, 1.6, and 1.11 reveal the optimal policy responses to structural oil price shocks. The results demonstrate that the optimal monetary policy response to an oil price fluctuation caused by structural world oil demand shock differs from the optimal policy response to structural oil supply disruption and speculative oil demand shocks.

An oil price hike (or slump) driven by world economic activities tends to stimulate (or dampen) the demand on domestic exports and domestic oil demand for production. The oil price hike caused by this shock leads to a higher level of domestic wages and increases the domestic inflation. As a result of this oil price shock, the domestic consumption, domestic output, and domestic investment increase as do the domestic oil consumption (see Figures 1.7-1.10). The optimal policy response, therefore, to an oil price hike (or slump) caused by world economic activities requires a tightening (or expansionary) monetary policy response with an the objective function of a central bank committed to stabilizing output-gap and inflation.

An oil price hike (or slump), however, caused by oil supply disruption and oil speculative demand shocks tends to dampen (or stimulate) domestic consumption, domestic output, and domestic investment in small open economies (see Figures). This oil price hike caused by those shocks leads to lower oil demand in production, lower domestic wages, and lower domestic inflation as well. As a result of this shock, the domestic oil consumption and oil in production decrease. The optimal policy response, therefore, to an oil price hike (or slump) due to oil supply disruption and oil speculative demand induces an expansionary (or tightening) monetary response to smooth its negative economic consequences on small open economies with a central bank committed to stabilizing output-gap and inflation.

1.5 Conclusion

Chapter 1 constructs a Dynamic Stochastic General Equilibrium (DSGE) model for small open economies to evaluate the optimal monetary policy response to the underlying causes of oil price fluctuations and its transmission channels to these economies. This chapter incorporates the underlying causes of oil price fluctuations including oil supply disruption, oil demand driven by world economic activities, and speculative oil demand. The results of Chapter 1 demonstrate that the origin of the underlying causes of oil price fluctuations induces different monetary policy response. The results find that the origin of oil price shocks have different economic consequences on small open economies and policy makers with stabilization objectives should indeed identify and respond to the causes of oil price fluctuations. An oil price hike (or slump) driven by world economic activities tends to stimulate (or dampen) the domestic economy and bring some inflationary (or deflationary) pressure. Therefore, such oil price hike (or slump) induces a tightening (or expansionary) monetary policy response. An oil price hike (or slump), however, caused by oil supply disruption and oil speculative demand tends to dampen (or stimulate) domestic economy and requires an expansionary (or tightening) monetary response to accommodate any unwanted economic consequences on small open economies.

1.6 Appendix

The model setup:

$$C_t^{-\chi} = \lambda_t \tag{1.37}$$

$$C_t^{-\chi} = \frac{(1-L_t)^{-\eta}}{W_t} \tag{1.38}$$

$$C_t^n = (1-\omega_{oc})\left(\frac{P_t^n}{P_t}\right)^{-\gamma} C_t \tag{1.39}$$

$$C_t^o = (\omega_{oc})\left(\frac{P_t^o}{P_t}\right)^{-\gamma} C_t \tag{1.40}$$

$$\frac{1}{(1+i_t)} = \beta E_t\left(\left(\frac{C_{t+1}^{-\chi}}{C_t^{-\chi}}\right)\left(\frac{1}{\Pi_{t+1}}\right)\right) \tag{1.41}$$

$$\frac{1}{\Upsilon_t(1+i_t^f)} = \beta E_t\left(\left(\frac{C_{t+1}^{-\chi}}{C_t^{-\chi}}\right)\left(\frac{1}{\Pi_{t+1}^*}\right)\left(\frac{RER_{t+1}}{RER_t}\right)\right) \tag{1.42}$$

$$1+\psi\left(\frac{K_{t+1}}{K_t}-1\right) = \beta E_t\left(\left(\frac{C_{t+1}^{-\chi}}{C_t^{-\chi}}\right)\left(1-\delta+r_{k,t+1}+\frac{\psi}{2}\left(\frac{K_{t+2}^2}{K_{t+1}^2}-1\right)\right)\right) \tag{1.43}$$

$$I_t = K_{t+1}+\psi(K_{t+1},K_t)-(1-\delta)K_t \tag{1.44}$$

$$\frac{(1+i_t^f)}{\pi^*} = \frac{(1+i_t^*)}{\pi^*} - \frac{\zeta\left(\frac{B_{t+1}}{P_t^*}\right)}{Y^x} \tag{1.45}$$

$$Y_t = X_t K_t^{\alpha} L_t^{1-\alpha} \tag{1.46}$$

$$w_t = (1-\alpha)\frac{Y_t}{L_t} mc_t \tag{1.47}$$

$$r_{k,t} = (\alpha)\frac{Y_t}{K_t} mc_t \tag{1.48}$$

$$P(j)_{d,t} = \left(\frac{(\theta)}{(\theta-1)} \frac{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} mc_{t+\tau} Y_{t+\tau}^{d} / P_{d,t+\tau}^{1-\theta}}{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} Y_{t+\tau}^{d} / P_{d,t+\tau}^{1-\theta}} \right) \tag{1.49}$$

$$P(j)_{m,t} = \left(\frac{(\theta)}{(\theta-1)} \frac{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} e_{t+\tau} P_{t+\tau}^{*} Y_{t+\tau}^{m} / P_{m,t+\tau}^{1-\theta}}{E_t \sum_{\tau=0}^{\infty} (\beta\phi)^{\tau} \lambda_{t+\tau} Y_{t+\tau}^{m} / P_{m,t+\tau}^{1-\theta}} \right)$$

$$i_t = i + \Lambda_{\pi} \hat{\pi}_t + \Lambda_Y \hat{Y}_t + \Lambda_{RER} R\hat{E}R \tag{1.50}$$

$$Z_t = C_t + I_t \tag{1.51}$$

$$Z_t^n = (1-\omega_{op}) \left(\frac{P_t^n}{P_t} \right)^{-\bar{\nu}} Z_t \tag{1.52}$$

$$Y_t^o = (\omega_{op}) \left(\frac{P_t^n}{P_t} \right)^{-\bar{\nu}} Z_t \tag{1.53}$$

$$Y_t^d = (1-\omega_m) \left(\frac{P_{d,t}}{P_t^n} \right)^{-\nu} Z_t^n \tag{1.54}$$

$$Y_t^m = (\omega_m) \left(\frac{P_{m,t}}{P_t^n} \right)^{-\nu} Z_t^n \tag{1.55}$$

$$Y(j)_t^x = \left(\frac{P_{d,t}}{RER_t}\right)^{-\xi} Y_t^* \tag{1.56}$$

$$Y_t = Y_t^d + Y_t^x \tag{1.57}$$

$$\frac{b_t^*}{(1+i_t^f)} - \frac{b_{t-1}^*}{\pi_t^*} = \frac{P_{d,t}}{P_t} Y_t^x - \left[RER_t Y_t^m + \frac{P_t^o}{P_t}\left(Y_t^o + C_t^o\right)\right] \tag{1.58}$$

$$P_t = \left((1-\omega_{op})\left(P_t^n\right)^{1-\gamma} + \omega_{op}\left(P_t^o\right)^{1-\gamma}\right)^{\frac{1}{1-\gamma}} \tag{1.59}$$

$$P_t^n = \left((1-\omega_m)\left(P_{d,t}\right)^{1-\nu} + \omega_m\left(P_{m,t}\right)^{1-\nu}\right)^{\frac{1}{1-\nu}} \tag{1.60}$$

$$\frac{aE_t\left(\frac{P_{t+1}^o}{P_{t+1}}\pi_{t+1}\right)}{(1+i_t^*)} = \frac{P_t^o}{P_t}\left(1+\varsigma+\varphi D_t Sd_t\right) \tag{1.61}$$

$$O_t^s + aD_{t-1} - D_t = O_t^d + C_t^O + Y_t^O \tag{1.62}$$

$$\pi_t^d = \left(\frac{\pi_t p_{d,t}}{p_{d,t-1}}\right) \tag{1.63}$$

Optimized policy Rule: $i_t = i + 0.014\hat{\pi}_t + 1.40\hat{Y}_t + 1.98\hat{RER}$

Standard Deviation	
	Shocks to O_t^s, Y_t^*, Sd_t
Variable	
Y_t	0.0079
C_t	0.0019
I_t	0.0104
π_t	0.0017
π_t^d	0.0023
i_t^d	0.0019
P_t^o	0.1251
RER_t	0.0047
W_t	0.0099
Y_t^x	0.0205
Y_t^m	0.0361

Means	
	Shocks to O_t^s, Y_t^*, Sd_t
Variable	
Y_t	0.282
C_t	0.13
I_t	-1.1375
π_t	0.0281
π_t^d	0.0281
i_t^d	0.0382
P_t^o	-6.0685
RER_t	-0.1385
W_t	0.8181
Y_t^x	-0.517
Y_t^m	0.0841

Table 1.1: The Results of the optimized Policy Rule

Coefficients of Autocorrelation

Variable					
Order	1	2	3	4	5
i_t^d	0.9476	0.8948	0.8425	0.7912	0.7414
P_t^o	0.8966	0.8093	0.7354	0.6726	0.6192
π_t	0.9011	0.8116	0.7308	0.6579	0.5923
W_t	0.9321	0.8686	0.8093	0.7542	0.7032
Y_t	0.896	0.8066	0.7297	0.6633	0.6059
Y_t^x	0.9273	0.8628	0.8052	0.7534	0.7067
C_t	0.9894	0.9748	0.9573	0.9379	0.9173
C_t^o	0.8967	0.8094	0.7355	0.6728	0.6194
Y_t^o	0.8965	0.8092	0.7352	0.6724	0.619
RER_t	0.8844	0.7868	0.7042	0.6342	0.5748

Table 1.2: The Results of the optimized Policy Rule

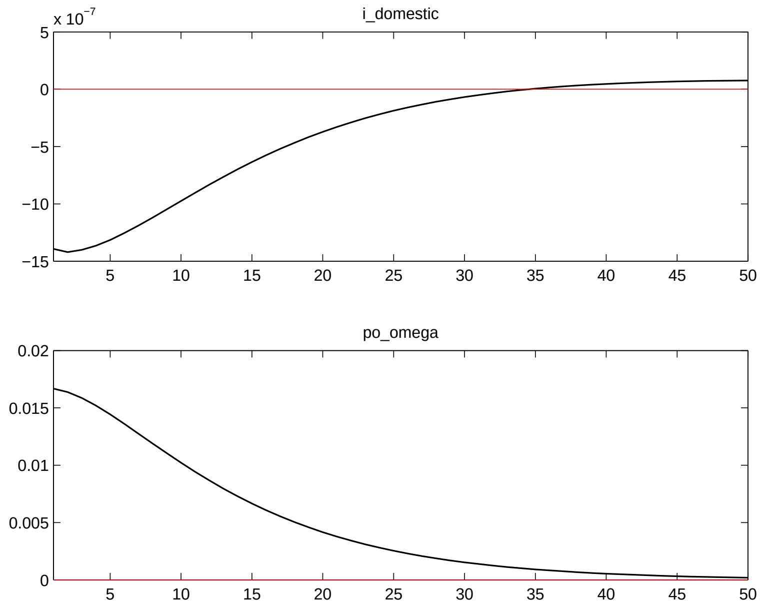

Figure 1.1: The Optimal Monetary Policy Impulse Response to Oil Price Fluctuations Caused by Oil Supply Disruption Shock.

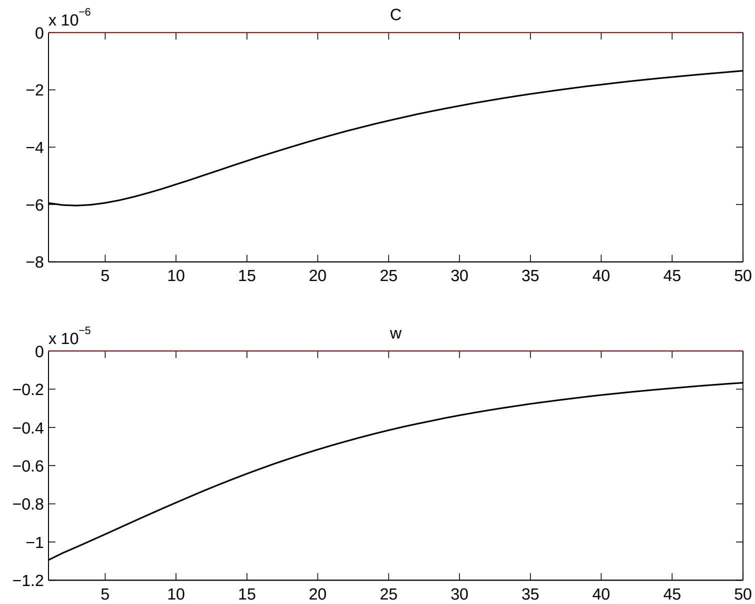

Figure 1.2: The Impulse Response of Domestic Consumption and Domestic Wages to Oil Price Fluctuations Caused by Oil Supply Disruption Shock.

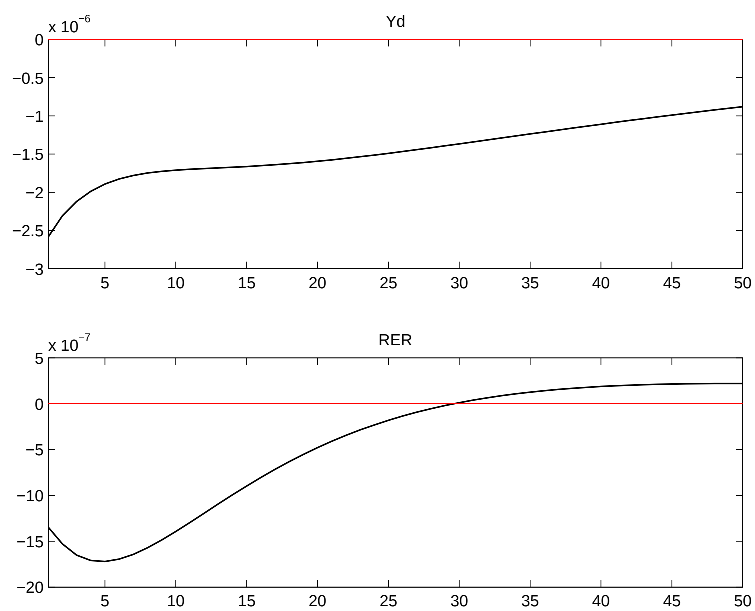

Figure 1.3: The Impulse Response of Domestic Output and Real Exchange Rate to Oil Price Fluctuations Caused by Oil Supply Disruption Shock.

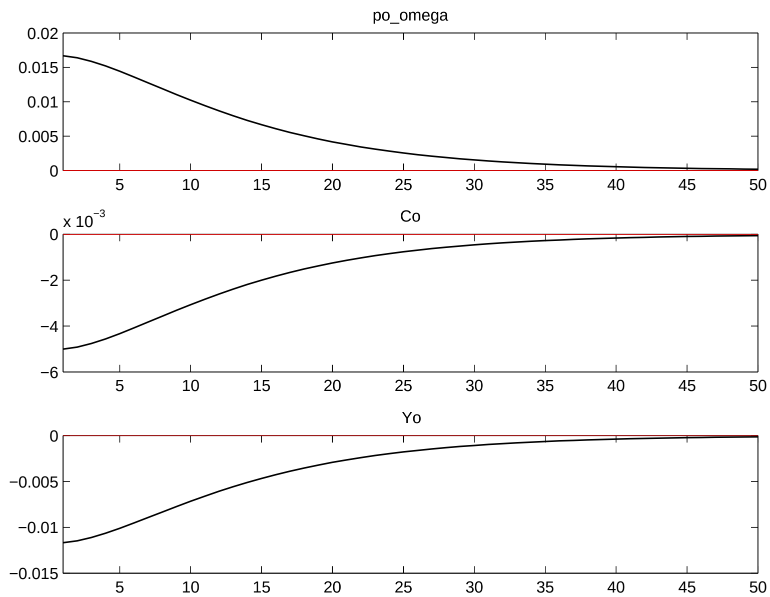

Figure 1.4: The Impulse Response of Domestic Oil Consumption and Oil in Domestic Production to Oil Price Fluctuations Caused by Oil Supply Disruption Shock.

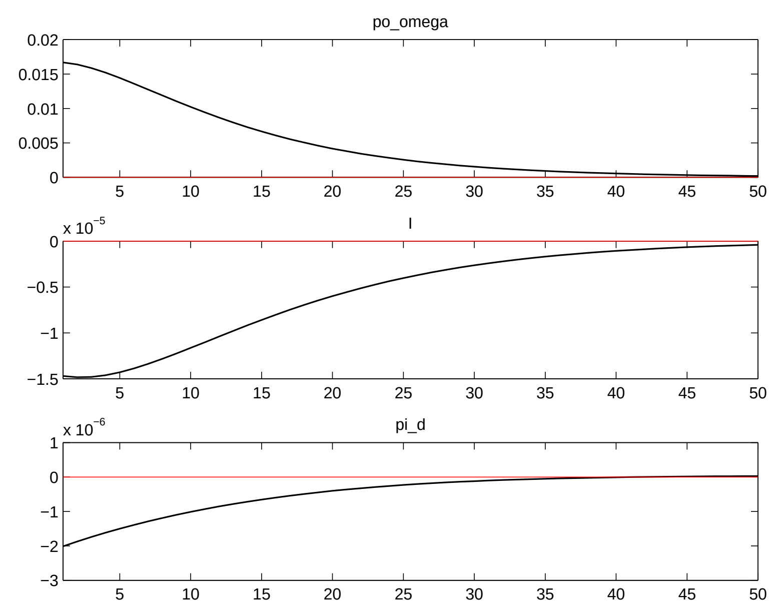

Figure 1.5: The Impulse Response of Domestic Investment and Domestic Inflation to Oil Price Fluctuations Caused by Oil Supply Disruption Shock.

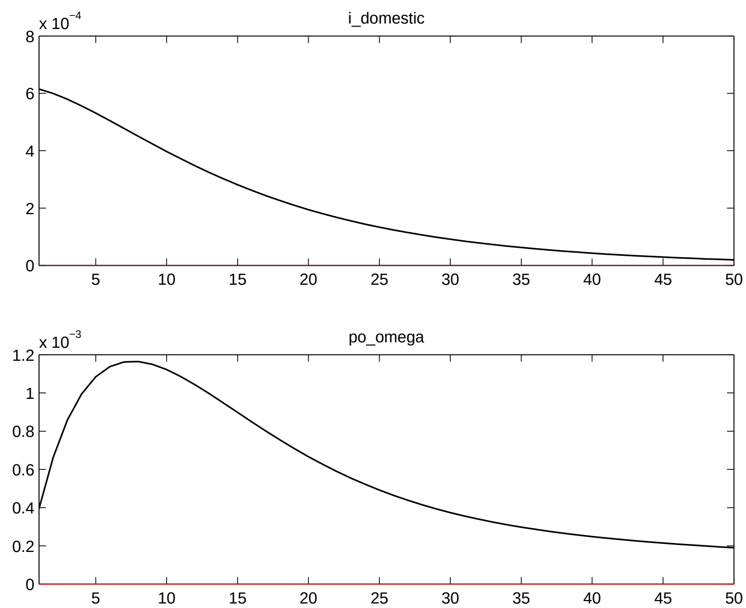

Figure 1.6: The Optimal Monetary Policy Impulse Response to Oil Price Fluctuations Caused by World Economic Activities Shock.

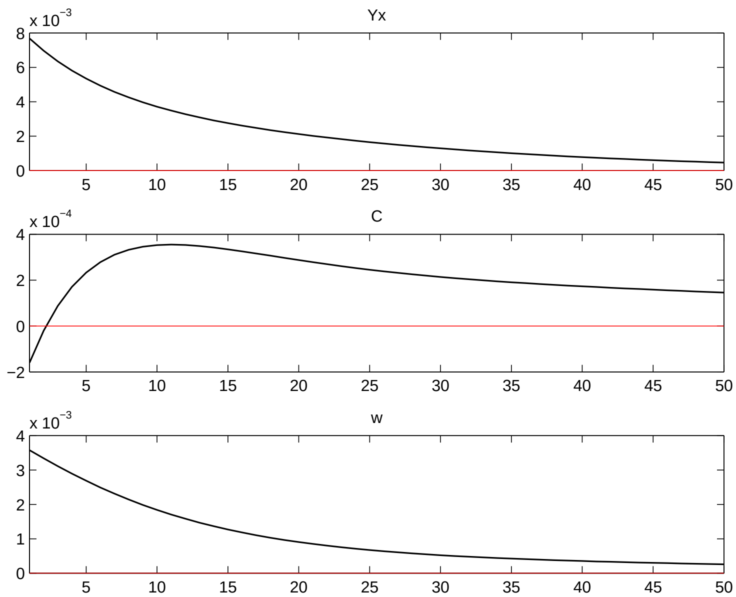

Figure 1.7: The Impulse Response of Domestic Exports, Domestic Consumption, and Domestic Wages to to Oil Price Fluctuations Caused by World Economic Activities Shock.

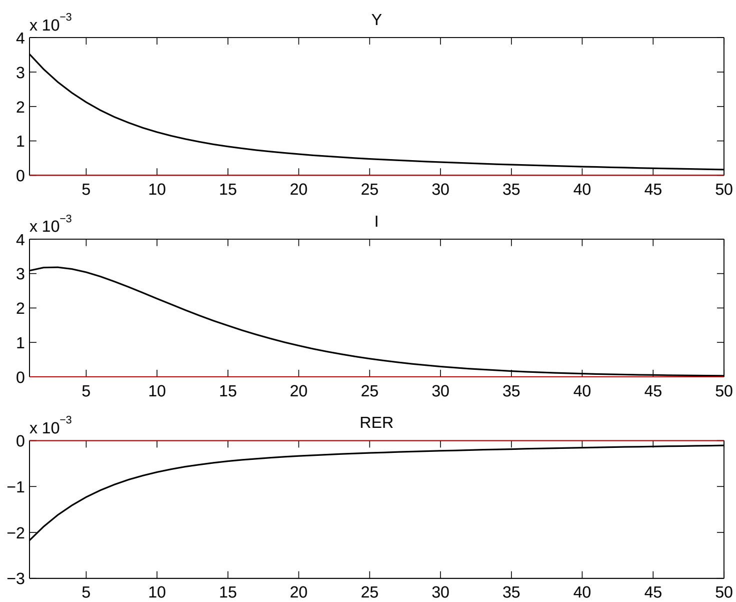

Figure 1.8: The Impulse Response of Domestic Output, Domestic Investment, and Real Exchange Rate to Oil Price Fluctuations Caused by World Economic Activities Shock.

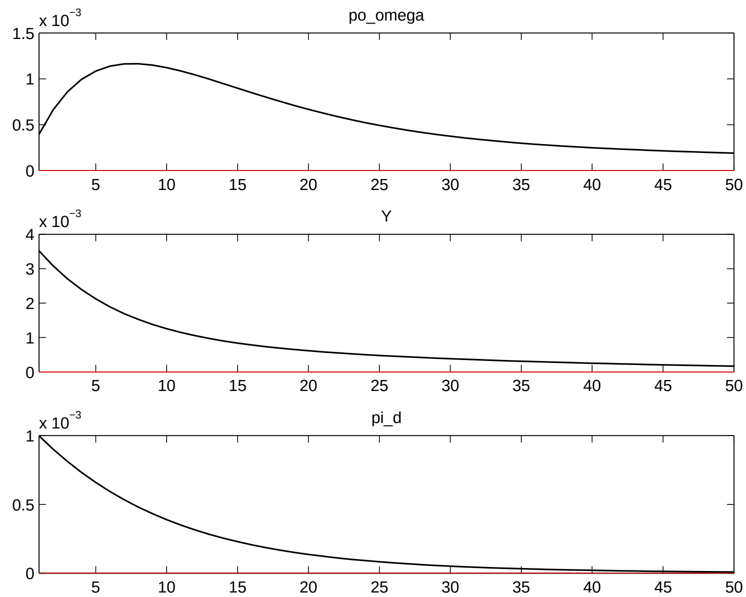

Figure 1.9: The Impulse Response of Domestic Output and Domestic Inflation to Oil Price Fluctuations Caused by World Economic Activities Shock.

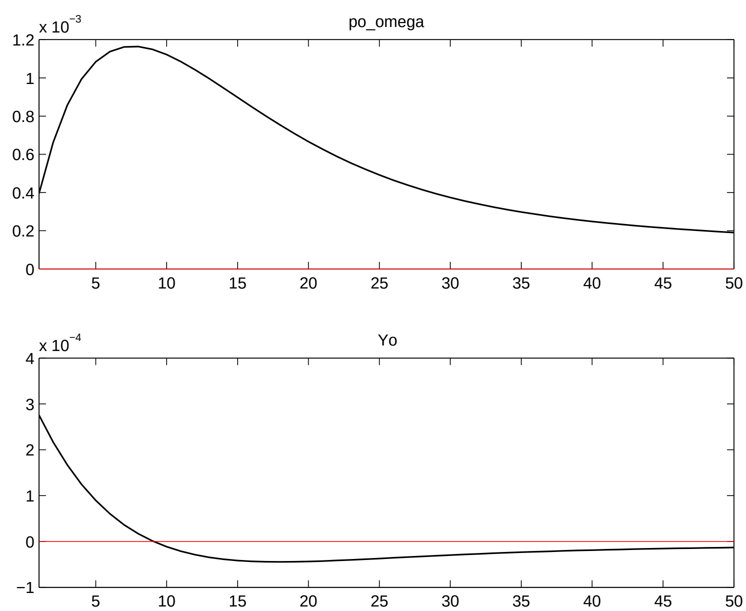

Figure 1.10: The Impulse Response of Oil in Domestic Production to Oil Price Fluctuations Caused by World Economic Activities Shock.

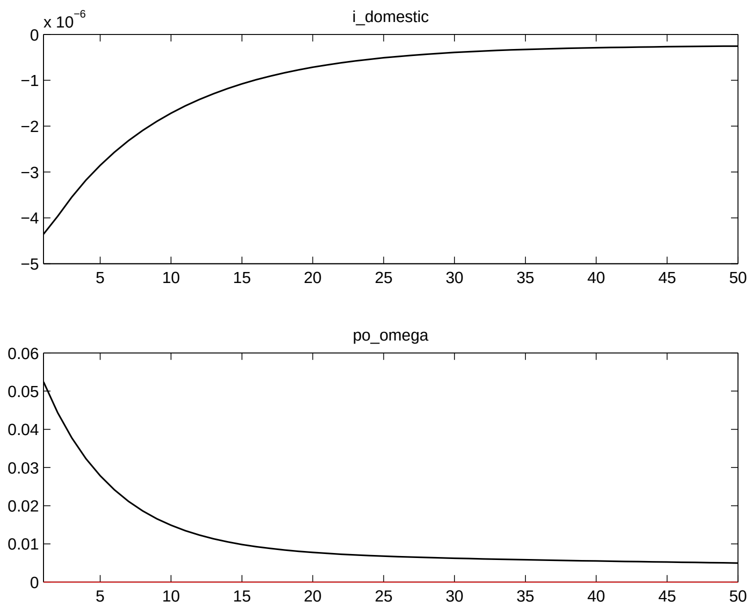

Figure 1.11: The Optimal Monetary Policy Impulse Responses to Oil Price Fluctuations Caused by Oil Speculative Demand Shock.

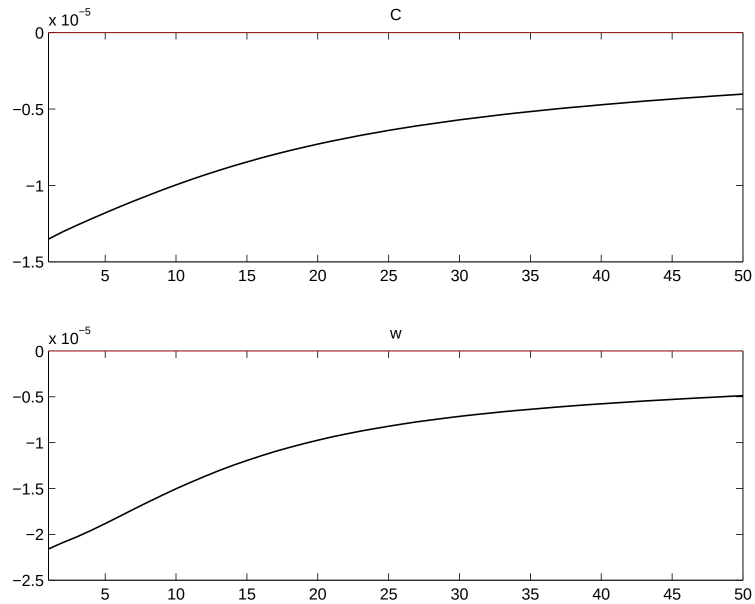

Figure 1.12: The Impulse Response of Domestic Consumption and Domestic Wages to Oil Price Fluctuations Caused by Oil Speculative Demand Shock.

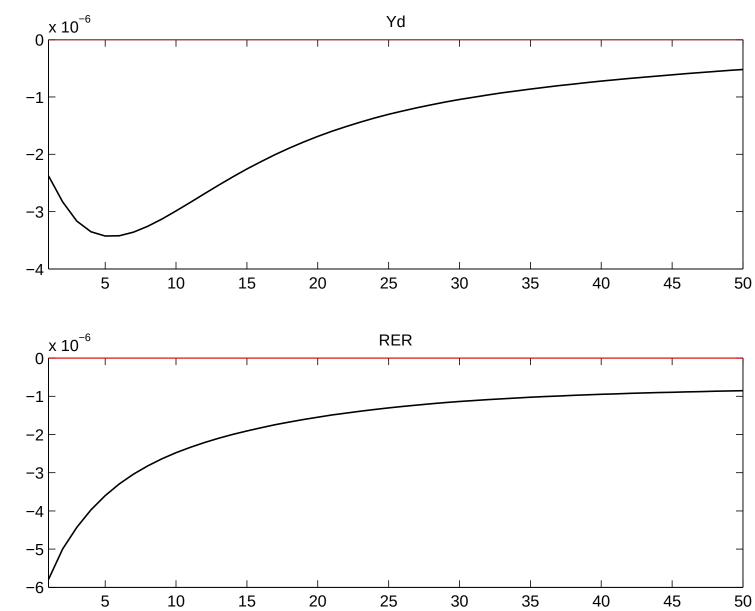

Figure 1.13: The Impulse Response of Domestic Output and Real Exchange Rate to Oil Price Fluctuations Caused by Oil Speculative Demand Shock.

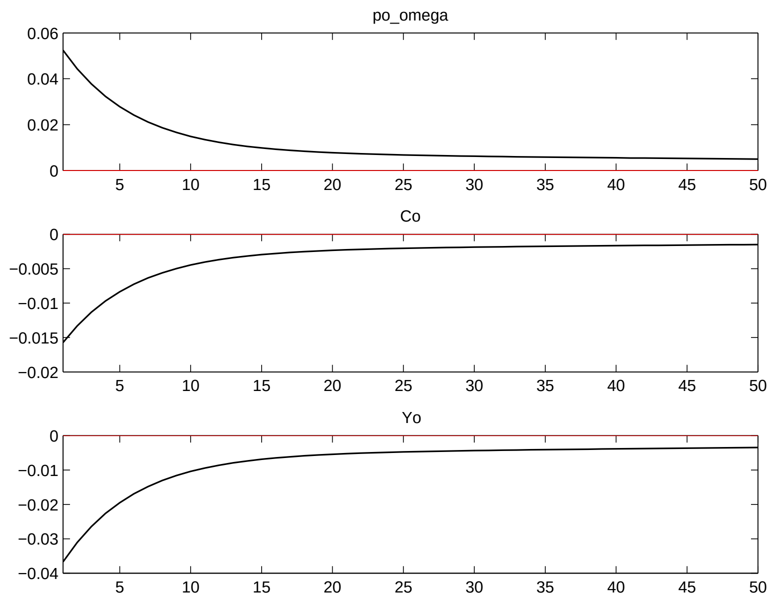

Figure 1.14: The Impulse Response of Domestic Oil Consumption and Oil in Domestic Production to Oil Price Fluctuations Caused by Oil Speculative Demand Shock.

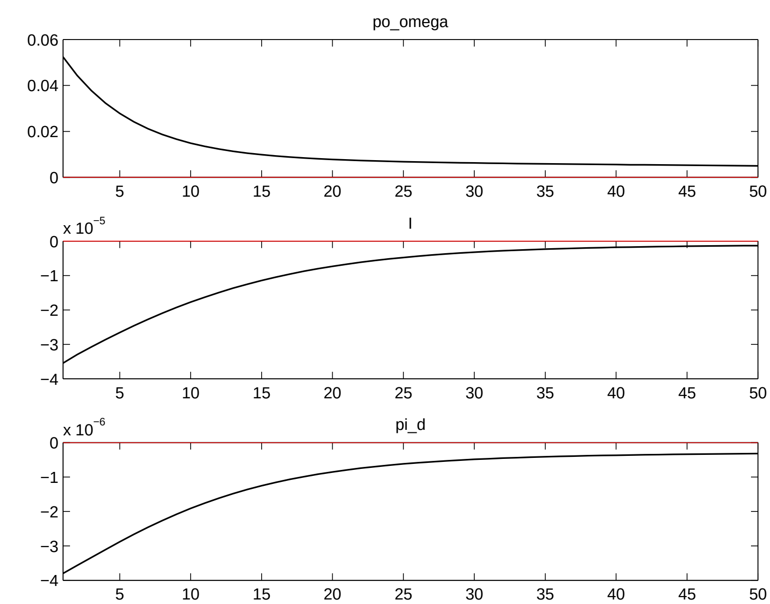

Figure 1.15: The Impulse Response of Domestic Investment and Domestic Inflation to Oil Price Fluctuations Caused by Oil Speculative Demand Shock.

Chapter 2

The Dynamic of Oil Shocks on Monetary Policy Response and Macroeconomic Aggregates across Oil-exporting and Oil-importing Open Economies

2.1 Introduction

This chapter constructs a structural VAR model that jointly captures the interaction between the monetary policy, the exchange rate and the underlying causes of oil price fluctuations. The model explores the dynamic effects of different oil shocks on domestic macroeconomic aggregates and how the monetary policy responds to these oil shocks across oil-exporting and oil-importing open economies. The model considers oil price fluctuations caused by oil supply disruption shock, oil demand driven by world economic activities, and oil specific-demand shock driven by precautionary demand for oil. The model follows the of Kilian (2009) in identifying different shocks underlying oil price fluctuations and follows Kim & Roubini (2000) in identifying monetary policies under an open economy framework. The identification scheme in this chapter avoids the common potential misspecification in the literature by constructing the model at monthly frequency under economically plausible restrictions.

2.2 Literature Review

The seminal work of Kilian (2009) on identifying the different shocks underlying oil price fluctuations lays the foundations for a growing literature on the dynamic of these oil price shocks to re-examine their effects on macroeconomic aggregates. Kilian (2009) structurally decomposes the oil price into i) oil supply disruption shock ii) oil demand shock driven by world economic activities, and iii) oil-specific demand shock driven by precautionary demand for oil. Kilian (2009) reports that an oil supply disruptions lead to a temporary decline in U.S. real GDP and a small increase in inflation, the world oil demand shocks lead to positive initial effect followed by a decline on U.S. real GDP and, the oil specific-demand shocks lead to a decline in U.S. real GDP but increase inflation. Aastveit et al. (2014), however, separate the oil demand for different groups of countries, namely developed and developing countries. The study finds developed countries responded more negatively to an oil price shock than developing countries, and that the demand from developing countries is twice as important as the oil demand from developed countries.

Hamilton (2003) reports that an oil price increase is more important than an oil price decrease, particularly in forecasting GDP. Hamilton (2011), further, reports that ten out of eleven postwar recessions were preceded by an oil price hike in the United States. Blanchard & Gali (2007) argue that the diminishing effect of the recent oil shocks is due to i) the decline in real wage rigidities, ii) the higher credibility of monetary policies, and iii) the decline of oil share in productions. However, Kilian (2009) rejects these hypotheses and identifies different oil supply and demand shocks in the international oil market. He argues that the effects of oil price shocks depends on whether the oil price shock is due to world demand for oil or due to global oil supply disruptions. Furthermore, Kilian (2009) shows that oil supply shocks were more important in the past, but oil demand shocks became more significant in the recent oil price fluctuations.

Kilian & Lewis (2011) find the federal funds rate rises in response to an oil price hike driven by world economic activities and oil specific-demand shocks. However, the federal funds rate falls in response to oil supply disruption shock. Peersman & Robays (2012) examine the effect of different oil shocks on macroeconomic aggregates for industrialized developed economies, namely the U.S., Japan, U.K., Italy, Germany, France, Canada, Norway, and Australia. They find that if the demand factors drive the oil price movements, the real GDP exhibits a transitory decline in almost all these economies. The oil supply shock, however, leads to a permanent fall in economic activity in all the oil-importing economies in their sample. Ahmed & Park (1995) examine the sources of macroeconomic fluctuations for small open economies, specifically seven OECD economies: Australia, Austria, Canada, Finland, France, Italy, and the United Kingdom. The main question in this paper is to examine how relevant external shocks are relative to internal shocks in explaining the business cycle. The empirical results show that external shocks were better in explaining the domestic macroeconomic fluctuations, which supports the real-business cycle proposition.

Elder and Serletis (2010) estimate a model with disaggregated measures of investment and find that uncertainty about oil prices tends to significantly lower real output in the United States. They, however, provide an explanation for the failure of the oil price hikes in inducing severe recessions and which is motivated by the relatively low uncertainty about oil prices in recent years.

Elder & Serletis (2009) find that increased uncertainty about oil prices also has a negative effect on real-output in Canada. They argue that the relatively low uncertainty about oil prices in mid the 80s may explain the failure of the sharp decline in oil prices in stimulating economic growth in Canada. The sharp decline in oil prices then raised the uncertainty about oil prices and hence weakened output growth. Moreover, Elder & Serletis (2009) show an asymmetric response in real output to negative and positive price shocks. As uncertainty about future oil prices increases, negative oil price shock fails to stimulate real-output, while positive oil shock tends to depress the real-output in Canada.

Rahman & Serletis (2010) extend the work of [Elder and Serletis (2009), Rahman and Serletis (2011), and others] by incorporating the monetary policy shock along with oil shocks to examine their effect on macroeconomic activities in the United States under high and low oil price volatility regimes. Rahman and Serletis (2010) find that under a high oil price volatility regime, output growth falls by more as opposed to a low oil price volatility regime. Interestingly, the study finds that the monetary policy reinforces the effect of oil price volatility and determines the asymmetric response of U.S. output to oil price shocks.

Rahman & Serletis (2011) focus on oil price uncertainty and its effect on the U.S. real economic activity implementing a bivariate VAR with asymmetric GARCH-in-mean errors. They use the conditional variance of changes forecast error in the oil price as a measure for oil price uncertainty. Consistent with the oil price-output literature, the study finds evidence that links the increased uncertainty about oil price and the weakened average growth rate of real economic activities.

Rahman & Serletis (2012) examine the relationship between the real economic activities in Canada and oil price uncertainty. The study finds that as uncertainty about oil price fluctuations increases, it is associated with lower average growth rate in real output in Canada. The study also confirms the asymmetric effect of the oil price on real economic activities in Canada consistent with Elder and Serletis (2009), and Rahman and Serletis (2010).

Serletis & Istiak (2013) examine the nature of the relationship between oil price and industrial production for the G-7 economies using slope-based tests and impulse response function test. The null hypothesis of slope-based tests is a linear symmetric relationship between industrial production and the oil price. The paper fails to reject the null hypothesis of linearity and symmetry in Canada, France, Germany, Italy, Japan, and the U.K. However, the paper rejects the null hypothesis of linearity and symmetry in the United States.

Grilli & Roubini (1995) have shown that small open economies implement tightening response of monetary policy once exchange rate depreciation was observed. The mechanism through which monetary policies affect the real economy takes different channels. As in Mishkin (1996), these channels include interest rates, exchange rates, equity prices, and credit channels. This chapter focuses on interest rate, and exchange rate channels under an open economy framework. Exchange rate and interest rate are particularly important channels through which different external shocks, including oil shocks, can be transmitted to domestic macroeconomic aggregates. For open economies, Cushman & Zha (1997) and Kim & Roubini (2000) focused particularly on identifying the monetary policies. While Cushman & Zha (1997) estimate a large SVAR model for Canada using block exogeneity, Kim & Roubini (2000) estimate a relatively smaller model with robust results.

2.3 Structural VAR Model:

Following Kim & Roubini (2000), suppose that the economy is described by a structural form equation :

$$\Theta(L)Y_t = \varepsilon_t \tag{2.1}$$

Var(ε_t)=Σ_ε and $\Theta(L)$ is a matrix polynomial with lag operator L.

$$\Theta(L) = \sum_{q=o}^{\infty} \Theta_q L^q = \Theta_0 + \sum_{q=1}^{\infty} \Theta_q L^q \Longrightarrow \Theta(L) = \Theta_0 + \Theta^0(L)$$

Note that Θ_0 is the contemporaneous coefficient matrix on L^0 in the structural form.

The reduced form SVAR is given as:

$$Y_t = B(L)Y_t + e_t \tag{2.2}$$

As discussed in Kim & Roubini (2000), the parameters in the structural form can be written as:

$$B(L) = -\Theta_0^{-1}\Theta^0(L)$$

The relationship between the structural disturbances and the reduced form residual can be presented as $\varepsilon_t = \Theta_0 e_t$. Given that $Var(\varepsilon_t) = \Sigma_\varepsilon$ and $Var(e_t) = \Sigma_e$, then:

$$E(e_t e_t^{'}) = E(\Theta_0^{-1}\varepsilon_t\varepsilon_t^t\Theta_0^{-1^t}) = \Theta_0^{-1}\Sigma_\varepsilon\Theta_0^{-1^t} = \Sigma_e$$

2.4 Identification

$$\begin{bmatrix} \varepsilon_t^{oil-supply} \\ \varepsilon_t^{oil-world-demand} \\ \varepsilon_t^{oil-specific-demand} \\ \varepsilon_t^{IP} \\ e_t^{CPI} \\ \varepsilon_t^{money-demand} \\ \varepsilon_t^{monetary-policy} \\ \varepsilon_t^{exchange-rate} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \theta_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \theta_{31} & \theta_{32} & 1 & 0 & 0 & 0 & 0 & 0 \\ \theta_{41} & \theta_{42} & \theta_{43} & 1 & 0 & 0 & 0 & 0 \\ \theta_{51} & \theta_{52} & \theta_{53} & \theta_{54} & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \theta_{64} & \theta_{65} & 1 & \theta_{67} & 0 \\ 0 & 0 & \theta_{73} & 0 & 0 & \theta_{76} & 1 & \theta_{78} \\ \theta_{81} & \theta_{82} & \theta_{83} & \theta_{84} & \theta_{84} & \theta_{85} & \theta_{86} & 1 \end{bmatrix} \begin{bmatrix} e_t^{q} \\ e_t^{Y*} \\ e_t^{oil-price} \\ e_t^{IP} \\ e_t^{CPI} \\ e_t^{M1} \\ e_t^{i} \\ e_t^{exchange-rate} \end{bmatrix}$$

This chapter builds on identification scheme of Kilian (2009) to identify the underlying causes of oil price fluctuations. Kilian (2009) states "this paper heavily relies on delay restrictions that are economically plausible only at the monthly frequency." Most of the work that builds on Kilian's identification tends to ignore that statement, and identify their models at quarterly frequencies [See Aastveit et al. (2014), Peersman & Robays (2012)]. This chapter avoids that potential misspecification by constructing the identification scheme at a monthly frequency under economically plausible restrictions.

$$\varepsilon_t^{oil-supply} = e_t^{q} \tag{2.3}$$

Oil supply disruption shocks (ε_t^{os}) are defined as "unpredictable innovations" to world oil production. Due to adjustment costs in oil production, the short-term oil supply curve is vertical within the month. The assumption also captures the delayed decision making process of crude oil production in OPEC countries. The shifts in the oil supply short-term curve are oil supply disruptions in the oil market[1]. For oil-exporting economies, domestic oil production is used. For

[1] Kilian & Murphy (2013) shows that the price elasticity of oil supply is around 0.02. The study confirms that oil

oil-importing economies, global oil production is used.

$$\varepsilon_t^{oil-world-demand} = \theta_{21} e_t^q + e_t^{Y^*} \tag{2.4}$$

World real economic activity is treated as an exogenous variable and contemporaneously unaffected by any domestic shocks. $\left(\varepsilon_t^{world-oil-demand}\right)$ are defined as "unpredictable innovations" to world economic activities that are not explained by oil supply shock. Kilian's index for world real economic activities is included to capture the demand shock driven by world economic activities. For short, oil demand driven by world economic activities is noted as "world oil demand shock."

$$\varepsilon_t^{oil-specific-demand} = \theta_{31} e_t^q + \theta_{32} e_t^{Y^*} + e_t^{P^{oil}} \tag{2.5}$$

$\left(\varepsilon_t^{oil-specific-demand}\right)$ are oil specific-demand shocks driven by precautionary demand for oil defined as "unpredictable innovations" to real oil price that are not explained by oil supply shock and world economic activities shock. The oil price movements as a result of this oil specific-demand shock are highly correlated with an "Independent measures of the precautionary demand component of the real price of oil based on futures prices" as stated in Killian (2009). Alquist & Kilian (2010) find this correlation to be around 80%.

supply has a vertical curve in the short-run.

Monetary Policy

$$\varepsilon_t^{monetary-policy} = \theta_{73} e_t^{oil-price} + \theta_{76} e_t^{M1} + \theta_{78} e_t^{exchange-rate} + e_t^{i} \tag{2.6}$$

The central bank in open economies implements a monetary policy rule that reacts to international oil price and exchange rate fluctuations. Due to an information delay assumption, world real economic activity, domestic industrial production, CPI, and world oil production are excluded from the contemporaneous policy response function of the central bank. To account for inflationary pressures, the domestic central bank responds contemporaneously to international oil price and exchange rate fluctuations. The model follows Kim & Roubini (2000) to identify the monetary policy under an open economy framework. Although Kim & Roubini (2000) restrict the monetary policy authority from contemporaneously responding to the U.S. fed rate, Cushman and Zha (1997) relax that restriction. Kim & Roubini (2000) argue that domestic monetary authorities are more interested in the movements of nominal exchange rates against the U.S dollar rather than movements in U.S. Fed rate. Due to the large size of the model in this chapter and its focus on the caused of oil price shocks, the U.S. Federal Fund rate is dropped from the model. The exchange rate is included not only as an important channel for external shocks but also to account for its interaction with domestic monetary policy under an open economy framework. As a forward-looking asset price, exchange rate responds to all available information, and hence to all the variables in the model.

$$\varepsilon_t^{money-demand} = \theta_{64} e_t^{IP} + \theta_{65} e_t^{CPI} + \theta_{67} e_t^{i} + e_t^{M1} \tag{2.7}$$

Both the real income and the nominal interest rate determine the demand for real money balances. It is assumed that the demand for real money balances does not respond contemporaneously to the other variables in the model.

2.5 Estimation of The Model

This chapter considers monthly data of oil production, Kilian's index for world real economic activities, international oil price, domestic industrial production, domestic CPI, domestic monetary aggregate (M1), domestic interest rate, and exchange rate per U.S. dollar. The data are collected for two groups: i) Oil importers: Japan (1973-2013), the United Kingdom (1975-2013), Thailand (1990-2013), South Korea (1990-2013), Denmark (1974-2013), and Sweden (1973-2013); ii) Oil exporters: Canada (1986-2013), Norway (1993-2013), and Mexico (1990-2013). The data are collected from the countries' Central Banks, the Federal Reserve Economic Data, and the IMF. This chapter considers the impulse responses to different shocks underlying oil price fluctuations: 1) unanticipated oil supply disruption shock, 2) unanticipated oil demand shock driven by world real economic activities, and 3) unanticipated oil specific-demand driven by the precautionary demand for oil. In order to track global real economic activities, Kilian (2009) constructs a monthly index to capture the component of global real economic activities driving the demand for industrial commodities in international industrial commodities markets. Kilian's index for world real economic activity is built on various studies in the literature confirming a positive correlation between ocean freight rates, world economic activities and business cycles [See Isserlis (1938), Klovland (2002), Kilian (2009)].

Hamilton & Herrera (2004) find evidence to support a longer lag selection to capture the oil shock dynamic effects, and suggests at least 12 lags specification. This chapter estimates the model under 12 lags specification. This chapter shall focus on the impulse responses to these different oil shocks. As in Kim & Roubini (2000), the confidence bands are constructed with one-standard error bands. This paper first conducts a maximum likelihood test for the over-identifying restrictions. The null hypothesis is that the restrictions imposed in the model presented in this chapter are valid[2].

[2] See Table 2.1 and 2.2 for the results of the over-identifying test.

2.6 Results

2.6.1 The Dynamic Effects of the Underlying Causes of Oil Price Fluctuations in Oil Exporting Economies

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Canada

The empirical results suggest that the policy interest rate responses to the underlying causes of oil price fluctuations are asymmetric in Canada. The results indicate that policy interest rate rises in response to unanticipated world oil demand shock and falls in response to unanticipated oil-specific demand shock. No significant interest rate response to unanticipated oil supply disruption shock is documented. The unanticipated world oil demand shock tends to stimulate the domestic economy and bring some inflationary pressures on domestic CPI. The unanticipated world oil demand and oil-specific demand shocks have an immediate appreciation effect on exchange rate. The forecast error variance decomposition for Canada are reported in Table 2.3. At 12-48 month horizon, world oil demand explains 13.18-20.78% of output variation, and 8.61-10.99% of exchange rate variation. At 12-48 month horizon, oil-specific demand shock explains 8-41.91% of domestic CPI variation, 3.7-12.13% of exchange rate variation, and 9.06-26% of the policy interest rate variation in Canada.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Norway

In Norway, the empirical results suggest that the response of the domestic policy interest rate to the underlying shocks of oil price fluctuations are symmetric. In contrast to Canada, the policy interest rate falls in response to all the shocks that underly the oil price fluctuations. Unanticipated oil supply disruption shock leads to an immediate, statistically significant exchange rate appreciation. Unanticipated oil specific demand shock leads to an immediate statistically significant exchange rate appreciation but a delayed statistically significant exchange rate depreciation after the 6th month. The unanticipated oil supply disruption shock has an immediate statistically significant negative effect on domestic economic activities in Norway. It emphasizes the dependency of Norwegian economy on the oil industries and oil production. Unanticipated oil supply disruption and oil specific demand shocks bring inflationary pressure on domestic CPI.

The forecast error variance decomposition for Norway are reported in Table 2.4. At 12-48 months horizon, oil supply disruption shock explains 43.16-25.77% of the domestic output variation, 4-20.27% of the domestic CPI variation, 14.2-23.5% of the exchange variation, and 1.3-24.03% of interest rate variation. At 12 months horizon, oil specific-demand shock explains about 22.95% of CPI variation, and 10.39% of interest rate variation.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Mexico

The empirical results indicate that the interest rate falls in response to unanticipated oil supply disruption and world oil demand shocks. Unanticipated oil specific-demand shock has an immediate statistically significant positive effect on domestic economic activities. Unanticipated oil supply disruption and world oil demand shocks have an immediate statistically significant deflationary effect on domestic CPI, while oil specific demand shock has the opposite effect. Unanticipated world oil demand shock has an immediate statistically significant appreciation effect on exchange rate. The forecast error variance decomposition for Mexico are reported in Table 2.5. At 12-48 months horizon, oil supply disruption shock explains 1.6-24.2% of the domestic output variation, and 12.23-10.06% of interest rate variation. At 12-48 month horizon, world oil demand explains 23-16% of domestic CPI variation, 16-12% of exchange rate variation, and 10.6-8.6% of interest rate variation.

2.6.2 The Dynamic Effects of the Underlying Causes of Oil Price Fluctuations in Oil Importing Economies

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Japan

The empirical results report that the policy interest rate rises in response to unanticipated world oil demand and oil specific demand shocks; however, the interest rate falls in response to unanticipated oil supply disruption shock. The unanticipated world oil demand and oil specific-demand shocks have an immediate positive and statistically significant effect on domestic economic activities. However, after the 10th month, oil specific demand shock tends to have a negative effect on domestic economic activities in Japan. Unanticipated world oil demand and oil specific demand shocks have an immediate positive statistically significant persistent effect on domestic CPI. The forecast error variance decomposition for Japan are reported in Table 2.6. At 12-48 months horizon, world oil demand shock explains 18.53-17.45% of output variation and 12.92-13.32% of interest rate variation.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in the United Kingdom

The empirical results indicate that policy interest rate rises in response to unanticipated world oil demand and oil specific-demand shocks. The unanticipated world oil demand shock stimulates domestic output with an immediate statistically significant effect, while unanticipated oil-specific demand shock has an immediate statistically significant negative effect on domestic output. The results report an immediate statistically significant appreciation effect on exchange rate after an unanticipated world oil demand shock; however, unanticipated oil-specific demand shock leads to an immediate statistically significant appreciation effect but a delayed depreciation effect on exchange rate. Both unanticipated world oil demand and oil-specific demand shocks have an immediate statistically significant inflationary effect on CPI; however, unanticipated oil supply disruption shock tends to have a deflationary effect on domestic CPI. The forecast error variance decomposition for the United Kingdom are reported in Table 2.7. At 12-48 months horizon, oil supply disruption shock explains 16.7-20.5% of the domestic CPI variation, and 4.01-18.8% of exchange rate. At 12-48 months horizon, world oil demand shock explains 11.9-17.2% of the domestic CPI variation, and 16.3-12.6% of exchange rate variation. At 12-48 months horizon, oil specific-demand shock explains 10.70-50.54% of the domestic output variation, and 16.08-12.15% of interest rate variation.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Thailand

The empirical results show that the interest rate falls in response to unanticipated oil supply disruption shock and rises in response to oil specific demand shock. The unanticipated oil specific demand shocks have an immediate positive and statistically significant effect on domestic economic activities. Unanticipated world oil demand and oil specific demand shocks have an immediate positive statistically significant persistent effect on domestic CPI. Unanticipated oil supply disruption shock has a negative effect on domestic output. The forecast error variance decomposition for Thailand are reported in Table 2.8. At 12-48 months horizon, world oil demand shock explains 6.2-14.91% of CPI variation and 15.08-17.35% of interest rate variation. At 12-48 months horizon, oil specific-demand shock explains 14.84-20.56% of output variation and 11.73-12.81% of exchange rate variation.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in South Korea

The empirical results show that the interest rate falls in response to unanticipated world oil demand, oil specific demand shocks, and oil supply disruption shock. Unanticipated world oil demand and oil specific demand shocks have an immediate positive statistically significant persistent effect on domestic CPI. Unanticipated world oil demand and oil specific-demand shocks have an immediate positive statistically significant effect on domestic economic activities. Unanticipated oil supply disruption, world oil demand, and oil specific-demand shocks lead to an exchange rate appreciation. The forecast error variance decomposition for South Korea are reported in Table 2.9. At 12-48 months horizon, world oil demand shock explains 13.7-36.69% of output variation, and 13.26-9.49 % of CPI variation. At 12-48 months horizon, oil specific-demand shock explains 12.0-21.6% of CPI variation, 1.88-23.5% of exchange rate variation, and 10.58-13.95% of interest rate variation.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Denmark

The empirical results show that the interest rate rises in response to unanticipated world oil demand and oil specific demand shocks. The interest rate, however, falls in response to unanticipated oil supply disruption shock. Unanticipated world oil demand and oil specific demand shocks have an immediate positive statistically significant persistent effect on domestic CPI. Unanticipated world oil demand shock leads to higher domestic output. Unanticipated world oil demand and oil specific demand shocks lead to an immediate exchange rate appreciation. Unanticipated oil supply disruption shock, however, leads to immediate statistically significant exchange rate depreciation. The forecast error variance decomposition for Denmark are reported in Table 2.10. At 12-48 months horizon, world oil demand shock explains 26.98-20.81% of CPI variation and 12.26-13.56% of interest rate variation. At 12-48 months horizon, oil specific-demand shock explains 12.71-24.35% of CPI variation, and 3.58-17.57% of exchange rate variation.

Interest Rate, Exchange Rate, CPI, Output and Different Oil Shocks in Sweden

The empirical results show that the interest rate rises in response to unanticipated world oil demand and oil specific demand shocks. Unanticipated world oil demand and oil specific demand shocks have an immediate positive statistically significant persistent effect on domestic CPI. Unanticipated world oil demand shock has immediate positive statistically significant effect on domestic economic activities. World oil demand and oil specific demand shocks lead to an immediate statistically significant exchange rate appreciation. Unanticipated oil supply disruption shock, however, leads to immediate statistically significant exchange rate depreciation. The forecast error variance decomposition for Sweden are reported in Table 2.11. At 12-48 months horizon, world oil demand shock explains 29.3-18.0% of output variation, 14.04-32.02 % of CPI variation, 15.8-24.7% of interest rate variation.

2.7 Conclusion

This chapter constructs a structural VAR model that jointly captures the interaction between the monetary policy, the exchange rate, and the underlying causes of oil price fluctuations. The model in this chapter explores the dynamic of different oil shocks on domestic macroeconomic aggregates and how the monetary policy responds to these oil shocks across open economies. The model follows the seminal work of Kilian (2009) in identifying the different shocks underlying oil price fluctuations and follows Kim and Roubini (2000) in identifying monetary policies under an open economy framework.

The results indicate that the oil supply disruption shock tends to have a diminished effect across oil-importing open economies. The oil demand shock driven by world economic activity, however, tends to stimulate domestic economic activities across oil exporting and oil importing open economies. Both world oil demand and oil-specific demand shocks place an inflationary pressure on domestic CPI across these economies. The results report asymmetric interest rate responses to different oil shocks within and across these open economies. In Mexico, Norway, Japan, Thailand, and Denmark; the interest rate falls in response to oil supply disruption shock. The results indicate that the interest rate rises in response to world oil demand shock across oil importing economies. The monetary policies, however, respond differently to oil-specific demand shock. The interest rate rises in oil-importing economies like Japan, the U.K., Thailand, Denmark, and Sweden and falls in oil-exporting economies like Canada, Norway, and Mexico.

Table 2.1: Over-identifying Restrictions Test For Oil-importing Economies

Over-identifying Restrictions Test For Oil-importing Economies	
Country	Significance Level
Japan	0.7970
U.K.	0.4990
Thailand	0.4932
S. Korea	0.8877
Denmark	0.021
Sweden	0.5760

Table 2.2: Over-identifying Restrictions Test For Oil-exporting Economies

Over-identifying Restrictions Test For Oil-exporting Economies	
Country	Significance Level
Canada	0.1157929
Norway	0.3464
Mexico	0.4619

Table 2.3: Canada - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Canada	Oil Supply Disruption Shock	0.20	7.87	7.63
	World Oil Demand Shock	13.18	9.41	20.78
	Oil Specific Demand Shock	5.25	4.84	4.24
	IP Shock	59.30	48.42	28.60
	CPI Shock	13.88	7.65	4.62
	Money Demand Shock	0.63	1.22	3.14
	Interest Rate Shock	1.73	9.88	13.90
	Exchange Rate Shock	5.78	10.66	17.05
CPI				
Country		12 Months	24 Months	48 Months
Canada	Oil Supply Disruption Shock	2.63	5.59	4.02
	World Oil Demand Shock	5.96	3.56	2.52
	Oil Specific Demand Shock	8.00	16.32	41.91
	IP Shock	0.79	1.00	11.56
	CPI Shock	76.90	47.01	19.25
	Money Demand Shock	1.59	2.93	4.57
	Interest Rate Shock	3.10	21.68	11.10
	Exchange Rate Shock	0.99	1.887	5.03
Exchange Rate				
Country		12 Months	24 Months	48 Months
Canada	Oil Supply Disruption Shock	1.57	1.29	2.66
	World Oil Demand Shock	8.61	10.67	10.99
	Oil Specific Demand Shock	3.70	2.96	12.13
	IP Shock	3.35	7.27	6.55
	CPI Shock	1.38	2.00	2.05
	Money Demand Shock	17.68	12.23	9.64
	Interest Rate Shock	4.96	19.63	13.88
	Exchange Rate Shock	58.71	43.92	42.07
Interest Rate				
Country		12 Months	24 Months	48 Months
Canada	Oil Supply Disruption Shock	3.49	2.58	4.33
	World Oil Demand Shock	4.83	3.33	7.86
	Oil Specific Demand Shock	9.06	36.82	26.44
	IP Shock	3.8	11.74	15.02
	CPI Shock	3.58	2.93	2.33
	Money Demand Shock	14.53	9.39	14.45
	Interest Rate Shock	52.92	24.57	17.62
	Exchange Rate Shock	7.67	8.60	11.92

Table 2.4: Norway - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Norway	Oil Supply Disruption Shock	43.16	29.25	25.77
	World Oil Demand Shock	3.10	4.32	4.89
	Oil Specific Demand Shock	5.22	5.26	5.80
	IP Shock	25.22	19.84	17.37
	CPI Shock	2.20	3.65	2.76
	Money Demand Shock	12.87	25.34	27.49
	Interest Rate Shock	2.70	3.09	3.05
	Exchange Rate Shock	5.50	9.21	12.83

CPI				
Country		12 Months	24 Months	48 Months
Norway	Oil Supply Disruption Shock	4.20	12.18	20.27
	World Oil Demand Shock	1.65	1.17	5.47
	Oil Specific Demand Shock	22.95	12.86	5.49
	IP Shock	7.73	5.88	4.09
	CPI Shock	43.52	21.35	7.70
	Money Demand Shock	17.02	21.36	24.93
	Interest Rate Shock	2.35	4.69	3.45
	Exchange Rate Shock	0.54	20.47	28.55

Exchange Rate				
Country		12 Months	24 Months	48 Months
Norway	Oil Supply Disruption Shock	14.20	26.31	23.53
	World Oil Demand Shock	3.08	3.21	15.70
	Oil Specific Demand Shock	9.50	7.20	4.79
	IP Shock	11.48	9.81	5.96
	CPI Shock	4.11	2.45	1.65
	Money Demand Shock	6.34	6.65	10.21
	Interest Rate Shock	1.12	0.85	2.93
	Exchange Rate Shock	50.14	43.48	35.20

Interest Rate				
Country		12 Months	24 Months	48 Months
Norway	Oil Supply Disruption Shock	1.33	12.85	24.03
	World Oil Demand Shock	6.66	1.68	9.64
	Oil Specific Demand Shock	10.39	6.15	2.89
	IP Shock	1.13	6.36	5.07
	CPI Shock	1.51	0.57	0.64
	Money Demand Shock	13.88	32.31	23.64
	Interest Rate Shock	57.84	6.81	2.85
	Exchange Rate Shock	7.22	33.24	31.20

Table 2.5: Mexico - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Mexico	Oil Supply Disruption Shock	1.61	27.36	24.24
	World Oil Demand Shock	1.11	2.83	1.25
	Oil Specific Demand Shock	0.78	2.25	7.69
	IP Shock	76.35	46.54	35.27
	CPI Shock	1.06	1.62	2.03
	Interest Rate Shock	6.80	6.29	3.91
	Exchange Rate Shock	12.26	13.09	25.59
CPI				
Country		12 Months	24 Months	48 Months
Mexico	Oil Supply Disruption Shock	3.33	1.30	1.48
	World Oil Demand Shock	23.81	23.51	16.27
	Oil Specific Demand Shock	4.98	2.42	11.81
	IP Shock	5.10	9.89	18.44
	CPI Shock	48.18	36.15	16.09
	Interest Rate Shock	0.08	6.22	13.81
	Exchange Rate Shock	14.56	20.48	22.07
Exchange Rate				
Country		12 Months	24 Months	48 Months
Mexico	Oil Supply Disruption Shock	5.35	3.35	3.29
	World Oil Demand Shock	16.33	13.60	12.26
	Oil Specific Demand Shock	2.62	3.94	18.77
	IP Shock	10.72	9.91	11.47
	CPI Shock	23.66	20.85	11.64
	Interest Rate Shock	3.15	11.27	18.32
	Exchange Rate Shock	38.15	37.04	24.22
Interest Rate				
Country		12 Months	24 Months	48 Months
Mexico	Oil Supply Disruption Shock	12.23	9.89	10.06
	World Oil Demand Shock	10.62	9.95	8.60
	Oil Specific Demand Shock	2.43	9.80	18.12
	IP Shock	18.94	20.25	15.64
	CPI Shock	8.73	7.22	8.48
	Interest Rate Shock	18.17	16.80	17.98
	Exchange Rate Shock	28.85	26.06	21.10

Table 2.6: Japan - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Japan	Oil Supply Disruption Shock	0.45	3.96	3.74
	World Demand Shock	18.53	15.31	17.45
	Oil Specific Demand Shock	6.48	4.83	6.90
	IP Shock	62.13	57.33	49.10
	CPI Shock	7.01	6.36	7.76
	Money Demand Shock	1.43	2.64	2.58
	Interest Rate Shock	1.36	7.03	10.11
	Exchange Rate Shock	2.58	2.50	1.33
CPI				
Country		12 Months	24 Months	48 Months
Japan	Oil Supply Disruption Shock	8.10	5.16	5.13
	World Demand Shock	4.53	17.17	12.76
	Oil Specific Demand Shock	4.53	1.95	2.06
	IP Shock	4.53	11.52	19.16
	CPI Shock	49.91	29.65	22.48
	Money Demand Shock	1.07	1.12	1.82
	Interest Rate Shock	5.93	8.91	18.67
	Exchange Rate Shock	24.19	24.49	17.89
Exchange Rate				
Country		12 Months	24 Months	48 Months
Japan	Oil Supply Disruption Shock	0.09	0.21	0.40
	World Demand Shock	0.674	0.915	3.45
	Oil Specific Demand Shock	0.743	3.12	6.45
	IP Shock	2.59	5.02	5.61
	CPI Shock	3.56	3.98	5.75
	Money Demand Shock	0.91	1.53	2.26
	Interest Rate Shock	6.79	13.68	13.96
	Exchange Rate Shock	84.61	71.51	62.09
Interest Rate				
Country		12 Months	24 Months	48 Months
Japan	Oil Supply Disruption Shock	0.69	0.50	0.52
	World Demand Shock	12.92	16.07	13.32
	Oil Specific Demand Shock	2.54	8.70	9.66
	IP Shock	1.56	3.61	4.51
	CPI Shock	11.25	10.48	8.82
	Money Demand Shock	2.26	5.20	6.97
	Interest Rate Shock	45.60	32.10	28.40
	Exchange Rate Shock	23.16	23.31	27.76

Table 2.7: United Kingdom - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
United Kingdom	Oil Supply Disruption Shock	0.53	0.83	1.70
	World Oil Demand Shock	8.347	4.00	2.36
	Oil Specific Demand Shock	10.70	41.69	50.54
	IP Shock	70.10	41.54	23.84
	CPI Shock	6.86	5.60	8.51
	Interest Rate Shock	1.63	5.45	8.81
	Exchange Rate Shock	1.80	0.86	4.19
CPI				
Country		12 Months	24 Months	48 Months
United Kingdom	Oil Supply Disruption Shock	16.79	12.92	20.53
	World Oil Demand Shock	11.91	15.87	17.20
	Oil Specific Demand Shock	15.07	13.95	6.85
	IP Shock	3.369	3.16	2.39
	CPI Shock	29.43	14.23	5.89
	Interest Rate Shock	19.04	18.32	9.82
	Exchange Rate Shock	4.37	21.50	37.28
Exchange Rate				
Country		12 Months	24 Months	48 Months
United Kingdom	Oil Supply Disruption Shock	4.01	11.67	18.86
	World Oil Demand Shock	16.30	15.45	12.66
	Oil Specific Demand Shock	2.16	5.96	10.47
	IP Shock	7.97	10.38	13.22
	CPI Shock	0.91	0.76	0.88
	Interest Rate Shock	2.96	2.07	1.63
	Exchange Rate Shock	65.65	53.69	42.25
Interest Rate				
Country		12 Months	24 Months	48 Months
United Kingdom	Oil Supply Disruption Shock	1.87	5.95	4.75
	World Oil Demand Shock	5.40	5.15	4.20
	Oil Specific Demand Shock	16.08	14.63	12.15
	IP Shock	1.46	6.42	14.41
	CPI Shock	4.21	7.44	6.91
	Interest Rate Shock	65.11	48.92	43.36
	Exchange Rate Shock	5.83	11.46	14.19

Table 2.8: Thailand - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Thailand	Oil Supply Disruption Shock	1.26	3.46	3.43
	World Oil Demand Shock	5.40	7.90	8.59
	Oil Specific Demand Shock	14.84	18.89	20.56
	IP Shock	54.44	38.56	26.71
	CPI Shock	2.37	3.36	2.24
	Money Demand Shock	3.39	4.18	8.98
	Interest Rate Shock	12.06	17.10	15.10
	Exchange Rate Shock	6.19	6.51	14.35
CPI				
Country		12 Months	24 Months	48 Months
Thailand	Oil Supply Disruption Shock	3.60	6.13	6.36
	World Oil Demand Shock	6.26	9.90	14.910
	Oil Specific Demand Shock	12.04	9.58	4.16
	IP Shock	1.30	2.86	7.79
	CPI Shock	53.68	45.30	14.52
	Money Demand Shock	2.85	2.51	0.78
	Interest Rate Shock	13.09	12.47	34.52
	Exchange Rate Shock	7.14	11.22	16.94
Exchange Rate				
Country		12 Months	24 Months	48 Months
Thailand	Oil Supply Disruption Shock	0.61	5.21	5.31
	World Oil Demand Shock	8.17	10.35	6.60
	Oil Specific Demand Shock	11.73	11.04	12.81
	IP Shock	4.96	7.94	14.79
	CPI Shock	2.28	3.52	3.83
	Money Demand Shock	6.71	4.46	3.38
	Interest Rate Shock	17.38	19.97	30.96
	Exchange Rate Shock	48.12	37.48	22.28
Interest Rate				
Country		12 Months	24 Months	48 Months
Thailand	Oil Supply Disruption Shock	0.50	2.03	3.13
	World Oil Demand Shock	15.08	21.16	17.35
	Oil Specific Demand Shock	1.18	4.54	12.27
	IP Shock	8.32	17.19	19.77
	CPI Shock	6.71	5.66	5.29
	Money Demand Shock	12.52	9.97	7.84
	Interest Rate Shock	52.38	31.18	21.47
	Exchange Rate Shock	3.27	8.24	2.84

Table 2.9: South Korea - Forecast Error Variance Decomposition

Country		12 Months	24 Months	48 Months
Output				
S. Korea	Oil Supply Disruption Shock	6.43	6.14	4.16
	World Oil Demand Shock	13.71	26.58	36.69
	Oil Specific Demand Shock	1.42	0.98	2.06
	IP Shock	42.72	40.78	39.35
	CPI Shock	11.71	8.29	5.35
	Interest Rate Shock	4.88	3.18	2.08
	Exchange Rate Shock	19.09	14.01	10.28
CPI				
S. Korea	Oil Supply Disruption Shock	4.09	4.49	8.40
	World Oil Demand Shock	13.26	10.74	9.49
	Oil Specific Demand Shock	12.00	13.59	21.63
	IP Shock	6.21	19.67	30.51
	CPI Shock	44.17	33.01	16.75
	Interest Rate Shock	6.66	7.92	7.15
	Exchange Rate Shock	13.58	10.55	6.03
Exchange Rate				
S. Korea	Oil Supply Disruption Shock	3.22	4.91	4.16
	World Oil Demand Shock	1.53	1.70	1.58
	Oil Specific Demand Shock	1.88	10.46	23.56
	IP Shock	1.86	1.95	5.96
	CPI Shock	15.06	14.08	11.29
	Interest Rate Shock	8.26	6.28	6.20
	Exchange Rate Shock	68.16	60.60	47.23
Interest Rate				
S. Korea	Oil Supply Disruption Shock	1.01	2.61	5.48
	World Oil Demand Shock	3.06	6.10	5.22
	Oil Specific Demand Shock	10.58	15.67	13.95
	IP Shock	4.58	5.26	4.89
	CPI Shock	17.62	11.51	10.94
	Interest Rate Shock	17.73	14.34	12.51
	Exchange Rate Shock	45.38	44.47	46.97

Table 2.10: Denmark - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Denmark	Oil Supply Disruption Shock	7.60	7.37	7.15
	World Oil Demand Shock	1.61	2.43	2.45
	Oil Specific Demand Shock	6.51	6.69	8.09
	IP Shock	62.46	50.87	47.83
	CPI Shock	7.84	11.74	9.36
	Money Demand Shock	7.43	7.18	5.54
	Interest Rate Shock	0.66	2.71	10.53
	Exchange Rate Shock	5.86	10.98	9.02
CPI				
Country		12 Months	24 Months	48 Months
Denmark	Oil Supply Disruption Shock	6.69	5.13	2.54
	World Oil Demand Shock	26.98	33.74	20.81
	Oil Specific Demand Shock	12.71	25.84	24.35
	IP Shock	1.38	2.00	6.65
	CPI Shock	40.46	26.23	30.64
	Money Demand Shock	8.46	5.03	6.50
	Interest Rate Shock	0.44	0.27	2.06
	Exchange Rate Shock	2.84	1.72	6.42
Exchange Rate				
Country		12 Months	24 Months	48 Months
Denmark	Oil Supply Disruption Shock	7.36	13.37	12.15
	World Oil Demand Shock	0.22	1.30	2.32
	Oil Specific Demand Shock	3.58	10.310	17.57
	IP Shock	1.73	1.51	3.14
	CPI Shock	0.43	0.52	5.04
	Money Demand Shock	3.74	3.14	6.67
	Interest Rate Shock	2.13	1.12	2.52
	Exchange Rate Shock	80.78	68.71	50.55
Interest Rate				
Country		12 Months	24 Months	48 Months
Denmark	Oil Supply Disruption Shock	0.41	1.76	6.03
	World Oil Demand Shock	12.26	17.70	13.56
	Oil Specific Demand Shock	0.22	0.26	1.30
	IP Shock	2.44	2.16	2.70
	CPI Shock	0.89	1.91	2.56
	Money Demand Shock	0.41	0.53	1.56
	Interest Rate Shock	81.98	73.57	56.15
	Exchange Rate Shock	1.35	2.08	16.09

Table 2.11: Sweden - Forecast Error Variance Decomposition

Output				
Country		12 Months	24 Months	48 Months
Sweden	Oil Supply Disruption Shock	1.07	0.80	3.95
	World Oil Demand Shock	29.31	21.72	18.00
	Oil Specific Demand Shock	1.49	2.77	2.95
	IP Shock	37.25	21.40	22.42
	CPI Shock	1.08	2.85	3.55
	Interest Rate Shock	20.46	41.79	40.76
	Exchange Rate Shock	9.30	8.65	8.34
CPI				
Country		12 Months	24 Months	48 Months
Sweden	Oil Supply Disruption Shock	0.73	1.49	2.49
	World Oil Demand Shock	14.04	24.12	32.02
	Oil Specific Demand Shock	9.91	6.80	6.69
	IP Shock	3.7	1.44	1.29
	CPI Shock	58.21	48.11	36.22
	Interest Rate Shock	12.14	14.86	17.04
	Exchange Rate Shock	1.25	3.15	4.22
Exchange Rate				
Country		12 Months	24 Months	48 Months
Sweden	Oil Supply Disruption Shock	0.84	5.60	7.95
	World Oil Demand Shock	8.49	10.35	12.31
	Oil Specific Demand Shock	2.27	3.49	4.02
	IP Shock	0.22	1.96	1.72
	CPI Shock	1.12	1.30	1.27
	Interest Rate Shock	3.09	6.38	5.12
	Exchange Rate Shock	83.94	70.88	67.58
Interest Rate				
Country		12 Months	24 Months	48 Months
Sweden	Oil Supply Disruption Shock	0.27	3.07	2.55
	World Oil Demand Shock	15.86	24.65	24.79
	Oil Specific Demand Shock	6.12	3.74	6.77
	IP Shock	2.43	5.46	8.90
	CPI Shock	3.75	6.85	5.67
	Interest Rate Shock	60.01	46.93	41.98
	Exchange Rate Shock	11.53	9.28	9.31

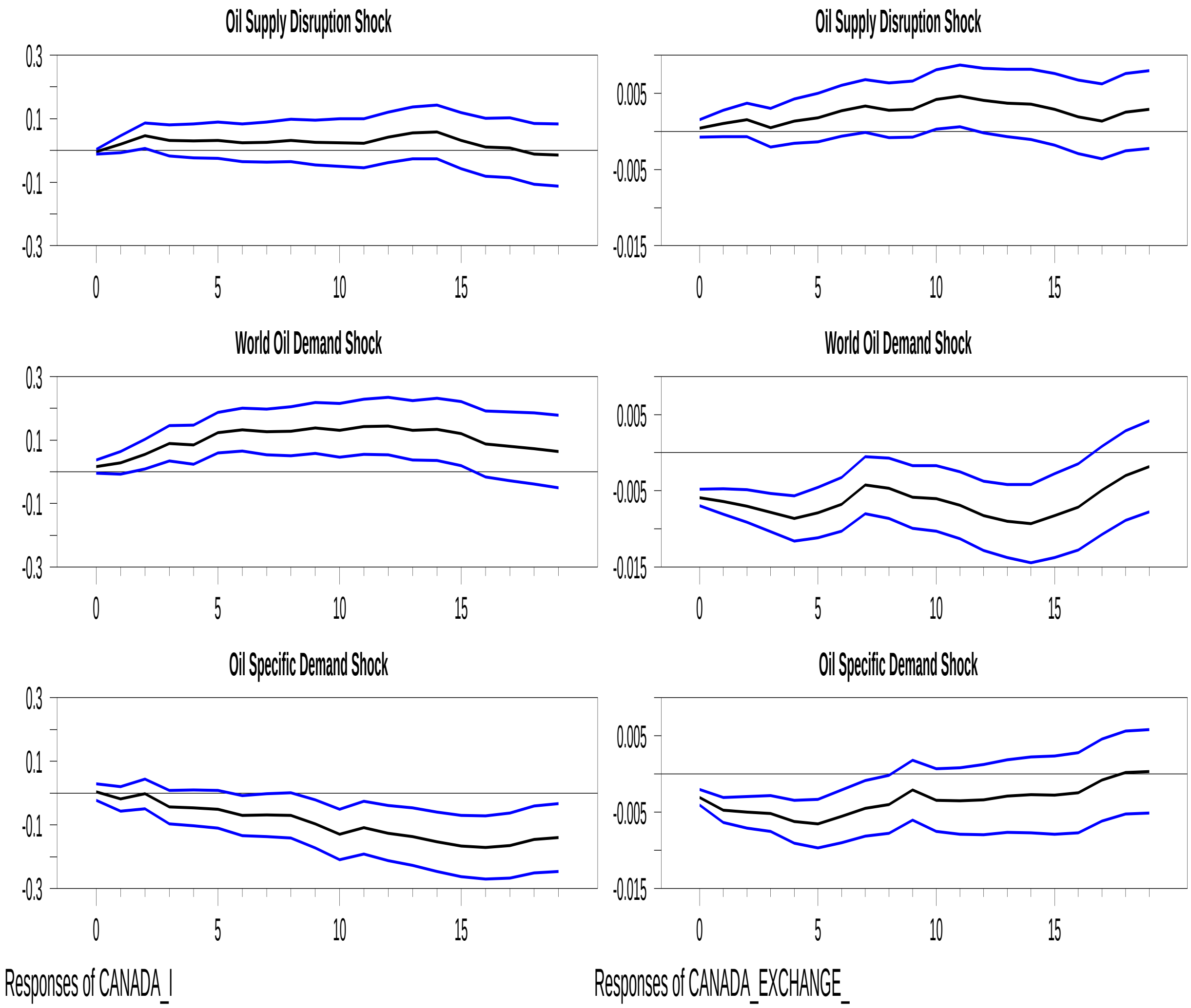

Figure 2.1: The Impulse Responses of Interest Rate, and Exchange Rate in Canada - Oil Exporting Economies

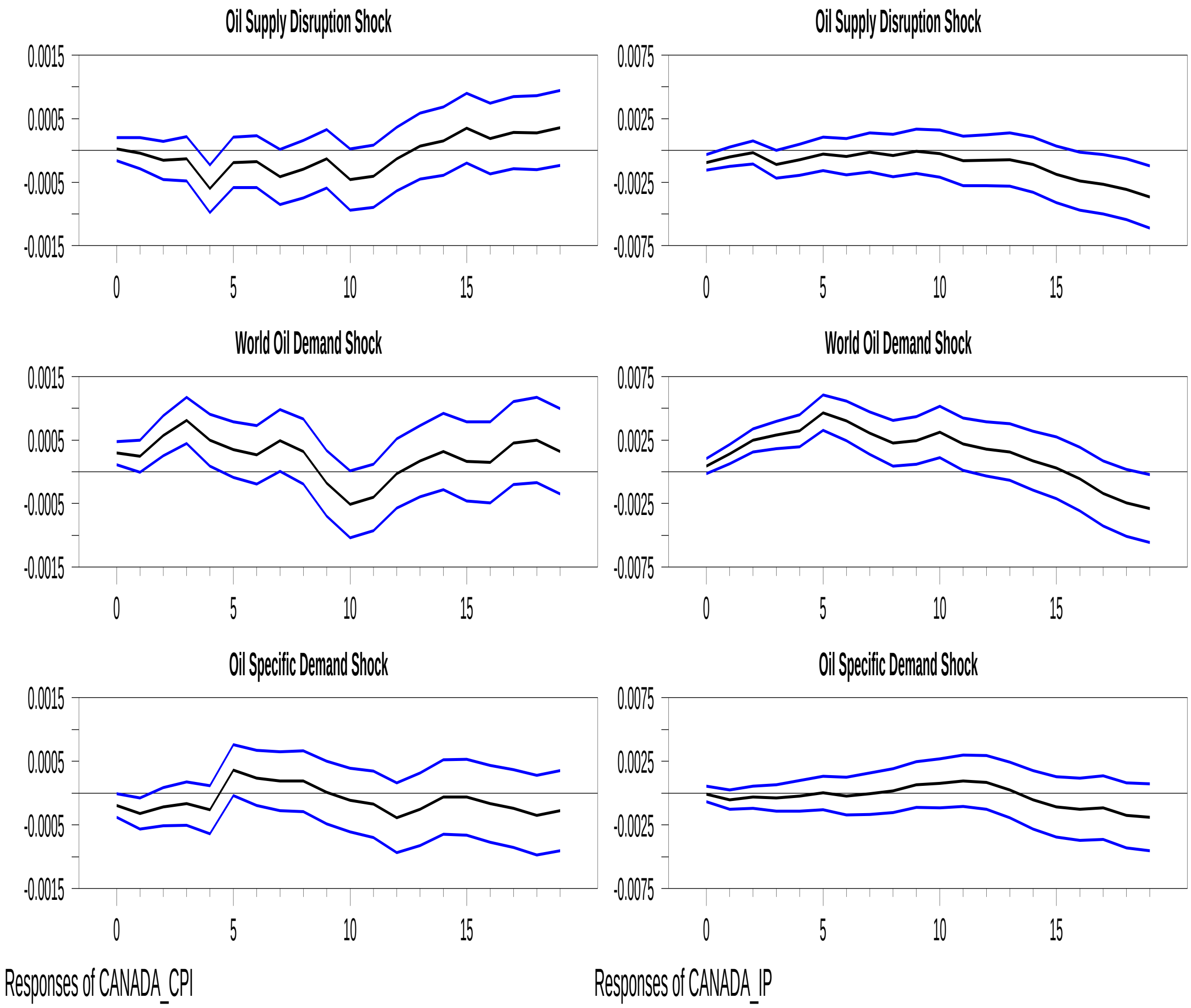

Figure 2.2: The Impulse Responses of CPI, and Industrial Production in Canada - Oil Exporting Economies

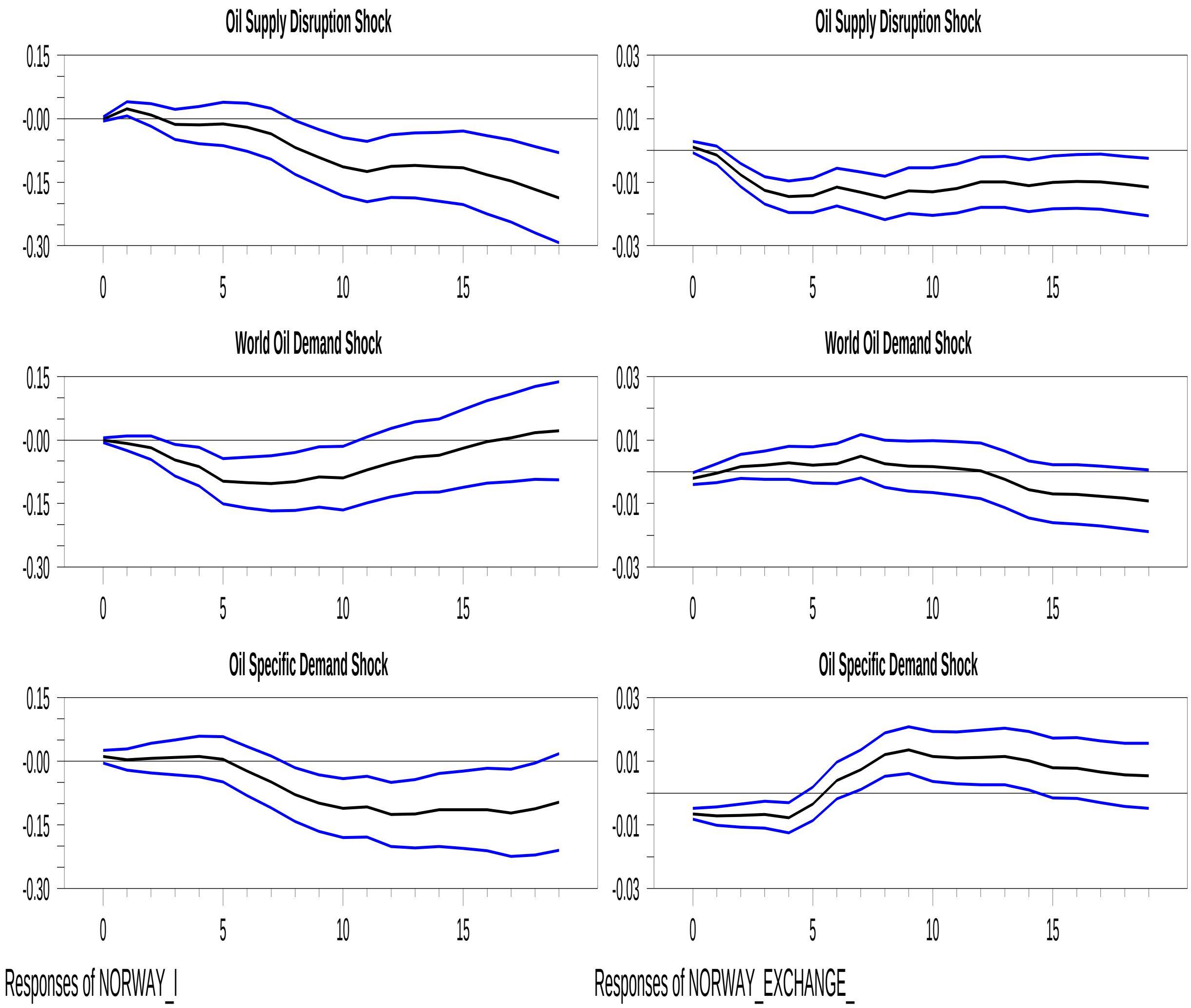

Figure 2.3: The Impulse Responses of Interest Rate, and Exchange Rate in Norway - Oil Exporting Economies

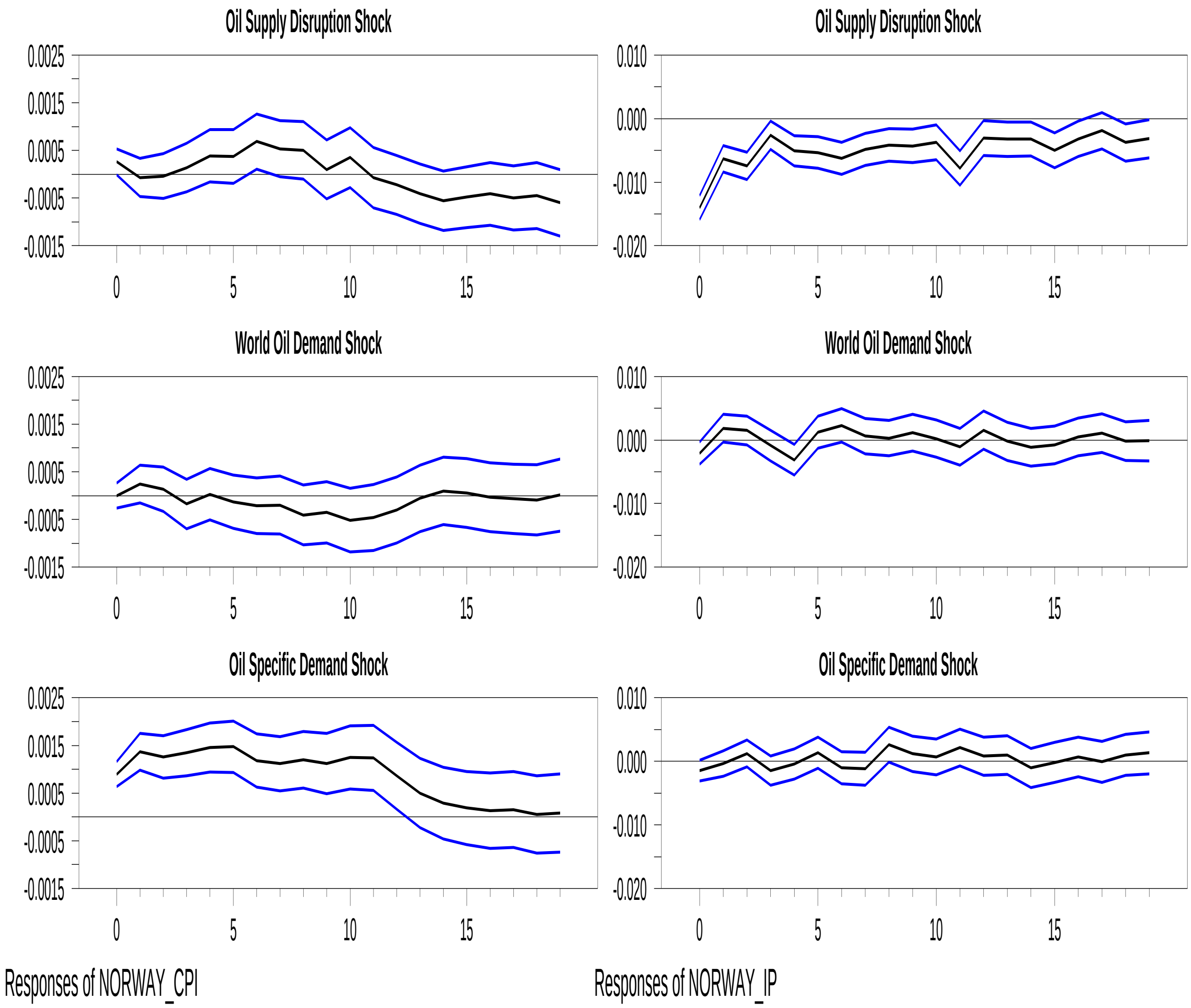

Figure 2.4: The Impulse Responses of CPI, and Industrial Production in Norway - Oil Exporting Economies

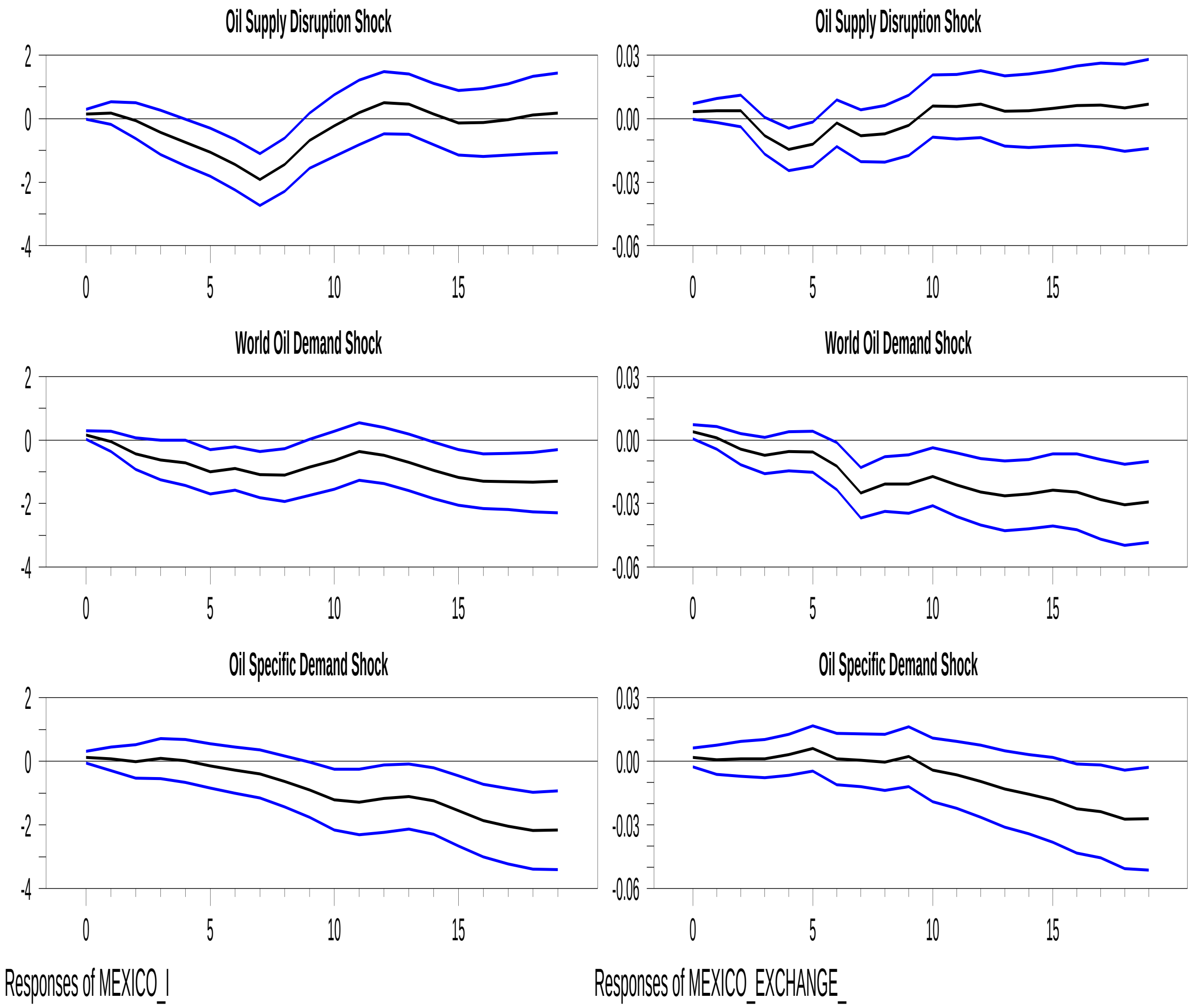

Figure 2.5: The Impulse Responses of Interest Rate, and Exchange Rate in Mexico - Oil Exporting Economies

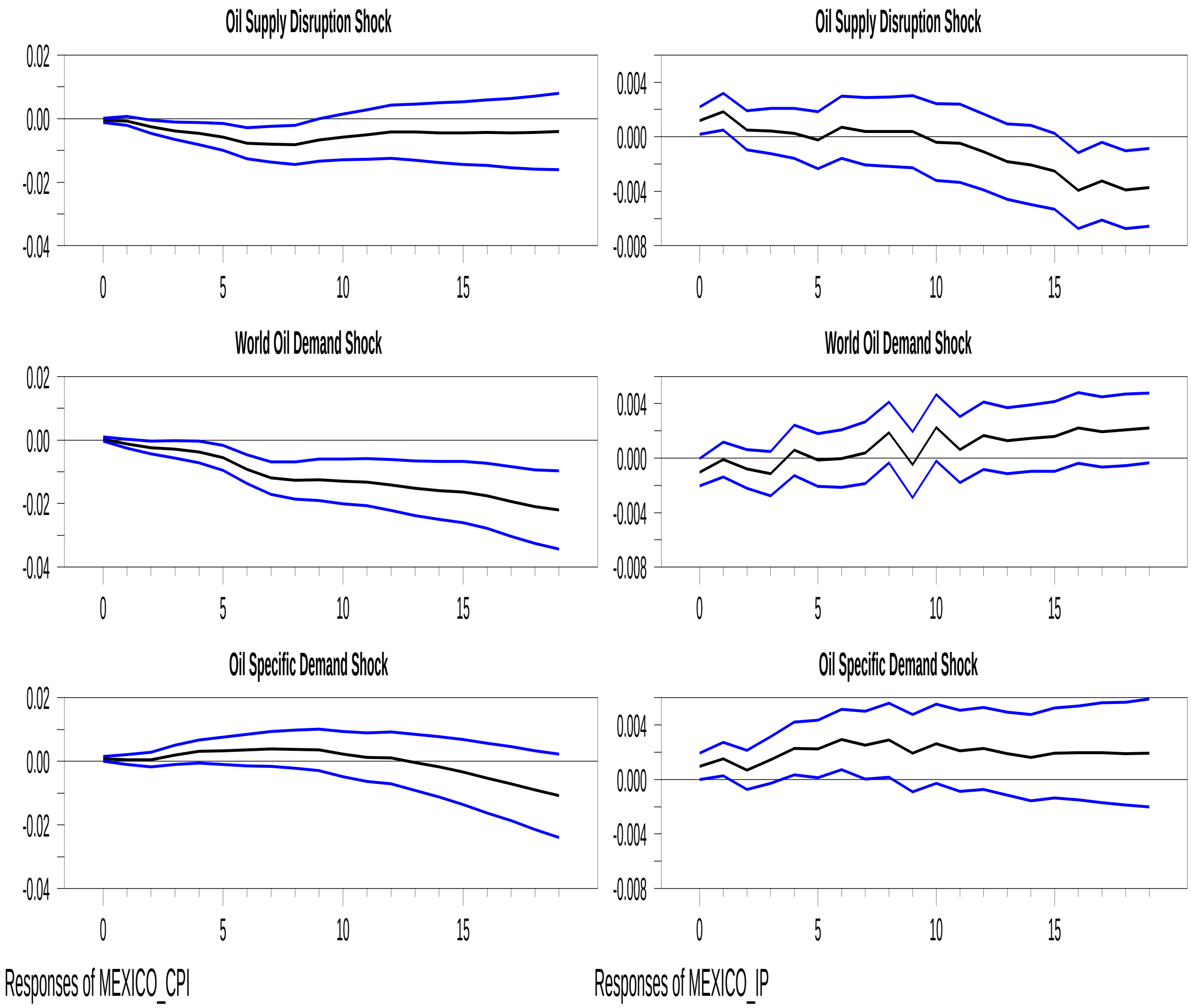

Figure 2.6: The Impulse Responses of CPI, and Industrial Production in Mexico - Oil Exporting Economies

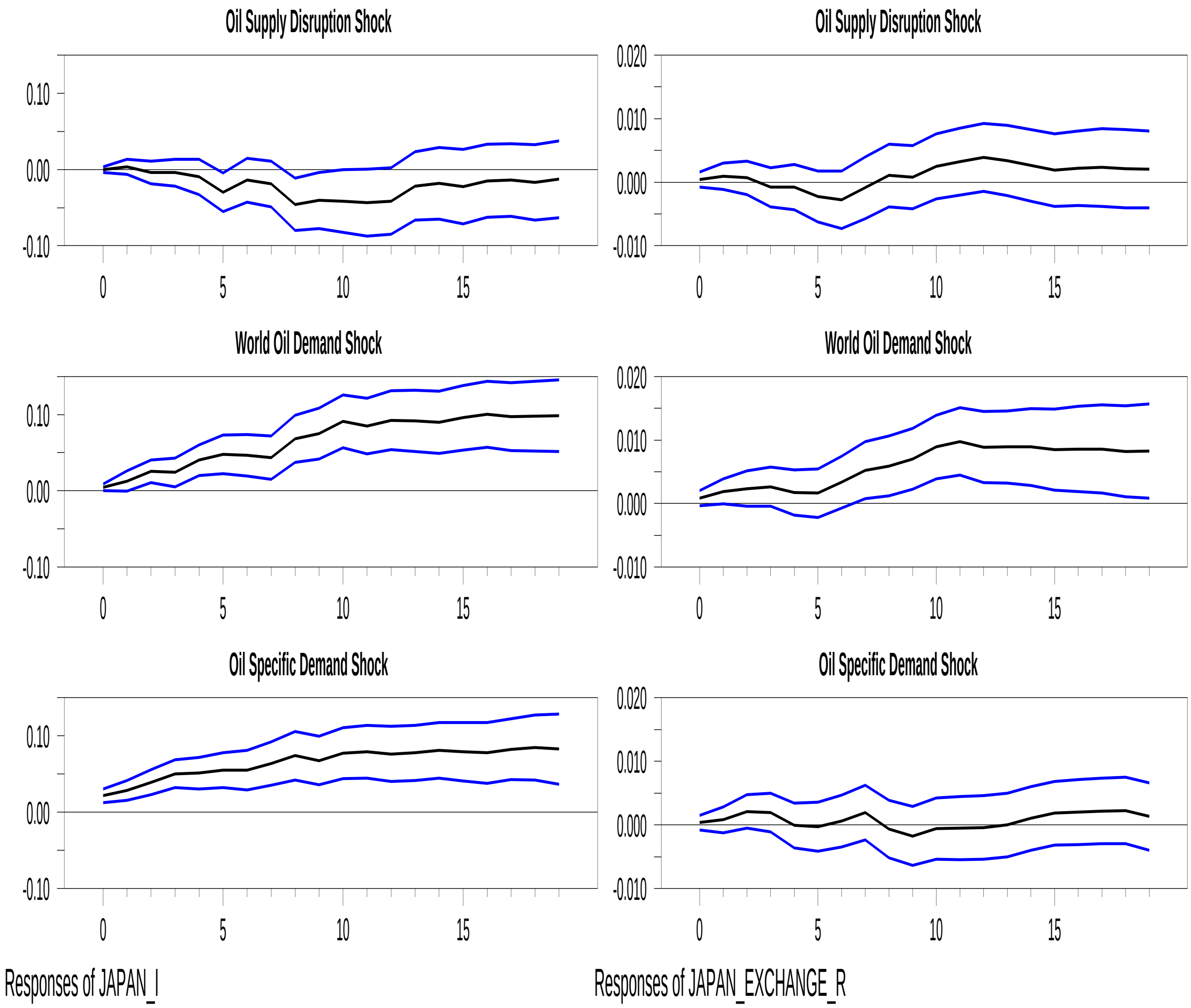

Figure 2.7: The Impulse Responses of Interest Rate, and Exchange Rate in Japan - Oil Importing Economies

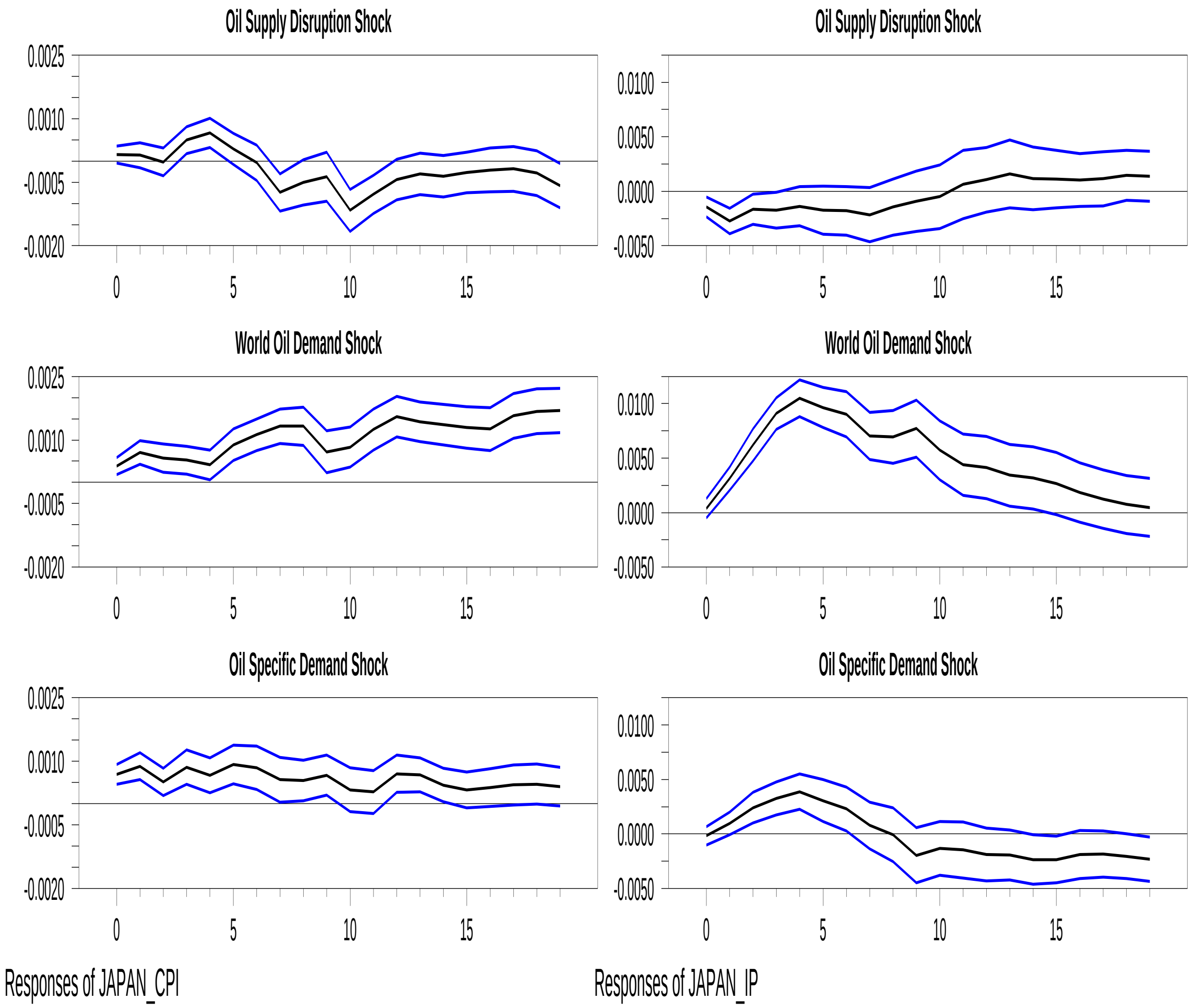

Figure 2.8: The Impulse Responses of CPI, and Industrial Production in Japan - Oil Importing Economies

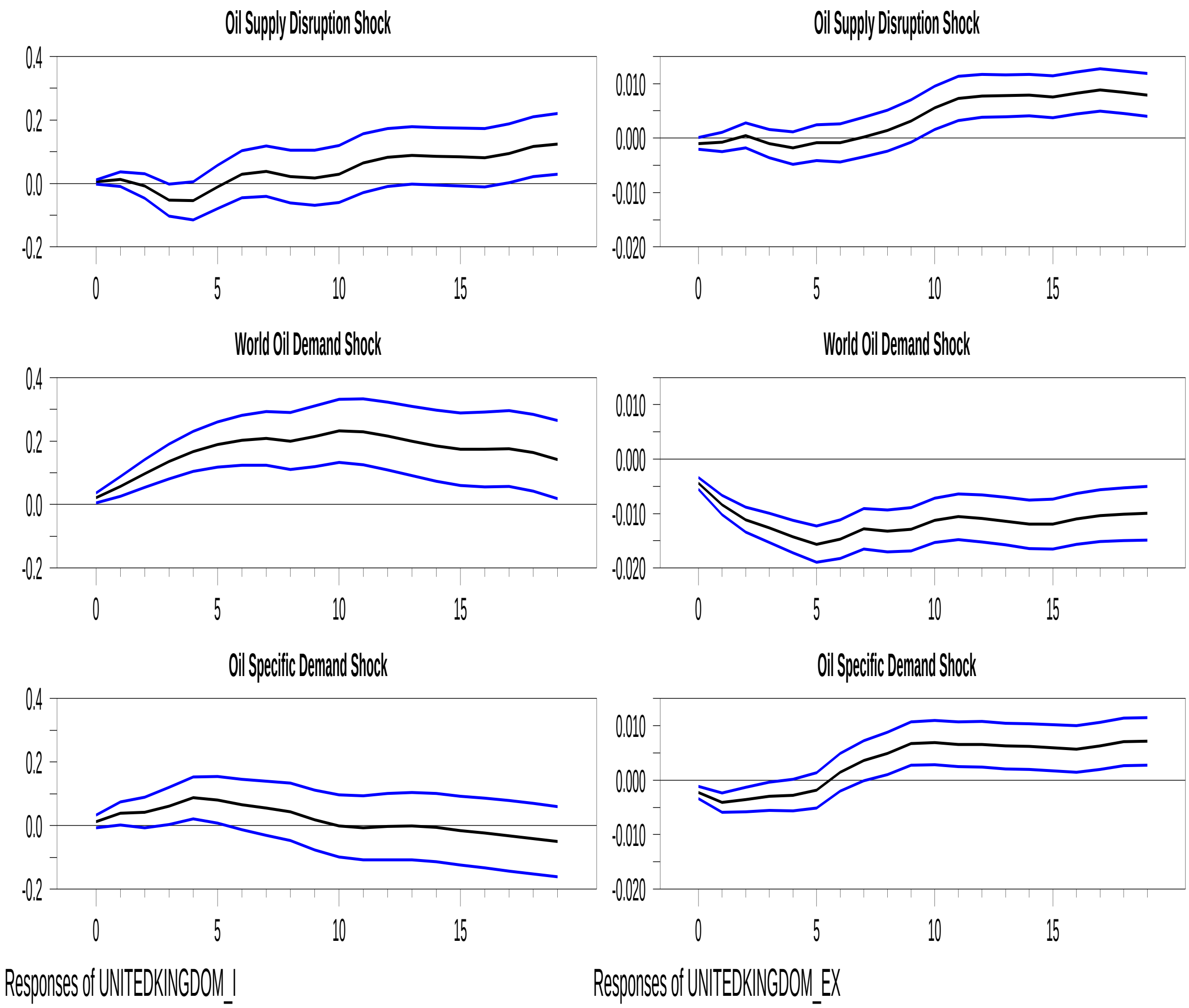

Figure 2.9: The Impulse Responses of Interest Rate, and Exchange Rate in United Kingdom - Oil Importing Economies

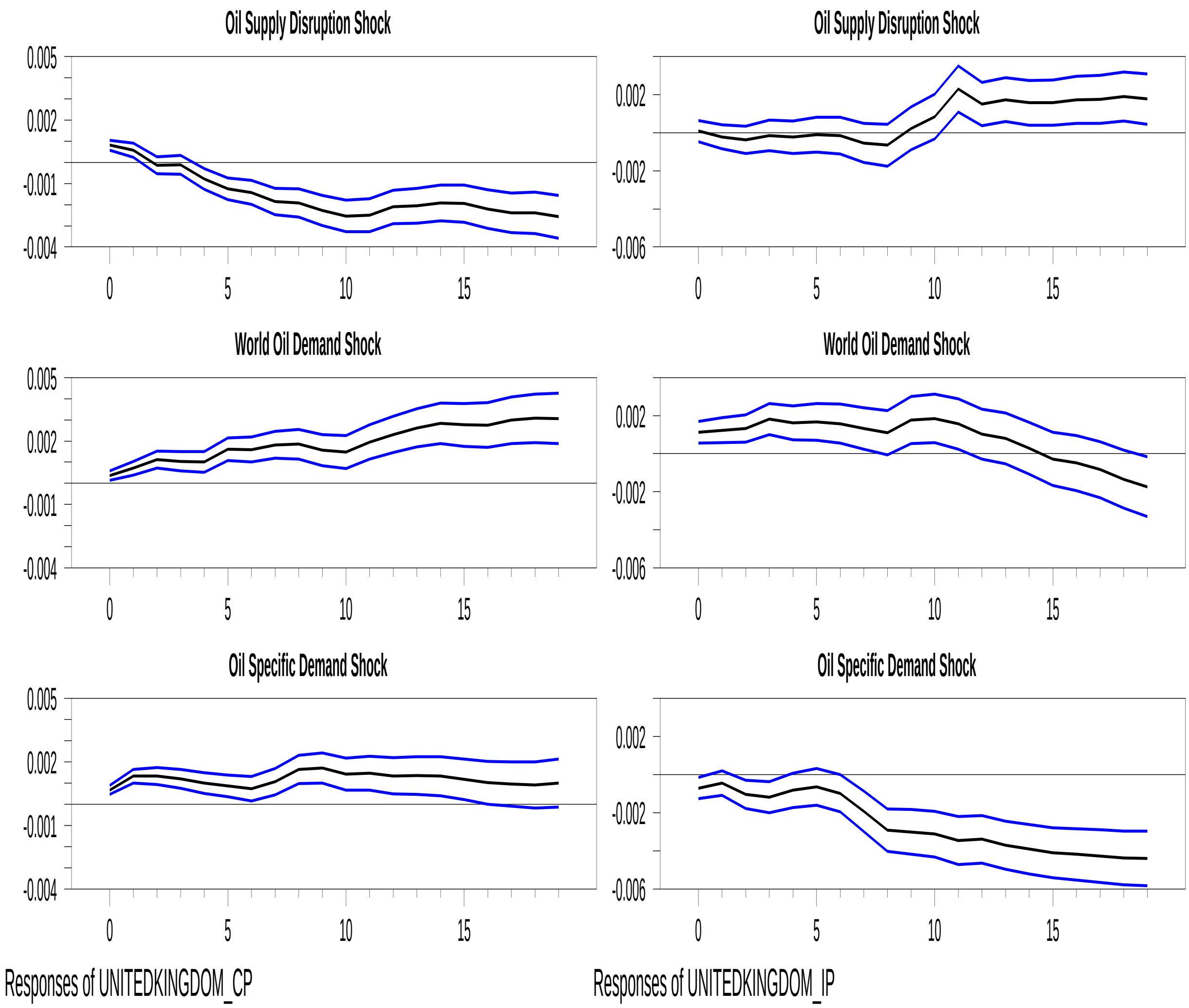

Figure 2.10: The Impulse Responses of CPI, and Industrial Production in United Kingdom - Oil Importing Economies

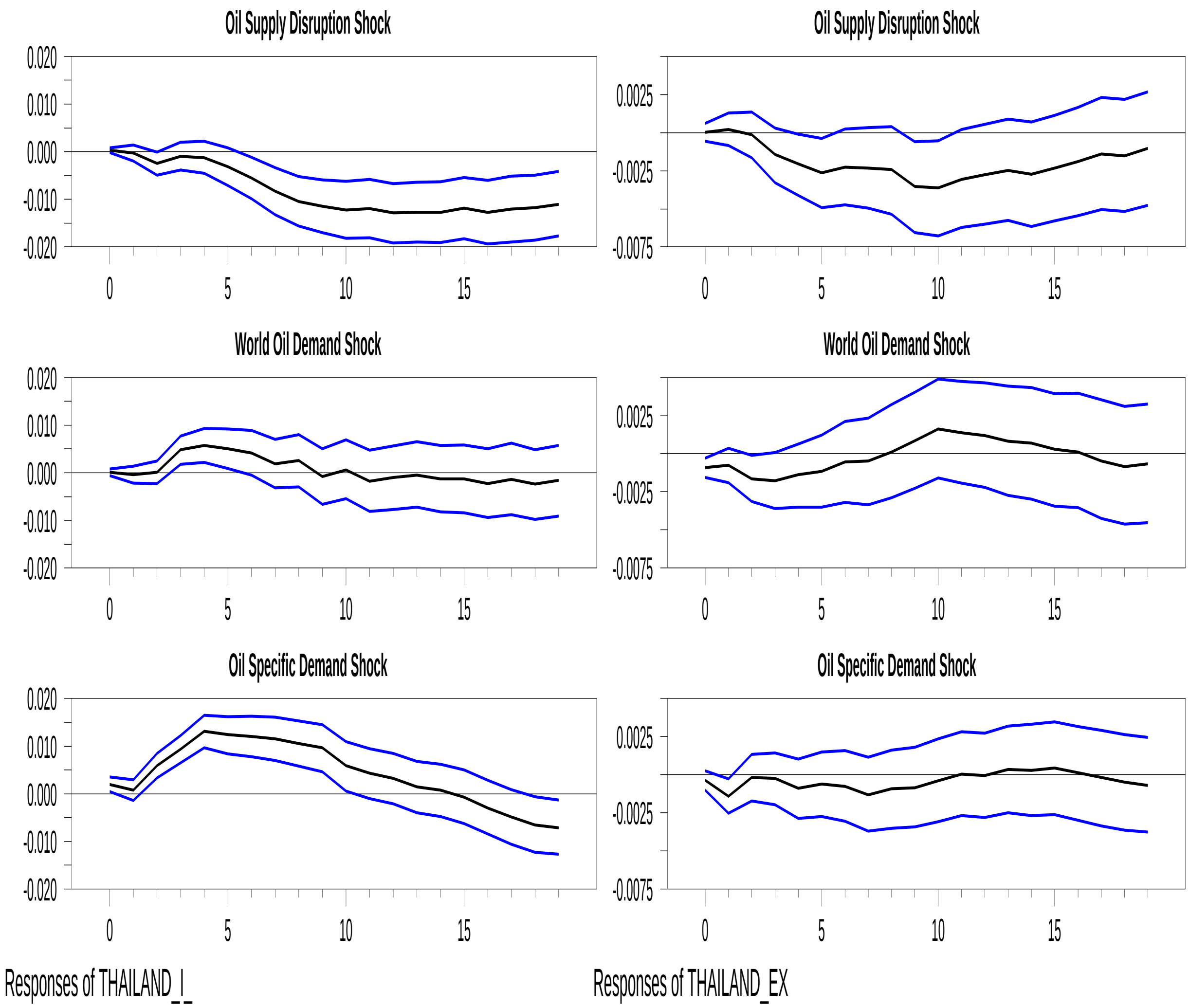

Figure 2.11: The Impulse Responses of Interest Rate, and Exchange Rate in Thailand - Oil Importing Economies

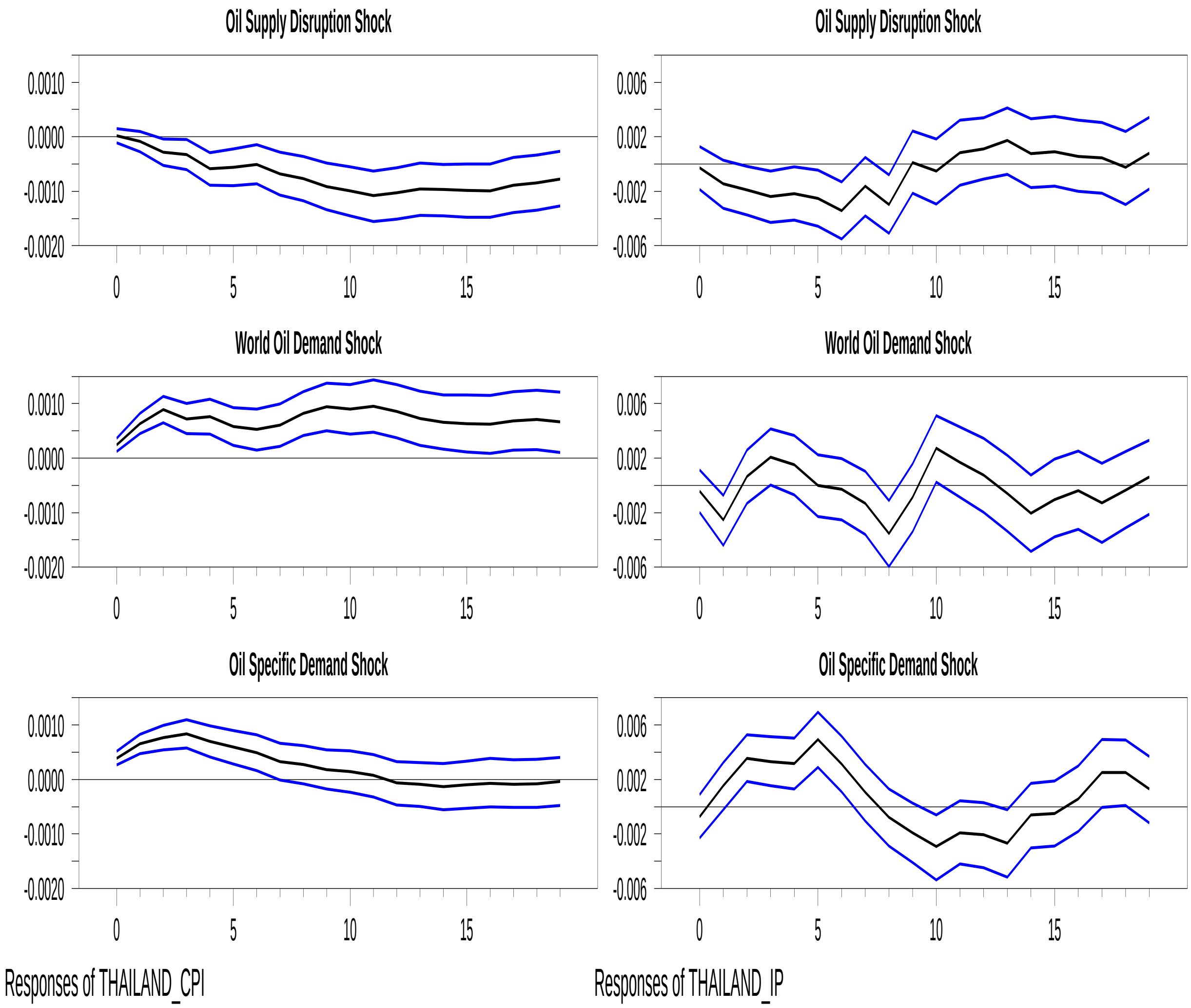

Figure 2.12: The Impulse Responses of CPI, and Industrial Production in Thailand - Oil Importing Economies

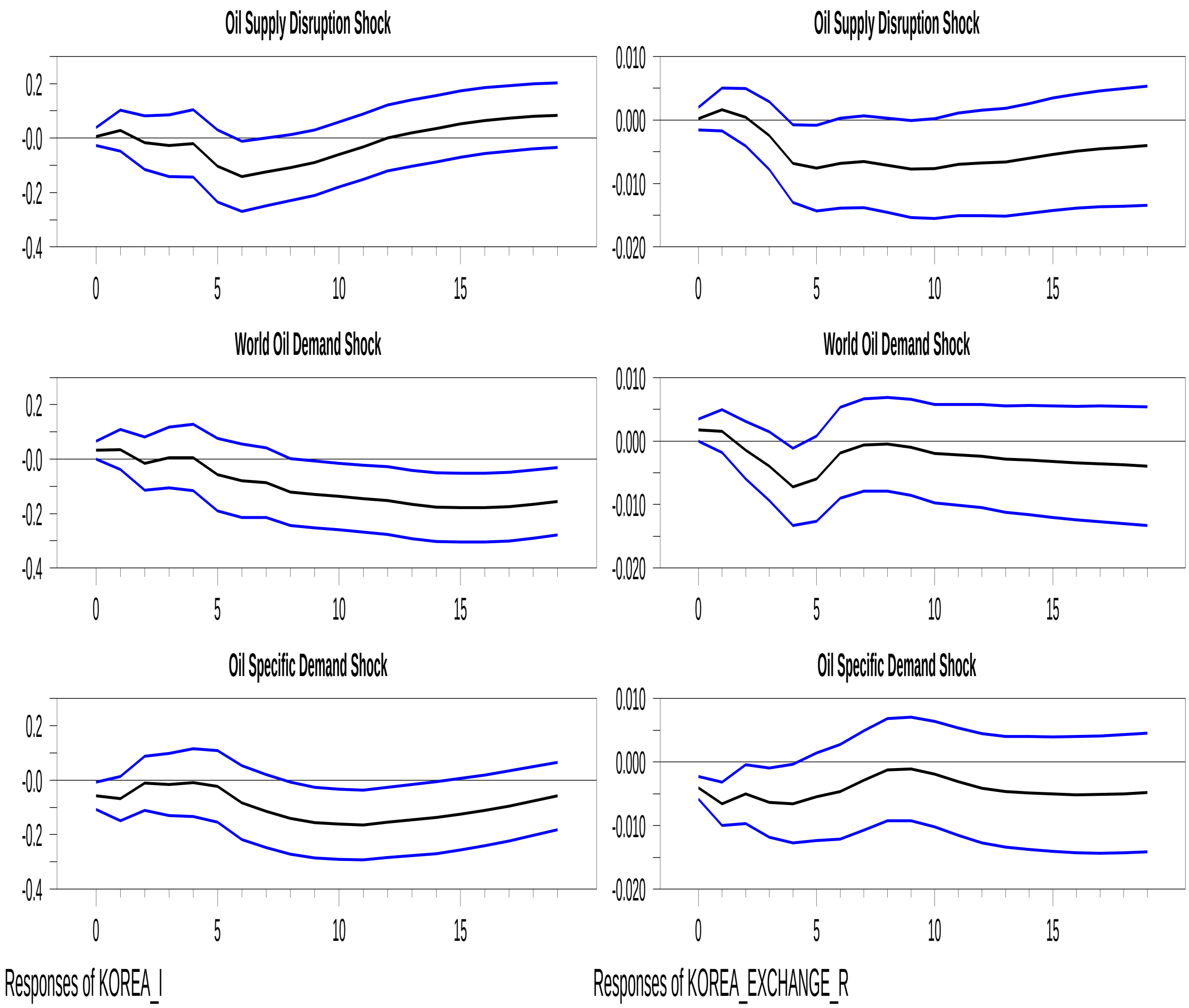

Figure 2.13: The Impulse Responses of Interest Rate, and Exchange Rate in S. Korea - Oil Importing Economies

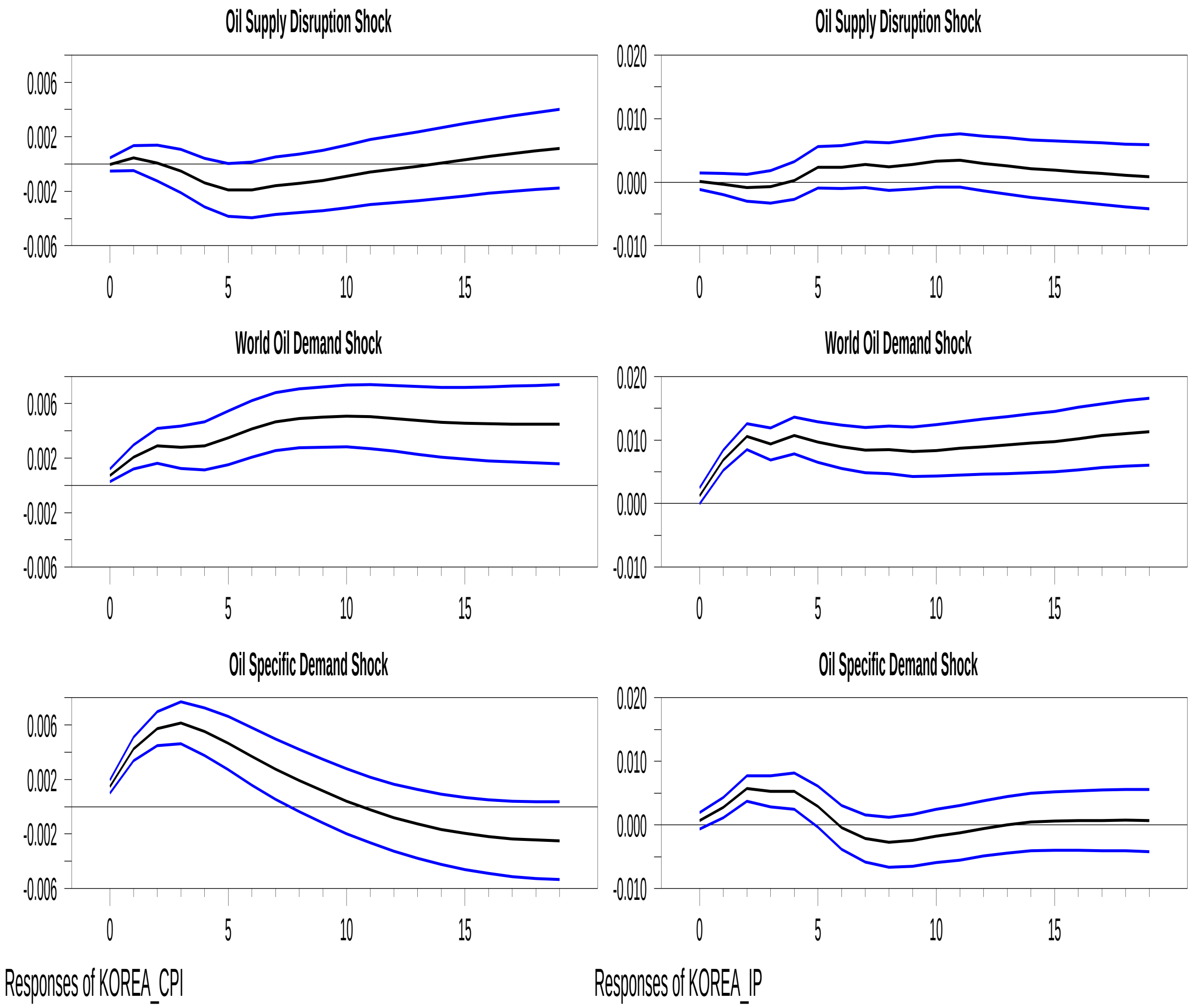

Figure 2.14: The Impulse Responses of CPI, and Industrial Production in S. Korea - Oil Importing Economies

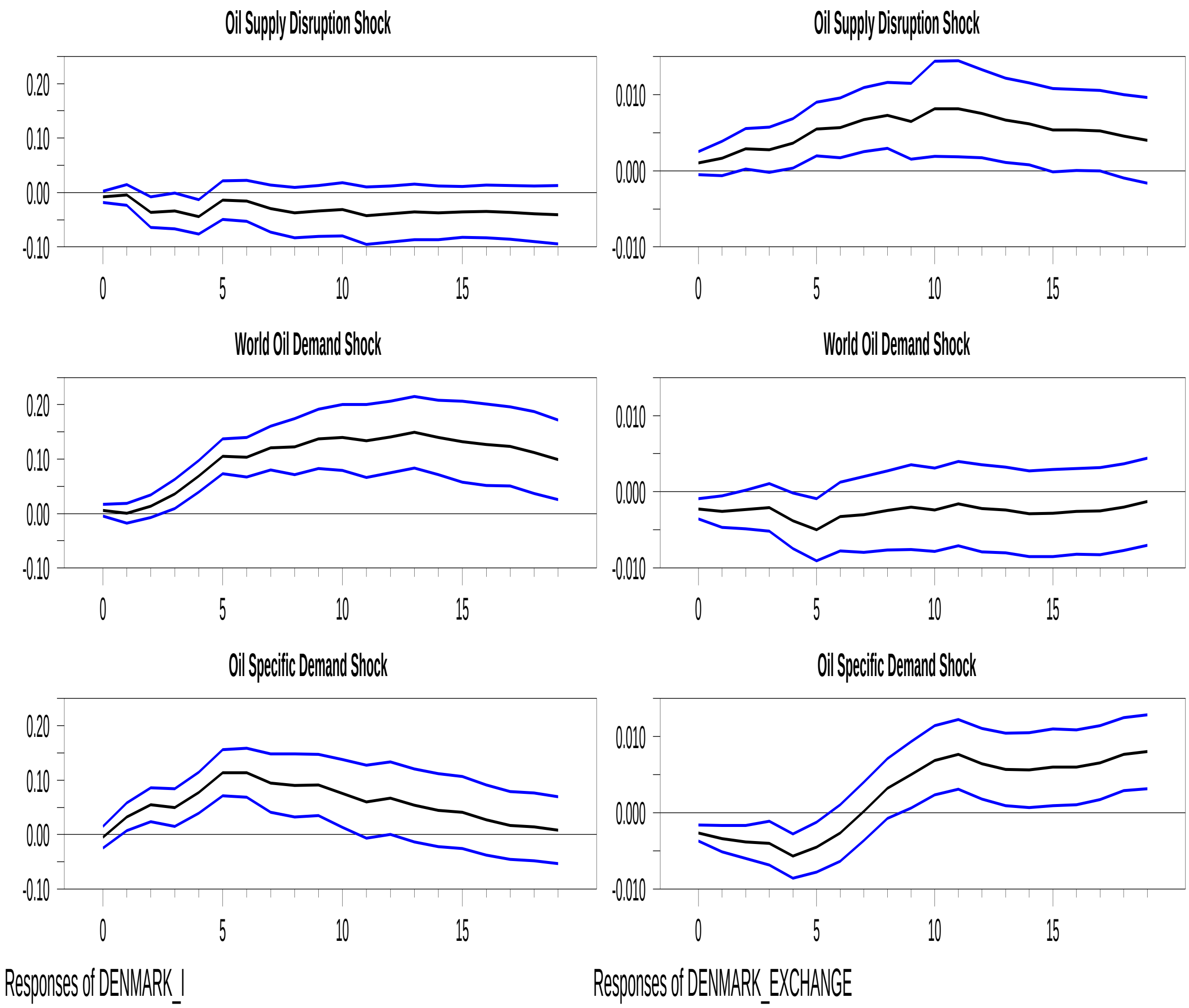

Figure 2.15: The Impulse Responses of Interest Rate, and Exchange Rate in Denmark - Oil Importing Economies

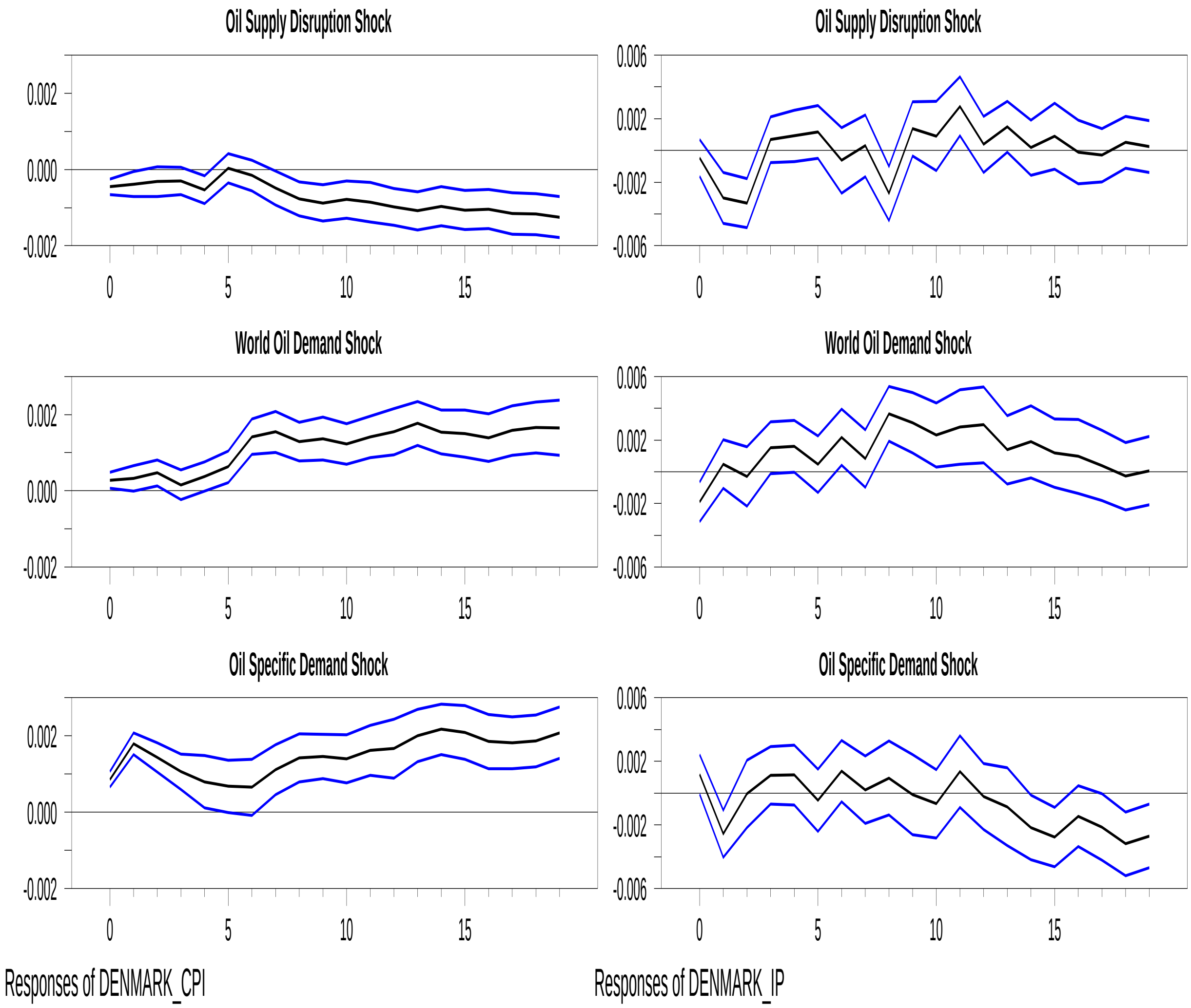

Figure 2.16: The Impulse Responses of CPI, and Industrial Production in Denmark - Oil Importing Economies

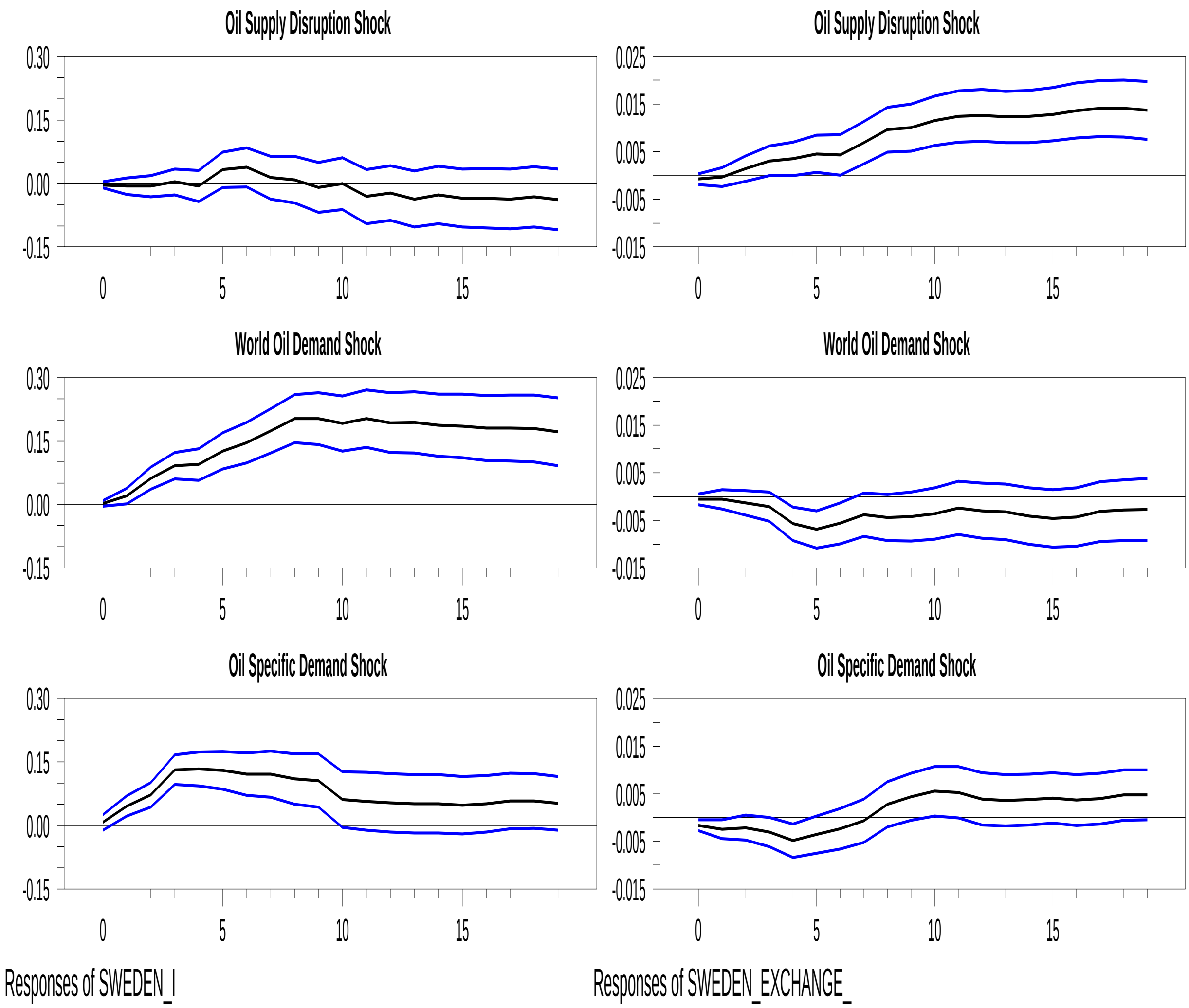

Figure 2.17: The Impulse Responses of Interest Rate, and Exchange Rate in Sweden - Oil Importing Economies

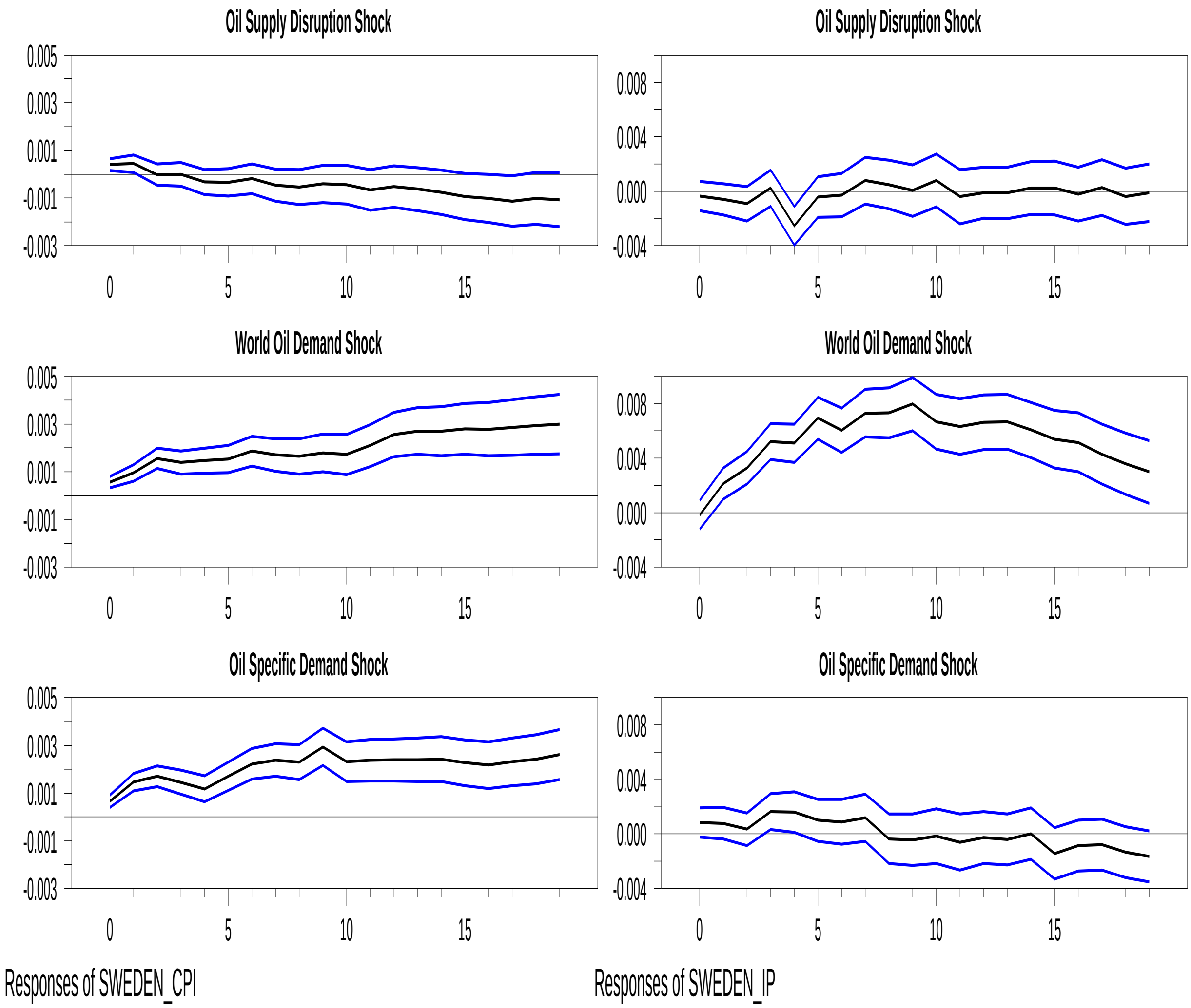

Figure 2.18: The Impulse Responses of CPI, and Industrial Production in Sweden - Oil Importing Economies

Chapter 3

Oil Prices, Credit Risks in Banking Systems, and Macro-Financial Linkages Across GCC Oil Exporters

3.1 Introduction

The recent 2014-2015 oil price slump has placed a macroeconomic pressure on oil exporting economies and their banking systems. With the current global macroeconomic conditions, international oil markets could enter a sustained period of low oil prices. The macroeconomic consequences of low oil prices on oil exporting economies are well documented. Chapter 3, however, focuses on the effect of the oil price slumps on the GCC banking stability. The first objective of Chapter 3 is to assess the oil price shock transmission channels, along with other macroeconomic shocks, to GCC banks' balance sheets. This part of Chapter 3 implements a System Generalized Method of Moments (GMM) model of Blundell & Bond (1998) and a Panel Fixed Effect Model to estimate the response of nonperforming loans (NPLs) to its macroeconomic determinants. The second objective of Chapter 3 is to assess any negative feedback effects between the GCC banking systems and the real economy. This second part of Chapter 3 implements a Panel VAR model to explore financial linkages between GCC banking systems and the real economy. The results find strong linkages between oil price fluctuations and nonperforming loans (NPLs) and further negative feedback effects from instability in banking systems to the GCC macroeconomy. Declines in oil prices increase NPLs, as do the declines in non-oil GDP and stock prices.

3.2 Literature Review

The recent financial crisis triggered the interest on the financial instability in banking systems and its influence on the macroeconomic instability. The work of Bernanke et al. (1999) lays a theoretical model with financial acceleration that links incomplete financial markets and the real economy. The work of Bernanke et al. (1999) aims to understand how endogenously determined credit frictions propagate disturbance and spread to the macroeconomy. The theoretical foundation of the role of credit risk shocks and its implications on the real economy are well grounded in the literature. The relevant literature to Chapter 3 are i) the determinants of nonperforming loans (NPLs), as a measurement for credit risk in the banking systems, and ii) the feedback relationship between the financial instability in banking systems and the real economy.

The literature on NPLs recognizes two major determinants explain the variation of NPLs. The first part of this literature assesses the macroeconomic determinants of NPLs which influence the the banks' balance sheets and the debt-service capacity of the borrowers. The macroeconomic determinants of NPLs include business cycles, exchange rate pressure, unemployment rates, and lending rates. The second part of this literature focuses on bank-specific determinants of NPLs which vary across banks. The bank-specific determinants of NPLs include differences in risk managements, operation costs, and the sizes of the banks. A comprehensive review of the literature on both parts are covered by Kaminsky and Reinhart (1999), Espinoza and Prasad (2010), Nkusu (2011), and Klein (2013).

Keeton & Morris (1987) is one of the early work to discuss the causes of loan loss variation across banks. They study the insured commercial banks in the United States and the effect of loan losses variations across these banks on managerial risk preferences and the local economic conditions. Berger and DeYoung (1997) use Granger causality techniques to examine the relationships among loan quality, cost efficiency, and bank capital across commercial banks in the United States. They find loan quality Granger causes cost efficiency and vice-versa. Further, the study finds low levels of cost efficiency is preceded by an increase in NPLs.

Kaminsky and Reinhart (1999) demonstrate that the instability of banking systems may trigger the beginning of a financial crisis. The study finds evidence from the 1990s crisis of emerging economies which indicates credit risks in banking systems typically lead to a currency crisis. The currency crisis, the study finds, deepens the crisis of banking systems and later spreads to the entire economy. This strand of the literature focuses on the adverse impact of credit risks on the stability of the financial sector.

Jesus and Gabriel (2006) find empirical evidence of a positive lagged relationship between rapid credit growth and NPLs. Their work examines the lending cycle and the required conditions and standards of the loans. The study empirically confirms that the banks, during the economic booms, tend to be more tolerant in both screening borrowers and collateral requirements.

Marcucci & Quagliariello (2009) study credit risks and the business cycles across different credit risk regimes in Italy. Their results confirm that the effect of business cycles on credit risks is more evident in weak financial conditions and hence there is a strong relationship between the severity of the financial crisis and the state of the economy. In another study, Marcucci and Quagliariello (2008) further examine the default rates of borrowers on Italian banks and their cyclical behavior. The results find default rates in the Italian banking system fall in economic booms and rise in economic recessions. The results confirm the intuitive relationship between credit risk and weak economic conditions.

Espinoza and Prasad (2010) is one of the few work in the literature that examines the banks in GCC region. They find that the NPL ratio increases as economic growth weakens and interest rates rises. However, Espinoza and Prasad (2010) cover the GCC banks before the financial crisis of 2008 and do not include oil prices. As oil exporting economies, oil prices are major and relevant determinant of NPLs across the region. The main focus of this chapter is to examine the effect of the oil price slumps on the GCC banking stability. Nkusu (2011) studies the link betwee NPLs and macroeconomic variables in advanced economies. The study finds that an adverse macroeconomic shock leads to a higher level of NPLs. Further, the study shows that a sharp increase in NPLs lead to a poor macroeconomic performance and weak economic growth.

Louzis et al. (2012) examine the determinants of NPLs in the Greek banking system. The study finds that macroeconomic determinants in Greece have a strong impact on NPLs across the banks. In particular, NPLs are largely explained by the GDP growth, the unemployment rate, the lending rate, and the public debt.

The work of Klein (2013) examines the NPLs in Central, Eastern and South-Eastern Europe (CESEE). The study looks at both bank-specific and macroeconomic factors and finds that the macroeconomic conditions have a stronger explanatory power across the CESEE region. Particularly, NPLs respond to GDP growth, unemployment and inflation across the region. Messai & Jouini (2013) study the determinants of NPLs in Italy, Greece and, Spain which suffered from the 2008 subprime crisis. The study finds that the increase in GDP growth lowers the credit risk as do

Country	General Government Gross Debt (% of GDP)			General Government Revenue (% of GDP)			Fuel exports (% of merchandise exports)		
	2008-2012	2013	2014	2008-2012	2013	2014	2008-2012	2013	2014
Saudi Arabia	8.7	2.2	1.6	43.1	41.4	37.3	88.65	87.42	..
UAE	18.7	15.9	15.7	37.1	41	37.7	64.81	..	..
Kuwait	9.5	6.4	6.9	69	71.8	68.7	94.85	94.22	..
Qatar	30.8	32.3	31.7	40.4	52.2	47.4	87.89	88.68	87.81
Bahrain	26.5	43.5	43.8	24.2	24	24.1	69.6	..	..
Oman	5.5	5.1	5.1	45	49.1	47.2	79.44	82.54	83.53

Sources: MCD October 2015 Regional Economic Outlook (IMF) and Development Indicators (World Bank).

Table 3.1: Oil and Macroeconomic Indicators in GCC Region

a decline in unemployment rates.

3.3 The Economies of Gulf Cooperation Council Region

Saudi Arabia, United Arab Emirates (UAE), Qatar, Kuwait, Bahrain, and Oman are GCC oil exporters and any fluctuations in international oil price could influence their GDP growth, government budgets, fiscal revenues, development programs and exports. As shown in Table 3.1, the fossil fuel exports in Saudi Arabia, Qatar, and Kuwait exceeded 80% of the total exports. For UAE, Oman, and Bahrain that ratio exceeded 60% of the total exports. The oil revenues account for more than 50% of total government revenues in these economies. The high oil-dependency reflects a high level of exposure of GCC economies to external shocks that could further threaten the financial markets and the stability of banking systems. GCC countries, however, accumulated a large amount of oil revenues that could help to smooth the severe fluctuations in international oil prices. The low debt-to-GDP ratio, in most GCC countries, indicates that these economies have the capacity and the fiscal space to maintain a sustainable level of debt if needed.

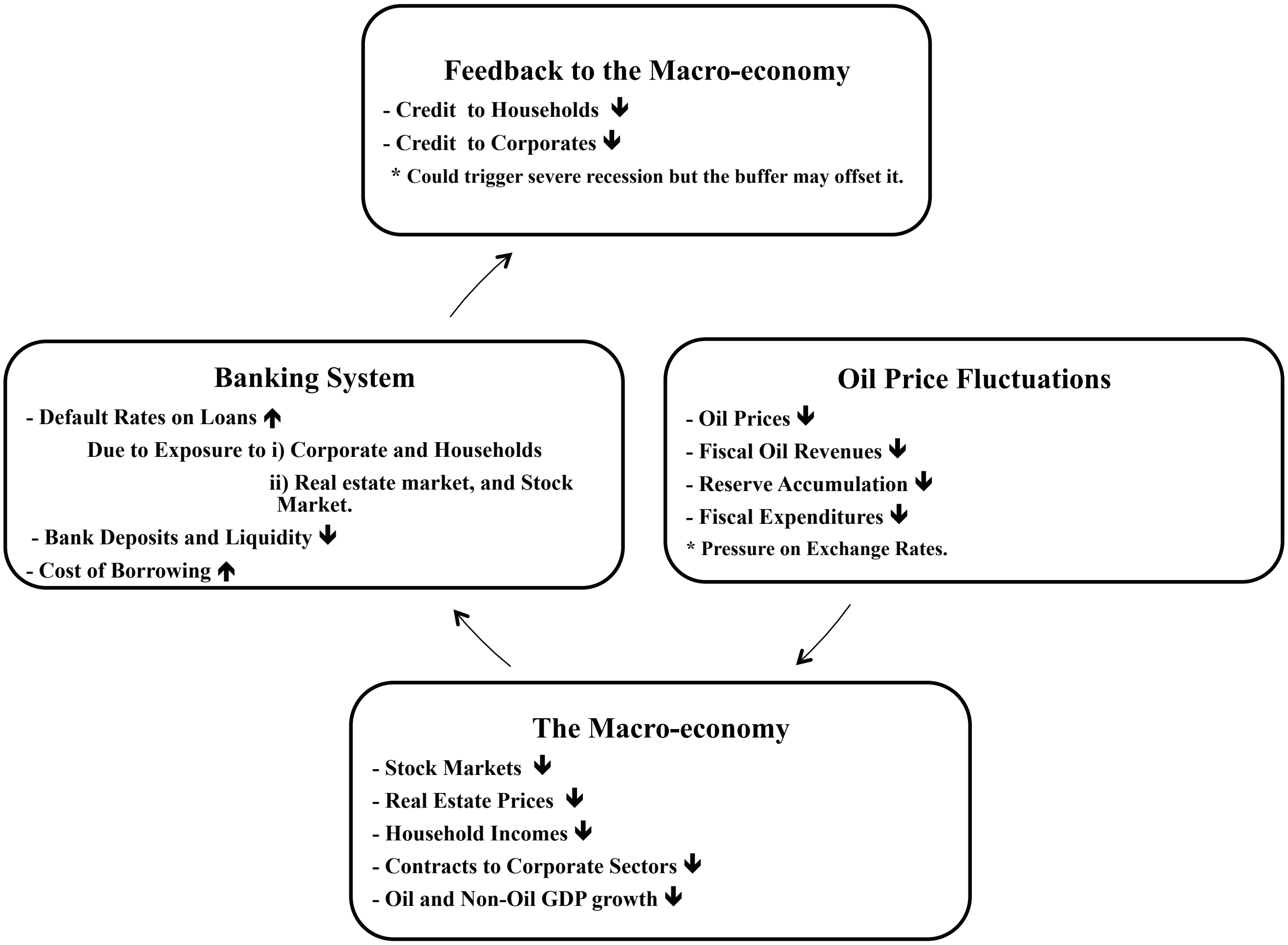

Figure 3.1: Possible Scenarios of the Transmission Channel of Oil Price Slumps to Banking Systems

3.3.1 The Effect of Oil Price Fluctuations on Banking Systems in Oil Exporting Economies

Figure 3.1 lays out the potential dynamic of oil price slumps on oil exporting economies and its transmission channels to the banks' balance sheets. As discussed earlier, fluctuations in international oil price influence the GCC economic growth and their banking systems. A sustained decline in oil prices, however, could lead to a decline in the liquidity and deposits of the GCC banking system. The GCC banks are particularly exposed to investments in non-oil sectors that include real estate, stock market, and loans to households and corporate sectors.

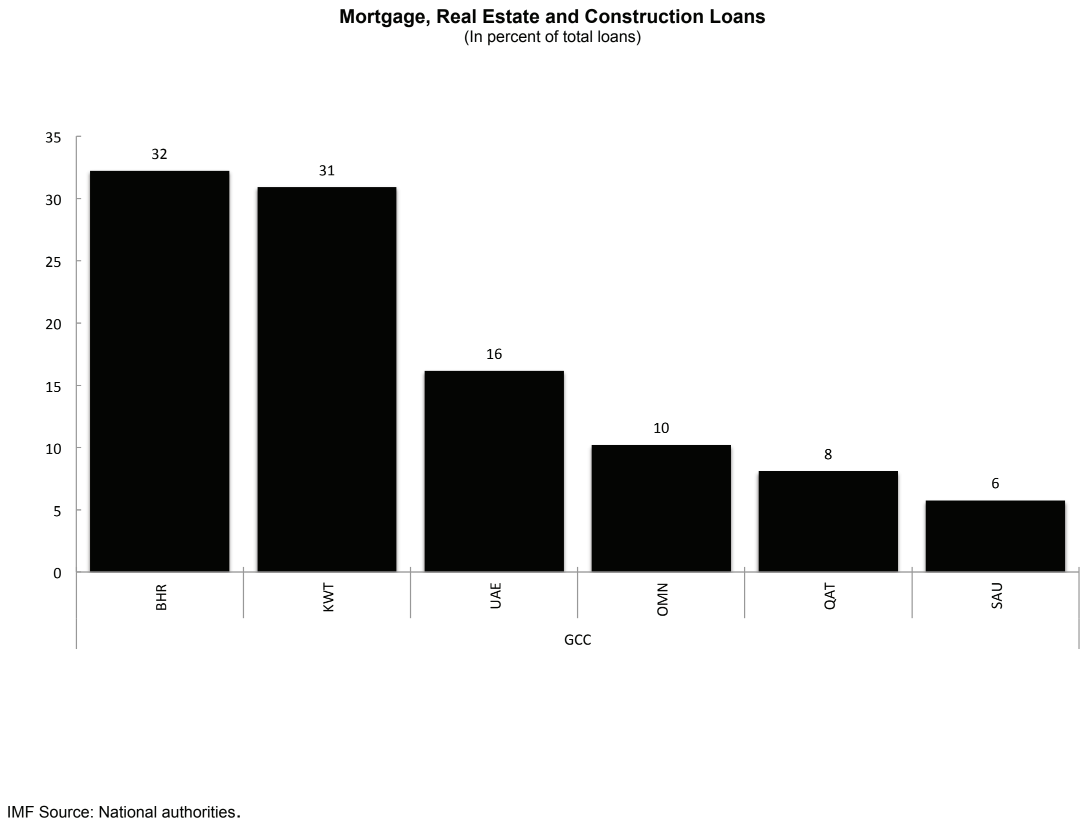

Table 3.2: The Shares of Real Estate in GCC Banking Loans.

Oil revenues influence the size of businesses and the depth of GCC financial and banking systems. GCC governments' expenditures on construction and infrastructure programs drive domestic non-oil GDP growth. GCC banks are particularly exposed to corporate sectors and households in these sectors. The channels of this exposure to non-oil GDP sectors are either through financing investments in stock markets real estate projects or through collateral requirements.

Table 3.2 [1] shows the exposure of GCC banks to real estate and construction loans. With more than 30%, Bahraini and Kuwaiti banks have the highest exposure rates to real estate and construction sectors. Given the above scenarios, this chapter considers oil price, non-oil GDP, lending interest rate, stock price, housing prices, and credit growth to examine the credit risk

[1] Lukonga et al (2016, forthcoming IMF Staff Discussion Note)

implications of the recent oil price slumps on GCC banking systems.

3.4 Data Description

This chapter considers a panel data of GCC individual banks' balance sheets from Fitch spanning 2000-2014 and macroeconomic data from the IMF. These include nonperforming loans ratio (NPL), average oil price, real non-oil GDP, lending interest rate, 3-years average of credit growth, stock prices, and housing prices. There are no indexes for GCC housing prices, however, this chapter utilizes CPI components of Housing, Water, Electricity & other Fuels as a proxy for the housing price indexes. In GCC region, the water and electricity are subsidized and the movements in this component of the CPI are mostly due to movements in housing prices. This chapter acknowledges that it may not be the optimal proxy for GCC housing prices but it might be the best feasible proxy for these prices. All the data are reported in the Appendix under data descriptions. Overall, however, this chapter acknowledges that the sample size (38 banks) and the time span (2000-2014) of the GCC banks considered for this chapter are relatively small to obtain precise estimates of the effect of oil price fluctuations on GCC banking stability.

3.5 The Macroeconomic Determinants of Credit Risk Across GCC Banks

This part of Chapter 3 examines the transmission channels of oil price fluctuations to GCC banks' balance sheets and its macroeconomic determinants. This chapter employs a dynamic system GMM and Fixed Effect models to estimate the response of nonperforming loans (NPLs) to different macroeconomic shocks, particularly to oil price fluctuations.

3.5.1 Methodology: Dynamic Panel models

$$NPL_{i,t} = \gamma NPL_{i,t-1} + \beta' X_{i,t} + \lambda_i + e_{i,t}$$

$NPL_{i,t}$is the NPL of the ith bank at time t where $i = 1,..,N$ and $t = 1,..,T$. $X_{i,t}$ is a vector of exogenous variables, λ_i is the panel-level fixed effect, and $e_{i,t}$ are i.i.d residuals. The analysis of this part of Chapter 3 considers two alternative econometric techniques to estimate the dynamic panel model: i) Fixed Effect model and ii) Dynamic System GMM Model. The former approach removes the unobserved heterogeneity across the banks but has a limitation once the lagged dependent variable is included. The fixed effect model with lagged dependent variable suffers "Dynamic Panel bias." This is a result of the correlation between the error term and the lagged dependent variable after the demeaning process. The latter econometric technique implemented is a Dynamic System GMM model of Blundell & Bond (1998). The collapsing method of Holtz-Eakin et al. (1988) is implemented to reduce the number of instruments in the model. Roodman (2006) and Roodman (2014) provide an excellent review of the Dynamic System GMM Models. In this chapter, the Dynamic System GMM Model are estimated following the techniques provided by Roodman (2006).

3.5.2 Model Specification

The objective of this part of Chapter 3 is to estimate the response of nonperforming loans (NPLs) to different macroeconomic shocks. Oil price is included in the analysis as a major macroeconomic determinant of NPLs in the region and hence influence the debt-service capacity of the borrowers. Non-Oil GDP also included as GCC banks largely exposed to corporate sectors and households in these sectors. Stock prices are included in the analysis for two main reasons: i) higher stock prices reflect higher income for households and corporate sectors, and ii) GCC banks are exposed to investments in domestic stock markets. GCC lending rates are included in the analysis to account for the borrowing cost across banks as a major determinant for NPLs. Housing prices are included as: i) GCC banks are exposed to real estate and construction loans, and ii) real estates are used as a collateral requirement for various types of loans. This chapter controls for the variations of credit growth across banks and includes the 3-year average growth of bank-specific total loans.

3.5.3 Econometric Results

The results of Arellano-Bond test reported in Table 3.3 rejects the null hypothesis of no autocorrelation in the first differenced errors and fails to reject the null hypothesis in the second differenced errors. Hence, the models pass Arellano-Bond tests, which are diagnostic tests for the validity of the model (see Roodman (2006)). The results fail to reject that the over-identifying restrictions of the instrument variables are valid (see Hansen Test in Table 3.3).

As a macroeconomic determinant of NPLs in the GCC region, a decline in oil price contributes to higher level of NPLs as the declines in Non-oil GDP, and stock prices. The results in Table 3.3 of the system GMM model (3) show a 1 percentage point decline in oil price growth leads to a statistically significant increase in NPLs by 0.458%. A 1 percentage point decline in Non-oil GDP leads to a statistically significant increase in NPLs by 0.708%. A 1 percentage point increase in interest rate leads to a statistically significant increase in NPLs by 0.0219%. A 1 percentage point decline in stock prices leads to a statistically significant increase in NPLs by 0.397%. A 1 percentage point decline in housing prices leads to a statistically significant increase in NPLs by 0.860%. The results indicate bank-specific credit growth rates are an insignificant determinant of NPLs in the region. Perhaps, this insignificant explanatory power of bank-specific credit growth reflects the macro-prudential measures and the strong financial regulation in the GCC region. The results are qualitatively and quantitatively robust using log transformation and logit transformations of NPLs [2].

[2] The results for logit transformations of NPLs are reported in Table 3.7.

VARIABLES	(1) System GMM	(2) FE	(3) System GMM	(4) FE
$NPL\ Growth_{t-1}$	0.817***	0.701***	0.814***	0.691***
	[0.0878]	[0.0508]	[0.0800]	[0.0488]
$Oil\ Price_{t-1}$	-0.00512***	-0.00679***	-0.00458***	-0.00586***
	[0.00187]	[0.00139]	[0.00165]	[0.00145]
$NOGDP\ RGrowth_{t-1}$	-0.00835*	-0.0131***	-0.00708*	-0.0103***
	[0.00420]	[0.00323]	[0.00374]	[0.00307]
$Interest\ Rate_{t-1}$	0.0231**	0.0514**	0.0219**	0.0512**
	[0.00866]	[0.0201]	[0.00901]	[0.0195]
$Credit\ Growth_{t-1}$	0.00111	-0.00245	0.00397	-0.00210
	[0.00485]	[0.00445]	[0.00490]	[0.00444]
$StockPrice\ Growth_{t-1}$	-0.00389***	-0.00290***	-0.00397***	-0.00310***
	[0.000800]	[0.000806]	[0.000785]	[0.000808]
$HousingPrices\ Growth_{t-1}$			-0.00860**	-0.00756**
			[0.00361]	[0.00292]
Constant	0.156	0.214*	0.158	0.235*
	[0.194]	[0.124]	[0.175]	[0.123]
Observations	467	467	463	463
R-squared		0.601		0.600
Number of id	38	38	38	38
No. of instruments	33		34	
Hansen test p-value	0.180		0.166	
A-B AR(1) test p-value	0.000641		0.000601	
A-B AR(2) test p-value	0.164		0.156	

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 3.3: Econometric Results of Fixed Effect and System GMM Models - Log transformation of NPLs

3.6 The Feedback Effect between Banking Instability and the Real Economy across the GCC Region

3.6.1 Methodology: Panel Vector Auto Regressions (PVAR) model

Under the second part of Chapter 3, a Panel Vector Auto Regressions (PVAR) model is implemented to assess the feedback effects between the banking systems and the real economy. To assess the feedback effect of disturbances in the banking system, the analysis focuses on the impulse responses to various structural shocks, particularly to credit risk shock and macroeconomic shocks. To avoid the earlier discussed issue of panel dynamic bias, the model follows Helmert transformation to demean the variables as in Love & Zicchino (2006). Canova & Ciccarelli (2013) and Love & Zicchino (2006) provide a comprehensive review of Panel VAR models. The Panel VAR used in this part is specified as:

$$Y_{i,t} = Y_{i,t-1}A + X_{i,t}B + \lambda_i + e_{i,t}$$

$Y_{i,t}$ is a vector of endogenous variables at time t where $i = 1,..,N$ and $t = 1,..,T$. $X_{i,t}$ is a vector of exogenous variables, λ_i is the panel-level fixed effect, and $e_{i,t}$ are i.i.d residuals.

3.6.2 Identification

The identification scheme in this part of Chapter 3 is a recursive Cholesky decomposition. Oil price is modeled as an exogenous variable in the identification of this chapter. The domestic variables are ordered as [Interest Rate, Non-oil GDP, Credit Growth, NPLs]. The macro variables are set first as Interest Rate, then Non-oil GDP. The interest rate is set first as GCC central banks adopt fixed exchange rate regimes and hence follow the U.S. Federal Fund Rate in setting domestic policy interest rate. The bank-specific variables are ordered as Credit Growth, then NPLs. Credit Growth responds contemporaneously to Interest Rate and Non-oil GDP, but with a lag to NPLs.

NPLs respond contemporaneously to all the variables in model.

3.6.3 Results of the Panel Vector Auto Regressions

Figure 3.2 indicates credit risk shock, a shock to nonperforming loans, tends to restrict credit growth across the banks and dampen economic growth in GCC economies. The interest rate declines in response to credit risk shock. The results confirm a significant negative feedback between the banking system instability and the real economy. A positive Non-oil GDP shock expands the credit growth across the banks and lowers NPLs, however, Non-oil GDP shock increases the interest rate (see Figure 3.3). An interest rate shock increases the cost of borrowing and hence leads to higher level of NPLs and could slowdown the GCC economic growth. A positive shock to credit growth across GCC banks leads to higher economic growth and lowers the NPLs across the region.

The variance decompositions are reported in Tables 3.4-3.6. The variance decomposition of Non-oil GDP (see Table 3.5) across GCC economies indicates that oil price shock explains about 35% of Non-oil GDP variation, while NPLs explains almost 30% of the Non-oil GDP variation. The variance decomposition of GCC credit growth (see Table 3.6) indicates that Non-oil GDP shock explains about 17% of credit growth variation, interest rate shock explains about 11% of credit growth variation, and NPLs shock explains about 40% of credit growth variation.

3.7 Conclusion

Oil price, Non-oil GDP, interest rate, stock prices, and housing prices are major determinants of NPLs across GCC banks and therefore of financial stability in the region. The Credit risk shock tends to propagate disturbance to Non-oil GDP, and credit growth across GCC economies. A higher level of NPLs restricts banks' credit growth and can dampen economic recovery in these economies. These results support the notion that disturbances in banking systems lead to unwanted economic consequences in the real sector. The results are qualitatively robust across different specifications. Counter cyclical policies that limit the GDP slowdown can promote financial stability across GCC region. Policy makers with financial stability objectives need to monitor the developments in international oil markets and smooth the potential spillover effects to GCC banking systems. GCC countries implement fixed exchange rate regimes, and therefore exchange rates do not impose serious credit risks in the region. The GCC economies, however, accumulated large amount of oil stabilization buffers and have the fiscal space to limit any negative feedback to the real economy.

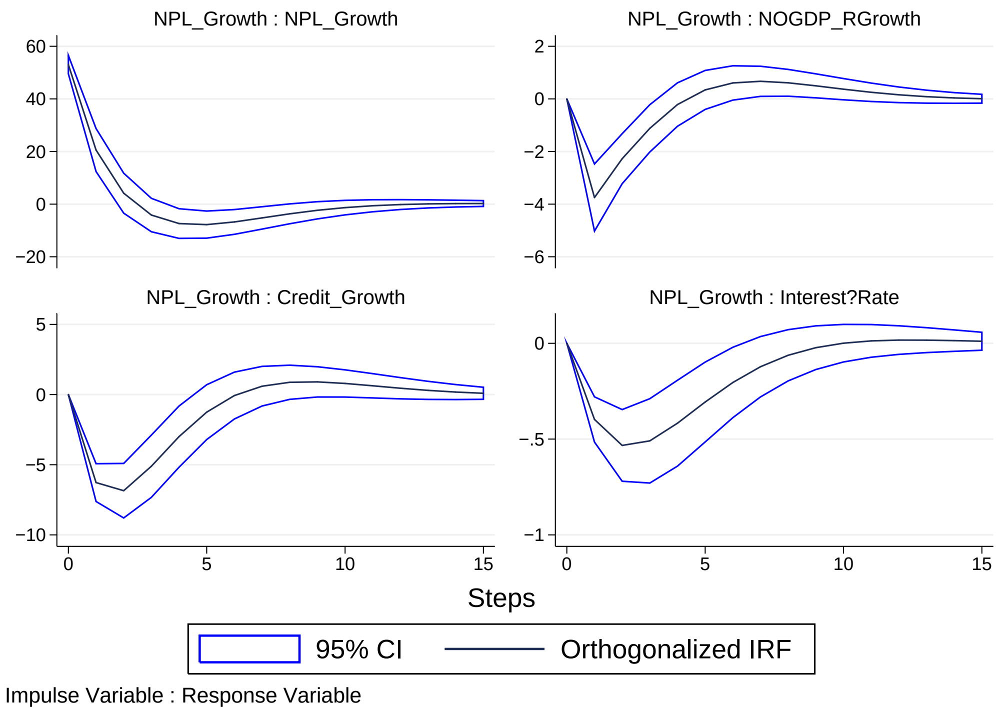

Figure 3.2: The Impulse Responses to Credit Risk Shock - GCC region

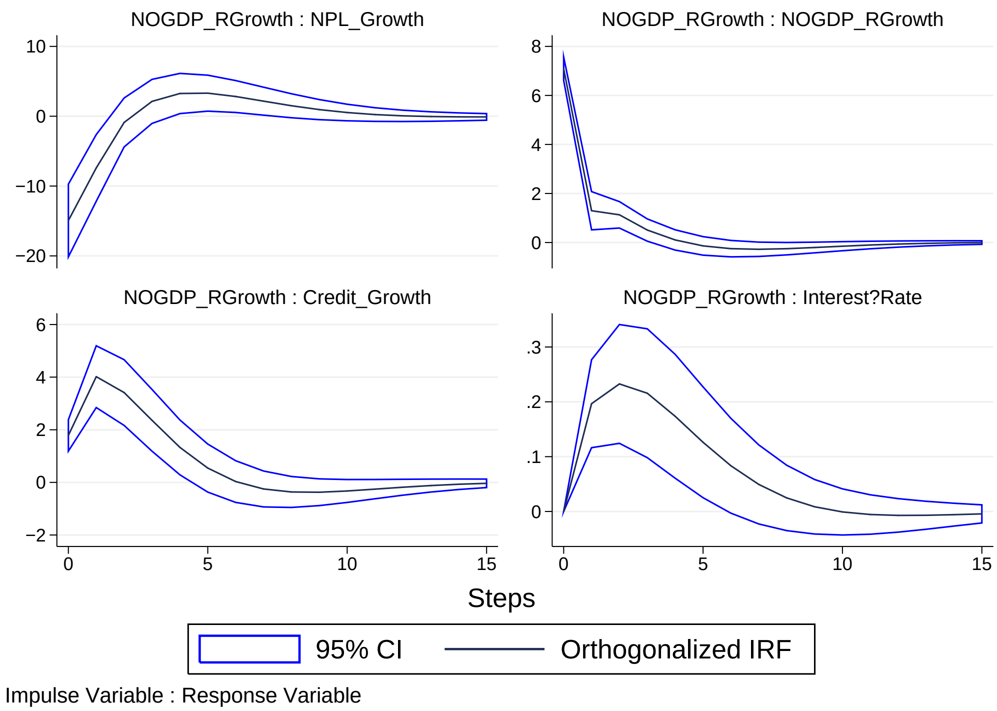

Figure 3.3: The Impulse Responses to Non-oil GDP Shock - GCC region

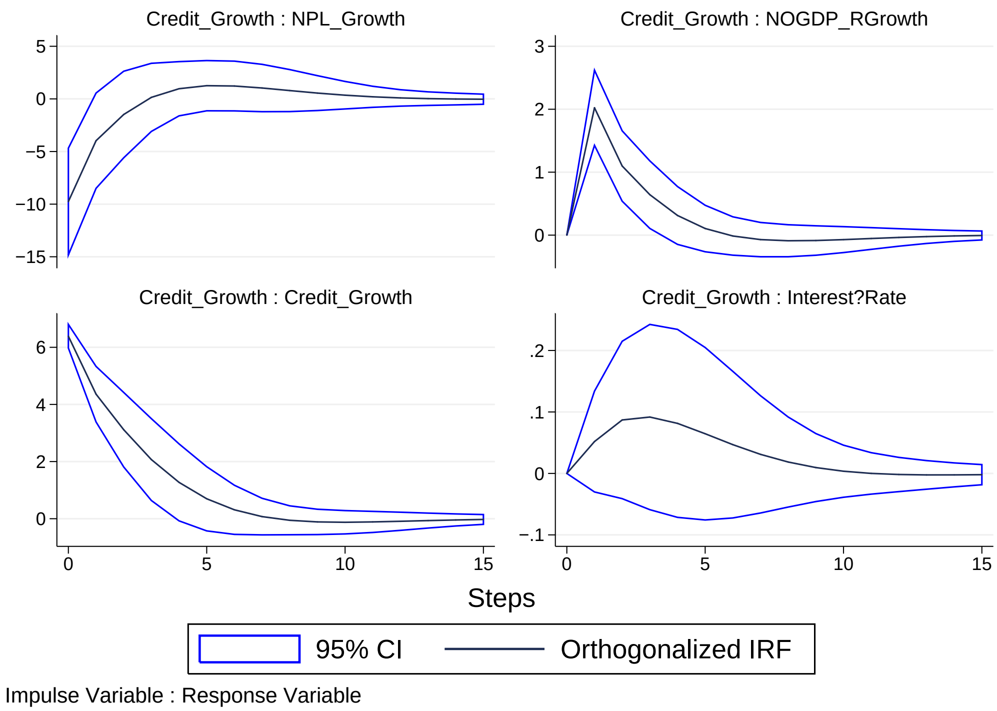

Figure 3.4: The Impulse Responses to Credit Growth Shock - GCC region

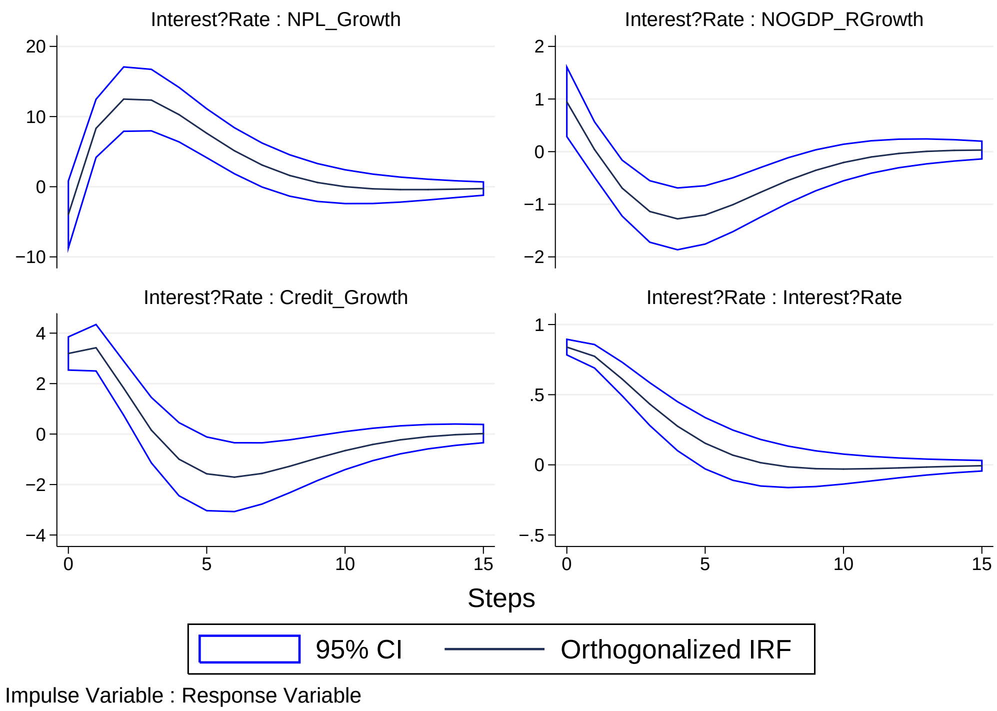

Figure 3.5: The Impulse Responses to Interest Rate Shock - GCC region

		Interest Rate			
Steps	Oil Price Growth	Interest Rate	Non-oil GDP Growth	Credit Growth	NPLs Growth
1	17.683	82.316	0	0	0
2	19.572	76.514	3.841	0.008	0.063
3	19.662	73.801	5.558	0.1965	0.781
4	18.992	71.975	6.929	0.361	1.740
5	18.294	70.611	7.846	0.488	2.760
6	17.722	69.608	8.477	0.561	3.630
7	17.307	68.897	8.898	0.599	4.297
8	17.023	68.405	9.180	0.615	4.774
9	16.834	68.068	9.372	0.620	5.103
10	16.708	67.833	9.507	0.621	5.329
11	16.622	67.663	9.605	0.620	5.487
12	16.561	67.536	9.681	0.618	5.602
13	16.514	67.436	9.741	0.617	5.690
14	16.476	67.354	9.790	0.617	5.760
15	16.444	67.286	9.832	0.617	5.819

Table 3.4: The Forecast Error Variance Decomposition of Interest Rate in GCC Region

		Non-oil GDP Growth			
Steps	**Oil Price Growth**	**Interest Rate**	**Non-oil GDP Growth**	**Credit Growth**	**NPLs Growth**
1	61.290	0.802	37.906	0	0
2	40.683	0.605	24.189	6.571	27.950
3	38.172	0.606	23.391	6.058	31.771
4	37.404	0.985	22.538	5.844	33.228
5	37.233	1.762	22.239	5.838	32.926
6	36.856	2.733	22.127	5.867	32.415
7	36.341	3.692	22.030	5.867	32.068
8	35.846	4.526	21.935	5.830	31.860
9	35.458	5.211	21.841	5.779	31.709
10	35.180	5.762	21.756	5.729	31.570
11	34.986	6.210	21.681	5.687	31.433
12	34.848	6.578	21.616	5.653	31.303
13	34.742	6.889	21.559	5.624	31.183
14	34.657	7.155	21.510	5.600	31.075
15	34.584	7.38	21.468	5.580	30.980

Table 3.5: The Forecast Error Variance Decomposition of Non-oil GDP in GCC Region

		Credit Growth			
Steps	**Oil Price Growth**	**Interest Rate**	**Non-oil GDP Growth**	**Credit Growth**	**NPLs Growth**
1	0.885	11.749	9.001	78.363	0
2	0.726	12.0701	18.192	46.132	22.877
3	0.713	11.661	18.519	33.545	35.559
4	0.706	11.502	18.147	28.448	41.195
5	0.686	11.512	17.826	26.525	43.449
6	0.672	11.580	17.673	25.965	44.108
7	0.675	11.636	17.621	25.881	44.185
8	0.692	11.664	17.603	25.891	44.147
9	0.715	11.677	17.591	25.891	44.123
10	0.737	11.689	17.578	25.879	44.114
11	0.755	11.706	17.568	25.866	44.103
12	0.769	11.728	17.561	25.854	44.086
13	0.779	11.753	17.557	25.843	44.066
14	0.786	11.778	17.554	25.832	44.047
15	0.792	11.802	17.552	25.821	44.031

Table 3.6: The Forecast Error Variance Decomposition of Credit Growth in GCC Region

VARIABLES	(1) System GMM	(2) FE	(3) System GMM	(4) FE
$NPL\ Growth_{t-1}$	0.817***	0.701***	0.814***	0.691***
	[0.0878]	[0.0508]	[0.0800]	[0.0488]
$Oil\ Price_{t-1}$	-0.00512***	-0.00679***	-0.00458***	-0.00586***
	[0.00187]	[0.00139]	[0.00165]	[0.00145]
$NOGDP\ RGrowth_{t-1}$	-0.00835*	-0.0131***	-0.00708*	-0.0103***
	[0.00420]	[0.00323]	[0.00374]	[0.00307]
$Interest\ Rate_{t-1}$	0.0231**	0.0514**	0.0219**	0.0512**
	[0.00866]	[0.0201]	[0.00901]	[0.0195]
$Credit\ Growth_{t-1}$	0.00111	-0.00245	0.00397	-0.00210
	[0.00485]	[0.00445]	[0.00490]	[0.00444]
$StockPrice\ Growth_{t-1}$	-0.00389***	-0.00290***	-0.00397***	-0.00310***
	[0.000800]	[0.000806]	[0.000785]	[0.000808]
$HousingPrices\ Growth_{t-1}$			-0.00860**	-0.00756**
			[0.00361]	[0.00292]
Constant	0.156	0.214*	0.158	0.235*
	[0.194]	[0.124]	[0.175]	[0.123]
Observations	467	467	463	463
R-squared		0.601		0.600
Number of id	38	38	38	38
No. of instruments	33		34	
Hansen test p-value	0.180		0.166	
A-B AR(1) test p-value	0.000641		0.000601	
A-B AR(2) test p-value	0.164		0.156	

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 3.7: Econometric Results of Fixed Effect and System GMM Models - Log transformation of NPLs

VARIABLES	(1) System GMM	(2) FE
$Logit\ NPL_{t-1}$	0.866***	0.700***
	[0.0782]	[0.0486]
$Oil\ Price_{t-1}$	-0.00394**	-0.00620***
	[0.00176]	[0.00154]
$NOGDP\ RGrowth_{t-1}$	-0.00685*	-0.0111***
	[0.00369]	[0.00325]
$Interest\ Rate_{t-1}$	0.0135	0.0535**
	[0.00818]	[0.0202]
$Credit\ Growth_{t-1}$	0.00350	-0.00152
	[0.00380]	[0.00454]
$StockPrice\ Growth_{t-1}$	-0.00385***	-0.00325***
	[0.000850]	[0.000830]
$HousingPrices\ Growth_{t-1}$	-0.00896**	-0.00786**
	[0.00362]	[0.00302]
Constant	-0.471*	-1.152***
	[0.244]	[0.175]
Observations	463	463
R-squared		0.613
Number of id	38	38
No. of instruments	34	
Hansen test p-value	0.211	
A-B AR(1) test p-value	0.00118	
A-B AR(2) test p-value	0.140	

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 3.8: Econometric Results of Fixed Effect and System GMM Models - Logit transformation of NPLs

Variable	Definition	Units	Description	Sources
NPL	Non-performing Loans	ratio	Non-performing Loans ratio (Bank level)	Fitch
Oil Price	International Oil price	U.S. Dollar	Crude Oil Price	IMF
Non-oil GDP	Non-oil sector real GDP	Non-oil sector Gross Domestic Product at 2005 prices	National authorities; staff reports	
Interest Rate	The lending Rate	%	The lending Rate	National authorities
$Credit\ Growth$	Gross Loans	U.S. Dollar	3-years Average of Total Gross Loans	Fitch
$Stock\ Prices$	Stock price index	Index	Average Stock market price index	Bloomberg
$Housing\ Prices$	Housing price index	Index	CPI components of Housing, water, electricity & other fuels	National authorities

Table 3.9: Variable Description and Data Sources

Country	Category	Name
Bahrain	Commercial Bank	Ahli United Bank BSC
Bahrain	Commercial Bank	Arab Banking Corporation
Bahrain	Commercial Bank	BBK B.S.C.
Bahrain	Commercial Bank	Gulf International Bank B.S.C.
Bahrain	Commercial Bank	National Bank of Bahrain
Kuwait	Commercial Bank	Ahli United Bank (Kuwait)
Kuwait	Commercial Bank	Commercial Bank of Kuwait
Kuwait	Commercial Bank	Gulf Bank
Kuwait	Commercial Bank	National Bank of Kuwait
Oman	Commercial Bank	Bank Dhofar S.A.O.G
Oman	Commercial Bank	Bank Muscat
Oman	Commercial Bank	HSBC Bank Oman SAOG
Oman	Commercial Bank	National Bank Of Oman
Oman	Commercial Bank	Oman Arab Bank SAOC
Qatar	Commercial Bank	Ahli Bank Q.S.C
Qatar	Commercial Bank	Commercial Bank of Qatar
Qatar	Commercial Bank	Doha Bank
Qatar	Islamic Banks	Qatar Islamic Bank
Qatar	Commercial Bank	Qatar National Bank
Saudi Arabia	Commercial Bank	Arab National Bank
Saudi Arabia	Commercial Bank	Bank Aljazira
Saudi Arabia	Commercial Bank	Banque Saudi Fransi
Saudi Arabia	Commercial Bank	National Commercial Bank (The)
Saudi Arabia	Commercial Bank	Riyad Bank
Saudi Arabia	Commercial Bank	SAMBA Financial Group
Saudi Arabia	Commercial Bank	Saudi British Bank
Saudi Arabia	Commercial Bank	Saudi Hollandi Bank
Saudi Arabia	Investment Bank	Saudi Investment Bank, The
United Arab Emirates	Commercial Bank	Abu Dhabi Commercial Bank
United Arab Emirates	Commercial Bank	Bank of Sharjah
United Arab Emirates	Commercial Bank	Commercial Bank International
United Arab Emirates	Commercial Bank	First Gulf Bank P.J.S.C.
United Arab Emirates	Commercial Bank	Mashreqbank
United Arab Emirates	Commercial Bank	National Bank Of Fujairah
United Arab Emirates	Commercial Bank	National Bank Of Umm Al-Qaiwain
United Arab Emirates	Commercial Bank	National Bank of Abu Dhabi PJSC
United Arab Emirates	Commercial Bank	Union National Bank

Table 3.10: List of the GCC Banks Sample - Fitch

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