A DATA-ORIENTED STUDY OF THE INTERNATIONAL TRANSMISSION OF MONETARY POLICY SHOCKS: THE CASE OF KOREA

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HYUN JOON SHIN

Dr. Whitney Hicks, Dissertation Supervisor

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UMI Number: 9999314

Bell & Howell Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled

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W. Whitney Hicks

Ronald Andrew Ratti

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ABSTRACT

The international transmission of monetary policy shocks from developed economies (the U.S. and Japan) to the output of a developing economy (Korea) is examined using a VAR methodology. During the period of flexible exchange rates, it was found that the impact of shocks in the U.S. and Japan on Korea were different. Korean output shows a negative response to U.S. expansionary monetary policy shocks and a positive response to the Japanese expansionary monetary policy shocks in the short run. Changes in Korean output are explained through the trade balance effect and the real interest rate effect. In the trade balance effect, important factors are the money supply in Korea and Japan, the exchange rates and Korean export dynamics resulting therefrom. The other explanation is provided through changes in the real interest rates.

The international monetary interdependence issue is examined and it was found that, during the flexible

exchange rate period, the Korean monetary authorities set monetary policy without regard to maintaining a target exchange rate between the U.S. dollar and the Korean won. However, in the case of Japan, the Korean authorities set monetary policy stance to keep the won undervalued against the Japanese yen.

Domestic transmission of U.S. and Japanese monetary policy shocks are examined with a focus on exchange rates and the trade balance. The U.S. dollar and the Japanese yen depreciate, in response to their own monetary policy shocks, against industrial countries' currencies. The U.S. trade balance shows similar dynamics with regard to its output, while the Japanese trade balance shows different dynamics.

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Chapter 1

Introduction

In November 1997, the Korean economy got into a serious trouble from liquidity problem due to excessive short-term debts. Until that time the economic fundamentals of the economy were relatively good so many economists have been trying to find the causes of the crisis. Among them some authors argue that the hikes in U.S. and Japanese interest rates triggered the financial crisis in Korea that was over-burdened by short-term debts. The purpose of this paper, however, is not to highlight the causes of the crisis. This paper tries to find evidence of international transmission mechanisms of monetary policy shocks using the case of Korea. Korea's economy is closely linked to U.S. and Japanese economy[1].

Investors, brokers, and analysts in the Korean stock market, even today, are eager to acquire the latest news or reliable forecasts from the Wall Street and Tokyo market. The reason is not hard to explain. They believe that

[1] In 1999, Korean exports and imports accounted for 35 percent and 29 percent of her GDP. Exports to the U.S. and Japan are 21 percent and 11 percent of total exports, while imports from the U.S. and Japan are 21 percent and 20 percent of total imports respectively. Time trends are shown in <Table 1.1>

changes in the monetary policy stance in the U.S. or Japan will affect economic variables and eventually change stock prices in Korea. In order to better understand why Koreans are interested in the events in the U.S. and Japan we need to understand mechanisms through which monetary shocks in these countries transmit to Korea. For this purpose, a study of the case of Korea, a small open[2] economy that is closely linked to U.S. and Japanese economy, will be useful by providing evidence of the international transmission mechanism of monetary policy shocks from developed economies such as the U.S. and Japan to developing economies such as Korea and the other "Asian Tigers."

Despite broad empirical and theoretical research as summarized in Chapter 2, the international transmission mechanism issue is still controversial for several reasons. First of all, predictions of major theories are ambiguous. The Mundell-Flemming-Dornbusch (MFD) model suggests that foreign monetary policy shocks have neutral impact on the domestic economy in the long run. However, in the short run, a monetary expansion of the foreign economy can either increase or decrease output and/or current account (trade balance) of domestic economy depending on the relative size

[2] This term is used in the sense of international trade, not in the sense of capital mobility.

of the expenditure-switching effects (negative) and the income-absorption effects (positive).

The direction of expenditure-switching effect itself depends on the assumption that the domestic money supply is determined independently and endogenously. The ambiguity in the direction of net effects has been increased after the intertemporal model (equipped with sticky prices and/or wages) was introduced to the discussions on the international transmission mechanism of monetary policy shocks. The intertemporal model emphasizes economic agents' forward-looking decisions on consumption, investment and saving using information on real interest rates. A monetary expansion of a foreign country may decrease the domestic output if the expenditure-switching effect dominates. However, a fall in the world real interest rate, that is plausible when the foreign country is a large open economy, may increase the world aggregate demand for current goods, including domestic goods. As a result, domestic output may rise.

Based on theoretical studies, there have been two strands of empirical work in this issue. First, there are simulation experiments that use large-scale structural models that employ different versions of the MFD models (for example, studies in Frankel and Rocket (1988), Bryant *et al.* (1988) and Taylor (1993)) or that use calibrated dynamic stochastic general equilibrium models. (Example are McKibbin and Sunberg (1990), Cardia (1991), Chari *et al.* (1996) Kollman (1997,1999), and Betts and Debreux (1998).) Most of models using this approach depend on hundreds of incredible identification restrictions, so that the results may not serve as the data-oriented empirical evidence. Sometimes the empirical results found are just self-fulfilled by the assumptions imposed to identify the structural system.

Another problem of this approach is difficulties in comparing results since each study is based on different theoretical model. We cannot make any meaningful comparison among empirical findings based on the different assumptions and models.

A second flow of studies which have developed more recently has used empirical models that not only employ minimal numbers of identification restrictions but also are not based on specific theoretical models (for example, Lastrapes and Koray (1990), Stam *et al.* (1991), Clarida and Gali (1994), Moreno (1994), Eichenbaum and Evans (1995), Schlagenhauf and Wrase(1995), Lee and Chinn (1998)). However, these studies are restricted in scope since they only investigate limited features of data, for example, exchange rate dynamics or the current account.

This paper follows the approach followed by Cristiano, Eichenbaum and Evans (1998) and Kim (1998) to document empirical evidence from a broad set of macro-variables for the Korean economy using a structural VAR model that not only employs minimal identification restrictions but that does not depend on a specific theoretical model.

Also this paper tries, using data-oriented evidence, to highlight the detailed international monetary transmission mechanism from developed economies to developing economies. For this purpose, I use several basic identification schemes, selected from the VAR literature. This literature includes Bernanke and Blinder (1992), Gordon and Leeper (1994), Strongin (1995), Eichenbaum and Evans(1995), Cristiano, Eichenbaum and Evans (1996), Sims and Zha (1998), Kim (1998,1999). The schemes in these papers generate reasonable dynamic effects for U.S. and Japanese macro-variables as a result of monetary policy shocks in the U.S. and Japan.

In Chapter 4, I include macro-variables of Korean economy one by one in the VAR systems to find the transmission mechanism of monetary policy shocks in the U.S. and Japan on the Korean economy. While the Korean economy has been open in the sense of the international trade on goods, her openness in capital mobility has been low over the entire course of the 1980s and the 1990s. So we can expect stronger effects through the trade balance channel than through the real interest rate channel, which is different from Kim (1998)'s finding for the relationships between the U.S. and non-U.S. G7 countries.

In Chapter 5, the international monetary interdependence issue is discussed in the U.S.-Korea and Japan-Korea relationships across the exchange rate regime. When we discuss the impacts of monetary shocks of country 'A' on country 'B' we implicitly assumes that money supply of country B is independently and endogenously determined, i.e. its money supply is independent from the money supply of country A. Based on this assumption we can anticipate the depreciation of currency A relative to currency B, in case of the expansionary monetary policy in country A, causing a negative expenditure-switching effect on country B. If this assumption does not hold, then we may have different movements in the exchange rate and expenditure-switching effect. In theory, a country is expected to be more independent in its monetary policy under the flexible exchange rate regime since there is no need to maintain the fixed exchange rate. Also, changes in the exchange rate are supposed to insulate domestic economy from external shocks under the flexible exchange regime. I compare responses of Korean monetary policy to the U.S. and Japanese expansionary monetary policy during the flexible exchange rate period with those during the fixed exchange rate period to examine a possible change in the independence of Korean monetary policy across exchange rate regime.

In Chapter 6, I discuss about the domestic transmission of U.S. and Japanese monetary policy to complete the other side of story for international transmission mechanism of monetary policy shocks. There are a large number of studies on the issue of the domestic transmission mechanism of monetary policy shocks. Mishkin (2000) categorizes the transmission channels introduced in literature into three groups: traditional interest rate channel, other asset price channel (exchange rate effects on net exports[3], Tobin's q effects and wealth effects) and credit view (bank lending channel, balance sheet channel, cash flow channel, unanticipated price level channel, and household liquidity effects). Among these, I examine domestic transmission issue with a focus on the exchange rate effects.

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[3] Net exports are equal to exports minus imports, so equivalent to trade balance.

Since the exchange rate regime in Korea significantly shifted in January 1980 from the fixed exchange rate[4] to the flexible exchange rate regime the data series in this study will begin in January 1980 and extend to October 1997, right before the economic turmoil in Korea which began in November 1997.

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[4] In January 1980 the Korean government adopted the managed floating system. Before then, Korean won had been pegged to the U.S. dollar since 1973 after the Bretton Woods system collapsed in 1971.

<table 1.1> Korean Exports and Imports

Korean Exports to (Million $ and percent of total exports)

year	Total Export	U.S.A.		Japan		Europe		Other Asia		Other	
		sums	%	Sums	%	sums	%	sums	%	Sums	%
1970	835	395	47	234	28	76	9	81	10	47	6
1975	5,081	1,536	13	1,293	25	937	18	760	15	555	11
1980	17,504	4,607	26	3,039	17	3,116	18	4,280	24	2,463	14
1985	30,283	10,754	36	4,543	15	4,297	14	5,683	19	5,005	17
1990	65,015	19,360	30	12,638	19	10,847	17	13,077	20	9,094	14
1995	125,058	24,152	19	17,051	14	20,894	17	44,666	36	18,295	15

Korean Imports from (Million $ and percent of total imports)

year	Total Import	U.S.A.		Japan		Europe		Other Asia		Other	
		sums	%	Sums	%	sums	%	sums	%	sums	%
1970	1,984	585	30	809	41	218	11	319	16	54	3
1975	7,274	1,881	26	2,434	34	606	8	1,876	26	478	7
1980	22,292	4,890	22	5,858	26	1,905	9	7,436	33	2,203	10
1985	31,136	6,489	21	7,560	24	4,027	13	6,633	21	6,427	21
1990	69,844	16,943	24	18,574	27	9,913	14	12,877	18	11,538	17
1995	135,119	30,425	23	32,622	24	22,452	17	23,168	17	26,452	20

Source: Korean Foreign Trade Association, Trade Year Books.

Chapter 2

Literature Review

The monetary transmission mechanism refers to the channels through which changes in money supply affect the economy. The main concern of literature on international transmission is how and how much innovations in foreign money supply affect domestic economic variables. In section 1, I describe different theoretical frameworks focusing on international transmission mechanism. In section 2, empirical studies are carefully summarized by issue and by methodology.

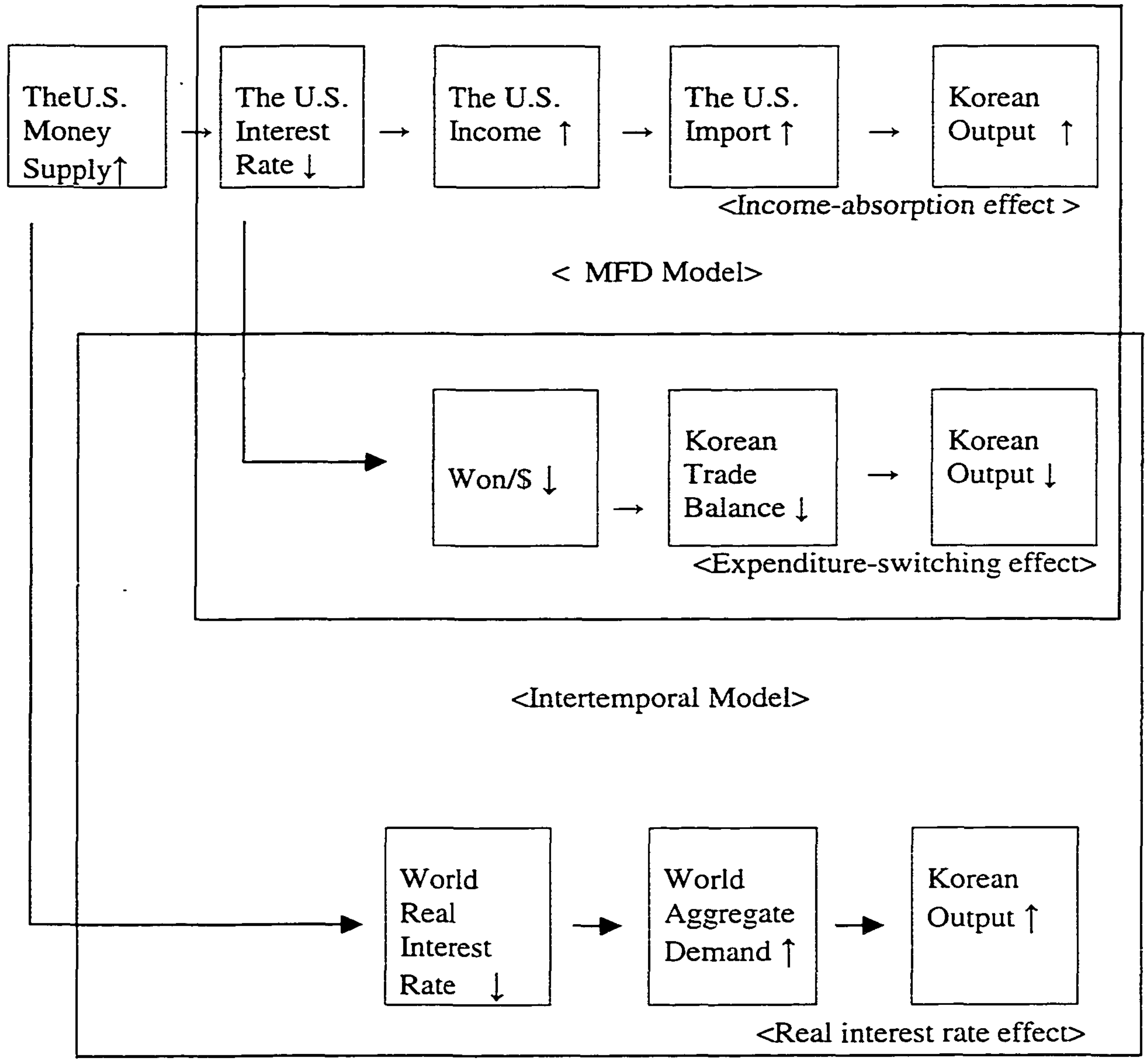
2.1 Theoretical frameworks

Mundell (1963,1964) and Flemming (1962) developed the Keynesian framework to study monetary policy issue in an open economy setup. Dornbusch (1976) extends this model with his famous perfect-foresight assumption. The basic Mundell-Flemming-Dornbusch (MFD) model predicts that a foreign monetary expansion, expected or not, can affect the domestic economy through various transmission channels. Foreign monetary expansion leads to the terms of trade deterioration or an exchange rate depreciation of the foreign economy, which leads to a trade balance improvement of the foreign economy and a trade balance deterioration of the domestic economy (expenditure-switching effect). However, a foreign income increase following a monetary expansion raises the foreign import demand that may worsen the trade balance and the output of foreign economy while it improves the trade balance and the output of domestic economy (income-absorption effect). The eventual direction of effect depends on the relative size of these two effects (See Figure 1).

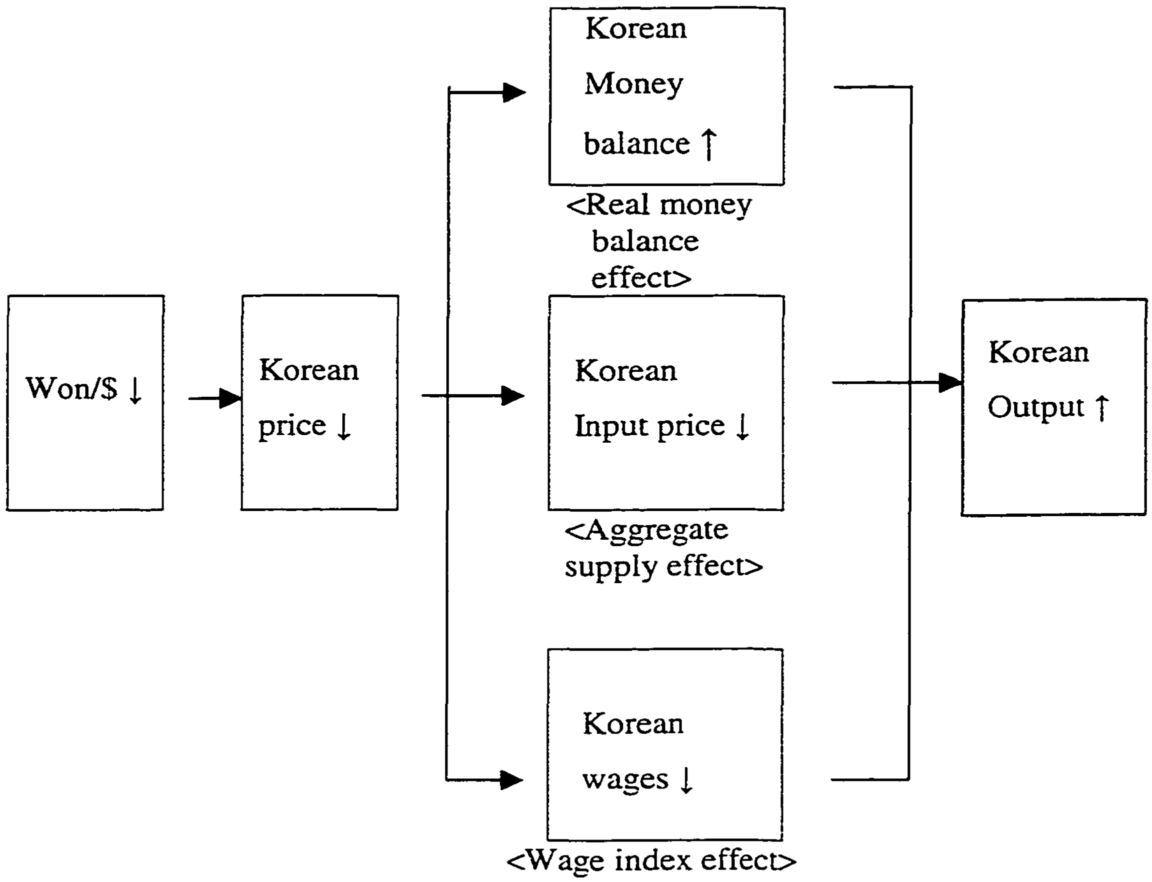
The intertemporal model is introduced by Svensson and Van Wijnbergen (1989) and Obstfeld and Rogoff (1995) from the criticism that the MFD model is lack of micro-foundation, for example lack of story on aggregate supply, and that it is ill-equipped to capture current account dynamics. The intertemporal framework emphasizes economic agents' forward-looking intertemporal decisions. A monetary expansion of an economy leads to a temporary increase in the income of the economy, so that the current account of the economy may improve as a result of consumption smoothing. However, the current account of this country

<Figure 1.1> Major Channels of International Monetary Transmission

: Effects of U.S. expansionary monetary policy on the Korean output



<Figure 1.2> Other Channels of International Monetary Tranasmission



may worsen if investment increases due to a fall in the real interest rates more than saving does. In this case current account of the neighbor economy may improve. This model also suggests a decrease in the domestic output in the case of a foreign expansion of money if the expenditure-switching effect dominates. However, a fall in the world real interest rate (this can be true if foreign country is a large open economy) may increase the world aggregate demand for current goods, including domestic goods. As the result, the domestic output may increase (See Figure 1.1).

We can further think about other channels from the changes in exchange rates. If the domestic currency is appreciated as is the case when the foreign money supply rise then the domestic output can increase through the fall in the domestic price levels, resulting in the money balance effect, aggregate supply effect and the wage index effect. However, there are many assumptions involved in each path of transmission. (See Figure 1.2)

As we see above, predictions of theories are ambiguous. The issue is to find empirical evidences on the relative size of effects and detailed international transmission mechanism of monetary shocks based on historical data.

2.2 Empirical Studies

2.2.1 empirical studies by methodology

First, there are simulation experiments that use large-scale structural models that adopt different versions of the MFD models. Studies in Frankel and Rockett (1988), Bryant et al. (1988) and Taylor (1993) are included in this category. Also there are many simulation experiments using calibrated dynamic stochastic general equilibrium model. For example, McKibbin and Sunberg (1990), Cardia (1991), Chari et al. (1996), Kollman (1997,1999), and Betts and Debreux (1997,1998) are included in this category. However, most models in this study depend so much on hundreds of incredible identifying restrictions that the evidence may not serve as the data-oriented empirical evidence. Furthermore, since they are based on different theoretical models there comes no meaningful comparison of results.

Second, some studies have used VAR models[5] that not only employ minimal numbers of identification restrictions but are not based on specific theoretical models (for example, Lastrapes and Koray (1990), Stam *et al.* (1991), Clarida and Gali (1994), Moreno (1994), Eichenbaum and Evans (1995),

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[5] Researches using VAR models are summarized in table 1.

Schlagenhauf and Wrase (1995), Lee and Chinn (1998)). However, this approach is restricted in scope since they only investigate limited features of data, for example, exchange rate dynamics or current account. To overcome the limits of previous researches, Kim (1998), using parsimonious VAR systems that have been developed in the literature to capture the innovations in U.S. monetary policy shocks, examines effects of U.S. monetary expansion on trade balances and outputs of non-U.S. G7 countries.

<Table 2.1> Researches using VAR methodology

Authors	VAR system	Data	Purpose of study
Lastrapes and Koray (1990)	$\{M, R, P, Y, M^f, R^f, P^f, Y^f\}$[6]	Monthly 1959:1~85:12 12 lags	Short and long run relationship between the U.S. and the UK, FR, GR
Stam et al (1991)	$\{Y, M, M^{US}\}$	Quarterly 1973:3~1986:4 4~8 lags	Impacts of U.S. & German money shocks on seven industrial countries
Hutchison And Walsh (1992)	{JGNP, oil, USGNP, USM1}	Quarterly 1956:1~1986:4	Impacts of external shocks and domestic shocks across alter-native exchange regime
Moreno (1994)	{oilp, usp, usrat, ustwd, cpi}[7]	Quarterly 1970:1~1990:4	Effects of world & U.S. shocks on the inflation of Korea and Taiwan
Clardia and Gali (1994)	$\{\Delta q, r\}$ $\{\Delta y, \Delta q, \pi\}$	Quarterly 1973:3~1992:1 4 lags	Determinants of real exchange rate fluc-tuations
Eichenbaum And Evans (1995)	$\{Y, P, NBRX, R^F - R^{US}, s_R{}^F\}$, $\{Y, P, Y^F, R^F, FF, NBRX, s_R{}^F\}$	Monthly data 1974:1~1990:5 6 lags	Effects of U.S. monetary policy shocks on exchange rate

[6] Superscript 'f' denotes foreign
[7] ustwd denotes trade weighted dollar. Oilp denotes oil price.

Schlagenhauf and Wrase (1995)	$\{FFR, R^F, P^D, P^F, Y^D, Y^F, e\}$	Quarterly 1972:1~1990:2	Impacts of U.S. money shocks on i, p, GDP, and e of UK, Canada, Japan and France
Cushman & Zha (1997)	$\{E, M1, R, P, Y, T_x, T_m\}$, $\{Y^*, P^*, R^*, Wxp^*\}$[8]	Monthly 1974~1993	Effects of monetary policy in Canada, a small open economy
Kim (1998)	{RGDP, PGDP, PC, FFR}{RGDP, PGDP, PC, NBRX, FFR}	Quarterly 1974:1 ~ 1999 4 lags	Domestic and international transmission of U.S. monetary policy
Lee and Chinn (1998)	{CA, e}	Quarterly 1979:2~1996:1 2 lags	Effects of U.S. money And productivity shock on the current account and real exchange rate of G7 countries

[8] Wxp denotes world export price.

2.2.2 Empirical studies by issue

2.2.2.A. Output Effects

There are researches that try to explain the international transmission of foreign monetary policy shocks on the domestic outputs. For example, Frankel and Rockett (1988), McKibbin and Sundberg (1990), Lastrapes and Koray (1990), Stam et al. (1991), Burdenkin and Burkett (1992), and Hutchison and Walsh (1992), and Kim (1998) are included in this category.

Frankel and Rockett examine the influence of U.S. monetary policy shocks on the rest of the world using twelve different MFD models. This paper shows that all models agree that a monetary expansion in the U.S. drives down its interest rates and stimulates the output. Also, the models generally agree on the depreciation of U.S. dollar in response to the monetary expansion of the U.S.. However, the models disagree as to whether the expansionary monetary policy improves the domestic trade balance by deteriorating foreign trade balance and decreasing foreign output. The Federal Reserve Board's multi-country model predicts negative transmission from the U.S. to Europe, while the OECD model predicts positive impacts.

Lastrapes and Koray analyze the transmission properties of aggregate shocks between the U.S. and three major

European economies (the U.K., France and Germany). They claim that the U.K. and France have been successful in isolating their economies from U.S. shocks in the short run by using flexible exchange rates, while Germany has not. Even under the flexible exchange rate regime, German macroeconomic fluctuations are substantially explained by the U.S. shocks.

Stam et al. explore the impact of U.S. and German money supplies on Japan and other European Monetary System (EMS) countries under the flexible exchange rates regime. They argue that U.S. monetary growth substantially influenced Belgian, Canadian, and U.K. outputs, but had little effect on German, Japanese, and Italian outputs.

Burdenkin and Burkett investigate the impact of U.S. economic variables on the Canadian economy. They find evidence for strong influences of U.S. variable on Canada's output gap both in fixed and flexible exchange rate regimes. Hutchison and Walsh show that U.S. monetary shocks have stronger positive effect on Japanese output under the flexible exchange rate regime than under the fixed exchange rate regime.

Kim finds that U.S. monetary expansion has a positive spillover effect on non-U.S. G7 countries outputs. He infers that this positive spillover effect occurs through the fall in the world interest rate and a subsequent increase in the world aggregate demand on current goods and services of both the U.S. and non-U.S. G7 countries. This channel is the same as theoretically suggested by some intertemporal models. Though a U.S. monetary expansion leads to the medium-run and long-run U.S. trade balance improvements (and possibly worsening foreign trade balance) as predicted by the basic MFD model, the size of the changes in trade balance is too small to ensure the beggar-thy-neighbor aspect of a monetary expansion. He also finds that a monetary expansion of the U.S. leads to a short-run U.S. trade balance worsening but a persistent medium-run and long-run trade balance improvements. These dynamics are consistent with the basic MFD model in which the income-absorption effect dominates in the short-run but the expenditure-switching effect dominates in the medium and long-run.

Different from above researches that deal with international relationship between developed countries McKibbin and Sunberg simulate impacts of U.S. and Japanese monetary policies shocks also on four Asian Newly Industrialized Economies (ANIEs, Hong Kong, Korea, Singapore and Taiwan) under the flexible exchange rate regime. Their results show that a permanent rise in the

U.S. money supply negatively affects the outputs of the Asian NIEs in a flexible exchange rate regime. They think that a rise in the U.S. money supply cause the relative price of ANIEs' goods to rise, resulting in decline in exports and outputs. An increase in Japanese money stocks stimulates the ANIEs' outputs for the first year, but it decreases them for the next three years. Some real depreciation of ANIEs' exchange rates relative to the U.S. dollar deems to stimulate ANIEs' exports and outputs. Notably, ANIEs' money stocks display unstable responses to Japanese expansionary monetary policy: a positive response for the first year, a negative one for the next two years and once again a positive one for the last two year.

2.2.2.B. Monetary Interdependence and Inflation Transfer

There are researches that try to explain monetary policy reactions of other countries to changes in U.S. money supply. Sheehan (1983, 1987, 1992), Stam et al. (1992), Chung (1993), and Kim (1998) are included in this category. Theories say that monetary interdependence will be weakened in the flexible exchange rate regime since domestic monetary policy is free from efforts to maintain the fixed exchange rates.

Sheehan (1983) finds significant differences among countries whether U.S. money growth has a significant influence on those. Money growth in Australia and Germany is influenced by U.S. money growth (M1). However money growth in Canada, Italy, Japan and the United Kingdom is not significantly influenced. Sheehan (1987) gives different finding. He can reject the monetary independence hypothesis only for Canada and Japan during the floating exchange rate period, whereas he cannot reject the same hypothesis for Belgium, France, Italy, Netherlands, Switzerland and the United Kingdom.

Stam et al. find that the central banks of Canada and Netherlands strongly respond to U.S. money growth, while those of Belgium, Italy and Japan respond little, which is contrasting to Sheehan (1987).

Sheehan (1992) re-examines the impacts of U.S. monetary policy on foreign money growth, using an IS-LM model instead of the reaction functions of the central banks, and concludes that attempts to explain foreign monetary policy makers' decisions are incomplete without considering the impacts of U.S. variables including U.S. monetary policy.

Chung investigates monetary interdependence among U.S., Japan, and Germany. He finds that the central bank in each country strongly responds to the other even under the flexible exchange rate regime.

Kim (1998) finds that non-U.S. G7 monetary authorities' endogenous reaction to U.S. monetary policy is insignificant (except for Canada).

There are a couple of researches in the issue of international linkage in inflation. Stockman (1992) and Moreno (1994) are included in this category. International inflation transfer issue is closely linked to the international monetary interdependence issue.

Stockman argues that there is little short-run transmission of inflation even under the Bretton Woods System.

Moreno focuses on the insulation properties of two developing countries (Korea and Taiwan) from U.S. shocks across alternative exchange rate regimes. He finds that U.S. shocks have had an important influence on the long-run price level behavior in the two economies, though less so in Korea than in Taiwan. This is consistent with the fact that Taiwan is more open in trade and capital mobility. He also finds that both Korea and Taiwan became more insulated from external shocks after they abandoned their respective pegs to the U.S. dollar.

Chapter 3

Econometric Model and Data

3.1 Methodology of VAR

3.1.1 Introduction of VAR

Vector autoregressions(VAR) were first introduced by Sims (1980) as a better alternative to the traditional structural models that depend on hundreds of incredible restrictions on parameters. VAR provides a means of explaining and predicting a set of economic variables without too many restrictions at any given point of time. After being introduced by Sims, VAR methodology has been used in the broad area of researches in macroeconomics. VAR made it possible to analyze the dynamic interrelationships among the variables in the system using impulse response functions and forecast error variance decompositions.[9]

The VAR methodology is inviting to many researchers for a couple of reasons. First, it does not depend on a priori assumptions on the structure of the economy, allowing all variables in the system to be endogenous. Second, it provides dynamic interrelationship between variables in the

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[9] The term, innovation accounting, is used to include the impulse response function and the forecast error variance decomposition.

system by generating responses of a variable to the innovations of another variable.

3.1.2 Theoretical background of VAR[10]

In the bivariate case, we can let the time path of $\{y_t\}$ be affected by current and past realization of $\{x_t\}$ and past realization of $\{y_t\}$ sequence. Also we can let the time path of $\{x_t\}$ be affected by current and past realization of $\{y_t\}$ and past realization of $\{x_t\}$ sequence. Let's consider the simple two variable simultaneous equations.

$$y_t = b_{10} - b_{12}x_t + c_{11}y_{t-1} + c_{12}x_{t-1} + \varepsilon_{yt} \qquad 1.1$$

$$x_t = b_{20} - b_{21}y_t + c_{21}y_{t-1} + c_{22}x_{t-1} + \varepsilon_{xt} \qquad 1.2$$

Where it is assumed that; (1) both y_t and x_t are stationary, (2) ε_{yt} and ε_{xt} are white-noise disturbances with standard deviations of σy and σx, respectively, and (3) $\{\varepsilon_{yt}\}$ and $\{\varepsilon_{xt}\}$ are uncorrelated.

Equations (1.1) and (1.2) constitute a first-order VAR since the longest lag length is one. The structure of the system incorporates feedback since y_t and x_t are allowed to affect each other. For example, $-b_{12}$ is the contemporaneous

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[10] This part follows Enders(1996)

effect of a unit change of x_t on y_t. If b_{12} is not equal to zero, ε_{xt} has an indirect contemporaneous effect on y_t, and if b_{21} is not equal to zero, ε_{yt} has an indirect contemporaneous effect on x_t.

Equations (1.1) and (1.2) are not reduced form equations since y_t has a contemporaneous effect on x_t and x_t has a contemporaneous effect on y_t.

Using matrix algebra, we can write the system in the compact form.

$$Bz_t = \Gamma_0 + \Gamma_1 z_{t-1} + \varepsilon_t \qquad 1.3$$

Where:

$$B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \quad z_t = \begin{bmatrix} y_t \\ x_t \end{bmatrix} \quad \Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$$

$$\Gamma_1 = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} \quad \varepsilon_t = \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{xt} \end{bmatrix}$$

Pre-multiplying by B^{-1} gives us

$$z_t = A_0 + A_1 z_{t-1} + e_t \qquad 1.4$$

Where $A_0 = B^{-1}\Gamma_0$; $A_1 = B^{-1}\Gamma_1$; and $e_t = B^{-1}\varepsilon_t$

For notational purposes, we can define a_{io} as *i*th element of the vector A_0; a_{ij} as the element of *i*th row and *j*th column of the matrix of A_1; and e_{it} as the *i*th element of the vector e_t. Using this new notation, we can rewrite (1.1) and (1.2) as

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}x_{t-1} + e_{1t} \quad 1.5$$

$$x_t = a_{20} + a_{21}y_{t-1} + a_{22}x_{t-1} + e_{2t} \quad 1.6$$

Since $e_t = B^{-1}\varepsilon_t$, we can compute e_{1t} and e_{2t} as:

$$e_{1t} = (\varepsilon_{yt} - b_{12}\varepsilon_{xt})/(1 - b_{12}b_{21}) \quad 1.7$$

$$e_{2t} = (\varepsilon_{xt} - b_{21}\varepsilon_{yt})/(1 - b_{12}b_{21}) \quad 1.8$$

ε_{xt} and ε_{yt} are white-noise processes, so it follows that both e_{1t} and e_{2t} have zero means, constant variances, and are individually serially uncorrelated. The covariance of the two terms is:

$$Ee_{1t}e_{2t} = E[(\varepsilon_{yt} - b_{12}\varepsilon_{xt})(\varepsilon_{xt} - b_{21}\varepsilon_{yt})]/(1 - b_{12}b_{21})^2 \quad 1.9$$

In general, (1.9) will not be zero so that the two shocks will be correlated. Since all variance and covariance terms are time-invariant, we can rewrite the variance/covariance matrix as:

$$\Sigma = \begin{bmatrix} \sigma^2_1 & \sigma_{12} \\ \sigma_{21} & \sigma^2_2 \end{bmatrix}$$

Where $Var(e_{it}) = \sigma_i^2$ and $\sigma_{12} = \sigma_{21} = Cov(e_{1t}, e_{2t})$

3.1.3 Identification of VARs

The VAR is under-identified system in the sense that there are more coefficients to be estimated than the number of equations in the system. There are two methods to deal with this problem. First one is to convert the structural equations into the reduced form and find the parameters in the reduced form. This approach is advocated by many researchers since, as Sims (1980) indicates, we don't need to depend on incredible assumptions or restrictions to explain economic relationships. Second one is to impose additional restrictions to recover coefficients in the structural form from the estimation made in the reduced form. This is generally called the structural VAR. There are several ways to identify the structural models. Among them I will explain the method used for this paper.

We assume the economy is described by a structural form equation.

$$A(L)y_t=e_t \qquad 1.10$$

Where $A(L)$ is a matrix polynomial in the lag operator L, y_t is n x 1 data vector and e_t is n x 1 structural disturbance vector. e_t is serially uncorrelated and $var(e_t)= \Lambda$. Λ is a diagonal matrix where diagonal elements are the variances of structural disturbances. Therefore, structural disturbances are assumed to be mutually uncorrelated.

We can convert the structural form equation into a reduced form equation.

$$y_t=B(L)y_{t-1}+u_t, \qquad 1.11$$

Where $B(L)$ is a matrix polynomial in lag operator L and $var(u_t) = \Sigma$.

Let A_0 be the contemporaneous coefficient matrix in the structural form, and let $A^0(L)$ be the coefficient matrix in $A(L)$ without the contemporaneous coefficient A_0 . That is,

$$A(L)=A_0+A^0(L).\qquad 1.12$$

Then, the parameters in the structural form equation and those in the reduced form equation are related by

$$B(L)=-A_0^{-1}A^0(L),\qquad 1.13$$

In addition, the structural disturbances and the reduced form residuals are related by

$$e_t=A_0u_t,\qquad 1.14$$

which implies

$$\Sigma=A_0^{-1}\Lambda A_0^{-1}.\qquad 1.15$$

In the method proposed by Sims (1980), the identification is achieved by Cholesky decomposition of the reduced form residuals, Λ. In this case, A_0 becomes triangular so that a recursive structure, that is, the World-causal chain is assumed.

3.1.4 Justification[11] of Recursive structure

The recursiveness assumption justifies the following two-step procedures for estimating the dynamic responses of a variable to a monetary policy shock. First, estimate the policy shocks by the fitted residuals in the ordinary least squares regression of S_t on the elements of Ω_t[12]. Second, estimate the dynamic responses of a variable to the estimated policy shocks.

To indicate how the recursiveness assumption restricts A_0 in 1.12 We partition Z_t into three blocks: the k_1 variables, X_{1t}, whose contemporaneous values appear in Ω_t, the k_2 variables, X_{2t}, which only appear with a lag in Ω_t, and S_t itself. Then, $k = k_1 + k_2 + 1$, where k is the dimension of Z_t. That is:

$$Z_t = \begin{pmatrix} X_{1t} \\ S_t \\ X_{2t} \end{pmatrix}$$

The recursiveness assumption places the following zero restrictions on A_0:

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[11] I follow CEE (1998).

[12] This is the monetary authority's information set.

$$A_0 = \begin{bmatrix} \underset{(k_1 \times k_1)}{a_{11}} & \underset{(k_1 \times 1)}{0} & \underset{(K_1 \times k_2)}{0} \\ \underset{(1 \times k_1)}{a_{21}} & \underset{(1 \times 1)}{a_{22}} & \underset{(1 \times k_2)}{0} \\ \underset{(k_2 \times k_1)}{A_{31}} & \underset{(k_2 \times 1)}{a_{32}} & \underset{(k_2 \times k_2)}{a_{33}} \end{bmatrix}$$

where expressions in parentheses indicate the dimensions of the associated matrix.

The zeros in the middle row of this matrix reflect the assumption that the policy maker does not see X_{2t} when S_t is set. The two zero blocks in the first row of A_0 reflect the assumption that the monetary policy shock is orthogonal to the elements in X_{1t}. These blocks correspond to the two distinct channels by which a monetary policy shock could affect the variables in X_{1t}. The first block corresponds to the direct effect of S_t on X_{1t}. The second block corresponds to the indirect effect that operates through the impact of a monetary policy shock on the variables in X_{2t}.

Even though the recursiveness assumption is not sufficient to identify all the elements of A_0, it is sufficient to identify the object of interest: the dynamic response of Z_t to a monetary policy shock.

3.1.5 Selection of Lag length

The VAR model is often criticized because it is easily over-parameterized because it does not allow different lag lengths for the system variables. Increases in the parameters caused by increase in lag length cause quick erosion of degrees of freedom. So, 'parsimony' becomes an important criterion in building a VAR model. Although lag length selection is important to have a proper result, there is no theoretically justified method of choosing lag lengths for the VAR model. One method recommended by Sims (1980) is a likelihood ratio test. The test statistic is

$$LR = (T-c)(\log|\Sigma_0| - \log|\Sigma_1|) \qquad 1.16$$

where Σ_0 and Σ_1 are the restricted(with lag p_0) and unrestricted (with lag $p_1(>p_0)$) covariance matrices obtained from an OLS of the reduced form VAR, respectively. T is the number of observation and c is a correction of small sample bias that is equal to the number of variables in each unrestricted equation in the system.

This is asymptotically distributed as χ^2 with degrees of freedom equal to the number of restrictions in the system. Using these statistics, we can test the null hypothesis that the last k lags of each variable in each equation of the VAR are jointly zero.

Another way of choosing the lag length is by adopting a selection criteria such as Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion(SIC) expressed as

$$AIC = T \cdot \log|\Sigma| + 2 \cdot M \qquad 1.17$$

$$SIC = T \cdot \log|\Sigma| + M \cdot \log T \qquad 1.18$$

where M is the total number of parameters in a VAR system.

We can compare the AIC and SIC value for each lag, and choose the lag length that minimizes the sum of values.

3.1.6 Innovation Accounting

As I discussed above, the VAR approach gives useful tools in examining the dynamic inter-relationship between variables in the system. One of the tools is impulse response analysis. The impulse response function (IRF) shows the size and direction of effects of a structural shock to each system variable over the time span. Consider the Wold moving average representation in the following form.

$$X_t = C_0\varepsilon_t + C_1\varepsilon_{t-1} + C_2\varepsilon_{t-2} + C_3\varepsilon_{t-3} + C_4\varepsilon_{t-4} + \cdots\cdots \qquad 1.19$$

Then the (i,j)th element of C_k is the effect of a jth structural shock on ith variable. If we collect the (i,j)th element for all time periods, it becomes the impulse response function for the ith variable to the jth shocks. If we draw a plot of the impulse response function, we can easily examine the response of a structural variable to structural disturbances.

Another way to get the dynamic interrelationship among the structural variables is the forecast error variance decomposition. The forecast error variance decomposition tells us the proportion of the movement in a system variable due to each different structural shock. Consider the Wold MA representation again for one period ahead.

$$X_{t+1} = C_0\varepsilon_{t-1} + C_1\varepsilon_t + C_2\varepsilon_{t-1} + C_3\varepsilon_{t-2} + C_4\varepsilon_{t-3} + \cdots\cdots \qquad 1.19a$$

Taking the conditional expectation of X_{t+1} and E_tX_{t+1}, and abstracting it from X_{t+1}, the one-step ahead forecast error would be

$$X_{t+1} - E_tX_{t+1} = C_0\varepsilon_{t+1}$$

Similarly, we can obtain the 2 and 3-step ahead forecast error as

$$X_{t+2} - E_tX_{t+2} = C_0\varepsilon_{t+2} + C_1\varepsilon_{t+1}$$

$$X_{t+3} - E_tX_{t+3} = C_0\varepsilon_{t+3} + C_1\varepsilon_{t+2} + C_2\varepsilon_{t+1}$$

Generally, we can express the n-step ahead forecast error as

$$X_{t+n} - E_tX_{t+n} = C_0\varepsilon_{t+n} + C_1\varepsilon_{t+n-1} + C_2\varepsilon_{t+n-2} + \cdots + C_{n-1}\varepsilon_{t+1}$$

Suppose simply for an illustrative purpose that $X_t=[X_{1t}, X_{2t}]'$ and $\varepsilon_t=[\varepsilon_{1t}, \varepsilon_{2t}]$. We can calculate the n-step ahead forecast error of X_{1t} as

$$X_{1t+n} - E_tX_{1t+n} = C_0(1,1)\varepsilon_{1t+n} + C_1(1,1)\varepsilon_{1t+n-1} + \cdots + C_{n-1}(1,1)\varepsilon_{1t+1} + C_0(1,2)\varepsilon_{2t+n} + C_1(1,2)\varepsilon_{2t+n-1} + \cdots + C_{n-1}(1,2)\varepsilon_{2t+1}$$

where $C_k(i,j)$ denotes (i,j)th element of C_k.

Then, the n-step ahead forecast error variance of variable X_1, σ_{1n}^2, is expressed as

$$\sigma_{1n}^2 = [\ C_0(1,1)^2 + C_1(1,1)^2 + \cdots + C_{n-1}(1,1)^2\ ] + [\ C_0(1,2)^2 + C_1(1,2)^2 + \cdots + C_{n-1}(1,2)^2\ ]$$

Equation above shows that the forecast error variance of X_1 can be decomposed into i) the variance caused by $\{\varepsilon_{1t}\}$ and ii) the variance caused by $\{\varepsilon_{2t}\}$. The relative proportion of

σ_{1n}^2 due to a shock in $\{\varepsilon_{1t}\}$ and $\{\varepsilon_{2t}\}$ can be expressed respectively as

$$[\ C_0(1,1)^2 + C_1(1,1)^2 + \cdots\cdots + C_{n-1}(1,1)^2\ ]\ /\ \sigma_{1n}^2 \text{ and}$$

$$[\ C_0(1,2)^2 + C_1(1,2)^2 + \cdots\cdots + C_{n-1}(1,2)^2\ ]\ /\ \sigma_{1n}^2$$

3.2 Identification schemes for Monetary shocks

In the VAR literature there are many competing identification schemes for monetary policy shocks. I select the basic identification schemes based on the several criteria. First, since I use monthly data, I choose the identification schemes that can be used for monthly estimation. Second, I choose the identification schemes in which the impulse responses of various macro variables to the identified monetary policy shocks in U.S. economy are similar to the likely effects of monetary expansion in the U.S. as theories predict. When similar schemes with different numbers of variables produce similar dynamic responses, the most parsimonious one is chosen. Finally, I examine whether the basic system can be easily extended to examine the effects on other variables. Based on these criteria, I select three recursive identification schemes, similar to those suggested by Christiano, Eichenbaum, and Evans (1996) and followed by Kim (1998). Industrial Production (IP), Consumer Price Index (CPI) and a commodity price (PC) are assumed to be contemporaneously exogenous to the monetary policy instrument, so are ordered first in the following recursive system. The first one, The federal funds rate system (CEE-R), uses the Federal Funds rate (FFR) innovations in the five-variable VAR system, ordering of {IP, CPI, PC, FFR, M[13]}. The second one, nonborrowed reserve system (CEE-X), uses the innovations in non-borrowed reserves plus extended credit as a measure of monetary policy shock in the six-variable VAR system, ordering of {IP, CPI, PC, NBRD, FFR, TRES[14]}. The third one, the oil system (CEER-OIL), uses an oil price variable instead of PC in CEE-R, ordering of {IP, CPI, OIL, FFR, M}. CEER-OIL is introduced from the fact that Korean economy and Japanese economy depend a lot on oil prices. I re-examine them since the estimation period of this paper starts from 1980 (when the Korean government actually adopted the flexible exchange rate regime) and I want to find schemes that can be used for both the U.S. and Japan.

3.3 Extended System

The basic systems for Japan and the U.S. are extended to include each domestic macro-variable and foreign (Korean) macro-variable. Since I examine recursive schemes, the only choice in the system is whether monetary policy affects the additional variable contemporaneously or not, that is, whether I order the additional variable before or after the monetary policy instrument (See CEE (1998) for

[13] I use M1 for the U.S and M2 for Japan to reflect their targeting history.
[14] represents total reserve.

details). Therefore, I experiment with two identifying restrictions for additional variables (contemporaneous effect of policy (C) and no contemporaneous effect of policy (N)). I infer the effects on the additional variable based on the results under (C) and (N) assumptions unless there is a strong reason to choose one over the other.

The following is the steps I follow to examine the effects of the monetary policy shocks of the U.S. and Japan on the Korean economy. First, I examine the impulse responses of the basic VAR systems in the U.S. and Japan. Second, I examine the impulse responses of other macro variables in the U.S. and Japan by extending the basic systems. Finally, each Korean variable is added one by one into the basic systems of the U.S. and Japan with (C) and (N) identification assumptions. Based on the impulse response function and the forecast error variance decomposition of each variable against the monetary expansion of the U.S. and Japan, the direction and size of impacts are explained. Also, using the evidence from those relationships international monetary transmission mechanism between developed economies and a developing country is inferred.

3.4. Data

Data series starts from the first month of 1980[15] when the Korean government actually adopted the flexible exchange rate system and ends in October 1997, right before the currency crisis. I get data from the International Financial Statistics (IFS), OECD database, and databases of the Bank of Korea and the Bank of Japan. Monthly data with six lags is used in most cases. [16] All variables are in the log form, except for the interest rates, current account balance and trade balance. For PC in the U.S.-Korea system producer price index (intermediate material) is used for estimations in the CEE-R model. In the CEE-X model, producer price index (all commodities) is used. For PC in the Japan-Korea system, the wholesale price index for all commodities is used for CEE-R. For oil shock data in the CEER-OIL system I use the world crude oil price from the International Financial Statistics.

For the Korean macro-variables, first, each of trade balance, current account variable is multiplied by 100 and divided by the mean of GDP over the sample period so that

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[15] When I compare fixed exchange regime and flexible exchange regime in Chapter 5, I use data from January 1960.

[16] When I see the impacts of expansionary monetary policy on consumption and investment, I use quarterly data with 4 lags.

the number shows the change in terms of the percentage of the mean of GDP. Second, industrial production (IP) is used for output data instead of GDP in order to conduct monthly estimation. Finally, in order to catch the detailed transmission mechanism, consumer price index (CPI), exports, imports, nominal exchange rates, consumption, investment, money supply and terms of trade data[17] are used.

For U.S. and Japanese domestic transmission I use industrial production (IP), consumer price index (CPI), exports, imports, trade balance, current account balance, nominal effective exchange rates, consumption, investment, and money supply[18]. Each of trade balance, current account variable is multiplied by 100 and divided by the mean of GDP over the sample period so that the number shows the change in terms of the percentage of the mean of GDP.

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[17] I use export prices/ import prices for the terms of trade data.

[18] For the U.S., I use M1 and for Japan, I use M2 +CD.

Chapter 4

International Transmission Effects on Outputs

The expansionary monetary policy in the foreign economy can have either positive or negative impacts on domestic outputs depending on the relative size of the income-absorption effects plus real interest rate effects (positive) and the expenditure-switching effect (negative). The negative expenditure-switching effect on the domestic economy comes from the appreciation of domestic currency under the assumption that the domestic money supply is determined independently and endogenously, that is, does not depend on the innovations in the foreign money supply. If this assumption does not hold, i.e. the domestic money supply does depend on the foreign money supply then the exchange rates can show different dynamics (i.e. depreciation of the domestic currency) resulting in the different direction of the expenditure-switching effects. Real interest rates effects can happen when the foreign country is a large open economy like the U.S. since only in that case expansionary monetary policy of the economy can affect the world real interest rate. Also, the domestic economy should have high degree of capital mobility in order to have a fall in the domestic real interest rate from a fall in the world real interest rate.

As we see in the literature review (Chapter 2), results of empirical researches are not the same. Frankel and Rockett (1988) examine the influence of U.S. monetary policy shocks on the rest of the world using twelve different MFD models. The models disagree as to whether the expansionary monetary policy improves the domestic trade balance by deteriorating foreign trade balance and decreasing foreign output. The Federal Reserve Board's multi-country model predicts negative transmission from the U.S. to Europe, while the OECD model predicts positive impacts on Europe. Hutchison and Walsh (1992) find that U.S. monetary shocks (M1) have stronger positive effect on Japanese output under the flexible exchange rate regime than under fixed exchange rate period. Kim (1998) finds that U.S. monetary expansion has a positive spillover effect on non-U.S. G7 countries outputs due to the positive income-absorption effects in the short-run and strong real interest effects. McKibbin and Sunberg (1990) show that a permanent rise in the U.S. money supply has negative effect on the outputs of the Asian NIEs in a flexible exchange rate regime. They think that a rise in the U.S. money supply cause the relative price of ANIEs' goods to rise, resulting in a decline in exports and outputs. An increase in Japanese money stocks stimulates the ANIEs' outputs for the first year, but it decreases them for the next three years. Some real depreciation of ANIES' exchange rates relative to the U.S. dollar seems to stimulate ANIEs' exports and outputs in short run. Notably, ANIEs' money stocks display unstable responses to Japanese expansionary monetary policy: a positive response for the first year, a negative one for the next two years and once again a positive one for the last two years.

In this chapter, in order to examine the impacts of U.S. and Japanese expansionary monetary shocks on the Korean economy I use a recursive structural VAR method. VAR systems that generate reasonable dynamics in U.S. and Japanese Economy are selected. Each system will be experimented with two restrictions: no contemporaneous effect (N) and contemporaneous effect (C).

For the U.S.-Korea relationship I experiment with three systems. First, CEE-R has the system of {IP^{us}, CPI^{us}, PC^{us}, FFR^{us}, $M1^{us}$, Korean Variables} where innovations in the Federal Funds Rates (FFR) are used as monetary policy shocks. IP represents log(Industrial Production). CPI represents log(Consumer Price Index). PC represents log(Commodity Price). FFR represents Federal Funds Rates. M1 represents log(M1). M1 is included to stabilize the system since we have more degrees of freedom from using monthly data. Second, CEE-X has the system of {IP^{US}, CPI^{US}, PC^{US}, $NBRD^{US}$, FFR^{US}, $TRES^{US}$, Korean Variables} where innovations in the Nonborrowed Reserve plus Extended credit are used as the monetary policy shocks. TRES represents the total reserve that is also the stabilizer of the system. Third, CEER-OIL has {IP^{US}, CPI^{US}, OIL^{W} [19], FFR^{US}, $M1^{US}$, Korean Variables} where innovations in Federal Funds Rates (FFR) are used as monetary policy shocks. CEER-OIL1 uses the oil price instead of PC in the CEE-R system. I put the oil price in the front of the system in CEER-OIL2 to follow the result in the literature that oil price shocks are exogenous to other economic variables.

For the Japan-Korea relationship I experiment with two systems[20]. First, CEE-R has the system of {IP^{J}, CPI^{J}, PC^{J}, $CALL^{J}$, $M2^{J}$, Korean Variables} where innovations in the Call Money Rates (CALL) are used as the monetary policy shocks. I include M2+CD in the Japan-Korea system instead of M1 as

[19] For OIL^{W}, I use the world crude oil price from the IFS.

[20] I do not experiment with the CEE-X system since Japanese monetary authorities have no experience of targeting the NBRD (Nonborrowed Reserve plus Extended Credit).

in the U.S.-Korea system to stabilize the system from the experience in which Japanese monetary authorities have targeted M2+CD. Second, CEER-OIL has {IP^J, CPI^J, OIL^W, $CALL^J$, $M2^J$, Korean Variables} where innovations in Call Money Rates (CALL) are used as monetary policy shocks. CEER-OIL1 uses the oil price instead of PC in the CEE-R system. I put the oil price in the front of the system in CEER-OIL2.

As Korean variables I use industrial production, consumer price index, money supply (M2+CD), exports, imports, trade balance, current account, exchange rates (won/SDR, won/dollar, won/yen) and terms of trade. When needed, I experiment with quarterly system since GDP data can be acquired only in quarterly frequency.

4.1 U.S.-Korea relationship

4.1.1 Results of CEE-R

In the system of {IP^{US}, CPI^{US}, PC^{US}, FFR^{US}, $M1^{US}$, Korean Variables}, innovations in the Federal Funds Rates (FFR) are used as U.S. monetary policy shocks. As we see from the impulse response graphs[21] in Figure A.1, U.S. expansionary monetary shocks have negative impacts (0.10 percent at the

[21] Impulse response graphs are drawn over 60 months (five years) periods. Standard error bands are calculated from 500 draws following Doan (1992). Results are explained based on the results with the assumption of no contemporaneous effect (N).

trough) on Korean output for the first two years and positive impacts (0.10 percent at the peak) after three years. Nominal exchange rate (won/$) is expected to rise (0.05 percent at the peak) for 2 years, subsequently following the impact fall (0.05 percent at the trough). Korean trade balance and current account is expected to improve for two years (0.12 percent at the peak) and deteriorate after three years. Korean exports show very similar pattern of responses as Korean output. It shows negative responses for the first two years (0.11 percent at the trough) but positive responses after three years. Korean consumer prices are expected to fall (0.15 percent at the trough) persistently for two years and converged to the original level thereafter. Korea's terms of trade deteriorates (0.16 percent at the trough) for the first 8 months and improve (0.18 percent at the peak) persistently thereafter. Korean money supply (M2) is expected to slightly rise (0.05 percent at the peak) on the impact, decrease (0.17 percent at the trough) for 30 months and increase after 40 months. The monetary base is expected to fall up for to 8 months and increase thereafter. Experiments with the restriction of contemporaneous effects

(C) provided in Figure A.2 show similar results as those with the restriction of no contemporaneous effects (N).[22]

As we see in <Table 4.1>, U.S. monetary shocks, in the case of CEE-R(N), explain 9.4 percent of forecast error variance for Korean industrial production in five years, which is greater than the portion that U.S. monetary shocks explain for non-U.S. G7 countries (See Kim(1998)'s results). Also, U.S. monetary policy shocks explain 13.1 percent and 10.2 percent of forecast error variances for Korean trade balance and exports respectively.

4.1.2 Results of CEE-X[23]

In the system of {IP^{US}, CPI^{US}, PC^{US}, $NBRD^{US}$, FFR^{US}, $TRES^{US}$, Korean Variables} innovations in the nonborrowed reserve plus extended credit (NBRD) are used as U.S. monetary policy shocks. TRES represents total reserves. As we see from impulse response graphs in figure A.1, results are similar as those in CEE-R system except that there is no significant long-term effect in the CEE-X system. U.S. expansionary monetary shocks have negative impacts on Korean output for the first 2 years and return to the

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22 Forecast error variance decompositions are reported in <table 3>.

23 Since I use logNBRD instead of NBRD, impulse response graphs generated with innovations in NBRD don't provide the meaningful scale of value. Therefore I only report the directions of responses.

original level. The nominal exchange rate (won/$) is expected to rise for 2 years, subsequently following the impact fall. The Korean trade balance and current account is expected to improve for two years. Korean exports show very similar responses as Korean output. It shows negative responses for the first 2 years and returns to the original level. Korean consumer prices are expected to fall persistently for the time span. The Korean money supply (M2) is expected to decrease for 30 months and slightly rise after 40 months. The monetary base is expected to fall for up to 2 years and increase thereafter. Korea's terms of trade improve persistently without a significant deterioration as we see in the CEE-R system. Experiments with the restriction of contemporaneous effects (C) provided in Figure A.2 shows similar results as those with the restriction of no contemporaneous effect (N).

As we see in <Table 4.1>, U.S. monetary shocks, in case of CEE-X(N), explain 7.0 percent of forecast error variance for Korean industrial production in five years, which is less than the portion explained in CEE-R(N). Also, U.S. monetary policy shocks explain 9.2 percent of forecast error for the Korean trade balance in two years and 11.1 percent for exports in four years. One thing to note is that the CEE-X system explains short-run dynamics of Korean trade balance better than the CEE-R system does.

4.1.3 Results of CEER-OIL[24]

In the system of {IP^{US}, CPI^{US}, OIL^{W} [25], FFR^{US}, $M1^{US}$, Korean Variables}, innovations in the Federal Funds Rates are used as U.S. monetary policy shocks. As we see from impulse response graphs in Figure A.1, the U.S. expansionary monetary shocks have negative impacts (0.05 percent at the trough) on Korean output for the first two years without a significant long-run positive effect. This result is similar as that in the CEE-X system. Variance decomposition shows that 12 percent of forecast error in Korean output is explained by U.S. monetary policy shocks, which is greater than 9.4 percent in the CEE-R system. The nominal exchange rate (won/$) is expected to rise (0.11 percent at the peak) for two years, subsequently following the impact fall (0.025 percent at the trough). The Korean trade balance and current account is expected to improve for two years (0.12 percent at the peak). Korean exports show very a similar pattern of responses as Korean output.

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[24] CEER-OIL1 represents {IP^{US}, CPI^{US}, OIL^{W}, FFR^{US}, $M1^{US}$, Korean Variables}
CEER-OIL2 represents {OIL^{W}, IP^{US}, CPI^{US}, FFR^{US}, $M1^{US}$, Korean Variables}

[25] For OIL^{W}, I use the world crude oil price from the IFS.

It shows negative responses for the first two years (0.11 percent at the trough) with no significant long run effect. Korean consumer price are expected to fall (0.13 percent at the trough) persistently for two years and converged to the original level thereafter. Korean money supply (M2) is expected to slightly rise (0.05 percent at the peak) on the impact, decrease (0.15 percent at the trough) for 30 months and increase again after 40 months. Korea's terms of trade improve persistently without a significant deterioration as we see in the CEE-R system. Experiments with the restriction of CEER-OIL2 provided in Figure A.2 shows similar results as those with CEER-OIL1.

As we see in <Table 4.1>, when we include the oil price in the system the explanation power of the system is increased. U.S. monetary shocks, in case of CEER-OIL1, explain 12.0 percent of forecast error variances for Korean industrial production in five years, which is greater than that in CEE-R(N). Also, U.S. monetary policy shocks explain 10.6 percent and 14.5 percent for Korean trade balance and exports respectively in five years. Explanation power increases over time over time, which is Different from the CEE-X system.

4.1.4 Interpretation of U.S.-Korea Relationship

The results of three VAR systems above agree that impacts of U.S. monetary policy shocks on Korean output are negative for the first two years. CEE-R shows positive (0.03 percent at the peak) impacts after three years. Inclusion of the oil price eliminates significant long-run positive effects, which is similar to the result of the CEE-X system. This negative result on Korean output in the first two years is different from the Kim (1998)'s finding that non-U.S. G7 countries' outputs show the positive responses to U.S. monetary shock after one year. It is however similar as the simulation result of McKibbin and Sunberg (1990) in which a permanent rise in the U.S. money supply gives negative impacts on the ANIEs' (including Korea) outputs. Variance decomposition in <Table 4.1> shows that U.S. monetary policy shocks explain 9.4 percent of forecast error in Korean output, which is 40 percent more than U.S. monetary policy shocks explain the forecast error variances of non-U.S. G7 outputs (6.7 percent)[26]. An interesting point to note is that Korean exports show a very similar response as Korean output in all of the three systems. Since one-third of Korean economy's GDP consists of exports it's not surprising to find the close

[26] See Kim (1998)'s results

relationships between exports and output. A more interesting point, I think, is why U.S. expansionary monetary policy generates such dynamics in Korean output and exports.

The expected depreciation (0.07 percent at the peak) of Korean won against U.S. dollar following the impact appreciation (0.05 percent at the trough) is somewhat beyond my expectations and the predictions of the main economic theories. Therefore I investigate further the impacts of U.S. monetary policy shocks on won/SDR[27], yen/dollar and won/yen exchange rates. As seen Figure A.4, I find not only that Korean won is expected to appreciate (0.10~0.13 percent) against Japanese yen and the SDR for 8 months and subsequently return to the original level but that the Japanese yen is expected to depreciate (0.2 percent at the peak) against the U.S. dollar for one year. Japanese money supply (M2) shows the positive response (0.15 percent at the peak) to U.S. expansionary monetary policy. I think this response is the cause of the depreciation of the Japanese yen against dollar and the subsequent depreciation of Korean won, relative to U.S. dollar, which is closely linked to yen. These results show

[27] I consider won/SDR exchange rate as the representative one in the international trade. The SDR represents the Special Drawing Right.

that the Korean won appreciates against the U.S dollar at the impact and subsequently appreciates against Japanese yen and the SDR, causing Korean exports to get negative impacts from U.S. expansionary policy by losing competitiveness in the world export markets. This is plausible since during 1980s and 1990s many Korean goods have faced severe competition, especially against Japanese goods in the U.S. markets. The appreciations of Korean won against the SDR and yen lower the price competitiveness of the Korean goods in the world export markets, reducing industrial production.

Another possible explanation for negative impacts on Korean output is through a fall in Korean consumer prices. The Korean money supply (M2) and output show negative response to the U.S. expansionary monetary policy, which are the causes of the fall in price levels. I cannot relate the change in import price to the change in consumer price levels. As we see in Figure A.8, the response of Korean import price is positive to U.S. monetary policy shocks. I infer that the monetary authorities of Korea are more concerned about imported inflation than the exchange rate of the Korean currency against U.S. dollar. As we see in Figure A.8, even though U.S. expansionary monetary policy shocks lower the nominal interest rate in Korea the real interest rates[28] rise because of a bigger fall in inflation rates. I infer that Korean consumption, investment and GDP get negative impacts from the hike in her real interest rates.[29]

I investigate the impacts of U.S. monetary policy shocks on Japanese output and find positive responses after 6 months. Since Korean output shows positive responses to the Japanese output, an indirect positive spillover effect on Korean output can be expected.

[28] I use 5-year corporate bond rates for the nominal interest rates and deduct CPI inflations from them to construct proxy for the real interest rates.

[29] I experiments with quarterly data with 3 lags due to the availability of consumption, investment and GDP data in quarterly frequency.

<Table 4.1> Forecast Error Variance Decomposition

U.S. Monetary Shocks

Korean Var.	steps	CEE-R(N)	CEE-R(C)	CEE-X(N)	CEE-X(C)	CEER-OIL1	CEER-OIL2
Industrial Production	6 months	2.4 (2.0)	1.9 (1.5)	2.7 (1.8)	1.9 (1.3)	1.7 (1.3)	1.7 (1.4)
	1 year	3.0 (2.4)	2.6 (2.3)	3.4 (2.2)	2.9 (2.1)	3.1 (2.6)	3.2 (2.5)
	2 year	4.2 (3.8)	4.0 (4.0)	4.2 (3.7)	4.1 (3.7)	7.5 (6.8)	7.6 (6.6)
	4 year	7.5 (7.0)	7.1 (6.4)	5.8 (5.1)	5.5 (4.8)	11.1 (10.0)	11.1 (9.7)
	5 year	9.4 (8.4)	8.9 (7.8)	7.0 (5.9)	6.4 (5.4)	12.0 (10.2)	11.9 (9.7)
Trade Balance	6 months	1.8 (1.3)	1.5 (1.1)	4.6 (2.5)	4.5 (2.6)	2.6 (2.0)	2.6 (1.9)
	1 year	2.5 (1.8)	2.2 (1.7)	6.0 (3.4)	6.2 (3.5)	4.5 (3.3)	4.5 (3.1)
	2 year	3.7 (3.4)	3.7 (3.6)	9.2 (5.7)	9.6 (5.7)	8.0 (6.1)	8.0 (6.1)
	4 year	9.8 (7.8)	10.6 (8.6)	8.4 (5.6)	8.5 (5.0)	10.1 (7.3)	10.0 (7.4)
	5 year	13.1 (9.7)	14.0 (10.3)	8.3 (5.6)	8.5 (5.4)	10.6 (7.5)	10.6 (7.6)
Exports	6 months	2.6 (1.6)	2.2 (2.0)	7.1 (2.9)	6.7 (3.0)	2.7 (1.5)	2.5 (1.5)
	1 year	3.3 (1.9)	5.2 (4.8)	7.1 (2.6)	6.6 (2.8)	3.5 (1.8)	3.3 (1.7)
	2 year	6.3 (4.1)	10.4 (9.1)	8.9 (3.4)	8.5 (3.6)	8.4 (5.0)	8.2 (4.7)
	4 year	9.3 (6.9)	11.8 (10.9)	11.1 (5.3)	10.9 (5.6)	14.4 (8.9)	14.4 (8.8)
	5 year	10.2 (7.6)	11.0 (9.7)	11.0 (5.3)	11.1 (5.6)	14.5 (9.1)	14.7 (8.8)

* Standard error in parenthesis.

4.2 Japan-Korea Relationship

4.2.1 Results of CEE-R system

In the system of {IP^J, CPI^J, PC^J, $CALL^J$, $M2^J$, Korean Variables}, innovations in Call Money Rates (CALL) are used as the variable of Japanese monetary policy shocks. As we see from impulse response graphs in Figure A.3, Japanese expansionary monetary shocks have short-run positive impacts (0.12 percent at the peak) on the Korean output for the first 20 months and long-run negative impacts (0.07 percent at the trough) from three to four years. The nominal exchange rate (won/yen) is expected to rise (0.17 percent at the peak) for the first two years and fall (0.18 percent at the trough) after three years. The Korean trade balance is expected to have no significant change for the first three years and subsequently deteriorates after three years. The current account is expected to improve (0.04 percent at the peak) at the impact, stay at the initial level for up to 4 years, and subsequently deteriorate (0.15 percent at the trough) after 4 years. Korean consumer prices are expected to fall (0.025 percent) at the impact and rise (0.08 percent at the peak) for 10 months and return to the original level thereafter. Korea's terms of trade are expected to deteriorate (0.05 percent at the trough) for the first 10 months, subsequently improve (0.09 percent at the peak) for up to 30 month, and deteriorate thereafter. The Korean money supply (M2) is expected to increase (0.08 percent at the peak) for up to one year.

As we see in <Table 4.2>, Japanese monetary policy shocks explain 3.5 percent of forecast error variance for the Korean outputs in 5 years, which is relatively small compared to U.S. monetary policy shocks. However, Japanese monetary policy shocks explain 9.5 percent and 4.3 percent for Korean trade balance and exports respectively.

4.2.2 Results of CEER-OIL

In the system of {IP^J, CPI^J, OIL^W, $CALL^J$, $M2^J$, Korean Variables}, innovations in Call Money Rates (CALL) are used as Japanese monetary policy shocks. As we see from impulse response graphs in Figure A.3, Japanese expansionary monetary shocks have short-run positive impacts (0.15 percent at the peak) on Korean output for the first 20 months and no long-run negative impacts as seen in the CEE-R system. The nominal exchange rate (won/yen) is expected to rise (0.2 percent at the peak) for two years and fall (0.15 percent at the trough) after three years. The Korean trade balance and current account are expected to persistently deteriorate (0.09 percent at the trough) because of a greater increase in imports. Korean consumer prices are expected to fall (0.025 percent) at the impact and persistently rise (0.1% at the peak) thereafter. Inclusion of the oil price makes the price levels persistently rise, different from the CEE-R system where consumer prices return to the original level after two years. Korea's terms of trade are expected to deteriorate (0.12 percent at the trough) for the first 10 months and return to the original level. The Korean money supply (M2) is expected to rise (0.11 percent at the peak) persistently. Positive responses of Korean money supply (M2) in three to four years are more significant in CEER-OIL than in CEE-R.

Variance decomposition, shown in <Table 4.2>, indicates that in the system of CEE-OIL, Japanese monetary shocks explain less of the forecast error variance for Korean output than in the CEE-R system. Japanese monetary policy shocks explain 3.4 percent of forecast error variance for the Korean output and 7.3 percent and 5.1 percent for trade balance and exports respectively.

4.2.3 Interpretation of Japan-Korea relationship

The two systems agree that impacts of Japanese monetary policy shocks on Korean output are significantly positive for the first 20 months. Inclusion of the oil price makes long-run negative effect insignificant. This result is similar to Kim (1998)'s finding that outputs of non-U.S. G7 countries show positive responses to U.S. monetary shocks after one year. It is also similar as the simulation result of McKibbin and Sunberg (1990) in which Japanese monetary policy stimulates Korean output for a year and subsequently reduces Korean output for next three years. Variance decomposition, shown in <Table 4.2>, indicates that Japanese monetary policy shocks explain 3.4 percent of the forecast error variance for Korean output, which is far less than the amount U.S. monetary policy shocks explain the variance of Korean output (9.4 percent). As in the U.S.-Korea relationship, Korean exports show very similar dynamics as her output. It increases for the first two years and decreases in three to four years in CEE-R system. Inclusion of the oil price makes long-run negative effect insignificant. To explain the causes of the increase in exports in the short-run, I look at the responses of nominal exchange rates. The Korean won is expected to depreciate against Japanese yen and the SDR for two years and appreciates thereafter. The Korean money supply (M2) shows positive responses to the Japanese expansionary monetary policy, which is the cause of depreciation of Korean won against the SDR and Japanese yen. Since many Korean goods are competing against Japanese goods in world exports markets, the depreciation of won against yen and SDR seem to boost Korean exports and outputs. Additional explanation can be provided through the rise in price levels. Japanese expansionary monetary policy shocks raise Korean price level persistently so that despite a small increase in the Korean nominal interest rates the real interest rates fall (See Figure A.8). The Korean money supply (M2) and output show strong positive responses to the Japanese expansionary monetary policy, which are, I think, the causes of the rise in the price levels. The Korean import price also slightly rises in response to the Japanese expansionary policy shocks. I infer that the monetary authorities of Korea are concerned more about the exchange rate between won and yen than the imported inflation. The decreases in the real interest rates seem to boost consumption, investment and output in Korea.

<Table 4.2> Forecast Error Variance Decomposition

Japanese Monetary Shocks

Korean Var.	steps	CEE-R(N)	CEE-R(C)	CEER-OIL1	CEER-OIL2
Industrial Production	6 months	2.3 (1.5)	1.4 (1.2)	2.1 (1.4)	2.0 (1.4)
	1 year	2.7 (1.9)	1.6 (1.4)	2.1 (1.5)	2.1 (1.6)
	2 year	2.8 (2.1)	1.8 (1.8)	2.8 (2.7)	2.2 (2.0)
	4 year	3.2 (2.7)	2.3 (2.2)	3.2 (3.2)	2.8 (2.5)
	5 year	3.5 (3.0)	2.6 (2.4)	3.4 (3.4)	3.0 (2.7)
Trade Balance	6 months	6.1 (3.2)	3.7 (2.3)	3.4 (1.7)	3.4 (1.7)
	1 year	8.3 (4.1)	5.6 (3.6)	4.5 (2.3)	4.5 (2.4)
	2 year	9.8 (5.1)	7.6 (5.1)	5.8 (3.4)	5.9 (3.5)
	4 year	9.8 (5.4)	8.2 (5.9)	7.0 (4.9)	7.4 (4.8)
	5 year	9.5 (5.2)	8.2 (6.0)	7.3 (5.3)	7.6 (5.1)
Exports	6 months	3.3 (1.7)	3.5 (2.2)	3.7 (2.1)	3.5 (2.0)
	1 year	4.2 (1.8)	4.6 (2.4)	4.4 (2.3)	4.2 (2.2)
	2 year	3.8 (2.1)	4.2 (2.3)	4.6 (2.9)	4.5 (2.9)
	4 year	4.0 (3.0)	5.0 (3.5)	5.0 (3.7)	5.0 (4.0)
	5 year	4.3 (3.5)	5.2 (3.7)	5.1 (3.9)	5.1 (4.2)

* Standard error in parenthesis.

Chapter 5

International Monetary Interdependence

When we discuss the international transmission mechanism of monetary policy shocks of country 'A' on country 'B' we implicitly assume that the money supply of country B is determined endogenously, i.e. it does not depend on the money supply of country A. Under this assumption expansionary monetary policy shocks in country A can result in the depreciation of the A's currency relative to the B's currency under a flexible exchange rate regime. If the money supply of country B is closely linked to the money supply of country A, the exchange rate between two currencies can show different dynamics depending on the relative size of increases in money supply. This will result in a different direction for the expenditure-switching effects. Under the Bretton Woods system, U.S. dollar was a reserve (key) currency and Korean won, as other currencies, was fixed[30] to the value of U.S. dollar. Therefore, Korean monetary policy was dependent on U.S. monetary policy in order to maintain the fixed exchange rate. When the U.S. adopted an expansionary monetary

[30] Korean won is pegged to U.S. dollar up to 1979:12 even after the collapse of the Bretton Woods system in 1971.

policy, Korean monetary authorities, in order to maintain the fixed exchange rate, would increase her money supply by buying U.S. dollars and selling Korean won in the market. This was 'the rule of the game'[31] under the Bretton Woods system. This means that in order to maintain the fixed exchange rate Korean economy would sacrifice such domestic goals as stability in prices and money supply. This has been mentioned as a pitfall of the fixed exchange rate system. On the other hand, the Korean monetary authorities, according to the theory, can conduct independent monetary policy under the flexible exchange rate regime, adopting other monetary policy goals. So, we can say that the monetary authorities gave relatively high weight to the exchange rate and trade balance goals under the fixed exchange rate regime and that they give relatively high weight to the domestic goals such as price stability under the flexible exchange rate regime. The current exchange rate system, what we call the flexible exchange system, is the managed floating system.

Many studies in the literature find that the money supply of the most developed economies depended on the U.S. money supply during the fixed exchange rate period.

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[31] This rule had not always been kept by central banks when we retrospect the history of the world economy

However, there are mixed results regarding to the independence of the developed economies' monetary policy under the flexible exchange rate regime. For example, Kim(1998) finds no significant interdependence of monetary policy between the U.S. and the aggregate G6 countries. Some results show that there are a few developed economies that maintain the independence of monetary policy, for example Sheehan (1987). A few researches have examined the monetary interdependence issue between the U.S. and developing countries. Among them, Moreno (1994) finds that the Korean economy is more insulated from U.S. shocks during the flexible exchange rate period. This implies that Korean monetary authorities set their monetary policy tools free from maintaining fixed exchange rates in order to pursue the other goals.

This chapter examines monetary interdependence between the U.S. and Korea and between Japan and Korea. Section 5.1 presents a simple IS-LM theoretical model and the outcome of the model with rational expectations solved for minimization of monetary authority's loss function subject to constraints imposed by the model. Section 5.2 and 5.3 present empirical results from using CEE-R system and CEER-OIL1 system. In the U.S.-Korea relationship, the data period for the fixed regime is 1960:1~1979:12 and the data period for the flexible regime is 1980:1 to 1997:10. Even after the collapse of Bretton Woods system in 1971, the Korean government pegged the value of the Korean won to U.S. dollar up until 1979:12. In the Japan-Korea relationship, the data period for the fixed regime is 1960:1~1972:12 and the data period for the flexible regime is 1973:1~1997:10.

5.1 A simple IS-LM model[32]

The model begins with equations for inflation and real output based on a Lucas supply function and output demand. To these are added equations for exchange rate determination, money demand and the monetary authority's objective function. For ease of exposition, a one-period maximum lag length restriction is imposed. This restriction does not alter the theoretical results. Time subscripts are omitted except for lags.

$$\dot{q} = \alpha_0 + \alpha_1(\dot{p} - E_{-1}\dot{p}) + \alpha_2\dot{q}-1 + \varepsilon_1 \qquad \alpha_1 > 1,\ 0 \le \alpha_2 < 1 \qquad 5.1$$

$$\dot{q} = \beta_0 + \beta_1(I - E\dot{p}_{+1}) + \beta_2 X + \varepsilon_2 \qquad \beta_1 < 0 \qquad 5.2$$

[32] This section is based on Sheehan (1992)

$$\Delta e = \tau_1(Er - E_{-1}r) + \tau_2 Z + \varepsilon_3 \qquad \tau_1>0 \qquad 5.3$$

$$\dot{m} = \delta_0 + \delta_1 \dot{m}-1 + \delta_2 i + \delta_3 \dot{q} + \delta_4 \dot{p} + \varepsilon_3 \qquad 0<\delta_1 \text{ and } \delta_4<1; \quad \delta_2<0; \ \delta_3>0 \qquad 5.4$$

$$\text{Min } L = \phi_1(E\dot{p} - \dot{p}^*)^2 + \phi_2(E\dot{q} - \dot{q}^*)^2 + \phi_3(Ei - i^*)^2 + \phi_4(E\Delta e)^2 + \phi_5(E\dot{p}_{+1} - \dot{p}^*)^2 + \phi_6(E\dot{q}_{+1} - \dot{q}^*)^2 + \phi_7(Ei_{+1} - i^*)^2 + \phi_8(E\Delta e_{+1})^2 \qquad 5.5$$

where $\dot{p}$ ≡ inflation rate, $\dot{m}$ ≡ money growth rate,

$\dot{q}$ ≡ growth rate of real output, i ≡ nominal interest rate,

e ≡ exchange rate (local currency per dollar)

r ≡ real interest rate ≡ i- $E\dot{p}_{+1}$

X ≡ vector of predetermined variables, other than lagged money growth, affecting the demand for good.

Z ≡ vector of predetermined variables influencing the exchange rate

E ≡ the expectation operator and * is a monetary authority's target.

Equation (5.1) describes the Lucas supply function. Current output depends on the gap between the actual price level and last period's expectation of this period's price level. Last period's output can be included based on a partial adjustment view or upon an argument that the normal level of output belongs in the equation. ε_1 is a vector of supply disturbances.

Equation (5.2) presents an **IS** schedule expressing output as a function of the real interest rate, a vector of exogenous variables, X, and a demand shock, ε_2. The vector X includes six terms. Since demand may adjust gradually to exogenous shocks, the vector X includes lags of inflation, real output growth and the exchange rate. In addition, U.S. inflation and real output growth, $\dot{p}^{us}$ and $\dot{q}^{us}$, are included in the X vector as proxy measures of world inflation and of world demand for this country's exports. Lags of $\dot{p}^{us}$ and $\dot{q}^{us}$ are included to allow partial adjustment. Finally, current and lagged values of U.S. money growth, $\dot{m}^{us}$, are included to allow U.S. money growth to directly affect real output growth in other countries. This impact of U.S. money growth is independent of U.S. monetary policy altering world interest rates (captured by the term in equation (5.3)) or altering U.S. inflation or U.S. real output growth (captured by the coefficients on the $\dot{p}^{us}$ and $\dot{q}^{us}$ terms in the vector X). The U.S. money growth terms capture any direct impact of U.S. monetary policy.

Relative interest rate parity underlies exchange rate determination, equation (5.3). Rational expectations suggest that exchange rates should change only in response to new information. Thus, the exchange rate should change if interest rate interest rate expectations in this country change relative to those in the United States. Exchange rate changes depend on changes in the expected domestic real interest rate and a vector, Z, of exogenous variables that includes changes in the expected U.S. real interest rate: $(Er^{US} - E_{-1}r^{US})$. Higher expected domestic rates generate currency appreciation while higher expected U.S. rates produce currency depreciation. Since the real U.S. interest rate and its expectation are unobservable, the U.S. money growth rate is included instead.

Equation (5.4) is a money demand equation assuming a nominal adjustment mechanism with money demand decreasing when interest rates increase or income decreases. Equation (5.5) states the monetary authorities' loss function following Cosimano and Van Huyck (1989). For expositional simplicity a two-period horizon is assumed. The monetary authority is assumed to react to expected deviations from targets in current and future inflation, real output growth, the nominal interest rate, and the exchange rate. Including the interest rate allows the monetary authority to attempt to target an interest rate variable. Including the exchange rate gives the monetary authority the option of fixing the exchange rate.

If the monetary authority does not know the current values when determining this period's money growth, it must form expectations of current prices and output. Its rational expectation solution of equations (5.1) to (5.5) for optimal money growth then yields

$$\dot{m} = \Phi_0 + \Phi_1 \dot{m}_{-1} + \Phi_2 \dot{q}_{-1} + \Phi_3 EZ + \Phi_3 EZ_{+1} + \Phi_4 EX + \Phi_5 EX_{+1} + \Phi_6 EX_{+2} + \ldots \tag{5.6}$$

Where the Φ_i's are complex functions of the parameters in equations (5.1) to (5.5) and Φ_0 also is a function of the target values. Based on equation (5.6), one must conclude that U.S. variables, including U.S. money growth, may influence money growth in other countries.

5.2 U.S.-Korea relationship

5.2.1 CEE-R system

As we see in Figure A.5, during the period of fixed exchange rate regime (1960:1~ 1979:12), the Korean money supply (M2) persistently shows significant positive responses[33] (0.2 percent at the peak) to U.S. expansionary monetary policy shocks, which means a strong monetary interdependence existed to maintain the fixed exchange rate.

During the period of flexible exchange rate regime (1980:1~1997:10), the Korean money supply (M2) shows negative responses (0.15 percent at the trough) for the first two years, which means Korean monetary authorities don't follow U.S. monetary policy stance, i.e. they set monetary policy tools free from maintaining the fixed exchange rate in order to pursue other monetary policy goals, such as price stability.

5.2.2 CEER-OIL1 system

To make a robustness check I included the oil price instead of the commodity price (PC), i.e. experiments with the CEER-OIL1 system. During the period of fixed exchange

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[33] See Figure A.5.

rate regime (1960:1~ 1979:12), Korean money supply (M2) shows significant positive responses[34] (0.2 percent at the peak) to U.S. expansionary monetary policy shocks for two years, which means a strong monetary interdependence to maintain the fixed exchange rate. Inclusion of the oil price makes impulse responses from three to five years more significant than in CEE-R. Furthermore, in CEER-OIL1, the Korean money supply (M2) shows negative response after 3 years. In CEE-R we do not find negative responses.

During the period of the flexible exchange rate regime (1980:1~1997:10), the Korean money supply (M2) shows negative responses (0.15 percent at the trough) for the first two years, which means the Korean monetary authorities set monetary policy tools free from maintaining fixed exchange rates in order to pursue the other goals, such as price stability. Inclusion of the oil price doesn't make any significant difference.

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[34] See Figure A.5.

5.3 Japan-Korea Relationship

5.3.1 CEE-R system

During the period of fixed exchange rate regime (1960:1~ 1972:12), Korean money supply (M2) shows positive responses (0.06 percent at the peak) to Japanese expansionary monetary policy shocks for the first 10 months, and subsequently negative responses (0.13 percent at the trough) up to second year. This means weak monetary interdependence between Japan and Korea.

During the period of flexible exchange rate regime (1973:1~1997:10), Korean money supply (M2) persistently shows positive responses (0.07 percent at the peak), which means a strong monetary interdependence between Japan and Korea. One possible explanation is that Korean monetary authorities use monetary policy tools to prevent its currency (won) from appreciating against yen.

5.3.2 CEER-OIL1 system

To make a robustness check I include the oil price instead of the commodity price (PC), i.e. CEER-OIL1. During the period of fixed exchange rate regime (1960:1~ 1972:12), Korean money supply (M2) shows unstable responses to Japanese expansionary monetary policy shocks as McKibbin and Sunberg (1990) find. It shows up and down responses (0.06 percent at the peak and the trough) for the first 10 months, and subsequently negative responses (0.13 percent at the trough) up to second year. This means weak monetary interdependence between Japan and Korea during the fixed exchange regime. Inclusion of the oil price makes impulse responses after three years more significant.

During the period of flexible exchange rate regime (1973:1~1997:10), the Korean money supply (M2) persistently shows positive responses (0.07 percent at the peak), which means a strong monetary interdependence between Japan and Korea. One possible explanation is that Korean monetary authorities use monetary policy tools to prevent its currency (won) from appreciating against yen. Inclusion of the oil price doesn't make significant difference in the result.

5.4 Interpretation of results

Korean monetary authorities have set its monetary policy tools free from maintaining the exchange rates between U.S. dollars and Korean won during the flexible exchange rate regime (1980:1~1997:10), while they had followed U.S. monetary policy stance during the period of the fixed exchange rate regime (1960:1~1979:12). By doing so, they can attain the goal of stability of price levels as we see from the impulse responses of Korean consumer prices in Figure A.1.

In other hand they have still followed Japanese monetary policy stance during the flexible exchange regime (1973:1~1997:10) period for keeping its currency undervalued (depreciated) against Japanese yen, while they didn't significantly follow the Japanese monetary policy stance during the fixed exchange regime period (1960:1~1972:12).

Chapter 6

Domestic Transmission of U.S. and Japanese Monetary Policy Shocks

In chapter four and five we discuss about the international transmission of monetary policy shocks from two developed countries (U.S. and Japan) to a developing country (Korea) based on the empirical data. In these discussions, U.S. and Japanese economy are set as the origins of the monetary shocks and impacts of those monetary shocks on the Korean economy are thoroughly examined. In order to complete the story of international transmission of monetary policy shocks, we now need to examine what is happening in U.S. and Japanese economy when there are positive innovations in their money supply.

There are a large number of studies on the issue of the domestic transmission mechanism of monetary policy shocks. Mishkin (2000) categorizes the transmission channels introduced in literature into three groups: the traditional interest rate channel, other asset price channels and the credit view. In the traditional interest rate channel an increase in the money supply lowers real interest rates, causing a rise in investment and consumer durable expenditure, thereby leading to a rise in output.

The other asset price channels include the following three effects: exchange rate effects on net exports[35], Tobin's q effects and wealth effects. The exchange rate channel, by recent research, has been found to play an important role in how monetary policy affects the domestic economy. According to this channel, when there is a rise in domestic money supply, real interest rates fall and the domestic currency depreciates, causing a rise in net exports and output.

James Tobin developed a theory, referred to as Tobin's q theory, which explains how monetary policy shocks can affect the economy through its effects on the stock prices. When there is a rise in the money supply, stock prices and Tobin's q[36] rise, stimulating investment and output. The wealth effect was first introduced by Franco Modigliani who thought that consumers smooth out their consumption over the lifetime. Therefore the lifetime resources, not just today's income, determines consumption spending. In this channel, a rise in stock (equity) prices resulted from a

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[35] Net exports are equal to exports minus imports, so equivalent to trade balance.

[36] Tobin's q means (market value of firms/replacement cost of capital)

rise in money supply causes a rise in wealth, stimulating consumption and output.

The credit view, proposed by economists dissatisfied with the conventional interests channel explanation, is based on the problem of asymmetric information in financial markets. Five channels are included in this category: the bank lending channel, the balance sheet channel, the cash flow channel, the unanticipated price level channel, and the household liquidity effects.

The bank lending channel is based on the analysis that certain borrowers will not have access to the credit markets unless they borrow from banks. Expansionary monetary policy, which increases bank reserves and bank deposits, increases the quantity of bank loans available. Investment and output subsequently rise due to the availability of fund.

The balance sheet channel is also, like bank lending channel, based on the asymmetric information problem in financial markets. Expansionary monetary policy raise stock (equity) prices and the net worth of firms, causing a rise in lending resulted from the decrease in adverse selection and moral hazard problems. A rise in lending will cause the rise in investment and output. Another balance sheet channel operates through its effects on cash flow.

Expansionary monetary policy, which lowers nominal interest rate, increases the liquidity of firm by increasing cash flow[37]. With the decrease in adverse selection and moral hazard problem due to the increase in the liquidity, lending, investment and output increase. A third balance sheet channel operates through monetary policy effects on the general price level (unanticipated price level channel). Since debt payments are contractually fixed in nominal terms, an unanticipated rise in the price level from the expansionary monetary policy lowers the burden of the firms' liability in real terms, causing the decrease in adverse selection and moral hazard problem, therefore lending, investment and output subsequently rise.

Household liquidity effects focus on the balance sheet of household. Expansionary monetary policy, which raises stock prices, increases the value of financial assets that households own. A subsequent decrease in the likelihood of financial distress will cause the increase in expenditure on both consumer durables and housing. Output rises as a result.

In this chapter the domestic transmission mechanism of monetary policy shocks on output is examined in the U.S.

[37] The meaningful cash flow in deciding the liquidity of firms is the present value of future cash flow, which is calculated after being discounted by the interest rate. A fall in the interest rate increases the present value of cash flow.

and Japanese economy with a focus on international variables such as exchange rates and trade balance. Important empirical studies in this issue are McKibbin and Sunberg (1990) and Kim (1998).

McKibbin and Sunberg find that U.S. expansionary monetary policy increases its output because of short-run rigidity of nominal wages. The rise in money reduces nominal interest rates, which stimulates private demand. The trade balance changes by very little because the rise in imports due to stronger demand (income-absorption effect) is offset partly by the increase in exports and partly by the decrease in imports resulted from a depreciation of the exchange rate. Japanese expansionary monetary policy increases its output but the size of the impact is smaller than the impact of U.S. monetary policy on its output. The Japanese trade balance improves only for a year due to the depreciation of yen.

Kim finds that U.S. expansionary monetary policy increases its output, exports and imports. The nominal exchange rate rises (depreciates) for a year and falls (appreciates) after one year. The trade balance deteriorates for one year and improves persistently thereafter. He interprets this finding in terms of the income-absorption effect dominating in the short run and the expenditure-switching effect dominating in the long run.

He further examine the major channel of intertemporal model and finds that in the short run the increase in income resulting from a fall in the real interest rate is greater than the increase in consumption and also the increase in investment is greater than the associated increase in saving (i.e. trade balance and current account deteriorate in the short run). In the long run the increase in saving is greater than the increase in investment, which cause improvements in trade balance and current account.

To examine the impacts of U.S. and Japanese expansionary monetary policy shocks on their domestic variables, I use two VAR systems that can be used commonly well in both U.S. and Japanese economy: CEE-R system and CEER-OIL1 system. For other U.S. and Japanese variables, I use the nominal effective exchange rate, exports, imports, the trade balance and the current account balance. To examine the impacts of monetary policy shocks on current account balance, I experiment with a quarterly system[38].

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[38] I use five variable system({RGDP, PGDP, PC, FFR, CA} with 4 lags). RGDP denotes log of real GDP. PGDP denotes log of GDP deflator. PC denotes log of commodity price, CA denotes current account balance.

6.1 U.S. Economy

6.1.1 CEE-R system

Domestic transmission of U.S. monetary policy shocks are examined in the system of {IP^{US}, CPI^{US}, PC^{US}, FFR^{US}, $M1^{US}$, other U.S. domestic variables}, where innovations in the Federal Funds Rates (FFR) are used as measure of the U.S. monetary policy shocks. As we see in Figure A.6, U.S. industrial production starts to rise after four months following the expansionary monetary policy after falling at the impacts. The consumer prices show the positive response (0.10 percent at the peak) after ten months and return to the original level after three years. The commodity prices start to rise after six months as the industrial production rises. Money supply (M1) falls at the impact starts to rise after six months and returns to the original level after three years.

The U.S. dollar[39] depreciates (0.18 percent at the peak) against 17 industrial countries' currencies for one year and appreciates (0.10% at the peak) after three years. The exports decrease at the impact and start to increase following the dollar's depreciation. The imports increase at the impact and decrease over time. The trade balance

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[39] See figure A.4.

deteriorates for a year and starts to improve after two years. The current account improves after three years.

As we see in <Table 6.1>, U.S. monetary policy shocks explain 35.1 percent of the forecast error in its industrial production. Also monetary shocks explain 15.4 percent and 12.1 percent of the forecast error variance in trade balance and exports respectively.

6.1.2 CEER-OIL1 system

Domestic transmission of U.S. monetary policy shocks is examined in the system of {IP^{US}, CPI^{US}, OIL^{W}, FFR^{US}, $M1^{US}$, other U.S. domestic variables}, where the innovations in the Federal Funds Rates (FFR) are used as the measure of the U.S. monetary policy shocks. The oil price is used instead of commodity price.

As we see in Figure A.6, U.S. industrial production starts to rise after four months following the expansionary monetary policy after falling at the impacts. The consumer prices show the positive response (0.10 percent at the peak) after four months and return to the original level after three years. Money supply (M1) falls at the impact and starts to rise after six months. After one year M1 stay at the increased level persistently. U.S. dollar depreciates (0.15 percent at the peak) for one year and appreciates (0.09 percent at the peak) after three years. The exports decrease at the impact and start to increase persistently following the dollar's depreciation. The imports increase at the impact (0.05 percent at the peak) and return to the original level over time. The trade balance deteriorates for a year and starts to improve after two years.

As we see in <Table 6.1>, U.S. monetary policy shocks explain 36.0 percent of the forecast error in its industrial production. Also monetary shocks explain 13.8 percent and 20.0 percent of forecast error variance in trade balance and exports respectively.

6.1.3 Interpretation of U.S. system

Both systems (CEE-R and CEER-OIL1) show that U.S. expansionary monetary policy increases its output after four months. This result is consistent with Kim (1998)'s finding and McKibbin and Sunberg (1990)'s result. One thing to note is that U.S. trade balance shows similar dynamics with its output. The trade balance starts to improve after one year. Exports rise after one year following the depreciation of U.S. dollar, while imports don't significantly increase over the same time period. The trade balance deteriorates for the first one year from the increase in imports and the decrease in exports. The increase in imports can be explained by the income-absorption effect. The decrease in exports in the short run can be explained by J-curve effect.

Inclusion of the oil price doesn't cause any significant difference in the impulse responses as we see in Figure A.6. However, as presented in <Table 6.1> the explanation power of U.S. monetary policy shocks on exports doubles in the CEER-OIL1 system compared to the CEE-R system.

6.2 Japanese Economy

6.2.1 CEE-R system

The domestic transmission of the Japanese expansionary monetary policy is examined in the system of {IP^J, CPI^J, PC^J, $CALL^J$, $M2^J$, other Japanese domestic variables}, where innovations in the Call Money Rates (CALL) are used as the measure of Japanese monetary policy shocks. As we see in Figure A.7, Japanese industrial production starts to rise after 12 months following the expansionary monetary policy shocks. The consumer price starts to rise (0.2 percent at the peak) after six months and return to the original level after four years. The producer prices rises after one year as the industrial production rises. The money supply (M2+CD) shows an unstable response: a short period of positive response and a negative response for two years and a positive response after three years. Japanese yen depreciates (0.2 percent at the peak) for two years and appreciates (0.15 percent at the trough) after three years. The exports increase (0.05 percent at the peak) following the yen's depreciation. The imports also increase (0.12 percent at the peak) as the industrial production rises. The trade balance starts to fall after one year as the increase in imports exceeds the increase in imports. As we see in <Table 6.1>, Japanese monetary policy shocks explain 3.6 percent of the forecast error variance in its industrial production. Also monetary shocks explain 7.0 percent and 9.9 percent of forecast error in trade balance and exports respectively.

6.2.2 CEER-OIL1 system

Domestic Transmission of the Japanese expansionary monetary policy is examined in the system of {IP^J, CPI^J, OIL^W, $CALL^J$, $M2^J$, other Japanese domestic variables}, where the innovations in the call money rates are used as the monetary policy shocks. The oil price is used instead of commodity price (PC). As we see in figure A.7, Japanese industrial production starts to rise after a year following the expansionary monetary policy shocks. The consumer price starts to rise (0.10 percent at the peak) after six months and return to the original level after four years. The money supply (M2+CD) shows unstable responses: a short period of positive response and a negative response for two years and a positive response after three years. Japanese yen depreciates (0.18 percent at the peak) for two years and appreciates (0.12 percent at the trough) after three years. Exports increase (0.18 percent at the peak) following the yen's depreciation. The imports also increase (0.12 percent at the peak). The trade balance improves for a year since the increase in exports is greater than the increase in imports. Trade balance starts to fall after two years as the persistent increase in imports dominates the increase in exports. As we see in <Table 6.1>, Japanese monetary policy shocks explain 14.0 percent of the forecast error variance in its industrial production. Also, monetary shocks explain 7.2 percent and 7.9 percent of the forecast error variance in trade balance and exports respectively.

6.2.3 Interpretation of Japanese System

Both systems (CEE-R and CEER-OIL1) show that Japanese expansionary monetary policy persistently increases its output after 12 months. This result is a little different from Kim (1998)'s finding and McKibbin and Sunberg (1990)'s result. One thing to note is that Japanese trade balance shows different dynamics from its output's. Trade balance improves (in CEE-R system) or doesn't change (in CEER-OIL1 system) for two years and starts to deteriorate after three years in both systems. Exports significantly rise from the depreciation of Japanese yen while imports don't increase as much over the same time period. The trade balance deteriorates after three years from the persistent increase in imports and the decrease in exports. The increase in imports in the long run can be explained by the income-absorption effect.

Inclusion of the oil price brings significant difference to impulse responses as we see in Figure A.7, especially on trade balance items. This result is consistent with the studies that find the importance of oil price shocks in identifying monetary policy shocks in the Japanese economy. Also, as we see in <Table 6.1> the explanation power of Japanese monetary policy shocks on its output becomes four times as big as in the CEE-R system.

6.3 Interpretation of Results

Domestic transmission of U.S. and Japanese monetary policy shocks is examined and explained in this chapter with a focus on the output and trade balance effects. Both systems (CEE-R and CEER-OIL1) show that U.S. and Japanese expansionary monetary policy increase their outputs after four to twelve months. This result is consistent with Kim (1998)'s finding and McKibbin and Sunberg (1990)'s result. One thing to note is that U.S. trade balance shows similar dynamics with its output. The trade balance starts to improve after one year. Exports rise after one year following the depreciation of the U.S. dollar, while imports don't significantly increase over the same time period. The trade balance deteriorates for the first one year from the increase in imports and the decrease in exports. The increase in imports can be explained by the income-absorption effect. The decrease in exports in the short run can be explained by J-curve effect. The Japanese trade balance shows different dynamics from its output. The trade balance improves (in CEE-R system) or doesn't change (in CEER-OIL1 system) for two years and starts to deteriorate after three years in both systems. In the short-run Exports significantly rise from the depreciation of Japanese yen while imports don't increase as much over the same time period. Trade balance deteriorates after three years from the persistent increase in imports and the decrease in exports. The increase in imports in the long run can be explained by the income-absorption effect.

Inclusion of the oil price doesn't cause any significant difference to impulse responses of U.S. domestic variables as we see in Figure A.6, while inclusion of the oil brings significant difference to impulse responses of Japanese domestic variables as we see in Figure A.7, especially on trade balance items. However, as presented in the Table 6.1, the explanatory power of both U.S. monetary policy shocks on its exports and output and Japanese monetary policy shocks on its exports are significantly increased in the CEER-OIL1 system compared to the CEE-R system.

<Table 6.1> Forecast Error Variance Decomposition for U.S. and Japanese Domestic Transmission

Var.	steps	U.S. Economy		Japanese Economy	
		CEE-R	CEER-OIL1	CEE-R	CEER-OIL1
Industrial Production	6 months	7.2 (3.9)	5.2 (3.1)	1.1 (1.1)	1.4 (1.2)
	1 year	25.8 (9.5)	21.8 (8.9)	1.9 (2.1)	3.0 (2.9)
	2 year	39.1 (13.9)	38.9 (13.6)	3.0 (3.5)	7.9 (6.9)
	4 year	37.3 (15.3)	38.9 (15.5)	3.5 (4.1)	12.9 (11.2)
	5 year	35.1 (15.1)	36.0 (15.4)	3.6 (4.1)	14.0 (12.2)
Trade Balance	6 months	3.2 (2.1)	3.6 (2.5)	3.5 (2.2)	2.6 (1.4)
	1 year	10.2 (6.1)	9.2 (5.3)	5.3 (3.3)	3.6 (2.1)
	2 year	14.4 (9.3)	14.1 (9.1)	7.2 (4.9)	5.4 (3.7)
	4 year	14.6 (9.1)	13.8 (9.5)	7.1 (4.8)	6.8 (5.1)
	5 year	15.4 (9.3)	13.8 (9.4)	7.0 (4.0)	7.2 (5.4)
Exports	6 months	2.3 (1.8)	1.9 (1.5)	2.9 (1.5)	4.4 (2.9)
	1 year	3.1 (2.1)	6.1 (4.3)	6.1 (2.7)	4.7 (3.2)
	2 year	6.8 (6.1)	20.1 (10.5)	10.5 (4.9)	5.4 (3.6)
	4 year	10.5 (9.0)	22.6 (14.4)	10.2 (5.2)	6.7 (5.2)
	5 year	12.1 (9.8)	20.0 (13.8)	9.9 (5.0)	7.9 (6.0)

* Standard error in parenthesis.

Chapter 7

Summary and Conclusion

This paper examines, using impulse response graphs and forecast error variance decomposition in the VAR methodology, the international transmission mechanism of monetary policy shocks from the U.S. and Japan to the case of Korea. I try to explain the detailed transmission mechanism of changes in economic activity from the U.S. and Japan to the Korean economy. In so doing, I found several models to explain the transmission mechanism from developed economies to newly industrializing countries in Asia. This approach is better than the previous ones in literature in that we do not need to depend on hundreds of incredible assumptions about the economy.

The international transmission of monetary policy shocks from developed economies (U.S. and Japan) to the output of a developing economy (Korea) is examined in chapter 4 and found to have been different from that from developed economies to developed economies during the flexible exchange rate regime. Especially, the Korean economy, which has one third of GDP in exports, responds in a different way to U.S. and Japanese expansionary monetary shocks. Korean output shows negative responses to U.S. expansionary monetary policy shocks and positive responses to the Japanese expansionary monetary policy shocks. Changes in Korean output are explained through changes in Korean trade balance and real interest rate.

The trade balance effect on output in the short run can be explained after examining the expected responses in the exchange rates and money supply. Important factors are the money supply in Korea and Japan, exchange rates (won/yen won/SDR), and export dynamics resulting thereof. Depreciation of the Korean won against Japanese yen and the SDR, which is the case with Japanese expansionary monetary policy, boosts Korean exports and output. The Korean money supply (M2) shows a strong positive dependence on Japanese monetary policy under the flexible exchange rate regime. Appreciation of Korean won against Japanese yen and the SDR and the impact appreciation of the won relative to U.S. dollar, which is the case with U.S. expansionary monetary policy shocks, decreases Korean exports and output. This plausibly explains the reality that many Korean goods (including textiles, automobiles, electronics and steels) compete against Japanese goods in the world exports markets, especially in the U.S. market.

Another explanation for the changes in Korean output is made through the changes in Korean price levels. In the U.S.-Korea relationships U.S. expansionary monetary policy shocks raise the real interest rates by lowering Korean price levels even though the nominal interest rates rise at the impact and subsequently fall, so that they give negative impacts on Korean consumption, investment and output. The persistent fall in Korean price levels can be explained by the fall in money supply as well as the fall in output. I cannot relate the change (fall) in Korea's consumer price levels to the change (rise) in the import price. I infer that the Korean monetary authorities were more concerned about imported inflation from the U.S. monetary shocks than rising real interest rates.

In the Japan-Korea relationship, Japanese expansionary monetary policy shocks lowered the real interest rate by raising Korean price levels even though the nominal interest rates rose slightly, resulting in positive impacts on Korean consumption, investment and output. The changes in the Korean price levels are explained by the increase in the Korean money supply (M2) as well as the rise in output. The Korean import price also rose slightly in response to the Japanese expansionary monetary shocks.

The major channel of the intertemporal model that predicts the increases in consumption, investment and output of the foreign economies resulted from a fall in the world real interest rates in case of an expansionary monetary policy in a large open home economy (for example the U.S.) cannot be found in the U.S.-Korea relationship. This is, I think, due to the limited opening of Korean capital markets during the sample period.

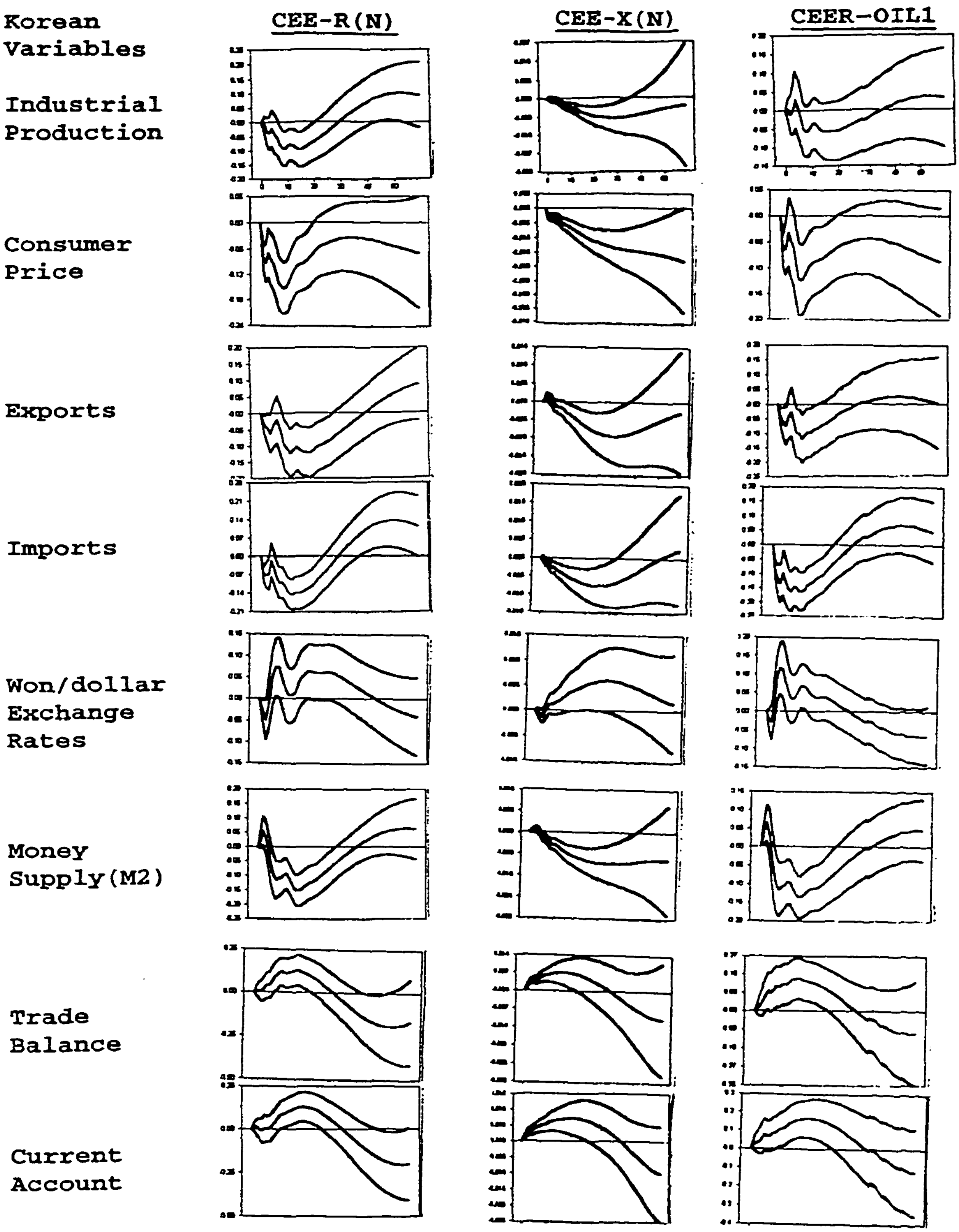
The international monetary interdependence issue is examined in chapter 5 in the close relations between two developed economies (the U.S. and Japan) and a developing economy (Korea). The findings of this paper that the exchange rates (won/dollar, won/yen, yen/dollar) show different dynamics from the predictions of theory imply that the Korean monetary authorities restrict monetary policy tools to maintain the target exchange rate. The Korean monetary authorities seem to free monetary policy from maintaining the exchange rates between U.S. dollars and Korean won during the flexible exchange rate regime, while they had followed the U.S. monetary policy stance under the fixed exchange rate regime. On other hand, they still follow Japanese monetary policy stance during the flexible exchange regime for keeping its currency under valued (depreciated) against Japanese yen in order to maintain price competitiveness in the world export markets. Monetary dependence of Korean economy on Japanese monetary policy stance is found to be weak under the fixed exchange rate regime.

Domestic transmission of U.S. and Japanese monetary policy shocks is examined and explained in Chapter 6 with a focus on the output and trade balance effects to complete the story of international transmission of monetary policy shocks. Both systems (CEE-R and CEER-OIL1) show that U.S. and Japanese expansionary monetary policy increase their outputs after four to twelve months. One thing to note is that the U.S. trade balance shows similar dynamics with its output. The trade balance starts to improve after one year. Exports rise after one year following the depreciation of U.S. dollar, while imports don't significantly increase over the same time period. The trade balance deteriorates for the first one year from the increase in imports and the decrease in exports. The increase in imports can be explained by the income-absorption effect. The decrease in exports in the short run can be explained by J-curve effect. The Japanese trade balance shows different dynamics from its output. The trade balance improves (in CEE-R system) or doesn't change (in CEER-OIL1 system) for two years and starts to deteriorate after three years in both systems. In the short-run Exports significantly rise from the depreciation of Japanese yen while imports don't increase as much over the same time period. Trade balance deteriorates after three years from the persistent increase in imports and the decrease in exports. The increase in imports in the long run can be explained by the income-absorption effect.

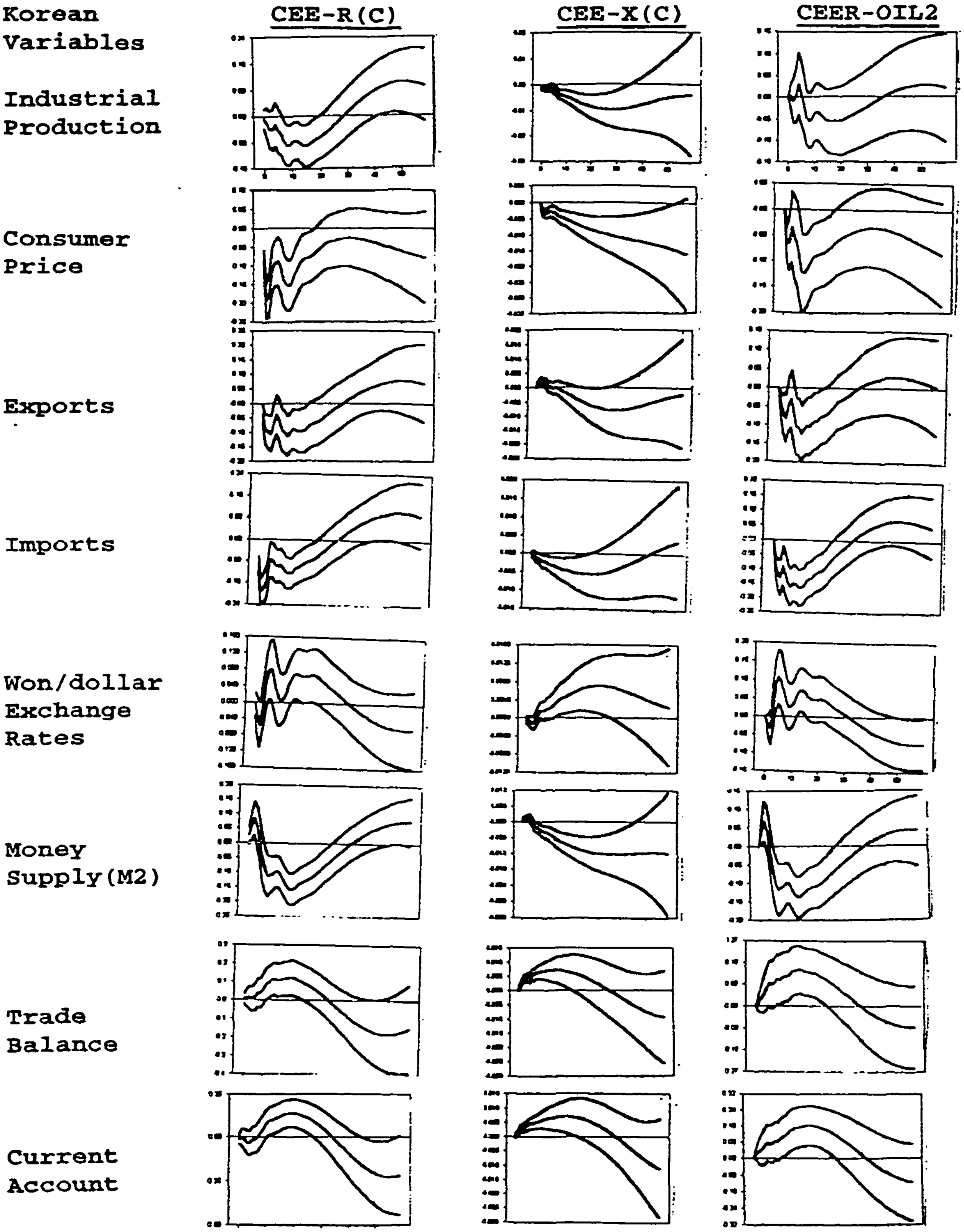
Inclusion of the oil price doesn't bring any significant difference to impulse responses of U.S. domestic variables as we see in Figure A.6, while inclusion of the oil brings significant difference to impulse responses of Japanese domestic variables as we see in Figure A.7, especially on trade balance items. However, as presented in the Table 6.1, the explanatory power of both U.S. monetary policy shocks on its exports and output and Japanese monetary policy shocks on its exports are significantly increased in the CEER-OIL1 system compared to the CEE-R system.

In this paper, I try to explain, in a detailed manner, the transmission mechanism from the U.S. and Japanese economy to Korean economy by extending my research to include related variables. Nonetheless I should admit that some results still show empirical irregularity. I think that further study can be made of cases for other developing countries to find more empirical evidence that can be used to explain the international transmission mechanism of monetary policy shocks from developed countries to developing countries.

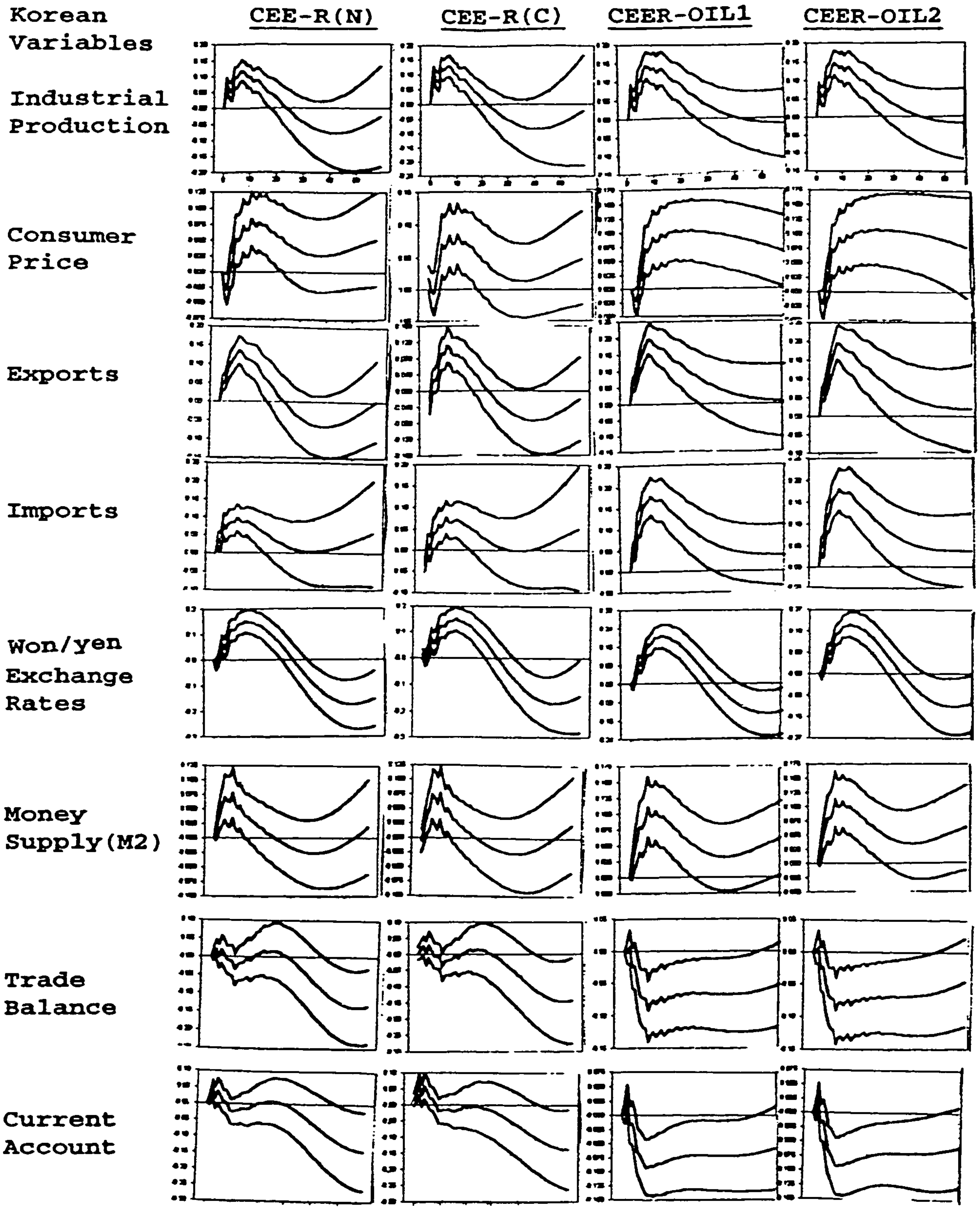
<Figure A.1> Responses to U.S. Expansionary Monetary Shocks (N)



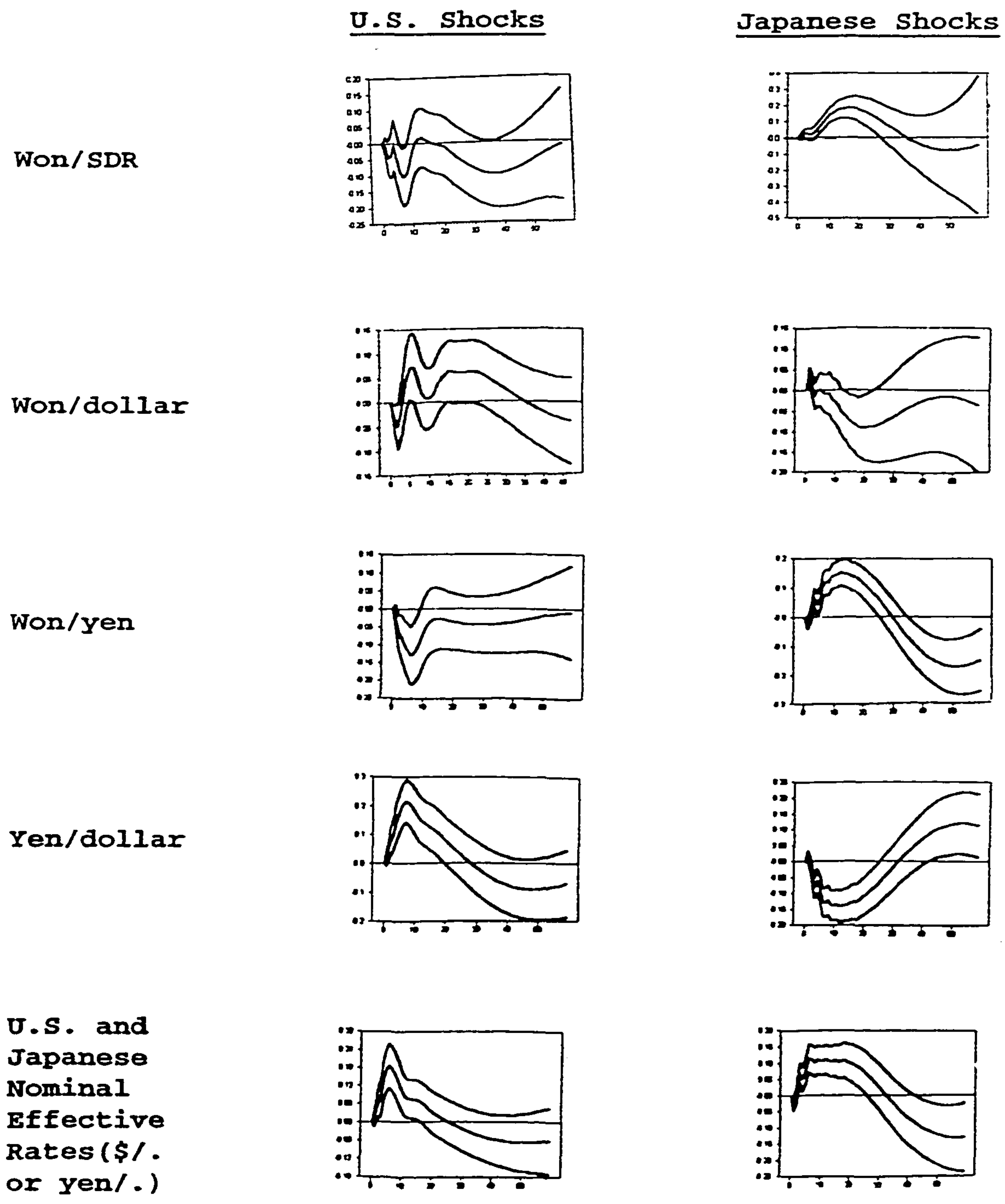
<Figure A.2> Responses to U.S. Expansionary Monetary Shocks(C)



<Figure A.3> Responses to Japanese Expansionary Monetary Shocks



<Figure A.4> Expansionary Monetary Shocks on Exchange Rates[40]



[40] I experiments with CEE-R (N) system.

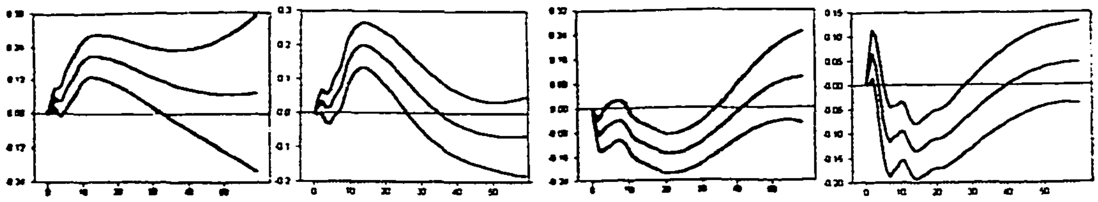
<Figure A.5> International monetary Interdependence

U.S. monetary shocks

Fixed regime | flexible regime

CEE-R | CEER-OIL1 | CEE-R | CEER-OIL1

Korea M2

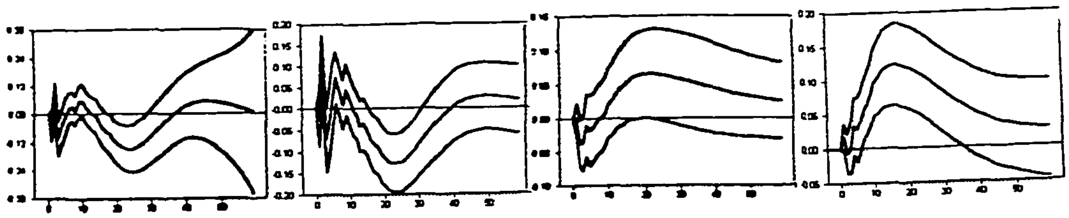


(1960:1~1979:12) (1980:1~1997:10)

Japanese Monetary Shocks

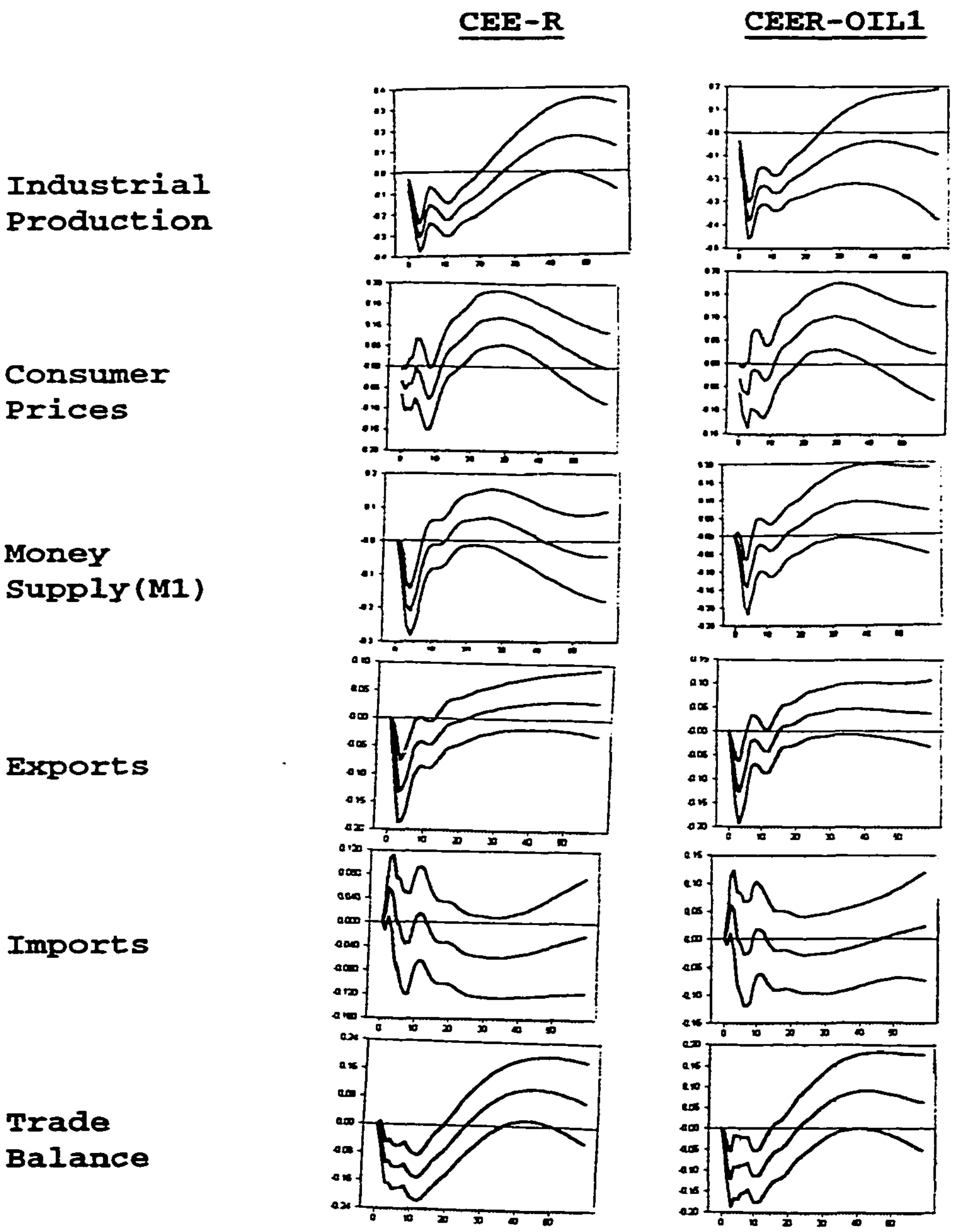
CEE-R | CEER-OIL1 | CEE-R | CEER-OIL1

Korea M2

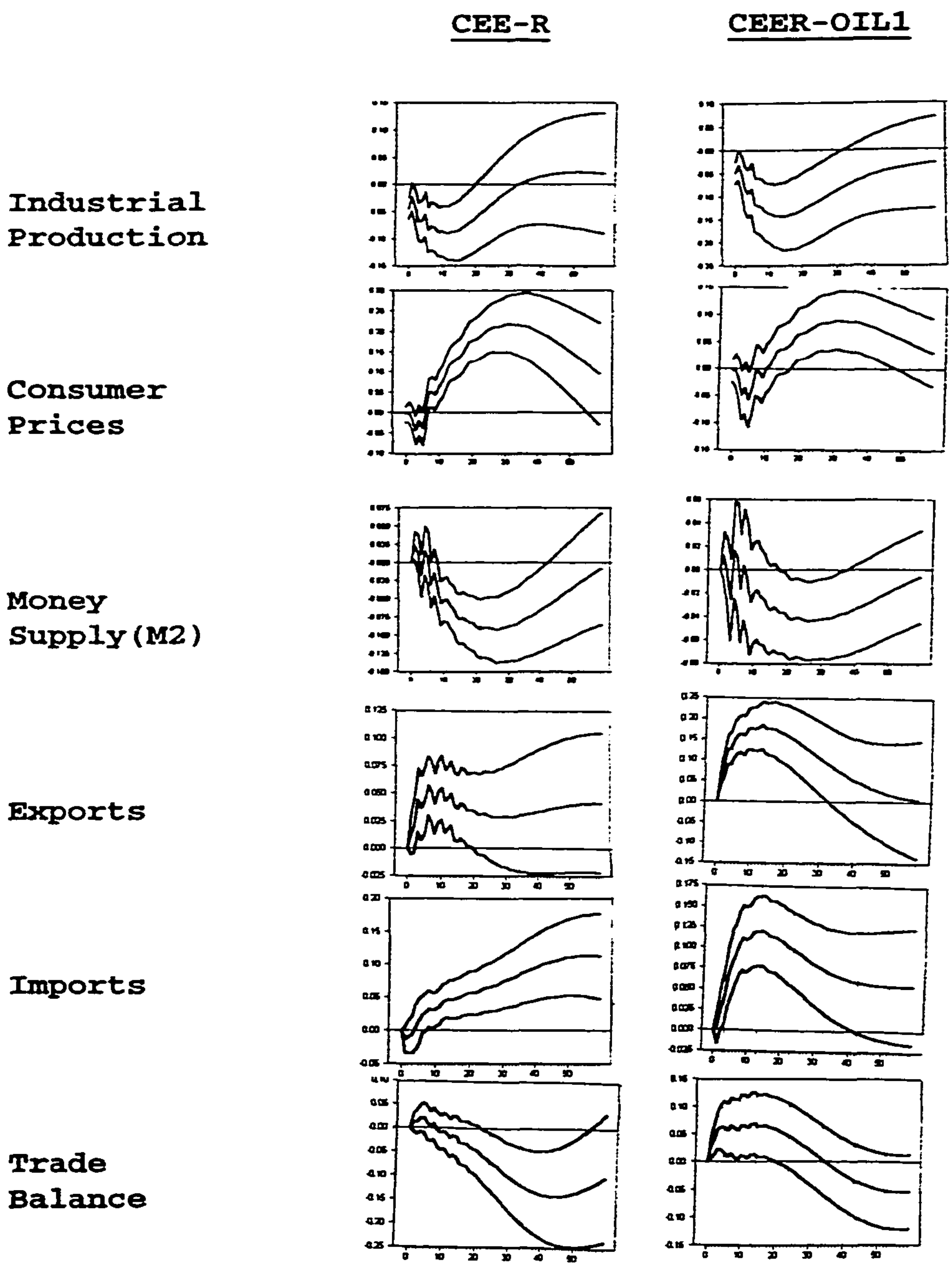


(1960:1~1972:12) (1973:1~1997:10)

<Figure A.6> Responses of U.S. Domestic Variables

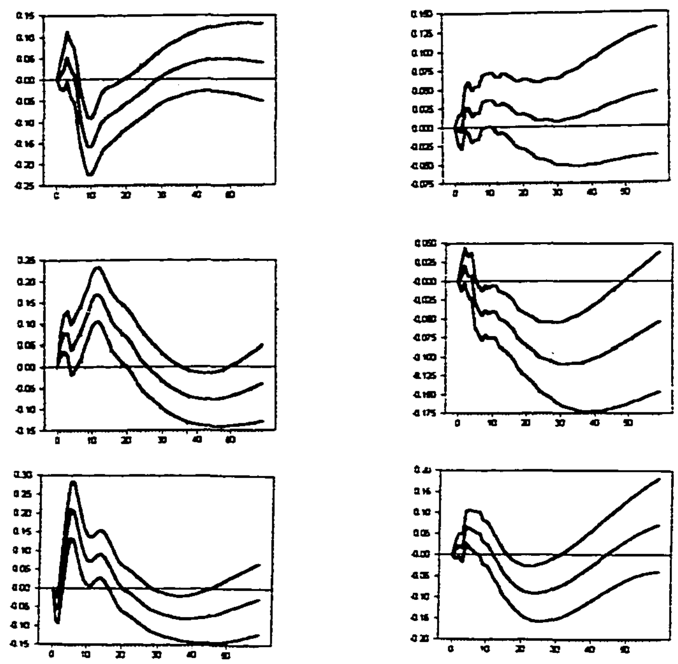


<Figure A.7> Responses of Japanese Domestic Variables



<Figure A.8> Responses of Other Korean Variables

Korean Varables	U.S. shocks	Japanese shocks
Nominal interest rate		
Real Interest rate		
Import Price		



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VITA

Hyun Joon Shin was born on January 28, 1966, in Seoul, Korea. After graduating from Yongmoon High School in 1984, he received a bachelor's degree in business administration in 1991 and subsequently finished MBA course in 1993 from Seoul National University. In 2000 he received a Ph. D in economics from the University of Missouri-Columbia. He has led discussion classes of the Money and Banking for undergraduate students at the University of Missouri-Columbia from 1998-2000. He was the recipient of Donald K. Anderson Teaching Award in 1999 for his excellence in teaching.

He has worked for the Ministry of Finance and Economy (MOFE) in Korea as a deputy director since 1992. In the Ministry, he worked for the Customs and Tariff Bureau, the Office of Budget, and the Secretary Office for the Deputy Prime Minister. During his stay in the United States he was entitled to the certificate of the public accountant in Delaware. He is currently working for the MOFE.

He has been married to Jeong-Min since 1994, and has one daughter, Elizabeth Ha-Kyung.