The Macroeconometric Model of Effects of U.S. Policy Mix on Korea: Some Simulation Results

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I. Introduction

The U.S. fiscal expansion in the past six years and the associated increase of the U.S. government budget deficit have been the subject of considerable international debate. On the other hand, the expansion has fueled the U.S. recovery from the 1982 recession. At the same time, the growing U.S. fiscal deficit has been the major factor underlying the high U.S. real interest rate, and a strong dollar. Long-term real interest rates in the United States have remained around 10 percent since the end of 1981. The dollar appreciated until early 1985. It has depreciated since the last quarter of 1985. Over the past seven months, the dollar has been weak and the yen strong, because of the coordinated international efforts to bring down the dollar and boost the yen. The macroeconomic performance during the period of the strong dollar in the U.S. has been the following: a sharp rise in the dollar caused by a capital inflow attracted to high U.S. interest rate and a sharp drop in inflation due to an appreciation of the dollar. It leads to the current account deficit in the United States. The large current account deficit in the U.S. has raised protectionist sentiment against the Korea. In reality, the current retrictive U.S. trade policy against Korea pushes up Korea to open the door. This change in external policy has been worsened the trade positions, economic activity in Korea since 1980. Therefore, changes in U.S. economic policies came to be viewed as important for Korea.

Current managed floating exchange rate regime introduced in January 1980 did not insulate Korean economy from external disturbances. This lead to a concern about implications for an effectiveness of domestic policies. We need the exchange rate to be endogenous in our model. The purpose of this study is to analyze the transmission mechanism of macroeconomic disturbances under current floating exchange rates. An issue of central importance is the extent to which fiscal and monetary policies adopted by the U.S. government generate and transmit disturbances to the Korean economy.

Section II deals briefly with the structure of our model. Section III will discuss simulation experiments of the U.S. fiscal, monetary shocks and the

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beggar-thy-neighbor policies in Korea. Section IV presents a concluding discussion. In appendix we report the estimates of our model and data.

II. Model Structure

1. A General Description of the Model

Our model of the Korean economy consists of twenty four equations. Included in this model is the detailed expenditure side of the national income accounts, a full trade sector, including estimates of bilateral trade with Korea's two largest trading partners (U.S. and Japan), three price variables, which are the absorption deflator, the export unit value index, and the import unit value index. Although our model essentially stands alone, and can be used to forecast and simulate as a single country macroeconomic model, our model can also be linked to other existing macro models through the trade sector, and the exchange rate equation. In a simulation experiments of section III, we try this approach by using the simulation results of Ishii, Mckibbin and Sachs' model.[1] The trade linkages used in the model are as follows: Korea's exports depend on its export price relative to its competitors' export price and the economic activities of its trading partners. Similarly, Korea's imports depend on its trading partners' export prices and economic activities of Korea. The structure of our model has been designed with two purposes in mind: 1) to analyze the impact of external shocks resulting from changes in recent U.S. fiscal and monetary policies on the Korean economy, 2) to empirically analyze policy coordination problems (for example, the beggar-thy-neighbor policies in Korea), which is a current major theoretical issue, and is part of recent growing literature in the field of international finance. This is accomplished by using a game theory framework.
The model contains seven major areas:

(1) Domestic consumption
(2) Government consumption
(3) Current Account (Foreign Trade)
(4) Domestic Assets Demand and Interest Rates
(5) Price Determination
(6) Wage Rates
(7) Exchange Rates

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1) See N. Ishii, W. Mckibbin, J. Sachs, "Macroeconomic Interdependence of Japan and the United States: Some Simulation Results," *N.B.E.R.* W.P. No. 1637 pp. 13-19, July, 1985.

The aggregate expenditure sector of our model is a Keynesian-oriented set of equations explaining domestic demand for goods and services. This sector contains equations for the following: private consumption, total fixed investment and inventory investment. Government consumption is viewed as exogeneously determined. Domestic aggregate expenditures, in conjunction with the foreign trade sector, is built into a traditional national income account framework. The national income account framework imposes structural discipline on the forecast by enforcing accounting identity constraints. The national income accounting real sector include: private consumption, government consumption, total fixed investment, total inventory accumulation changes, total exports of goods and services, and total imports of goods and services.

The foreign trade sector of our model is disaggregated into the following major trading partners of Korea:

(1) the United States
(2) Japan
(3) Rest of the World

In addition to merchandise export and import equation for the above regions, exports and imports of services were also modeled so that the current account balance could be derived as a identity.

Using the Tobin-Brainard[2] financial framework, we formulate explicit asset demand functions for currency, demand deposits, time deposits, and loans outstanding in the unorganized money market. Also, our model makes the rate of interest in the curb market endogenous, which links the financial sector with the real sector, since interest rates on bank deposits and bank loans are fixed at a level below the market equilibrium.

The aggregate supply equation which is implicit in the production function and the marginal productivity condition, is inverted to provide a price equation for direct estimation. There are three main price variables: absorption deflator, export unit value index, import unit value index. The import unit value is determined by the export price of foreign countries and by the exchange rates which convert foreign currency export prices into domestic currency. Recent empirical studies about the formation of expectations in Korea show that the rational expectation hypothesis is rejected, while the regressive expectation hypothesis is significantly accepted.[3] Therefore, we specify the wage equation using a regressive ex-

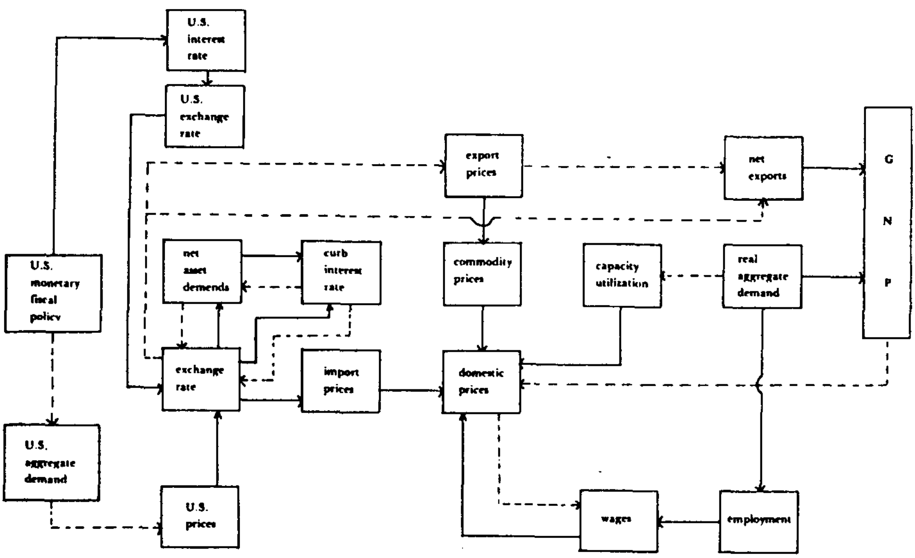
2) See J. Tobin and W.C. Brainard, "Pitfalls in Financial Model Building," *American Economic Review* May, 1968, pp. 99-122.

3) See Lee, K.S., "The Analysis of Economic Effects on the Inflationary Expectation in Korea," *Korea Development Institute,* Seasonal Reports, Sept. 1985.

pectation hypothesis.

We assume a causal relationship between the U.S. interest rates and the exchange rate movement of the Korean currency. The bilateral exchange rate is made endogenous in our model. The equations explaining the demand and supply for foreign assets which are used to derive the bilateral exchange rate, follow the small-country portfolio balance approach[4)] and are specified in stock form.

Figure 1 is a simplified flowchart of our model which indicates the major directions of causality. We list the GNP components, which are fed by the main demand decisions of the economy—consumption, investment, net exports. Since the analysis of our model takes into account the endogenous determination of the exchange rate, the increase in domestic prices associated with a change in the exchange rate can vary in two directions. First, factors such as interest that cause exchange rate changes can affect domestic prices independently of their impact through the exchange rate. Second, both the exchange rate change and the factors that cause it initiate changes in other variables that feed back onto the exchange rate itself. The importance of other variables causing change in the exchange rate is illustrated in the box of the exchange rates in the flowchart.



[Figure 1] Flow Chart

2. Discussion of Some Selected Equations

(1) Domestic Expenditure

As in the traditional Keynesian approach, the domestic private expenditure sector contains equations for the following: private consumption, fixed investment, andinventory investment. Consumption depends on real disposable income, real net worth and a real interest rate. The proxy for private wealth is obtained by a monetary base plus government deficit minus bonds held by government plus cumulative current account from the Flow of Funds in Korea. The coefficient of net worth captures the dynamic effect that real wealth has on consumption. The parameter of the interest rate variable captures the intertemporal substitution effect because an increase in the interest rate makes it more expensive to consume today. The specification of fixed investment behavior uses a modification of the neoclassical theory of investment with incorporating the liquidity availity. Fixed investment (following the neoclassical approach) is positively related to GNP and negatively related to the user cost of capital. Since the liquidity availability is an important determinant of the firm's investment in developing countries like Korea, we include the domestic credit plus private borrowing abroad as a credit availability for investment. A period's inventory investment will depend on the expected volume of sales, actual sales, and the inherited inventory stock from the previous period. The expected volume of final sales was modeled through a distributed lag on final sales and the change in the capacity utilization, and a merchandise imports was added as a source of supply in an open economy.

(2) Current Account

The current account consist of merchandise trade, services and transfers. Each of these components need to be explained. Our model disaggregates total imports and exports in the U.S., Japan and the rest of the world. In choosing a functional form for import and export demand, the loglinear function of prices and activity has been experimented. The activity variable in the specification is the gross national product (GNP). In the real world, the presence of adjustment costs and of incomplete information implies that the adjustment of dependent variables will not be instantaneous. The delayed response of imports and exports due to

4) See W. Branson, W. Halttun and Paul Masson, "Exchange Rates in the Short Run: The Dollar Deutschemark Rate," *European Economic Review*, Dec. 1977, pp. 303-324.

recognition lags, delivery lags, production lags, is likely to differ depending on the explanatory variable that initiates the response. For this reason, we impose the lag pattern only on all the independent variables in the following trade equations. The price of domestic goods and the price of imported goods are included as separate explanatory variables in each import and export equation, because imported and domestic goods differ both in price and non-price characteristics, and consumers' tastes for these goods. Real imports are explained as a function of aggregate economic activity in Korea (GNP), and its domestic price relative to the exporting country's price. Variables measuring tariffs are considered in the import demand function, with an effective tariff rate (won per dollar). We have considered the demand-system approach for specifying the export supply equations. The demand for exports in Korea is a function of demand of the U.S., Japan and rest of the world for the imports from Korea. Korea's exports depend on its export prices relative to its competitors' export price and economic activities of its trading partners. We have used the exchange rates and effective subsidy rate to exporters as the commercial policy variables. Although the exchange rate has varied, the effective subsidies has changed in such a way as to keep the effective exchange rate for exports relatively constant over the sample period. It is plausible to hypothesize that the Korean exports were sensitive to export incentives, since the means of encouraging exports is implicit in the government's method of administering the various export subsidies and targets.

(3) Exchange Rate

In the late 1960s, the standard model of the foreign exchange market had supply and demand as stable functions of exports and imports; however, the period of floating rates that began in the early 1970s has revealed that exchange rates exhibit the volatility of financial market prices. The monetary approach to exchange rate determination has essentionally one way causation from money to exchange rates, via purchasing power parity. The exchange rate, in the asset market view, is determined by financial market equilibrium conditions. Initial stocks of assets determine temporary equilibrium values for endogenous variables such as exchange rates. They also influences the trade balance and current account. The latter in turn is the rate of accumulation of national claims or liabilities to foreigners. It feeds back into the financial market equilibrium. On the other hand, the trade balance will affect directly the exchange rate.

Branson, Halttunen and Masson[5] considered only three outside assets for each country: M1, the cumulated current account, and net government debt. The exchange rate equation excluded two government debts. In Dornbush's study,[6] there was only one asset whose unexpected movement had an impact on the exchange movement: the net stock of foreign assets held by residents of another country. In our study, we limit our specification to the outside assets of the two countries (Korea-U.S.A.) under consideration. The exchange rate equation used in the final structural form is as follows:

The log of the exchange rate varies positively with the ratio of domestic to U.S. price levels, the lagged exchange rate, trade balance, and the cumulative current account; it varies negatively with the interest differential, the ratios of domestic to U.S. wealth, and private foreign claims to liabilities. We used the intervention equation. The motivation of this intervention equation is that central banks intervene in exchange markets to counter disorderly market conditions or to prevent their exchange rates from moving away from some rate thought of as a target or an equilibrium exchange rate under a managed floating exchange rate.

We assumed that the intervention function might exhibit a tendency to smooth changes in the exchange rate. This implies that the monetary authorities in Korea will buy dollars when the currency is appreciating and sell dollars in the opposite case. This assumes an additional objective of preventing large swings in their reserve stocks. Assuming that central banks intervene to restore reserves to some desired level, their purchases and sales of foreign exchange can be described by the change in the official foreign exchange reserves, the ratio between the flow of foreign reserves and imports, the change in the exchange rates.

III. Simulation Results

The estimates of our model show transmission mechanism through exchange rates from foreign countries to Korea in Appendix. Except for the exchange rate and intervention equations, the equations are estimated from data collected from the first quarter of 1973 to the fourth quarter of

5) See Branson, W. and Halttun, W. and Masson, P., "Exchange Rates in the Short Run: The Dollar Deutsche mark Rate," *European Economic Review*, Dec. 1977, (pp. 303-304)

6. See Dornbush, R., "Exchange Rate Economics: Where do we stand?" *Brookings Papers on Economic Activity*, 1980, pp. 143-206.

1983. This section continues to investigate these finding by presenting the results of exogenous shock of foreign interest rates and foreign outputs resulting from fiscal and monetary policy via simulations. Each simulation is conducted, using an exogenous shock, under the assumption that all other exogenous variables remain unchanged. Thus, the difference between the shocked and controlled solution allows for estimates of the response of the models.[7] In this section we present the simulation results of changes in U.S. fiscal and monetary policy, and policy coordination between U.S. and Korea's monetary policy.

1. U.S. Fiscal Shock Experiments

Sachs[8] recently developed the simulation forecasting models of the effects of U.S. fiscal policy changes on the U.S. economy and Japan; we have taken the results from his simulation forecasting model. Assume that the U.S. fiscal stimulus of a sustained 1 percent increase in GNP increases the U.S.'s GNP by 1 percent and Japan's GNP by 0.6 percent; and that U.S. interest rates rise by 1 percent and Japan's interest rate by 0.6 percent in the first year. Additionally we assume a 0.3 percent increase in the U.S. WPI and 0.4 percent increase in the Japanese WPI in the first year.

Table 3-1, 3-2, and 3-3 percent the simulation results of the U.S. fiscal shock experiments on the Korean economy. Each column gives the simulated impacts of the shock on selected variables (computed as a shock path minus a control path).

A key channel for strengthening or weakening the transmission effects of a fiscal shock is the exchange rate movements. The issue of how much of the dollar's strength can be attributed to fiscal policy shifts and the extent to which they explain high real interest rates both in the United states and elsewhere, has been addressed in two recent papers. Blanchard and Summers (1984)[9] consider a number of explanations for high real interest rates and argue that fiscal deficits may be a cause. They argue further that

7) We use the dynamic solution techniques using Gauss-seidel methods.

8) See N., Ishii, W. Mckibbin, J. Sachs, "Macroeconomic Interdependence of Japan and the United States: Some Simulation Results," *N.B.E.R.* W.P. No. 1637, pp. 13-19, July 1985.

9) Blanchard, O.J. and Summers, L.H., "Perspectives on high world real interest rates," *Brookings Papers on Economic Activity*, 2: 1984, pp. 273-324.

[Table 3-1] Effects of U.S. Fiscal Shocks on Korea

Periods	GNP (%)	C (%)	IF (%)	XKUV (%)	XUKV (%)
1 qr.	1.2565	0.0657	1.0321	1.1948	0.0718
2 qr.	1.2153	0.0443	1.0348	1.1926	1.1073
3 qr.	1.2787	0.0015	1.0312	1.1942	0.9852
4 qr.	1.2499	0.0067	1.0552	1.1980	1.0087
5 qr.	1.1430	0.0285	1.1150	0.0335	1.0013
6 qr.	1.0466	0.0055	1.1524	0.0176	1.1185
7 qr.	0.9892	0.0094	1.2726	1.0110	1.2252
8 qr.	0.9745	0.0118	1.0160	0.0217	1.2884

% : percent $(Y^s - Y^a)/Y^a \times 100$

Y^a = control path solutions

Y^s = exogenous shock path solutions

[Table 3-2] Effects of U.S. Fiscal Shocks on Korea

Periods	XKJV (%)	XJKV (%)	EI (%)	WPI (%)	PC (%)
1 qr.	1.2930	0.1559	0.2774	0.3695	0.1421
2 qr.	1.2820	0.2177	0.2362	0.2440	0.0170
3 qr.	1.2640	0.2580	0.2341	0.1961	0.0421
4 qr.	1.2370	0.2910	0.2081	0.1352	0.0243
5 qr.	0.0717	0.3323	0.2128	0.0900	0.0421
6 qr.	0.0237	0.3592	0.1874	0.0518	0.0261
7 qr.	0.0056	0.3790	0.1586	0.0283	0.0214
8 qr.	0.0048	0.4040	0.1440	0.0492	0.0257

% : percent $(Y^s - Y^a)/Y^a \times 100$

Y^a = control path solutions

Y^s = exogenous shock path solutions

[Table 3-3] Effects of U.S. Fiscal Shocks on Korea

Periods	PMG (%)	PXG (%)	CA (%)	RP (%)	WR (%)
1 qr.	0.05851	0.0308	0.6507	-0.4862	0.0548
2 qr.	0.03599	0.0831	0.5006	-0.4680	0.0571
3 qr.	0.10990	0.0615	0.5570	-0.4494	0.0881
4 qr.	0.13800	0.0209	0.6950	-0.4248	0.0707
5 qr.	0.04356	0.0530	0.6066	-0.3819	0.0573
6 qr.	0.02360	0.0060	0.4881	-0.3472	0.0283
7 qr.	0.05641	0.0367	0.4519	-0.3374	0.0850
8 qr.	0.01789	0.0093	0.3946	-0.3130	0.1030

% : percent $(Y^s - Y^a)/Y^a \times 100$

Y^a = control path solutions

Y^s = exogenous shock path solutions

even though the U.S. deficit shows an increase of 3.9 percent of GNP over the period 1978-1985, fiscal contraction in other countries implies an increase of only 0.8 percent points for the six largest OECD countries. Adjusting deficits for inflation and for cyclical positions, and allowing for anticipated future deficits, leads them to conclude:[10)]

> "We find no evidence that fiscal policy in the OECD as whole is responsible, through its effect on saving of high real interes rates. Fiscal policy is not the only factor that may shift saving. Another potential candidate is a shift in saving behavior of the oil exporting countries."

Another recent paper[11)] examines the consequences of the U.S. policy mix of fiscal expansion and monetary contraction especially on the value of the U.S. dollar. Simulations of a small, world macroeconomic model tends to support the view that the U.S. monetary/fiscal policy mix goes a long way toward explaining developments in financial and exchange markets in the last few years. His finding is that the fiscal expansion causes the U.S. exchange rate to appreciate by 3.8 percentage points. U.S. short term real interest rates rise relative to abroad.

One reason for the difference in the conclusion of these two papers is disagreement concerning the extent of shifts in the stance of fiscal policy; i.e., both the stance of current and expected future policy. We will not attempt to shed any light on the particular issue. We will follow the results of Sachs.

The Mundell-Fleming model suggests that an expansionary U.S. fiscal policy exerts appreciation pressure on U.S. dollars and that an expansionary U.S. fiscal policy is fully nullified by a reduction in net export surplus in real terms caused by the appreciation of the U.S. dollar. An expansionary fiscal shock given by a large foreign country like the U.S. will be transmitted into the small open country, because U.S. fiscal expansion will crowd out U.S. net exports and crowd in Korea's net exports. This result depends upon the appreciation of the U.S. dollar and depreciation of the Korean currency. If the domestic price level is sensitive to changes in the exchange rates in contrast to nominal wages,[12)] the full transmission will be reduced. If the domestic price level is sensitive to an increase in

10) Blanchard, O. J. and Summers, L. H., *Ibid.*, pp. 302-305.

11) J. Sachs and W. Mckibbin, "Macroeconomic Policies in the OECD and LDC External Adjustment," *N.B.E.R.* W.P. 1534, 1985.

12) Note that the Mundell-Fleming model assumes price rigidity.

demand, expansionary U.S. fiscal policy should raise domestic prices, working for a depreciation of the exchange rate. This price effect should offset the transmission effect of the expansionary fiscal shock.

The results of our simulation show that the Korean currency depreciates around 14-27 percent (See, Table 3-2, column "EI"). In general, the fiscal expansion induced high interest rates in the U.S. invite net capital inflows from other countries. This could strengthen the U.S. currency. As a result, the Korean currency depreciates against the U.S. dollar. This in turn exerts influences on several parts of the model, most importantly on the trade sector.

We find that the effect of the U.S. fiscal expansion on the GNP of Korea is positive. The GNP will increase by 1.25 percent in the first quarter. The Korean economies gain in terms of GNP from the U.S. expansion. Most of the initial stimulus to Korea's GNP is through increased exports to the United States stimulated by U.S. expansion. The growth of net exports to the U.S. is stimulated by the depreciation of the Korean currency against the dollar. The exports to the U.S. is estimated to increase by 1.19 percent in the first year. The current account improves around the range of 0.65 percent to 0.39 percent over the simulation period and provides a stimulus to domestic output.

Dornbush argues that generating a given increase i the trade surplus by depreciating is much easier for Korea, than for Brazil, because Korea's export sector accounts for a relatively large share of GNP.[13] Further, Dornbush argues that:[14]

> "In Korea, income distribution is remarkably equal, social services are advanced. Depreciation is largely uncontroversial, because it does not significantly redistribute income between different groups. In Korea, depreciation is practically a growth machine, since it applies to the large trade sector and a very large share of GNP."

Our result confirms this kind of argument in the Korean context.

Consumption is not directly affected by exchange rates. Consumption rises slightly, partly because exchange rate depreciation raises the current account balance, resulting in higher disposable income, and partly because of the wealth effect through the accumulated current account. The price variable confirms the theoretical results. After initial shocks, the

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13) Dornbush, R., "Policy and Performance links between LDC Debtors and Industrial Nations, "*Brookings Papers on Economic Activity*, 2. 1984, pp. 303-368.

14) Dornbush, ___________, *Ibid.*, pp. 367-368.

price (WPI, PC) level is increased. The depreciation of the Korean currency against the dollar, initially induced by the increase in the U.S. interest rates lead to significant increase in domestic prices and import prices. The level of import prices increased by 0.46 percent over the simulation period. These price effects involve increases in the inflation rate. The impact on prices is positive because exchange rate effects and aggregate demand effects are working in positive directions.

In our model the exchange rate is quite interest rate sensitive. A fall in the interest rate causes won to depreciate. This in turn exerts influences on several parts of the model, most importantly on the trade sector. Decreased interest rates and the resulting depreciation of the home currency is to increase demand and output. As a consequence of the increase in output, prices are higher and wage rate is up slightly. The mechanism for the transmission of U.S. interest rates are not direct but indirect in a sense that U.S. economic disturbances affect the demand for assets in a domestic economy, leading to changes in interest rates. The interest rate in our model is determined by a demand and supply conditions of funds in unorganized money markets. When the U.S. fiscal policy becomes expansionary, the demand for assets increases due to the rise in nominal GNP. In addition, it is in turn caused by the expansionary transmission of U.S. fiscal shock to real GNP in Korea, and by depreciation of the won; and these changes lead to higher the exchange rate and the curb interest rates do fully or rapidly feed through into the asset demands. This leads to increase in investment and output in the short run. Our results show that fixed investment (IF) increase by 1.01 percent. It leads to increase in the GNP by 1.25 percent. Another noteworthy feature is that the exchange rate movement is dampened because of feedback effects from current account variable, since current account surpluses will lead to an appreciation of the Korean currency in the long run. The size of the appreciation of the Korean currency depends on how much the current account is improved.

In summing up the insulation and transmission effects of U.S. expansionary fiscal shocks on the Korean economy, it depends critically not only on the direction of the exchange rate movement but also on the relative magnitude of the U.S. exchange rate appreciation under a floating exchange rate regime. If international asset substitution between domestic and foreign is not perfect as shown by our model, net capital inflow or outflow induced by international interest rate differential alone does not determine the direction of change in the exchange rate. As specificied in the exchange rate equation, the current account imbalance plays a role in the exchange rate determination when assets are imperfect substitutes.

2. U.S. Monetary Expansion Shocks

Assume that the U.S. monetary expansion of 1 percent increases the U.S.' GNP by 0.9 percent and Japan's GNP by 0.1 percent. Additionally, the U.S. WPI increases by 0.1 percent. Also assume that the monetary shock decreases U.S. interest rates by 0.3 percent and Japan's interest rates by 0.1 percent. All of these assumptions are also taken from the results of Sachs' model simulation.[15] The simulation results of U.S. monetary shocks are reported in Table 3-4, 3-5, and 3-6. The results give the simulated impacts of the shock on selected variables (computed as a shock path minus a control path).

[Table 3-4] Effects of U.S. Monetary Shocks on Korea

Periods	GNP(%)	C (%)	IF (%)	XKUV (%)	XUKV (%)
1 qr.	-0.9765	-0.4013	-0.9335	-1.67	1.0087
2 qr.	-1.2565	-0.3671	-0.9792	-1.70	1.0135
3 qr.	-1.2153	-0.5528	-0.9047	-1.72	1.1185
4 qr.	-1.2787	-0.3100	-0.9182	-1.64	1.2252
5 qr.	-1.0430	-0.6123	-0.9832	-1.55	1.2884
6 qr.	-1.2490	-0.5209	-0.9467	-1.54	1.4215
7 qr.	-1.1160	-0.5765	-0.9269	-1.59	1.4215
8 qr.	-1.1070	-0.4761	-0.9007	-1.43	1.4598

% : percent $(Y^s - Y^a)/Y^a \times 100$
Y^a = control path solutions
Y^s = exogenous shock path solutions

[Table 3-5] Effects of U.S. Monetary Shocks on Korea

Periods	EI (%)	WR (%)	PC (%)	WPI (%)
1 qr.	-0.2985	-0.3226	-0.0681	-0.2583
2 qr.	-0.2572	-0.5732	-0.0260	-0.2011
3 qr.	-0.2543	-0.2311	-0.0339	-0.1772
4 qr.	-0.2290	-0.3551	-0.0268	-0.1490
5 qr.	-0.1945	-0.1901	-0.0310	-0.1265
6 qr.	-0.1794	-0.1401	-0.0256	-0.1122
7 qr.	-0.1506	-0.1639	-0.0236	-0.1044
8 qr.	-0.1355	-0.1206	-0.0213	-0.0993

% : percent $(Y^s - Y^a)/Y^a \times 100$
Y^a = control path solutions
Y^s = exogenous shock path solutions

15) See N. Ishii, W. Mckibbin, J. Sachs, ______, *Ibid.*, pp. 18-20.

[Table 3-6] Effects of U.S. Monetary Shocks on Korea

Periods	XJKV (%)	XKJV (%)	PMG (%)	CA (%)
1 qr.	0.1559	-0.9302	-0.0116	-0.0065
2 qr.	0.2177	-0.5994	-0.0219	-0.5576
3 qr.	0.2580	-0.4044	-0.0195	-0.6953
4 qr.	0.2910	-0.2809	-0.0204	-0.6066
5 qr.	0.3323	-0.2316	-0.0183	-0.4880
6 qr.	0.3592	-0.1544	-0.0194	-0.4656
7 qr.	0.3790	-0.1048	-0.0191	-0.4519
8 qr.	0.4040	-0.0714	-0.0190	-0.4656

% : percent $(Y^s - Y^a)/Y^a \times 100$
Y^a = control path solutions
Y^s = exogenous shock path solutions

A 1 percent sustained increase in the U.S. money supply raises U.S. GNP by 0.9 percent in the first year, which results in a decrease in the U.S. interest rate of 0.3 percent. This will induce capital outflow in the U.S., which results in the depreciation of the U.S. dollar. This results in an inflationary impulse in the U.S. of 0.1 percent. This leads to an appreciation of the Korean currency against the U.S. dollar. After the initial shock, the exchange rate has appreciated by 0.29 percent (See Table 3-5 column "EI"). Because of the appreciation of the Korean currency, real exports of goods decline against the U.S. dollar as reported in Table 3-4 (See column "XKUV").

The effect of U.S. monetary policy on Korea's GNP is negative under flexible exchange rates. This reflects the dominance of exchange rate effects resulting from appreciation of the Korean currency against the U.S. dollar. The Korean currency will appreciate by 0.29 percent in the first quarter. Overvaluation (appreciation) leads to a change in the composition of spending. Demand for domestic goods declines and demand for importables rises. The shift implies a reduction in domestic output and employment (See Table 3-4, column "GNP"). Our results show that the GNP will decrease by 1.25 percent until third quarter. After the third quarter has passed, the GNP will decrease by 1.1 percent level. The effects of U.S. monetary policy on Korea's GNP are distributed over a long time because of lags in the impact of interest rates on fixed investment. The decline in GNP in turn reduces imports and exerts upward pressure on the value of the Korean currency. The decline in real net exports strengthen the crowding out of GNP.

The appreciation of the Korean currency (won), in turn, has important effects on the price level. By reducing import prices, it offsets the domestic inflationary impact of the U.S. monetary expansion, so that the consumer price level declines very little. Therefore, Korea's inflation rate falls slightly, partly because an appreciation initially dominates the inflationary effects of the U.S. monetary expansion. The effects of exchange rate appreciation on the price level is through import price changes (PMG). A passthrough of 1% appreciation of the won lowers import prices by 0.01 percent in the first quarter, and 0.021 percent in the second quarter; but, the impact of import prices on the domestic price seems to be small, since import prices appears to affect the price level with long and variable lags. The results of the price equations show the external sector affecting domestic prices indirectly through the effects of competitive import prices on domestic markups, because import prices affect costs and prices. The simulation indicates that the exchange effects associated with U.S. monetary policy shocks are important. The exchange rate movements affect wage rate through an indirect effects via consumer prices or output.

3. Beggar-Thy-Neighbor Policy Simulation

In an interdependent world, since the major economies are linked in commodities and financial markets, no country can achieve its economic goal by its own efforts alone and any change in economic policy by a major economy like the U.S. has sizable effects on other economies. In these circumstances, the government which suffers from unfavorable conditions might be driven to pursue deflationary policies designed to shift the burden of external adjustments and inflationary pressures to others. Given concerns among policymakers about the possibility of beggar-thy-neighbor policies, advocacy for international coordination of macroeconomic policies has found a wider audience during the decade of world wide stagflation since 1973.

The last decade has witnessed much progress made in the theoretical analysis of policy coordination. Although most of the literature on macroeconomic policy design has focused on policy questions in a single open economy, there is an important stance that is concerned with the issues raised by interdependence between economies.[16] This literature emphasizes the game theoretic, stragetic aspect of policy making in the international arena. The prospects that non-cooperative forms of policy, arising from the elements of externality in the effects of policy internationally may lead to outcomes inferior to those of cooperative policies. Since Hamada analyzed the coordination problem of monetary policies under fixed exchange rates in a game theoretic framework, much work has been done to extend his approach to the case of flexible exchange rates, to address issues of fiscal policies within a dynamic framework.

In the model developed by Hamada (1976), each country is assumed to target its rate of inflation and its balance of payments position in a fixed exchange rate regime. The only policy instrument available to each country is the rate of domestic credit creation. He shows that, if the sum of target positions of balance of payments of countries is greater (smaller) than the exogenous increase in international liquidity, the Cournot outcome is deflationary (inflationary) biased. His policy prescription is to create the international liquidity exogenously to match the demand for it and to make the Cournot outcome lie on the contract curve.

In reality, the players of a policy game are not stalemated as a Cournot outcome depicts. Individual economies have occasionally tried to expand in the midst of a world contraction, sometimes successfully and sometimes unsuccessfully. Each economy adopted expansionary policies unilaterally, expecting other economies to follow its move. These case can be described in terms of Stackelberg leadership. The locomotive approach, proposed first at the 1977 London summit and adopted at Bonn the next year, which is usually cited as an example of Stackelberg leadership, where the U.S., Japan and West Germany are leaders and other economies are followers. An analysis of leadership is important because advocates of policy coordination argue that the coordination plays a role similar to U.S. hegemony.

16) The game theoretic aspect of policymaking in an interdependent world have been recognized by a number of earlier writers, See, Hamada. K., "Alternative Exchange rate Systems and the Interdependence of Monetary Policies," in R.A. Aliber (ed.) *National Monetary Policies and the International Financial System* 1974 University of Chicago Press. Hamada, K., "A Strategic Analysis of Monetary Interdependence," *Journal of Political Economy* 1976, Vol. 84, No. 4, pp. 677-700, Canzoneri and Gray, "Monetary Policy Games and the Consequences of Non-cooperative Behavior," *International Economic Review* October, 1985, pp. 547-564, Cooper, R., "Economic Interdependence and Coordination of Economic Policies," in R. Jones and P.B. Kenen (eds.) *Handbook of International Economics* Vol. II Amsterdam: North-Holland 1985, Canzoneri, M.B. and henderson, D.W., "Strategic Aspects of Macroeconomic Policymaking in Interdependent Economics: Three Countries and Coalitions," unpublished manuscript, forthcoming.

Canzoneri, M.B. and Gray, J.A. (1985) shows that the spillover effects of U.S. monetary policy are positive, but the spillover effects of rest of the world are most likely to be negative and the Nash solution to the game too expansionary or contractionary in an asymmetric policy world. Each country has an incentive to cheat on this arrangement by expanding or contracting its money supply and depreciating or appreciating its exchange rates. In this situation, one might expect to be concerned about "beggar-thy-neighbor" policies. He shows that the Stackelberg and fixed-rate regimes can provide Pareto-superior outcomes compared to Nash outcomes. He concludes that the restrictive monetary policy pursued by the U.S. during 1981-1982 has been referred to as the "third oil shock".

We argue that the Korean monetary policies over past five years are beggar-thy-neighbor monetary policies that contribute to overly contractionary policies in terms of monetary growth rate.

In order to analyze beggar-thy-neighbor policies in Korea, we assume that the U.S. reduces their monetary growth rate by 1 percent. A monetary

[Table 3-7] Effects of a Beggar-Thy-Neighbor Policy in Korea

Periods	GNP (%)	C (%)	IF (%)	EI (%)	RP (%)
1 qr.	-0.9892	-0.0212	-1.0348	-0.7592	1.087
2 qr.	-1.1690	-0.0131	-1.0312	-0.4406	1.055
3 qr.	-1.1575	-0.0346	-1.0552	-0.4379	0.738
4 qr.	-1.3044	-0.0577	-1.1150	-0.3999	1.549
5 qr.	-1.1296	-0.0379	-1.1524	-0.3900	0.597
6 qr.	-1.6243	-0.0258	-1.1726	-0.3892	1.299
7 qr.	-1.2230	-0.0288	-1.0310	-0.3623	1.623
8 qr.	-1.0391	-0.0383	-1.4900	-0.3460	1.744

% : percent $(Y^s - Y^a) / Y^a \times 100$.

Y^a = control path solutions

Y^s = exogenous shock path solutions

restraint in the U.S. reduces U.S. by 0.9 percent and Japanese GNP by 0.1 percent. Additionally we assume that U.S. inflation rates increase by 0.4 percent, short term U.S. interest rates rise by 0.3 percent and and Japanese interest rates by 0.1 percent respectively. Also, we assume that the Korean central bank reacts to reduce the monetary growth rate by 5 percent, because Korean authorities want to reduce the inflation rate through beggar-thy-neighbor policies.

[Table 3-8] Effects of a Beggar-Thy-Neighbor Policy in Korea

Periods	XKUV (%)	XKJV (%)	PXG (%)	PMG (%)	WPI (%)
1 qr.	-4.9283	-1.1646	0.01652	-0.0542	-1.1250
2 qr.	-5.0846	-1.1783	0.01746	-0.0549	-1.1130
3 qr.	-5.2098	-1.1926	0.01762	-0.0553	-1.0960
4 qr.	-5.2917	-1.2124	0.01712	-0.0558	-1.1149
5 qr.	-5.3563	-1.2480	0.01613	-0.0560	-1.0980
6 qr.	-5.4373	-1.2610	0.01713	-0.0559	-1.0910
7 qr.	-5.5366	-1.2750	0.01737	-0.0558	-1.073
8 qr.	-5.6534	-1.2181	0.17030	-0.0564	-1.065

% : percent $(Y^s - Y^a)/Y^a \times 100$.
Y^a = control path solutions
Y^s = exogenous shock path solutions

[Table 3-9] Effects of a Beggar-Thy-Neighbor Policy in Korea

Periods	XUKV (%)	XJKV (%)	WR (%)	PC (%)
1 qr.	-2.917	-0.5972	-0.3226	-1.0989
2 qr.	-2.0743	-0.5591	-0.5732	-1.0793
3 qr.	-2.0168	-0.5370	-0.2311	-1.0820
4 qr.	-2.1347	-0.4841	-0.2206	-1.0830
5 qr.	-2.1454	-0.4793	-0.1090	-1.0792
6 qr.	-2.2177	-0.4991	-0.1401	-1.0662
7 qr.	-2.2219	-0.4870	-0.1000	-1.0660
8 qr.	-2.2000	-0.4000	-0.0900	-1.0600

% : percent $(Y^s - Y^a)/Y^a \times 100$
Y^a = control path solutions
Y^s = exogenous shock path solutions

In an open economy, by having tighter monetary policies than abroad, the domestic currency will strengthen in value, thereby reducing import prices and domestic inflation. From the point of view of the Korean central bank, a strong exchange rate seems to have an added anti-inflation results that comes from tight monetary policy. As a result of this policy, the Korean currency is overvalued (appreciates). Exchange will appreciate by 0.75 percent in the first quarter; however, Korea does not achieve the anti-inflation benefits. Korea will suffer from exceedingly tight monetary policies. Appreciation tends to reduce Korea's exports, adding to the direct effect of the monetary tightening by depressing GNP in Korea. Our results show that exports to the U.S. and Japan is reduced by 5 percent and 1.2 percent, respectively. The tightening of monetary policy results in an immediate increase of about 1 percentage point in the curb interest rates, which leads to a decrease in fixed investment by 1.03 percent in the first quarter. Changes in interest rates are the main channel through which monetary policy alters aggregate demand in the model, mainly by affecting fixed investment. After an initial surge, the interest rates decline slowly as aggregate demand falls off. In line with the weakening of aggregate demand, the price level declines slightly by 1 percent (See Table 3-8, 3-8 column "WPI" "PC").

The favorable effect of monetary constraint in Korea is that the rate of inflation declines. After a shock, the rate of inflation has declined by about 8.21 basis points over the simulation period, where the rate of inflation is measured by the wholesale price index. This decline in the rate of inflation persists in subsequent quarters as a result of a decline in the rate of money growth in Korea; however, the cost of such a policy is large in terms of lost output in Korea. The reduction in GNP tends to gradually increase after the second quarter. By the end of the eighth quarter, the cumulative lost output accounts for 7.69 percent reduction in the GNP. The results of our simulation indicate that in order to offset the effect of the strong dollar, which puts depreciation pressure on the Korean exchange rate, the policy of monetary restraint would have led not only to a reduction in inflation rates as measures by the domestic deflator, but also to a major recession.

In summing up, uncoordinated monetary (beggar-thy-neighbor) policy is likely to lead to competitive and potentially unstable process as small, open economies react to the competitiveness effects of partners' policies. Because of this, the Korean monetary policy makers should have accepted coordinated constraints on this monetary policies. An important issue is how the exchange rate is affected by this policy under floating exchange rate regime. As soon as Korean policy thinking were positively concerned about the exchange rate and external constraints, their concern for policy coordination with the U.S. would be increased.

IV. Conclusions

It is worthwhile to enumerate briefly the major results of the simulation study. A fiscal expansion in the U.S. causes the Korean currency to depreciate. As a consequence, domestic prices rise. This price increase would offset the positive transmission effect of U.S. fiscal policy. Thus, expansionary fiscal policy of the U.S. can explain the improvement in Korea's current account balance. On the other hand, the U.S. monetary shocks are transmitted negatively to the Korean economy under floating exchange rate regimes. This leads the Korean currency to appreciate. Overvaluation (appreciation) leads to a change in the composition of spending. Demand for importables rises. The shift implies a reduction in domestic output. Our model does not show the results of full insulation when a U.S. monetary shock occurs. Beggar-thy-neighbor policies in Korea makes the Korean currency stronger in value, thereby reducing import prices and domestic inflation. However, Korea does not benefit from the anti-inflation influences. Appreciation tends to reduce exports, resulting in a decline in the Korean GNP. It is impossible to say a priori whether a Korean monetary contraction policy than United States monetary policy will at any one time be more attractive in reducing domestic inflation.

Our model in which exchange rates are endogenous has been as a useful for studying the transmission and insulation properties of managed floating exchange rates. This empirical model is useful in particular for gauging whether some of the assumptions made in theoretical work and the conclusions drawn from them are consistent with the data generated by the past decade of managed floating exchange rates. But our model is limited, since models for foreign economies have not been developed. In the future, we should develop models of the U.S. and the Japanese sector in order to capture exactly the transmission mechanism of the U.S. and Japan's macroeconomic policy changes. This kind of research is expansive and time consuming. Some amendments to our structural models may improve the multiplier values. Reestimation with an improved three stage least squares method should be done to improve the properties of our model simulation. Research should be carried out for improving the convergence properties of simulations. Our thesis represents only a first step in this direction. The further research suggested will have to be implemented before we can confidently use the extended applications.

Appendix

A. Identities

1. GNP = C + IF + II + XG - MG + XSO - MSO + G + NFIA + SD
2. XG = XKUV + XKJV + XRKV
3. MG = XUKV + XJKV + XRKV
4. TB = XG - MG

5. $CA = XG - MG + XSO - MSO$
6. $CU = (GNP/GNPP) * 100$
7. $KI = KI_{-1} + II$
8. $M1 = CC + DD$
9. $M2 = CC + DD + DT$
10. $PGNP = GNPV/GNP$
11. $INF = \{(PGNP - PGNP)/PGNP_{-1}\} * 100$
12. $DEF = TV/PGNP - G/PGNP$
13. $YD = GNPV - TV$
14. $S = C + IF + XG$
15. $FGNP = (USGNP)^{0.42} * (JAGNP)^{0.40} * (UKIP)^{0.07} * (GIP)^{0.06} * (FIP)^{0.05}$
16. $FP = (USWPI)^{0.42} * (JAWPI)^{0.40} * (UKWPI)^{0.07} * (GWPI)^{0.06} * (FWPI)^{0.05}$
17. $UC = q\,(R - \triangle q + \delta\,)/(1 - w)$
18. $NW = MB + DEF - GC + EI\ * CA$

B. Behavioral Equations

Consumption Function

19. $$\text{Log}(C) = \underset{(5.569)}{2.367} + \underset{(4.352)}{0.298}\,\text{LOG}(NW) - \underset{(-\,2.253)}{0.170}\,\text{Log}(NW_{-1}) + \underset{(5.262)}{0.407}\,\text{Log}(YD) + \underset{(2.894)}{0.308}\,\text{Log}(YD_{-1}) + \underset{(1.248)}{0.069}\,\text{Log}(rr) - \underset{(-1.363)}{0.167}\,\text{Log}(C_{-1})$$

$R^2 = 0.958$ Durbin's h = 1.765

$F(6, 36) = 165.141$ Estimation method = CORC

Fixed Investment Function

20. $$IF = \underset{(-5.66)}{-2393.64} - \underset{(-1.061)}{321.42}\,(PGNP/UC) + \underset{(13.76)}{0.468}\,GNP + \underset{(2.85)}{1.681}\,(DC + FK)/WPI + \underset{(2.49)}{0.006}\,KV_{-1}$$

$R^2 = 0.926$ D-W = 1.953

$F(3, 39) = 3.82$ Estimation Method = CORC

Inventory Investment Function

21. $$II = \underset{(-2.629)}{-703.585} - \underset{(-89.518)}{0.999}\,S + \underset{(23.046)}{1.111}\,S_{-1} + \underset{(19.228)}{6204.5}\,CU + \underset{(1.567)}{0.003}\,KI_{-1} - \underset{(-2.490)}{0.101}\,MG + \underset{(22.182)}{1.153}\,II_{-1}$$

$R^2 = 0.996$ D-W = 2.34

$F(10, 33) = 1539.85$ Estimation Method = OLS

Imports from the U.S.

22. $\text{Log}(XUKV) = -2.586 + 0.716\,\text{Log}(GNP) - 1.22\,\text{Log}(UPXGUV)$
$(-1.267)\ (2.623)\qquad (-4.225)$
$- 0.437\,\text{Log}(EI) + 1.031\,\text{Log}(WPI) - 0.313\,\text{Log}(TAR)$
$(-1.806)\qquad (2.911)\qquad (-2.259)$

$R^2 = 0.725$ D-W = 1.605
$F(5, 37) = 5.24$ Estimation Method = OLS

Imports from the Japan

23. $\text{Log}(XJKV) = 8.149 + 1.005\,\text{Log}(GNP) - 2.215\,\text{Log}(JPXGUV)$
$(12.395)\ (3.663)\qquad (-3.706)$
$+ 0.026\,\text{Log}(EI/JEI) - 0.007\,\text{Log}(WPI) - 0.045\,\text{Log}(TAR)$
$(0.799)\qquad (-0.197)\qquad (-1.134)$

$R^2 = 0.30$ D-W = 2.208
$F(5, 37) = 3.10$ Estimation Method = CORC

Exports to the U.S.

24. $\text{Log}(XKUV) = -44.353 + 0.665\,\text{Log}(USGNP)$
$(-7.278)\ (7.373)$
$-0.383\,\text{Log}(USWPI) + 0.238\,\text{Log}(PXG)$
$(-0.463)\qquad (0.470)$
$+ 0.078\,\text{Log}(EI) - 0.219\,\text{Log}(SUB)$
$(2.136)\qquad (-0.779)$

$R^2 = 0.831$ D-W = 1.572
$F(5, 38) = 220.41$ Estimation Method = CORC

Exports to Japan

25. $\text{Log}(XKJV) = 9.432 + 0.455\,\text{Log}(JAGNP)$
$(7.760)\ (3.138)$
$+ 1.686\,\text{Log}(PXG) + 0.085\,\text{Log}(EI/JEI)$
$(3.488)\qquad (3.117)$
$+ 0.006\,\text{Log}(SUB) - 3.641\,\text{Log}(JAWPI)$
$(0.068)\qquad (-4.404)$

$R^2 = 0.490$ D-W = 2.25
$F(5, 38) = 74.27$ Estimation Method = CORC

Imports from the Rest of the World

26. $\text{Log}(XRKV) = -4.067 + 0.517\,\text{Log}(GNP) - 0.923\,\text{Log}(WPI)$
$(-2.734)\ (0.417)\qquad (-3.062)$
$+ 0.014\,\text{Log}(EI) - 0.141\,\text{Log}(TAR) + 0.475\,\text{Log}(WWP)$
$(0.354)\qquad (0.798)\qquad (0.931)$

$R^2 = 0.584$ D-W = 2.049
$F(5, 37) = 13.99$ Estimation Method = CORC

Exports to the Rest of the World

27. Log (XKRV) = 14.316 + 3.39 Log (GNPW) -0.086 Log (PXG)
(3.350) (3.439) (-0.138)
+ 0.021 Log (EI) -0.819 Log (WWP)
(0.756) (-1.092)
- 0.058 Log (SUB)
(-0.445)

R^2 = 0.463 D-W = 1.826
F (5, 37) = 8.24 Estimation Method = CORC

Imports of Services

28. Log (MSO) = -24.610 + 2.776 Log (GNP) - 0.362 Log (PMS/PC)
(-2.320) (2.272) (1.722)
-0.149 Log (MXG) - 0.037 T + 0.645 Log $(MSO)_{-1}$
(-0.601) (-2.019) (4.533)

R^2 = 0.913 Durbin's h = 1.902
F (7, 35) = 110.75 Estimation Method = CORC

Exports of Services

29. Log (XSO) = -18.103 + 1.956 Log (FGNP) - 0.698 Log (FP/PXS)
(-3.958) (3.112) (-1.503)
+ 0.464 Log (XG) - 0.049 T + 0.677 Log $(XSO)_{-1}$
(1.785) (-3.153) (8.512)

R^2 = 0.971 Durbin's h = 1.894
F (7, 35) = 6.209 Estimation Method = CORC

Tax Revenue

30. TV/PGNP = -2.164 + 0.001 (GNPV/PGNP) + 0.266 $(TV/PGNP)_{-4}$
(-1.634) (5.35) (2.623)

R^2 = 0.893 Durbin's h = 1.87
F (2, 41) = 182.26 Estimation Method = OLS

Demand for Currency

31. CC/NW = 0.019 + 0.203 (GNPV/NW) - 0.0005 RP - 0.0008 RT
(0.885) (7.635) (-0.484) (-0.645)
-0.0018 YB + 0.0035 INF
(-0.787) (2.615)

R^2 = 0.949 D-W = 1.757
F (5, 9) = 54.09 Estimation Method = CORC

Demand Deposit

32. DD/NW = 0.350 + 0.069 (GNPV/NW) -0.0007 RP + 0.0006 RT
(1.123) (2.019) (-0.236) (1.96)

$$-0.0024\ YB\ -0.0097\ R^*\ 0.0005\ (EI_{+1}-EI)/EI$$
$$(-0.636)\quad(-3.48)\quad(-0.134)$$
$$+0.0084\ INF$$
$$(1.43)$$

$R^2 = 0.77$ D-W = 1.98
F (7, 7) = 3.86 Estimation Method = CORC

Time Deposit

33. DT/NW

$$= 14.524 + 2.427\ (GNPV/NW) + 0.131\ RT + 0.251\ RP$$
$$(2.393)\quad(2.461)\quad(2.105)\quad(4.697)$$
$$-0.017\ YB + 0.033\ R^* - 0.017\ (EI_{+1}-EI)/EI\ -0.143\ INF$$
$$(-1.988)\quad(0.611)\quad(-2.744)\quad(-1.526)$$

$R^2 = 0.892$ D-W = 1.703
F (7, 8) = 18.77 Estimation Method = CORC

Unorganized Money

34. UMM/NW

$$= 0.146 + 0.003\ (GNPV/NW)\ -0.002\ RT + 0.002\ RP$$
$$(1.863)\quad(0.513)\quad(-2.629)\quad(2.679)$$
$$+0.001\ YB\ -0.001\ R^*\ -0.0007\ (EI_{+1}-EI)/EI + 0.004\ INF$$
$$(1.43)\quad(-2.05)\quad(-0.712)\quad(3.405)$$

$R^2 = 0.909$ D-W = 1.818
F (7, 7) = 21.2 Estimation Method = CORC

Interest Rate

35. RP

$$= 22.609\ -0.0002\ DC + 0.534\ RT + 0.290\ RLN$$
$$(2.214)(-0.941)\quad(2.073)\quad(1.011)$$
$$+0.295\ R^* + 0.007\ (EI_{+1}-EI)/EI\ -0.041\ INF$$
$$(1.439)\quad(0.310)\quad(-0.864)$$

$R^2 = 0.489$ D-W = 1.744
F (6, 36) = 5.74 Estimation Method = OLS

Consumer Price

36. Log (PC)

$$= -1.975 + 0.051\ Log\ (WR) - 0.004\ Log\ (EI)$$
$$(-1.863)\quad(3.707)\quad(-0.924)$$
$$+0.624\ Log\ (WUJ) + 0.131\ Log\ (UC) + 0.091\ Log\ (PP)$$
$$(4.707)\quad(2.028)\quad(2.44)$$
$$+0.369\ Log\ (PMS) + 0.009\ T + 0.099\ Log\ (GNP)$$
$$(2.13)\quad(1.44)\quad(1.301)$$

$R^2 = 0.98$ D-W = 1.36
F (8, 34) = 419.87 Estimation Method = CORC

Wholesale Price

37. $\text{Log (WPI)} = 2.763 + 0.131 \text{ Log (WR)} + 0.219 \text{ Log (UC)}$
(2.123) (2.012) (3.140)
$+ 0.010 \text{ Log (EI)} + 0.078 \text{ Log (WUJ)} + 0.440 \text{ Log (PMS)}$
(1.55) (0.396) (4.122)
$+ 0.012\, T + 0.137 \text{ Log (PP)} - 0.364 \text{ Log (GNP)}$
(2.44) (2.187) (-2.547)

$R^2 = 0.998$ D-W = 2.04
$F(8, 36) = 5351.64$ Estimation Method = CORC

Export Unit Value

38. $\text{Log (PXG)} = 3.124 + 0.016 \text{ Log (WR)} + 0.065 \text{ Log (UC)}$
(2.795) (2.37) (0.83)
$-0.007 \text{ Log (EI)} + 0.114 \text{ Log (PP)} + 0.047 \text{ Log (WUJ)}$
(-1.15) (2.657) (0.213)
$+ 0.007\, T$
(0.998)

$R^2 = 0.269$ D-W = 1.44
$F(6, 36) = 2.21$ Estimation Method = CORC

Import Unit Value

39. $\text{LOG (PMG)} = -0.006 + 0.049 \text{ Log (EI*PP)}$
(-0.452) (1.414)
$+ 0.301 \text{ Log (EI*WUJ)}$
(9.364)

$R^2 = 0.99$ D-W = 2.09
$F(6, 36) = 4.98$ Estimation Method = CORC

Wage Rate

40. $\text{WR} = 0.846 - 0.489 (1-\text{CU}) + 0.316\, \text{PC}^e + 0.504\, \text{WR}_{-1}$
(3.047)(-4.21) (3.45) (8.28)

$R^2 = 0.977$ Durbin's h = 1.88
$F(3, 11) = 205$ Estimation Method = CORC

Exchange Rate (1980. I - 1984. IV)

41. $\text{Log (EI)} = 5.207 - 0.071 \text{ Log (R/R*)} - 0.773 \text{ Log (P/P*)}$
(91.757)(-3.54) (-2.615)
$-0.089 \text{ Log(NW/NW*)} + 0.007 \text{ Log(TB)} - 0.069 \text{ Log(EI)}_{-1}$
(-6.152) (1.764) (-3.461)
$+ 0.014 \text{ Log } (\Delta \text{NFA/MG})_{-1} + 0.105 \text{ Log (B*/F)}$
(0.789) (3.613)
$+ 0.126 \text{ Log (CA)}$
(8.232)

$R^2 = 0.995$ D-W = 1.787
$F(8, 7) = 48.787$ Estimation Method = OLS

Intervention function (1980. I - 1984. IV)

42. $\text{Log}(\triangle NFA) = 9.934 - 1.400 \text{ Log}(EI) + 0.330 \text{ Log}(\triangle NFA/MG)_{-1}$
(1.698)(-1.152) (0.939)
$-0.359 \text{ Log}(\triangle NFA)_{-1}$
(-0.737)

$R^2 = 0.32$ Durbin's h = 1.67
F (3, 11) = 1.796 Estimation Method = CORC

The t-statistics for the regression coefficients are contained in parenthesis. The R^2 is corrected for degrees of freedom. The "F" stands for the F statistics. The CORC stands for the Cochrane-Orcutt procedure. The OLS stands for the ordinary least square method.

DATA

Variables	Definition of Variables	Units	Sources
B*	foreign holdings of domestic financial asset	billion won	B.O.K.
C	private consumption expenditure	billion won	B.O.K.
CA	current acount	million dollar	B.O.K.
CA	cumulative current account	million dollar	B.O.K.
CC	currency	billion won	B.O.K.
CIP	consumer price index	1980 = 100	B.O.K.
CU	capacity utilization	%	B.O.K.
DC	domestic credit	billion won	B.O.K.
DD	demand deposit	billion won	B.O.K.
DEF	government budget deficit	billion won	B.O.K.
DT	time and saving deposits	billion won	B.O.K.
EI	exchange rate	won/dollar	B.O.K.
F	domestic holding of foreign asset	billion won	B.O.K.
FGNP	weighted average of foreign GNP	million dollar	I.F.S.
FP	foreign average price (a geometric mean of WPI of U.S.A., Japan, U.K., Germany, France with weight .42, 0.4, 0.07, 0.06, 0.05)[18]	1980 = 100	I.F.S.
FIP	France's industrial production index	1980 = 100	I.F.S.
FWPI	France's wholesale price	1980 = 100	I.F.S.

18) Because of lack of quarterly data in the rest of the world countries, we do not include in the geometric mean.

G	government consumption expenditure	billion won	B.O.K.
GNP	gross national product	billion won	B.O.K.
GNPP	potentional GNP (calculated by a peak to peak regression with GNP)	billion won	
GNPW	weighted average of industrial production of U.K., Germany, France	1980 = 100	I.F.S.
GIP	Germany's industrial production index	1980 = 100	I.F.S.
GWPI	Germany's wholesale price index	1980 = 100	I.F.S.
IF	gross domestic fixed capital formation	billion won	B.O.K.
II	inventory investment	billion won	B.O.K.
INF	inflation rate	%	B.O.K.
JPXGUV	Japan's unit value of exports	1980 = 100	B.O.J.
JPMGUV	Japan's unit value of imports	1980 = 100	B.O.J.
KI	stock of inventories	billion won	B.O.K.
KV	capital stock	billion won	B.O.K. K.D.I.
MB	monetary base	billion won	B.O.K.
M1	currency plus demand deposit	billion won	B.O.K.
M2	M1 plus time ans savings deposits	billion won	B.O.K.
MG	total commodity imports	million dollar	B.O.K.
MSO	total imports of services	million dollar	B.O.K.
NFA	net foreign assets	billion won	B.O.K.
NFIA	net factor income from abroad	billion won	B.O.K.
NW	private financial net worth	billion won	B.O.K. F.O.K[k].
NW*	U.S.' private financial net worth	billion dollar	F.O.F[u].
PC	domestic consumption deflator	1980 = 100	B.O.K.
PGNP	GNP deflator	1980 = 100	B.O.K.
PGM	unit value of imports	1980 = 100	B.O.K.
PMS	goods and services of import deflator	1980 = 100	B.O.K.
PXG	unit value of exports	1980 = 100	B.O.K.
q	deflator for investment goods	1980 = 100	B.O.K.
R*	U.S.' prime loan interest rate	%	S.C.B.
RD	offical discount rate	%	B.O.K.
RLN	commercial banks loan rate	%	B.O.K.
RP	interest rate for curb market	%	B.O.K.

RT	interest rate for savings	%	B.O.K.
rr	real interest rate (RP-INF)	%	
S	final sales	billion won	B.O.K.
SD	statistical discrepancy	billion won	B.O.K.
SUB	effective subsidy rate	won per dollar	B.O.K.
T	time trend		
TAR	effective tariff rate	won per dollar	B.O.K.
TB	trade balance	million dollar	B.O.K.
UC	real user's cost		B.O.K.
UKIP	U.K.' industrial production index	1980 = 100	I.F.S.
UKWPI	U.K.' wholesaleprice index	1980 = 100	I.F.S.
UMM	unorganized money	billion won	F.O.F.[k]
UPMGUV	U.S.'s unit value of index	1980 = 100	I.F.S. S.C.B.
USGNP	U.S. gross national product	billion dollar	I.F.S. S.C.B.
USWPI (P*)	U.S. wholesale price index	1980 = 100	I.F.S.
UPXGUV	U.S.'s unit value of index	1980 = 100	I.F.S. S.C.B.
w	corporate income tax rate	%	M.O.F.
WPI (P)	wholesale price index	1980 = 100	B.O.K.
WR	wage rate index	1980 = 100	I.F.S.
WUJ	weighted average of foreign export unit value indexes	1980 = 100	I.F.S.
WWP	weighted average export unit value of the U.K., Germany, France		I.F.S.
WWPI	weighted average WPI of the U.K., Germany, France	1980 = 100	I.F.S.
XG	total commodity exports	million dollar	B.O.K.
XKJV	Korea's export to Japan	million dollar	B.O.K.
XKUV	Korea's export to U.S.A.	million dollar	B.O.K.
XJKV	Korea's import from Japan	million dollar	B.O.K.
XKRV	Korea's export to the rest of the world	million dollar	B.O.K.
XRKV	Korea's import from the rest of the world	million dollar	B.O.K.
XUKV	Korea's import from U.S.A.	million dollar	B.O.K.
XSO	exports of services and other goods	million dollar	B.O.K.

Y	real output (GNP)	billion won	B.O.K.
YB	yield on corporate bonds	%	B.O.K.
δ	rate of physical depreciation of capital goods		

Sources: B.O.K. Bank of Korea, *Monthly Bulletin and Statistical Year Book* 1965-1985.
F.O.F.^{k} = Flow of Funds Account in Korea, Bank of Korea
F.O.F^u = Flow of Funds Account in U.S.A., the Board of Federal Reserve
M.O.F. = Ministry of Finance in Korea
I.F.S. = International Financial of Statistics 1970-1986
B.O.J. = Bank of Japan, Monthly Bulletin, 1970-1985
S.C.B. = Survey of Current Business in U.S.A.
K.D.I. = Korea Development Institute

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