How the Republic of Korea's Financial Structure Affects the Volatility of Four Asset Prices

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Abstract

This study investigates the role of financial structure on the volatility of four asset prices in Korea. First, historical development of size, activity and efficiency of financial structure is investigated and development of non-bank financial institutions analyzed for the last three decades. Second, using the concept of bank-based and market-based financial structure, it is shown that there exists a stable long-run relationship among financial structure and volatility of real effective exchange rate, money market rate, stock price, and government bond yield on housing. Finally, we find that dynamic impact of financial structure is asymmetric to different financial variables. This implies that different transmission mechanisms of monetary policies are necessary to achieve different policy goals of the economy. For example, if the policy goal of the monetary authority is stabilizing the volatility of the money market rate, monetary authority's intervention in the banking sector is more efficient than intervening into other sectors of the financial system. We report each case using cointegrating vector and impulse response function analysis.

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I. Introduction

The literature on currency crises has provided a number of suggestions about the possible influence of financial structure on the volatility of asset prices and capital flows. There is by now a documented empirical evidence of the relationship between the financial structure and financial crisis. While this may provide some indirect insight about the relationship between asset volatility – interpreted as extreme variations of prices – and financial structure, a more direct analysis seems to be missing. Although finance theory tells us that the linkage between the financial structure of the economy and the likelihood of financial crises is provided by the volatility of financial and non-financial assets this intermediate link is still somewhat unexplored. Stock prices often double or fall in half in a space of a few years, when there seems to be no concrete reason why stock prices should have changed at all. Sometimes speculative prices change dramatically in a matter of days or even hours. On 19 October 1987, the day of the worst crash in U.S. stock market history, the Dow Jones Industrial Average lost 16 percent of its value in the space of three hours, from 1.15 p.m. to 4.00 p.m. Analyses of news service records show that during that interval of time there was virtually no economic news except for the news of the stock market drop itself. Such evidence would seem to suggest that the source of market volatility is something loosely called "market psychology," the changing public expectations, attitudes, and theories about the market (Shiller, 1992).

In this paper, we examine how the financial structure of an economy, Korea, affects the asset price volatility of several key financial variables using time-series data. To measure empirically the financial structure of a country we employ the recently developed concept of bank-based versus market-based financial structure (Demirguc-

Kunt and Levine, 1999). In section II, we describe the development of Korea's financial structure. In section III, we investigate the statistical properties of each time series used in this study and test for a stable long-run relationship among financial structure and volatility of four financial variables in Korea using Johansen's conintegration technique. In section IV, we investigate the dynamic impact of financial structure on the volatility of four financial variables using the vector-autoregression model. Conclusions are presented in section V.

II. The Development of Korea's Financial Structure

This section will investigate the changes in financial structure and the underlying regulation, tax, and legal changes that caused them. The most important policy measure of government-led economic development in Korea was financial policy (e.g., interest-rate regulation and policy loans). The heavy intervention of the Korean government in the financial system during the 1960s and 1970s is revealed by its discretionary allocation of funds to target industries through policy loans (credit rationing). This caused misallocation (overinvestment) of financial resources into the heavy manufacturing and chemical industries, which led to creditor bankers' losses. The banking sector suffered from a lack of competitiveness, an accumulation of non-performing assets, and delays in liberalization. Policy loans at preferential interest rates accounted for half of the total credit offered by domestic financial institutions in 1970s and about 30 percent in the 1980s with the expansion of non-bank financial Institutions (NBFIs, hereafter; Bank of Korea, 1995).

In the fifth economic development plan ('82-'86), the Korean government put more emphasis on the stability, efficiency, and social equity within the economy, believing that a massive misallocation of resources in the heavy manufacturing and chemical industries could have been avoided if the functioning of the financial system had been left in the hands of the private sector. The government tried to improve efficiency through the promotion of competition and private initiative. The goals of financial reform were reducing inefficiency and preventing private rent-seeking and foreign control of the financial market (Amsden and Euh, 1993).

1. Changes in Financial Structure, Size, Activity and Efficiency in Korea

Among financial institutions, banks provide funds mostly through loans and they dominated in financial institution borrowings until the 1970s. Their relative importance has gradually declined, slipping from 29.2 percent of the market in the first half of the 1970s to 19.2 percent in the first half of the 1990s. Whereas Table 1 shows that the market shares of non-banks and securities market increased over the period 1970-74 to 1990-94 from 8.8 percent to 33.2 percent and from 11.1 percent to 27.0 percent respectively. The share of deposits held by nonbanks increased from 31.6 percent in 1980 to 67.6 percent in 1995 (see Table 2).

Despite the slow pace of reform, Korea's financial market experienced growth in overall size and activity. Korean financial depth increased from 49.4 percent in 1981 to 103.2 percent in 1989 and to 150.0 percent in 1995, mostly due to the growth in the nonbanking sector. However, stock market capitalization to GDP grew even more over this period, from 6 percent to 63.4 percent. This explains the growth in the stock market's relative size, which started out at 20 percent in early 1980s, but ended the decade at 90 percent. During the same period, stock market liquidity and bank credit to the private sector also increased, leading to an increase in overall activity from 44 percent to 82 percent of GDP. However, the growth in stock market liquidity far outweighed that in bank credit as can be seen from relative activity figures. Looking at efficiency indicators, relative efficiency increased whereas overall efficiency fell during the period. This is because although stock market turnover increased with liberalization, banking spreads increased even more.

2. Development of Non-Bank Financial Institutions

In this section, we will analyze the development of non-bank financial institutions (NBFIs), their special treatment by law and regulation, their structure and business activities, their role in stimulating and mobilizing savings, and their contribution to Korea's economic development

Many NBFIs were introduced in 1972 in response to the Presidential Emergency Decree for Economic Stabilization and Growth. Their numbers and volume of funds grew significantly during the rapid economic growth of the 1970s and 1980s. A further contribution to their rapid growth came from the relatively higher interest rates permitted to them and the greater degree of autonomy in management they were allowed compared to traditional banks. In 1982, requirements for establishing NBFIs were reduced and consequently twelve short-term finance companies and 57 mutual savings and finance companies began operations. During the period 1987 to 1990, five securities trust companies and eighteen life insurance companies were in operation (Bank of Korea, 1995).

NBFIs can be classified into four categories according to their business activities: i) development institutions, which consist of the Korea Development Bank, the Export-Import Bank of Korea, and the Korea Long Term Credit Bank; ii) investment institutions, which consist of investment and finance companies, merchant banking corporations, and securities investment trust companies; iii) savings institutions including trust accounts of banks, mutual savings and finance companies, credit unions, mutual credit facilities, community credit cooperatives, and postal savings; and iv) life insurance institutions. Out of these four categories of NBFIs, investment and life insurance institutions grew most rapidly during the period 1980-1995. These NBFIs have contributed significantly to the stimulation and mobilization of savings since they were able to circumvent the interest-rate ceilings on both the sources and uses of funds (Koo, 1993). Table 2 shows that over the period 1980-1995, the share of loans made by NBFIs increased from 36.7 percent to 57.1 percent. On the demand side, high real interest rates (due to slowing price increases in the early 1980s) jeopardized the viability of firms with high financial leverage. Because of the repressed commercial bank interest rates, corporations not supported by the government were forced to borrow from NBFIs. NBFIs evaded the low interest-rate policy of MOF by requiring compensating balances that borrowers had to redeposit in the same financial institution, thereby raising the effective interest rates on the original loans (Bank of Korea, 1995).

3. A Measure of Financial Structure

The measurement of financial structure in this study draws heavily on the recent work by Demirguc-Kunt and Levine (1999) that derived several findings on the relationship between financial structure and per capita income level. According to their study, in higher income countries, banks and other financial intermediaries as well as stock markets and the overall financial system tend to be larger, more active, and more efficient. In higher income countries insurance companies, pension funds, and other non-bank financial intermediaries are larger as a share of GDP.

For practical purposes, we used three variables as indicators of Korea's financial structure: bank assets to GDP (claims on the private sector by commercial banks to GDP, **BANK**); non-banking financial institution's assets to GDP as a measurement of other financial institution's size (**NBFI**); and stock-market capitalization to GDP as a measure of stock market development (**MK**). Variable definitions are given in the Appendix. Figure 1 shows the changing pattern of the financial structure in Korea and Table 2 shows the volatility of four financial variables.

III. The Data and Their Statistical Properties

In this section we define the variables used in this study and test the stationarity of those variables using two different unit root test procedures.

1. The Data and Their Statistical Properties

All quarterly data are from the March 1999 issue of the IMF's *International Financial Statistics*, CD-Rom version, and are seasonally adjusted using exponential smoothing. Data definitions are found in the Appendix. A control variable is used to isolate the effects of structural variables (that are expected to maintain their impact over the long run) from the short-run effects of policy -- monetary or fiscal -- on the volatility of each economic variable a la Krumm (1993). Volatility responds to both real and monetary variables. Monetary and fiscal variables are combined into one macroeconomic control variable, VV, which is defined as the percentage change in domestic credit over and above the percentage change in GDP, foreign prices, and the nominal exchange rate.

$$VV = DC^* - Y^* - P_f^* - NE^* , \qquad (1)$$

where DC is domestic credit, Y is GDP, P_f is U.S. WPI, NE is the nominal exchange rate to the U.S. dollar, and * indicates percentage change.

In order to examine the stationarity of each time series, we conducted unit root tests. Table 3 reports the results from the Augmented Dickey-Fuller and Paco Goerlich Tests, which reveal that all series have unit roots.

2. Johansen's Cointegration Test

Since all variables are non-stationary, we use Johansen's co-integration analysis to test whether those variables have co-integrating vectors. Johansen (1988) and Johansen and Juselius (1990) developed a cointegration test methodology that overcome most of the problems of the previous two-step approach.

Johansen and Juselius (1990) considered the following general model:

$$X_t = \Pi_1 X_{t-1} + ... + \Pi_{t-k} X_{t-k} + v + \varepsilon_t \quad \text{for } t=1,\ldots T, \qquad (2)$$

where X_t is a vector of variables ; $\varepsilon_{1\ldots\ldots}$ ε_T are independent and normal errors with zero mean and covariance matrix Σ; $X_{t-k,}$ X_0 are fixed; and v is an intercept vector. Economic time series are often non-stationary and systems such as the above vector-autoregressive representation (VAR) can be written in the conventional first-difference form:

$$\Delta X_t = \Gamma_{k-i} \Delta X_{t-k-1} + \Pi X_{t-k} + v + \varepsilon_t , \qquad (3)$$

where $\Gamma_i = -(1 - \Pi_1 - \Pi_2 - \ldots\ldots\ldots\ldots - \Pi_k)$ for i=1,2,……k-1,

and $\Pi = -(1 - \Pi_1 - \ldots\ldots\ldots\ldots - \Pi_k)$.

The only level term in equation (3) is $\Pi X_{t-k.}$ Thus, only the Π matrix contains information about the long-run relationship between the variables in the data vector. There are three possible cases:

1. If the Π matrix has rank zero then all variables in X are integrated of order one or higher and the VAR has no long-run properties;

2. If the Π matrix has rank p (i.e., it is of full rank), the variables in X are stationary; and

3. If Π matrix has rank r ($0 < r < p$), Π can be decomposed into two distinct (p*r) matrices α and β such that $\Pi = \alpha\beta'$.

The third case implies that there are r cointegrating vectors. The parameters of the cointegrating vectors are contained in the β matrix. Therefore $\beta'X$ is stationary even though X_t itself is nonstationary. The α matrix gives weights with which the cointegrating vectors enter each equation of the system. To determine the number of cointegrating vectors, r, Johansen and Juselius (1990) used two likelihood-ratio tests. The first test is based on the maximal eigenvalue (λMAX) -- the null hypothesis is that there are at most r cointegrating vectors against the alternative r+1 cointegrating vectors. The second test is based on the trace of the stochastic matrix (TRACE) -- the null hypothesis is that there are at most r cointegrating vectors against the alternative hypothesis that there are r or more cointegrating vectors. Two likelihood-ratio tests for the existence and cointegrating vectors are reported in Table 4. Johansen's cointegration tests are implemented using four lags and for four sets of five variables which include the volatility, financial structure, and control variables.

Table 5-A shows that the volatility of stock prices has two cointegrating vectors with the financial structural variables at the 10 percent critical level based on both λmax and Trace statistics. One of the cointegrating vectors can be written as follows:

$$-.058\,VSTK - 1.644\,NBFI + 12.22\,BANK + .662\,MK + 0.018\,VV = 0 \qquad (6)$$

Equation (6) implies that increases in bank assets to GDP and stock market capitalization to GDP increases the volatility of the stock price. This finding is consistent with the impulse response analysis of the vector-autoregression model. The economic implication of this cointegrating vector is that increase in bank assets (BANK) and stock market capitalization (MK) destabilize the volatility of stock prices, implying a high sensitivity of stock prices to financial activities of the economy. The impulse response function in Figure 3 confirms this finding.

Table 5-B shows that the volatility of the real effective exchange rate has three cointegrating vectors with the financial structure variables at the 10 percent critical level based on both λmax and Trace statistics. One of the cointegrating vector scan be written as follows:

$$.024\ VREX + 2.052\ NBFI - 13.05\ BANK - .723\ MK + 0.151\ VV = 0 \qquad (7).$$

This cointegrating vector is consistent with the impulse response analysis of the vector-autoregression model presented in Figures 4-A and 4-B.

Table 5-C shows that the volatility of money-market interest rates has three cointegrating vectors with the financial structural variables at the 10 percent critical level based on both λmax and Trace statistics. One of the cointegrating vectors can be written as follows:

$$-1.138\ VMMR + 4.504\ NBFI - 25.846\ BANK - 1.285\ MK + 0.654\ VV = 0. \qquad (8)$$

This implies that increases in non-bank financial institutions' assets to GDP increase the volatility of the bond yield, whereas increases in stock market capitalization to GDP decrease the volatility of money-market rates. This finding is consistent with the impulse response analysis of the vector-autoregression model shown in Figures 5-A and 5-C. The economic implication of this cointegrating vector is that increases in stock market capitalization to GDP and non-bank financial institutions' assets destabilize the volatility of the money-market rate because their activities are less regulated than other financial sector.

Table 5-D shows that the volatility of government bond yield has two cointegrating vectors with the financial structural variables at the 10 percent critical level based on both λmax and Trace statistics. One of the cointegrating vectors can be written as follows:

$$-.226\ VBOND + 2.543\ NBFI - 16.78\ BANK - .925\ MK + 0.188\ VV = 0. \qquad (8)$$

This implies that increases in bank assets to GDP and stock market capitalization to GDP decrease the volatility of the government bond yield. This finding is consistent with the impulse response analysis of the vector-autoregression model which is presented in Figure 6. The economic implication of this cointegrating vector is that while increases in bank asset and stock market capitalization stabilize the volatility of the government bond yield, increases in non-bank financial institutions' assets destabilize the volatility of the government bond yields because their activities are less regulated.

IV. Dynamic Analysis Using a Vector-Autoregression Model

In this section we use the vector-autoregression model to examine the dynamic impact of financial structure on the volatility of the financial variables.

1. A Vector-Autoregression Model

We will test the dynamic impact of changing financial structure on the volatility of four economic variables using the vector-autoregressive model presented in equations (9) through (13):

$$VRX = \Sigma\, \alpha_i\ MK + \Sigma\, \alpha_i\ BANK + \Sigma\, \alpha_i\ NBFI + \Sigma\, \alpha_i\ VV \qquad (9)$$

$$MK = \Sigma \alpha_i \ VRX + \Sigma \alpha_i \ BANK + \Sigma \alpha_i \ NBFI + \Sigma \alpha_i \ VV \quad (10)$$

$$BANK = \Sigma \alpha_i \ MK + \Sigma \alpha_i \ VRX + \Sigma \alpha_i \ NBFI + \Sigma \alpha_i \ VV \quad (11)$$

$$NBFI = \Sigma \alpha_i \ MK + \Sigma \alpha_i \ BANK + \Sigma \alpha_i \ VRX + \Sigma \alpha_i \ VV \quad (12)$$

$$VV = \Sigma \alpha_i \ MK + \Sigma \alpha_i \ BANK + \Sigma \alpha_i \ NBFI + \Sigma \alpha_i \ VRX, \quad (13)$$

where VRX is the volatility of the real effective exchange rate, MK is the amount of stock market capitalization divided by GDP, BANK is claims on the private sector by commercial banks, NBFI is the ratio of bank to non-bank financial institutions' assets, and VV is the macroeconomic policy stance variable to control for the impact of macroeconomic policies.

2. Impulse Response Function

The goal of this section is to investigate the dynamic impact of financial structural variables on the volatility of economic variables. Granger-causality amongst these variables is examined and the results are reported in Table 4. Based on these causality tests and economic theory, the ordering of the variables in the vector-autoregression is determined. Various different orderings are tried to see the robustness of the test result.

The dynamic impact of financial structure and macroeconomic policy stance variables are analyzed through the computation of variance decompositions (VDCs) and impulse response functions (IRFs) which, in turn, are based on the moving-average representation of the VAR model and reflect both direct and indirect effects. In particular, the VDCs for VREX indicate the percentage of the forecast-error variance in the VREX accounted by the financial structure and VV.

3. Dynamic Impact of Financial Structure on Economic Volatility

An optimal lag of four is chosen based on the likelihood-ratio test and the model is then estimated. Since different orderings of the variables in the VAR estimation yield different results, various orderings based on the Granger-causality tests reported in Table 4 were tried. However, different orderings did not bring about significant differences. From the impulse response function and variance decomposition of forecast-error variances, we find the following:

Volatility of the stock price

Impulse response functions show that stock market capitalization (MK) and private claims of commercial banks (BANK) increase the volatility of the stock prices in Korea. Increased stock market capitalization increases the uncertainty of the market and leads to the increased volatility of stock prices -- this reflects the highly volatile characteristics of the stock price independent of the financial structure. Finally, the macroeconomic policy stance variable has a negative impact on VSTK The impulse response functions are shown in Figures 3-A to 3-C.

Table 6-A shows the innovation accountings of the volatility of the stock price. With the exception the stock price volatility variable itself, BANK plays the most important role in explaining the variance decomposition of the forecast error variance of the volatility of the stock price, explaining about 12 percent of the 12-step ahead forecast error variance. The stock market capitalization to GDP (MK) variable is next in importance. However, the policy stance (VV) and stock market capitalization (MK) variables explain very little of the forecast-error variance of the volatility of the stock

price volatility. Table 6-C shows the variance decomposition of the volatility of the stock price from one to 48 quarters.

Volatility of real effective exchange rate

The impulse response function shows that stock market capitalization (MK) increases the volatility of the real effective exchange rate, whereas private claims of commercial banks to GDP (BANK) destabilize the volatility in Korea. This can be explained by the strong restrictions on the foreigners' investments in Korea's stock market and on most capital flows, which are one of the most important variables affecting exchange-rate movements. Impulse response functions are shown in Figures 4-A to 4-C. In sum, with the exception of the real effective exchange rate itself, stock market capitalization to GDP plays the most important role in explaining the forecast error variance of the volatility of the real effective exchange rate, explaining about 12 percent of the forecast error variance by 8 quarters. The next most important explanatory variable is private claims of the banking sector (BANK), explaining about 7 percent by 8 quarters. However, the policy stance and non-bank financial institutions (NBFI) variables explain very little of the forecast-error variance of the volatility of the real effective exchange rate. Table 6-B shows the variance decomposition of the volatility of the real effective exchange rate in Korea.

Volatility of the money market rate (VMMR)

Impulse response functions are shown in Figures 5-A to 5-C. These indicate that the stock market capitalization to GDP (MK) increases the volatility of the money-market rate, while private claims of commercial banks (BANK) decrease the volatility of the money-market rate. This implies that as a country moves from a bank-based financial structure to a market-based financial structure, the volatility of the money-market rate increases. From the variance decomposition of the forecast error variance of the volatility of the money-market rate, except volatility of the money market rate itself, stock market capitalization is playing the most important role, explaining some 22 percent of the forecast error variance in 24 quarters ahead (commercial banks claims on private sector to GDP (BANK) is the next most important variable). Both the policy stance variable (VV) and NBFI have very small roles to play in explaining the forecast-error variance of the volatility of the stock price volatility. Table 6-C shows the variance decomposition of the volatility of the money-market rate from one to 24 quarters.

Volatility of the Government Bond Yield on Housing

Both the stock market capitalization to GDP (MK) and private claims of commercial bank to GDP (BANK) decrease the volatility of the government bond yield on housing. This can be explained by the strong commitment of the Korean government to supplying stable funds for new housing construction. However, an increase in the macroeconomic policy stance variable (VV) causes an increase in the volatility of the government bond yield. This finding is consistent with economic theory. The impulse response function of BOND is shown in Figures 6-A to 6-C.

When we move to the relative importance of financial structure on the forecasting-error variance of the bond yield volatility, claims of the commercial bank to the private sector (BANK) plays the most important role and stock market capitalization to GDP (MK) is plays the next most important role. Innovation accounting of the government bond yield on housing is given in Table 6-D.

V. Conclusions

This study tried to identify the role of financial structure on the volatility of economic variables, the real effective exchange rate, the money-market rate, government bond yield, and stock price. We used the concept of market-based and bank-based financial structure developed by Demirguc-Kunt and Levine (1999) to investigate the changing role of financial structure on the volatility of several economic variables. From this case study of Korea, it is difficult to say that our findings are unique. However, some of our more interesting findings, at least for Korea, are summarized in what follows.

It seems that there exists more than one long-run stable relationship between financial structure and economic variables which are volatility of real effective exchange rate, money market rate, stock price, and government bond yields on housing in Korea. We also found that the dynamic impact of financial structure on the volatility of each economic variable is asymmetric, i.e., some economic variable's volatility increased whereas other variable's volatility decreased. For the stock price volatility, increased claims to private sector by commercial bank to GDP and stock market capitalization to GDP both increase the volatility of the stock price. This reflects the highly volatile nature of stock prices, which is independent of Korea's financial structure.

For the volatility of the real effective exchange rate, claims to private sector by commercial bank to GDP (BANK) increases volatility and government should monitor closely the commercial bank's activity in foreign exchange market for to avoid their excessive risk exposure and destabilizing speculations. However, stock market capitalization to GDP (MK) decreases the volatility of the real effective exchange rates implying that as Korea's financial structure moves from a bank-based to a market-based system, the volatility of the real effective exchange rate decreased since mid-1980s even with a more flexible exchange rate system and this is confirmed by Figure 2.

Since the exchange rate is determined (at least in the short run) by capital inflows and outflows in the foreign-exchange market, this finding reflects the restrictions on foreigners' ownership of domestic stock in Korea during the analysis period and the fact that most of the capital flows are channeled through commercial banks.

For the volatility of the money-market interest rate, stock market capitalization to GDP (MK) increases the volatility whereas increased claims to the private sector of commercial banks to GDP (BANK) decreases the volatility of the money-market rate. This implies that if interest targeting is the primary goal of policy authority, strong supervision and monitoring is necessary in the stock market to stabilize the money-market rate. For the volatility of the government bond yield, both the claims to private sector by commercial bank to GDP (BANK) and stock market capitalization to GDP (MK) decrease the volatility of the yield on government bond on housing. This explains the intrinsic stability of the yield on government bond yield on housing. The Korean government's policy goal of stabilizing the house supply in Korea has successfully isolated the housing market from the impact of financial structure.

This study identified a stable long-run relationship between financial structure and volatility of financial variables in Korea implying that stabilization policy should be different depending on priority of the policy goals. Future study will investigate whether the findings of this study are robust with respect to different definitions of financial structure and for different data sets, i.e., cross-country data.

References

Ahmed, B Ickes, P. Wang, and B.S. Yoo, 1993,"International Business Cycle," *American Economic Review*, 83, 335-59.

Amsden, A.H. and Y.D. Euh,1993, "South Korea's 1980s Financial Reforms: Good Bye Financial Repression (Maybe), Hello New Institutional Restraints," *World Development*, 21, 379-390.

Bank of Korea, 1990, 1995, *The Financial System in Korea*, Seoul, Korea.

Cho, Y.J. and J.K. Kim, 1995, "Credit Policies and the Industrialization of Korea," *World Bank Discussion Paper No. 286*, The World Bank, Washington D.C.

Demirguc-Kunt, A. and R. Levine, 1999, "Bank-based and Market-based Financial Systems: Cross-Country Comparisons," mimeo, The World Bank.

Demirguc-Kunt, A. and V. Maksimovic, 1996a, "Financial Markets and Firm Debt Maturity," World Bank Working Paper No. 1686, The World Bank.

__________________________________, 1996b, "Financial Constraints, Uses of Funds and Firm Growth: An International Comparison," World Bank Working Paper No. 1671, The World Bank.

Johansen, Soren, 1988, "Statistical Analysis of Cointegrating Vectors," *Journal of Dynamics and Control*, 231-254.

Johansen, S. and K. Juselius, 1990, "Maximum Likelihood Estimation and Inference on Cointegration -- With Application to the Demand for Money," *Oxford Bulletin of Economics and Statistics,* May, 169-210.

Jung, J. and J.W. Lee, 1993, "Recent Financial Reforms in Korea: Real Name Financial System Launched," *Korean Financial Review*, vol. 3, no. 3, 3-22.

Kang, M.S., 1990, "Money Market and Monetary Policy in Korea," Korea Development Institute, Seoul, Korea.

Koo, B.H., 1993, "Industrial Policy and Financial Reforms in Korea," in *Financial Sector Reforms in Asia and Latin American Countries*, edited by Shakil Faruqi, The World Bank.

Krumm, K.L., 1993, "A Medium-term Framework for Analyzing the Real Exchange Rate with Applications to the Philippines and Tanzania," *World Bank Economic Review*, vol 2, May, 219-245.

Park, J.H., 1993, "Financial liberalization and Internationalization in Korea," *Korean Financial Review*, vol. 3, no. 4, 3-23.

Data Appendix: Sources and Definitions

1. RX: real effective exchange rate of Korean won from JP Morgan.

2. BOND: government bond yield on housing (IFS line 61).

3. STK: stock price index (IFS line 62).

4. MMR: money-market rate (IFS line 60b).

5. VRX: volatility of real effective exchange rate defined as a six-month window standard deviation for each quarter; data are from JP Morgan.

6. VBOND: volatility of the government bond yield on housing defined as a six-month window standard deviation for each quarter (IFS line 61).

7. VSTK: volatility of the stock price defined as a six-month window standard deviation for each quarter (IFS line 62).

8. VMMR: volatility of the money-market rate defined as a six-month window standard deviation for each quarter (IFS line 60b).

9. NBFI: Other financial institutions' domestic assets (IFS lines 42a-d) to GDP (IFS line 90 bp).

10. BANK: Commercial banks' domestic assets (IFS lines 22 a-d) to GDP (IFS line 90 bp).

11. MK: Stock market capitalization (Monthly Bulletin of the Stock Market) to GDP (IFS line 90 bp).

12. VV: Macroeconomic Control Variable defined in the text.

Table 1. Financial Market Composition of Korea*

	1970-74	1975-79	1980-84	1985-89	1990-94
(1)Financial Institutions	*38.0*	*40.7*	*45.6*	*48.7*	*52.5*
Banks	29.2	26.2	23.2	20.3	19.2
Non-Banks	8.8	14.5	22.4	28.4	33.2
(2)Security Market	*11.1*	*15.6*	*20.0*	*27.1*	*27.0*
Stocks	9.7	11.1	11.9	16.4	11.4
Bonds	1.3	4.5	8.1	10.7	15.6
(3) CP Market	0.5	1.4	3.2	4.7	4.0
(4) Foreign Market	13.6	13.3	6.0	0.2	2.2
(5) Other Finance	36.9	29.0	25.2	19.3	14.4
Total	100	100	100	100	100

Notes: * denotes the non-financial sector's fund raising
CP denotes commercial paper

Source: *The Financial System in Korea* (1995), Bank of Korea.

Table 2. Market Share of Financial Institutions in Korea

	Loans (in percent)				Deposits (in percent)			
	1980	1985	1990	1995*	1980	1985	1990	1995*
Dep. Money Bank**	63.3	58.4	48.3	42.9	68.4	53.5	41.0	32.4
				-32.2%				-52.6%
NBFIs * **	36.7	41.6	51.7	57.1	31.6	46.5	59.0	67.6
				55.6%				113.9%
A.Development	14.8	10.8	8.3	8.0	3.8	4.1	3.1	4.2
				-45.9%				10.5%
B.Savings	13.0	16.3	25.3	33.3	13.5	15.5	27.1	36.5
				152.6%				170%
C.Investment	5.8	7.6	8.1	6.8	9.5	15.8	16.2	15.5
				17.2%				63%
D.LifeInsurance Co.	3.1	6.9	10.0	9.0	4.8	11.1	12.6	11.4
				190.3%				137.5%

Notes: 1)* denotes the amount by the end of June, 1995
2)** denotes money deposits at banks
3)*** denotes Non-banking Financial Institutions
4)% denotes the total growth rate between June 1980 and June 1995

Source: *The Financial System in Korea* (1995), Bank of Korea.

Table 3. Tests of Unit Roots

A. Augmented Dickey-Fuller Test

Variable	Lags	ADF_{τ}	ADF_{Z}	Joint test of unit root and no constant
VRX	2 (1)	-2.29	-10.7	4.0
VSTK	1 (1)	-2.20	-9.16	2.45
VBOND	13 (1)	-2.84	-8.2	4.07
VMMR	2 (1)	-2.87	-6.8	4.12
NBVB	0 (0)	1.15	0.82	3.27
BANK	14 (1)	-0.63	-0.87	2.29
MK	8 (8)	-1.25	-3.07	1.23

Note: ** denotes that the estimate is significant at 5 percent critical level.

B. Paco Goerlich Test

Variable	AR	Constant Trend	Constant	No constant,	Conclusion
VRX	4	-1.29	-1.07	-1.12	Unit root, no drift
VSTK	4	-1.61	-1.73	-0.75	Unit root, no drift
VBOND	4	-2.90	-2.54	-1.09	Unit root, no drift
VMMR	4	-2.50	-2.38	-0.70	Unit root, no driftt
NBVB	4	-2.66	-0.12	N.A.	Unit root, drift
BANK	4	-1.79	-1.03	1.61	Unit root, no drift
MK	4	-1.98	2.19	1.29	Unit root no drift

Note: ** denotes that the estimate is significant at 5 percent critical level.

Table 4. Granger-Causality Test

A. Volatility of Stock Price

	VSTK	NBFI	BANK	MK	VV
VSTK	.000**	.38	.29	.67	.67
NBFI	.07	.000**	.045**	.217	.520
BANK	.780	.011**	.000**	.057	.042**
MK	.009**	.000**	.490	.000**	.230
VV	.057	.063	.490	.250	.059

Notes: Figures are significance probabilities. ** denotes significant at 5 percent.

B. Volatility of Real Effective Exchange Rate

	VREX	NBFI	BANK	MK	VV
VREX	.000**	.14	.29	.25	.90
NBFI	.65	.000**	.001**	.006**	.035**
BANK	.018**	.000**	.000**	.000**	.014**
MK	.23	..000**	.75	.000**	.35
VV	.69	.23	.019**	.63	.023**

Notes: Figures are significance probabilities. ** denotes significant at 5 percent.

C. Volatility of Money-Market Rate

	VMMR	NBFI	BANK	MK	VV
VMMR	.000**	.43	.078	.98	.29
NBFI	.92	.000**	.29	.12	.13
BANK	.77	.0002**	.000**	.0007**	.034**
MK	.58	.000**	.83	.0001**	.26
VV	.78	.22	.06	.63	.18

Notes: Figures are significance probabilities. ** denotes significant at 5 percent.

D. Volatility of Government Bond Yield

	VBOND	NBFI	BANK	MK	VV
VBOND	.000**	.190	.056	.160	.620
NBFI	.230	.000**	.269	.435	.268
BANK	.293	.002**	.000**	.006**	.044**
MK	.710	.000**	.890	.000**	.390
VV	.200	.210	.066	.960	.030**

Notes: Figures are significance probabilities. ** denotes significant at 5 percent.

Table 5. Johansen's Cointegration Test

A. Endogenous Series: **VSTP**, NBFI, BANK, MK, VV

Lags in the model: 4, No. of observations=65, No. of observations - no. of variables=45

Eigen-Value	L-max	Trace	H0: r	p-r	L-max90	Trace90
0.8912	144.19**	208.74**	0	5	18.96	55.54
0.4919	44.01**	64.55**	1	4	15.00	36.58
0.2106	15.37**	20.54	2	3	11.23	21.58
0.0750	5.07	5.16	3	2	7.37	10.35
0.0014	0.09	0.09	4	1	2.98	2.98

Notes: ** denotes significant at 10 percent.

Cointegrating Vector:

VSTP	NBFI	BANK	MK	VV
-.058	-1.644	12.225	0.662	0.018
-0.716	-2.739	19.046	0.789	0.089

B. Endogenous Series**: VREX**, NBFI, BANK, MK, VV

Lags in the model: 4, No. of observations=65, No. of observations - no. of variables=45

Eigen-Value	L-max	Trace	H0: r	p-r	L-max90	Trace90
0.8804	138.03**	212.02**	0	5	18.96	55.54
0.4726	41.59**	73.99**	1	4	15.00	36.58
0.3126	24.37**	32.40**	2	3	11.23	21.58
0.1049	7.20	8.03	3	2	7.37	10.35
0.0127	0.83	0.83	4	1	2.98	2.98

Notes: ** denotes significant at 10 percent.

Cointegrating Vector:

VREX	NBFI	BANK	MK	VV
0.024	2.052	-13.05	-0.723	0.151
0.496	5.429	-27.166	-1.250	-0.594

Table 5. Johansen's Cointegration Test (continued)

C. Endogenous Series: VMMR, NBFI, BANK, MK, VV

Lags in the model: 4, No. of observations = 65, No. of observations - no. of variables=45

Eigen-Value	L-max	Trace	H0: r	p-r	L-max90	Trace90
0.8643	129.85**	184.80**	0	5	18.96	55.54
0.3376	26.78**	54.95**	1	4	15.00	36.58
0.2835	21.67**	28.17**	2	3	11.23	21.58
0.0761	5.15	6.51	3	2	7.37	10.35
0.0207	1.36	1.36	4	1	2.98	2.98

Notes: ** denotes significant at 5 percent.

Cointegrating Vector:

VMMR	NBFI	BANK	MK	VV
-1.138	4.504	-25.846	-1.285	0.654
1.934	-7.608	44.483	2.425	0.492

D. Endogenous Series: VBOND, NBFI, BANK, MK, VV

Lags in the model: 4, No. of observations = 65, No. of observations - no. of variables=45

Eigen-Value	L-max	Trace	H0: r	p-r	L-max90	Trace90
0.8864	141.36**	202.38**	0	5	18.96	55.54
0.3231	25.37**	61.02**	1	4	15.00	36.58
0.2968	22.89**	35.65**	2	3	11.23	21.58
0.1672	11.89**	12.76**	3	2	7.37	10.35
0.0132	0.87	0.87	4	1	2.98	2.98

Notes: ** denotes significant at 10 percent.

Cointegrating Vector:

VBOND	NBFI	BANK	MK	VV
-.226	2.543	-16.788	-.925	.188
.683	-1.287	9.604	0.655	0.895

Table 6: Variance Decomposition of the VAR Model:

A. Decomposition of Volatility of Stock Price (VSTK)

	Percentage of the forecast-error variance of VSTK explained by				
quarters	VSTK	NBFI	BANK	MK	VV
4	92.74	1.72	3.33	1.56	0.62
8	78.57	3.43	11.37	6.04	0.57
12	77.38	3.52	11.83	6.70	0.54
16	76.84	3.52	12.23	6.81	0.58
20	76.59	3.56	12.05	7.15	0.64
24	76.37	3.65	11.99	7.32	0.65

B. Decomposition of Volatility of Real Effective Exchange Rate (VREX)

	Percentage of the forecast-error variance of VREX explained by				
quarters	VREX	NBFI	BANK	MK	VV
4	90.05	0.08	2.73	6.21	0.92
8	80.23	0.29	6.80	11.57	1.08
12	79.81	0.30	6.56	11.91	1.40
16	79.61	0.32	6.60	11.98	1.48
20	79.24	0.35	6.72	12.19	1.48
24	79.16	0.36	6.71	12.27	1.48

Table 6: Variance Decomposition of the VAR Model (continued)

C. Decomposition of Volatility of Money-Market Rate (MMR)

	Percentage of the forecast-error variance of MMR explained by				
quarters	MMR	NBFI	BANK	MK	VV
4	85.10	0.07	13.76	0.04	1.01
8	76.49	0.19	17.67	1.53	4.09
12	69.75	0.45	15.91	9.91	3.95
16	63.60	0.55	14.43	17.82	3.58
20	60.38	0.57	14.25	21.33	3.45
24	59.62	0.60	14.69	21.60	3.47

D. Decomposition of Volatility of Government Bond Yield (BOND)

	Percentage of the forecast-error variance of BOND explained by				
quarters	BOND	NBFI	BANK	MK	VV
4	82.04	0.45	14.31	0.79	2.39
8	68.84	0.94	20.39	6.52	3.28
12	66.48	10.7	22.26	6.96	3.21
16	64.46	1.10	22.21	9.09	3.12
20	61.01	1.04	20.97	14.01	2.95
24	58.06	1.04	20.39	17.67	2.82

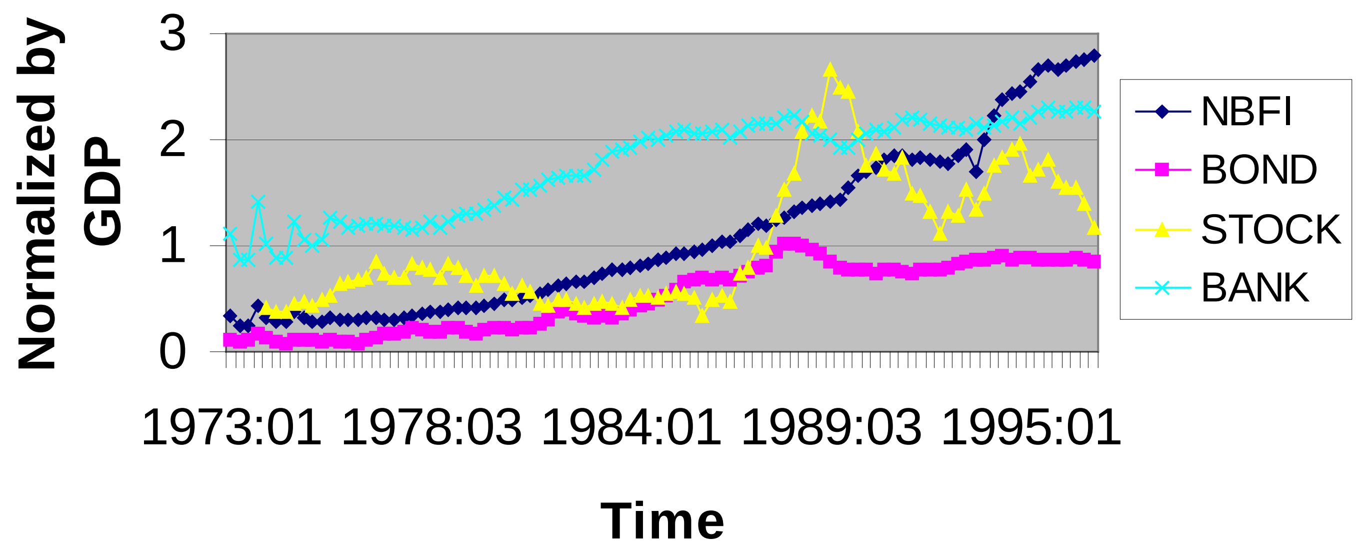


Figure 1. Financial Structure of Korea

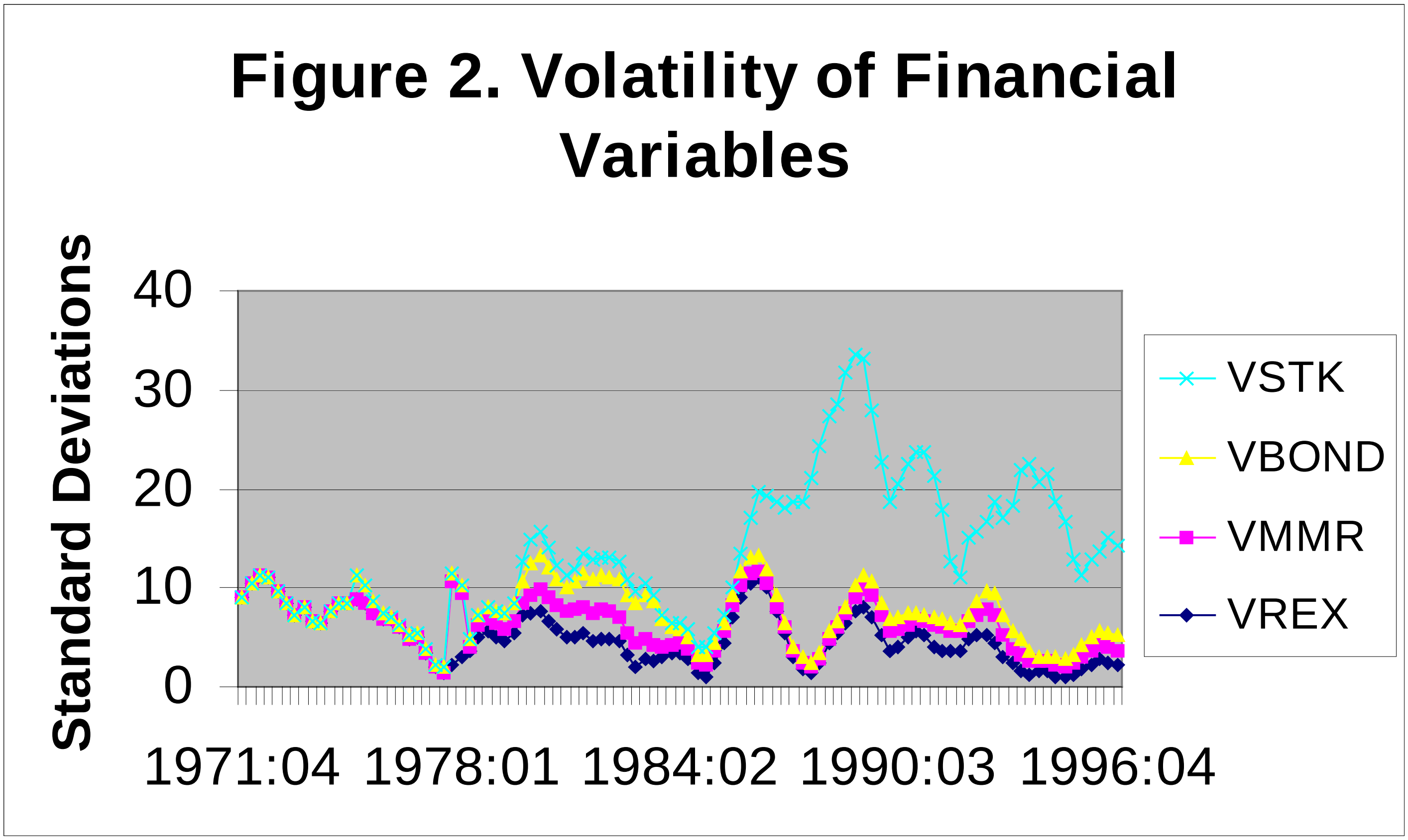
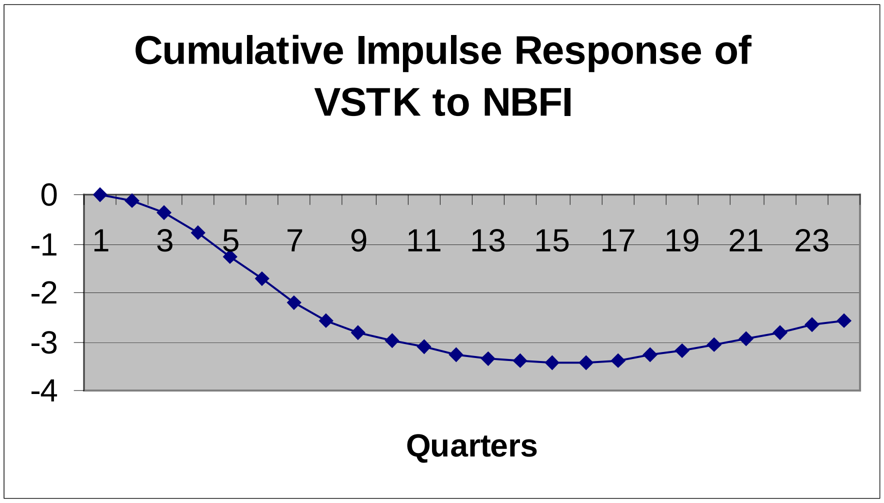


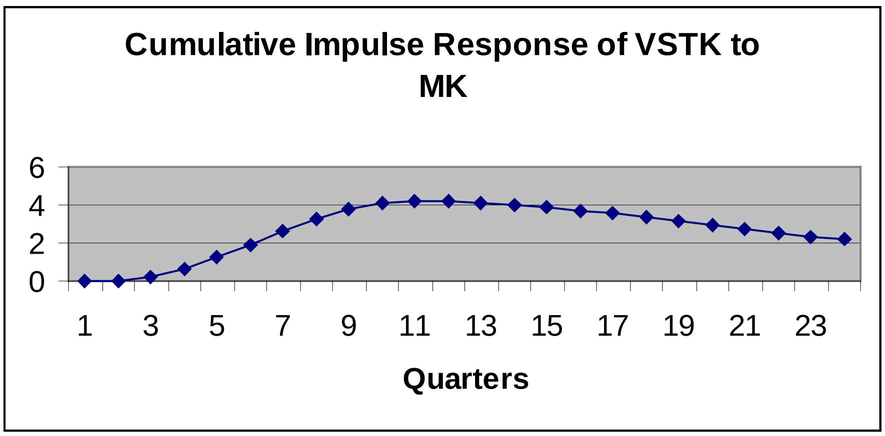
Figure 2. Volatility of Financial Variables
Standard Deviations
40
30
20
10
0
1971:04
1978:01
1984:02
1990:03
1996:04
VSTK
VBOND
VMMR
VREX

Figure 3. Cumulative Impulse Response Functions of Stock Price Volatility

A. Shock of Non-Bank Assets



B. Shock of Market Capitalization (MK)



C. Shock of Bank Assets

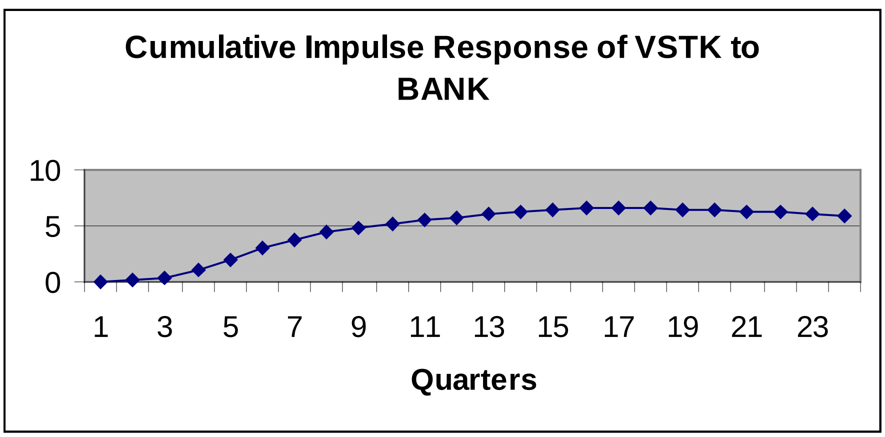
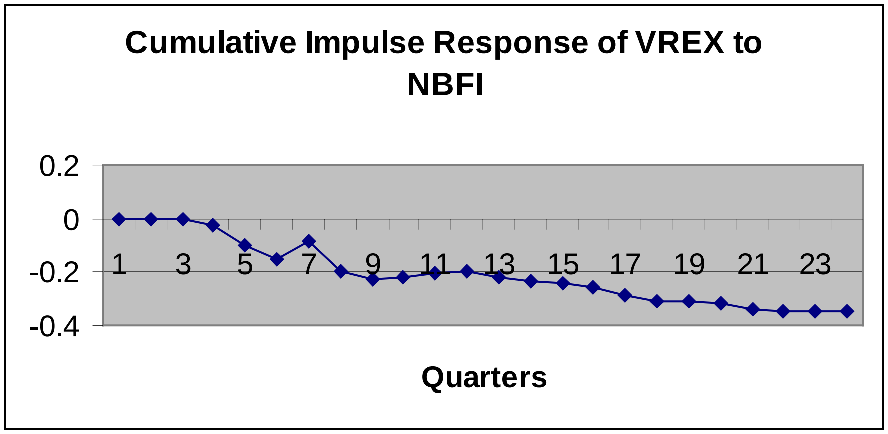
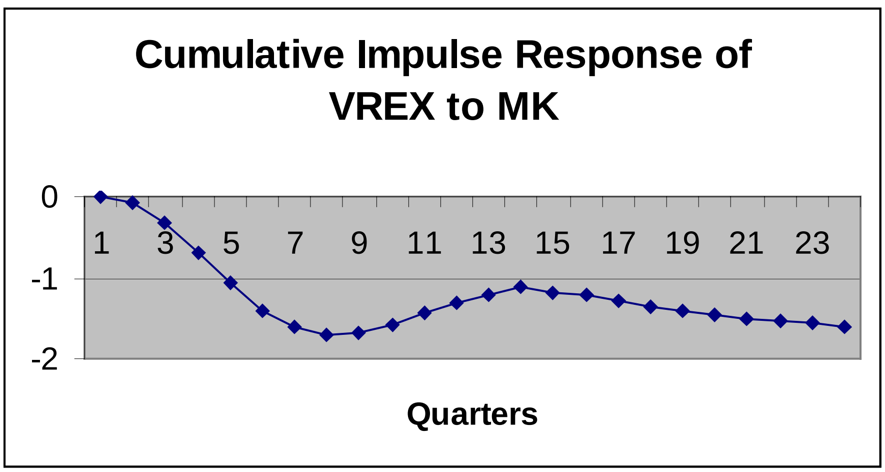


Figure 4. Cumulative Impulse Response Functions of REER Volatility

A. Shocks to Non-Bank Financial Institutions' Assets



B. Shocks of Market Capitalizations



C. Shocks of Bank Assets

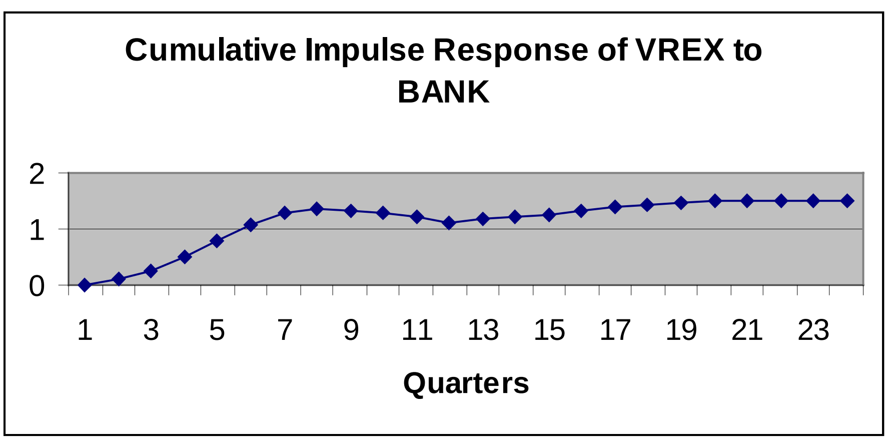
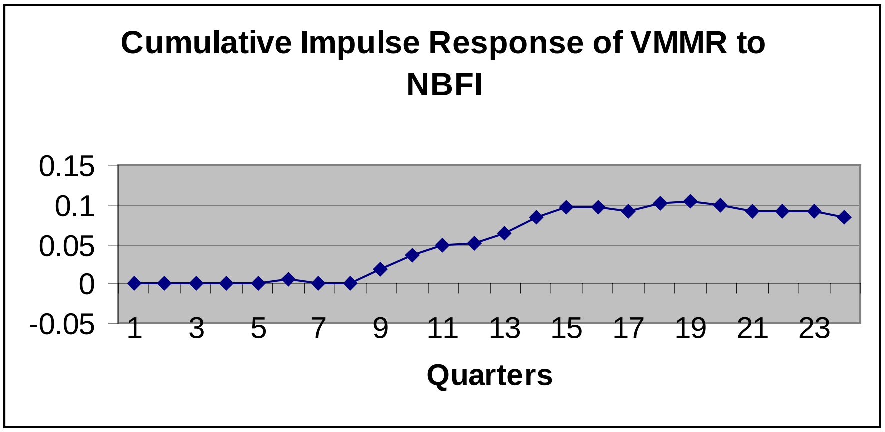
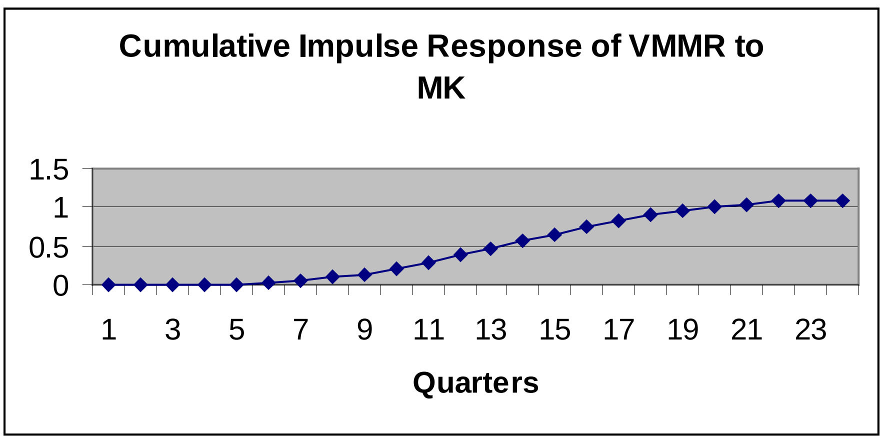


Figure 5. Cumulative Impulse Response Functions of Money-Market Rate (MMR)

A. Shock of Non-Bank Assets



B. Shock of Market Capitalization (MK)



C. Shock of Bank Assets

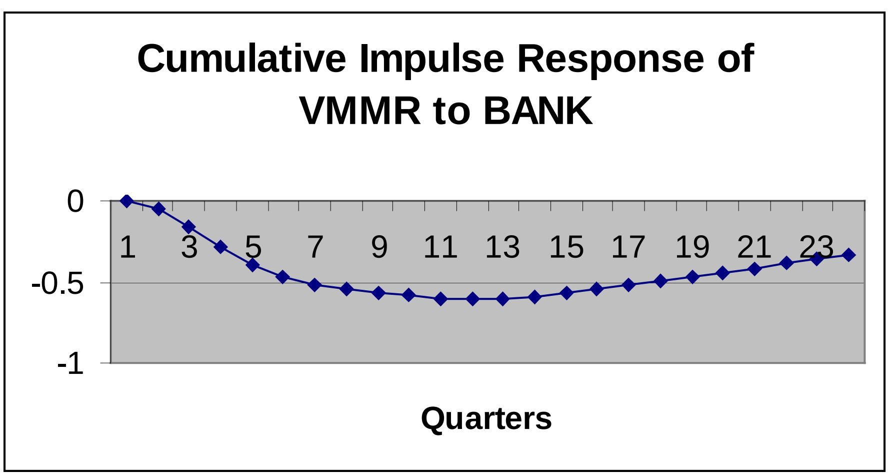
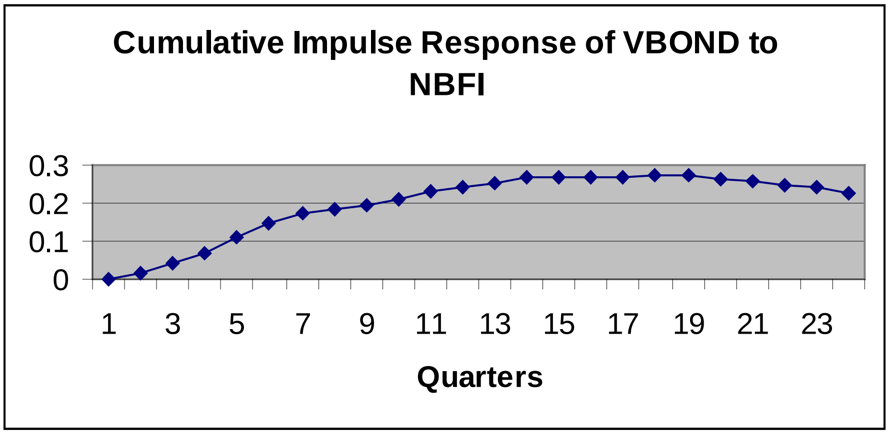
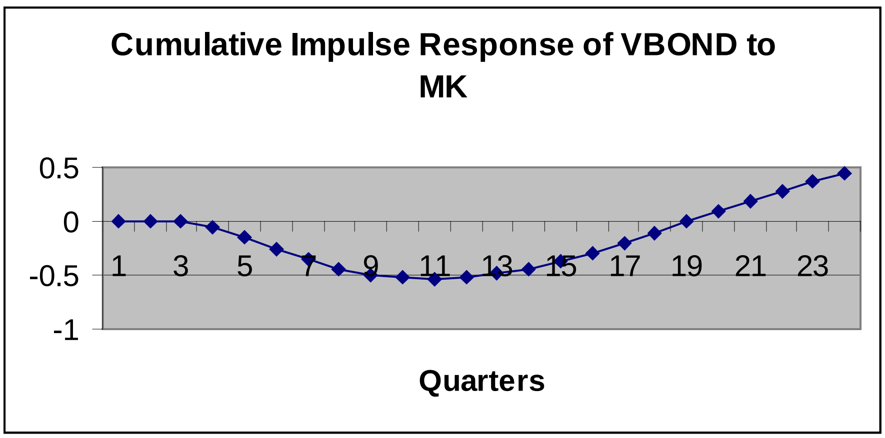


Figure 6. Cumulative Impulse Response Functions of Bond Yield Volatility

A. Shocks of Non-Bank Financial Institutions' Assets



B. Shocks of Market Capitalizations



C. Shocks of Bank Assets