Interest Rate and Exchange Rate Exposures of Korean Financial Institutions: Implications for the Propagation of Financial Crisis

by

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Abstract

This paper empirically investigates the interest rate and exchange rate exposures of financial institutions in pre-crisis Korea. Using the sensitivity of stock returns as a measure of exposure, we found that Korean commercial banks and merchant banking corporations have indeed been significantly exposed to both risk factors in the pre-crisis period. The evidence strongly suggests that, coupled with sharp depreciation of Korean won and subsequent high interest rate policies, the negative exposure of financial institutions may have played a critical role in the propagation of initial currency crisis into a full-fledged financial crisis. The Korean case highlights again the importance of upgrading financial supervision and risk management infrastructure as a precondition of successful financial liberalization.

1. Introduction

With the financial markets being considerably liberalized, it has become increasingly important for financial institutions to safeguard their net values against unexpected movements in interest rate and exchange rate. Inadequate risk management practices of financial institutions and the absence of effective financial supervision often lead to structural vulnerability of the entire financial system and thus to financial crisis. This paper empirically investigates the interest rate and exchange rate exposures of financial institutions in pre-crisis Korea – a period characterized by comprehensive financial liberalization which ended with a sweeping financial crisis.

Recent asymmetric information view of financial crises[1] has emphasized deterioration of bank balance sheet as a crucial factor leading to the financial crisis. Contractions in bank capital not only reduce the amount of financial intermediation but also worsen asymmetric information problems. While there are various shocks such as terms of trade shock which directly affects corporate profitability and hence bank asset quality, unexpected movements in interest rate and exchange rate are another important factors that can cause substantial deterioration in bank balance sheets in emerging market countries. For example, an increase in interest rate negatively affects balance sheet of a bank as assets have typically longer durations than its liabilities. It may also have an indirect negative effect on bank capital as it raises borrower credit risks and thus deteriorates bank asset quality. The transformation of a market risk for borrowers to a credit risk faced by banks could be substantially harmful in emerging market environment where the corporate sector is often characterized by highly leveraged

[1] For the detailed description of asymmetric information view of financial crisis, see Mishkin (1996, 1997) among others.

financial structure.

Unexpected depreciation of local currency also has a direct negative effect on bank balance sheet if it has more foreign currency denominated liabilities than foreign currency assets. Notwithstanding the regulation on foreign exchange positions, various off-balance sheet transactions could make banks vulnerable to exchange rate shocks.[2,3] More importantly, corporate sector in emerging market countries is typically exposed to substantial foreign exchange risks as firms carry large amount of net foreign currency debt and hedging instruments are not readily available.[4] Again, even if banks have a matched portfolio of foreign currency assets and liabilities, local currency depreciation can nonetheless cause substantial harm to bank balance sheet because the mismatch on borrowers' balance sheets can lead to defaults on their loans and thus substantial worsening of bank asset quality. Note that unexpected depreciation also causes nominal interest rate to rise as a higher inflation is expected due to the increase in import prices. The interaction between exchange rate and interest rate shocks would cause further damage to bank capital base and worsen information problems.

The deterioration in bank balance sheets means a substantial contraction in its

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[2] Before April 1999, foreign exchange positions of commercial banks were regulated by the Bank of Korea, where the sum of spot and future foreign exchange over-bought position was limited to 15%, and the over-sold position to 10% of previous month's bank equity capital. Currently the Financial Supervisory Service is monitoring the foreign exchange exposure of commercial banks and the larger of over-bought or over-sold position should be less than 20% of previous month's bank equity capital.

[3] For example in Korea, on-balance sheet foreign exchange exposures of commercial banks have been mainly monitored and off-balance sheet transactions have not been closely monitored before 1998. However, the amount of off-balance sheet transactions of commercial banks has been rapidly rising from 77 trillion won in 1996 to 122 trillion won in 1997, where a substantial fraction was currency related transactions.

[4] Hahm and Mishkin (2000) shows that approximately 60% of total foreign currency denominated corporate debt in Korea was not hedged at the end of 1996.

capital, implying less ability to conduct financial intermediation.[5] If the capital contraction is severe enough, it can even lead to bank panics. In panic, depositors and creditors, fearing the safety of their deposits and credits and not knowing the quality of the banks' asset portfolios, would withdraw their deposits and credits from the banking system causing a wider bank panic and financial crisis.[6]

Above discussions imply that depending on the magnitude and direction of exposure, the interest rate and exchange rate exposure of financial institutions could become a non-trivial propagation channel in which initial currency crisis develops into a full-blown financial crisis. Once a currency crisis occurs in emerging market countries the interest rate and exchange rate exposure of financial institutions makes their balance sheets even weaker, and as a result of the critical damage in capital base, serious financial disruption arises and the currency crisis develops into a full-blown financial crisis.[7]

The present study investigates the risk exposure of Korean commercial banks and merchant banking corporations[8] – two major financial industries that played important

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[5] Deterioration in bank asset quality reduces accounting measure of bank equity capital as banks need to accumulate additional provisions for loan losses and securities reevaluation losses. However, regardless of actual adjustment in the provision, the market value of equity capital will reflect the effect of shocks instantaneously, and the market value of capital would be more important in their portfolio allocation decision.

[6] Based upon analyses of foreign exchange supply and demand during the crisis episode, Shin (1999) argued that the currency crisis in Korea has been mainly driven by foreign bank creditors' run on Korean commercial banks.

[7] The argument does not imply that the interest rate and exchange rate exposure alone is single major cause of full-blown financial crisis. As argued by Hahm and Mishkin (2000), speculative attack is more likely to materialize with weak financial sector because it is more difficult for central bank to defend its currency by raising short-term interest rates as it hurts already weak banking sector. In Korea, the bank balance sheet was indeed already weak before the currency crisis due to the large terms of trade shock in 1996 and resulting accumulation of non-performing loans. The above argument only implies that, in emerging market environment, the additional damage due to the currency crisis and bank exposure to it could be critical and further deterioration of already weak balance sheets of the banking sector could accelerate the propagation of financial crisis.

[8] Merchant banking corporations are wholesale financial institutions engaging in underwriting

roles in the propagation of Korean financial crisis. More specifically, this paper tries to answer the following questions: Were the banks and merchant banking corporations indeed significantly exposed to the interest rate and exchange rate risks during the 90s and especially in the pre-crisis episode? Second, if they were, what was the magnitude and pattern of the risk exposures across different industries and time-periods? Finally, is the direction of exposures consistent with the above crisis propagation hypothesis?

The paper is organized as follows. Section two reviews related literature and presents econometric methodologies. Section three discusses data and empirical findings. Finally section four summarizes and concludes.

2. Econometric Methodology

As is clear in the above introduction, the objective of present study pertains to a more comprehensive measure of risk exposures including not only direct accounting and translation exposures but also indirect economic exposures such as transaction and operating exposures of financial institutions. One such broad measure of risk exposure is the sensitivity of firm market values to the interest rate and exchange rate shocks. Even in normal economic environment the sensitivities of firm values to macroeconomic factors are important issues, and the finance literature has devoted considerable amount of research to investigate whether firm values are influenced by the interest rate and exchange rate innovations, and whether this risk is systematically priced in the capital market. Various authors have investigated the validity of including the interest rate and/or exchange rate variables as additional risk factors in asset pricing

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commercial papers, leasing and short-term lending to corporate sector by funding themselves from issuing bonds and commercial papers and borrowing from inter-bank and foreign markets.

equations in the context of multi-factor model such as arbitrage pricing theory (APT).

For instance, Stone (1974), Sweeney and Warga (1986), Flannery and James (1984), Booth and Officer (1985), Chen and Chan (1989) and Mitchell (1989) among others, have focused on the interest rate sensitivity of common stock returns. This literature has generally found that the interest rate factor adds substantial explanatory power to the traditional single market factor model such as capital asset pricing model (CAPM). With regards to the source of differing interest rate sensitivities across firms, Flannery and James (1984) for example, showed that the interest rate sensitivity is systematically related to the maturity composition of firm’s holding of nominal assets and liabilities in the case of financial institutions such as commercial banks and savings and loan associations. As to the manufacturing firms, Sweeney and Warga (1986) found some evidence that the utility industry firms are interest rate sensitive and these firms are required to pay an ex-ante premium for bearing the interest rate risk.

With regards to the exchange rate sensitivity, since Adler and Dumas (1983) showed that the exchange rate exposure could be estimated in the context of multivariate regression with common stock return as a dependent variable, various authors have studied the correlation between abnormal returns of corporate firms and changes in the exchange rate. While Eun and Resnick (1988) found some evidence that the exchange rate risk is a factor that is systematically priced in the stock market, other authors such as Jorion (1990), Bodnar and Gentry (1993) and Bartov and Bodnar (1994) have met with limited success in identifying a significant relationship between stock returns and contemporaneous changes in exchange rate. Bartov and Bodnar (1994) found that the lagged change in exchange rate is a significant variable in explaining the common stock returns and interpreted this as an outcome of investors’ mispricing behavior. On the sources of differing exchange rate sensitivities, Jorion (1990) showed that the sensitivity is positively related to the percentage of foreign operations for US multinationals.

While above authors focused on the foreign exchange exposure of corporate firms, Grammatikos et al. (1986) and Chamberlain et al. (1997), among others, have investigated foreign exchange exposure of financial institutions and found that US banks are significantly exposed to the exchange rate changes. Chamberlain et al. (1997) found that approximately one-third of large U.S. bank holding companies are significantly exposed to the exchange rate risk. They also showed that accounting measures of currency exposure only partially explain the actual magnitude of foreign exchange exposures.

While most of the research has focused on either interest rate or exchange rate exposure on a separate basis, Choi et al. (1992) investigated a model where joint interaction between exchange rate and interest rate is explicitly allowed. Using a multifactor model of bank stock returns that incorporates market return, interest rate and exchange rate risk factors, they found some positive evidence that, in addition to interest rate, exchange rate is an important factor that cannot be omitted in explaining the stock returns of large US commercial banks.

Finally, in the case of Korea, Hahm and Yoo (1999) investigated exchange rate exposure of Korean financial institutions employing a two-factor model. They found that the exchange rate exposure became increasingly evident in the second half of 90s – a period of comprehensive financial liberalization. While Hahm and Yoo (1999) focused on the exchange rate exposure of Korean financial institutions, Park and Chung (2000) investigated interest rate exposures of Korean banks. They also found that the Korean banks were significantly exposed to interest rate risk in the 1994-97 period – a period of significant interest rate liberalization.

The present study, following the spirit of Choi et al. (1992), investigates a three-factor model where, in addition to the market returns, interest rate and exchange rate factors are simultaneously present in the bank stock return equation. Note that in the case of Korea, no empirical evidence is available yet on the simultaneous exposure of financial institutions to both interest rate and exchange rate factors. One clear contribution of the present empirical study lies in filling this gap. However as emphasized above, the aim of the present study is not confined to testing the null hypothesis that Korean financial institutions have not been exposed to those risks in the pre-crisis period. A more interesting contribution would be to diagnose the possibility of the risk exposures having constituted a potentially important triggering mechanism in the propagation of Korean financial crisis.

In order to estimate the sensitivities of bank stock returns to interest rate and exchange rate, we employ variants of the following form of multivariate factor model:

$$R_{it} = \beta_{0i} + \beta_{1i} \cdot RMKT_t + \beta_{2i} \cdot DY_t + \beta_{3i} \cdot DS_t + \varepsilon_{it} \qquad (1)$$

where R_{it} = holding period return on the i_{th} stock from $t\text{-}1$ to t

$RMKT_t$ = holding period return on the value weighted market portfolio from $t\text{-}1$ to t

$DY_t = (Y_t - Y_{t-1})/Y_{t-1}$ = rate of change in the yield to maturity (Y_t) of benchmark bond from $t\text{-}1$ to t (approximately equal to the negative value of holding period return on the benchmark bond)

DS_t = rate of change in nominal spot exchange rate from $t\text{-}1$ to t expressed in local currency value per unit of foreign currency

ε_{it} = error term for bank i and period t

The above model is an augmented version of simple one factor CAPM in that the market portfolio return is included in the estimation equation as a first factor. In the above regression model, β_{1i} represents the systematic risk of i_{th} bank's stock return due to variations in market portfolio return. The interest rate exposure is estimated as the coefficient estimate β_{2i} of yield changes and the exchange rate exposure is estimated as the coefficient estimate β_{3i} of local currency depreciation rates. Normally we expect a negative coefficient estimate for β_{2i} because increases in interest rates lead to lower net market values as bank assets typically have longer durations than liabilities. The degree of this negative exposure to interest rate will, however, differ across banks and across different financial industries since it is determined by risk attitude, portfolio structure, and hedging activities of individual institution and differential regulatory structure over the industries. Of course, in addition to the direct effect on the market value of balance sheet components, the interest rate change could affect the value of a financial firm by affecting expected future cash-flows associated with each component of assets and liabilities.

Contrary to the interest rate exposure, the direction of exchange rate exposure is not readily predictable. The depreciation of local currencies would negatively affect bank balance sheet if it has net foreign currency denominated liabilities. However, although the bank itself has a matched position of assets and liabilities such that its own net exposure is zero, the value of bank could be affected by the exchange rate change as it alters expected future cash-flows of various asset and liability components of the bank.

For example, if corporate borrowers from the bank carry large amount of net foreign debt, the bank may be negatively affected by the local currency depreciation. To the contrary, a financial institution, depending on its loan portfolio and corporate exposure, can be affected positively if the exchange rate depreciation improves economic prospects, for example, by raising export demands from abroad. Hence, the direction and magnitude of the exchange rate exposure may vary across different financial institutions.

By testing statistical significance of individual coefficients we can infer whether financial institutions were significantly exposed to the interest rate or exchange rate shock, respectively. Also by testing the null hypothesis that β_{2i} and β_{3i} are jointly zero, we are able to infer the validity of the argument that financial institutions were reasonably well hedged and thus not significantly influenced by the interest rate and exchange rate beyond the impact through the market return. In addition to the regression specification above, following many of previous authors and to check the robustness of our findings, we also estimate simple two-factor models where either the interest rate or the exchange rate alone is included in addition to the market return factor.

In estimating the above model, an important issue is on the form of interest rate and exchange rate variables, that is, whether to use actual value or only unanticipated component of changes in interest rate and exchange rate. Theoretically more appropriate measure would be to use innovations because, if market is efficient, there is no reason to believe that previously anticipated changes in yields and currency values are associated with stock returns this period. However, as argued by Bartov and Bodnar (1994) stock market may not be efficient, which may give rise to mispricing. Since the focus of the present study is not on the test of market efficiency, we estimate above models using both actual values and innovations in the yield and exchange rate changes.

3. Empirical Results and Interpretations

A. The Data and Basic Statistical Properties

We used monthly stock prices, interest rate and exchange rate data from March 1990 to November 1997. Closing prices and exchange rates of the last business day of the month were used to compute monthly stock returns, yield changes and depreciation rates.[9] In addition to Korea stock price index (KOSPI), we used banking and merchant banking industry indices and individual stock prices of the 26 commercial banks and 29 merchant banking corporations that were listed at the Korea Stock Exchange at the onset of the crisis.[10] The benchmark three-year corporate bond yield was used for the interest rate data and won/dollar spot exchange rate was used for the exchange rate data.[11]

Our sample starts from March 1990 on the ground that Korea adopted a semi-floating exchange rate regime of market average rate system from March 1990 and discarded previous multiple currency basket exchange rate pegging system. Our sample covers data up to November 1997 because, given the objective of the present study, it is necessary to focus on the data before the currency crisis developed into a full-blown

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[9] In computation of stock returns, dividend payments were ignored.

[10] The stock price data were obtained from the Korea Securities Research Institute. See Appendix for the list of the 26 commercial banks and 29 merchant banking corporations used in the empirical analysis.

[11] Note that the won/dollar exchange rate was selected as the benchmark exchange rate based on the fact that most of foreign assets and liabilities of Korean financial institutions are denominated in US dollars. According to Seo and Kim (1999), as of the end of 1998, the US dollar denomination accounted for 82.6% of total foreign currency assets and 88.7% of total foreign currency liabilities of Korean financial institutions. The trade volume weighted nominal effective exchange rates were also used as an alternative measure of exchange rate and the empirical results were not sensitive to this variation. This result should not be surprising given that the US dollar is used as a settlement currency for more than 85% of export and import transactions in Korea.

financial crisis. Indeed, operations of many of our sample financial institutions began to be suspended starting from December 1997, and it would be desirable to avoid any possible bias caused by peculiar stock price movement due to the suspension.

We also explore the changing nature of interest rate and exchange rate exposures of financial institutions by splitting the sample period into two sub-samples with approximately equal sizes, where the first sub-period covers data from March 1990 to December 1993 and the second sub-period covers data from January 1994 to November 1997. Note that the second sub-period is characterized as a period of accelerating financial liberalization in Korea, and by comparing empirical results across two sub-samples we can draw inferences on whether the acceleration of financial liberalization and market openings have affected the nature and magnitude of risk exposures of domestic financial institutions.[12]

[Insert Table 1-1 here]

Tables 1-1 and 1-2 show basic statistical properties of our sample data for the whole sample period and for the two sub-sample periods. Table 1-1 shows sample means and standard deviations of monthly market portfolio returns (*RMKT*), returns on banking industry portfolio (*RBANK*), returns on merchant banking industry portfolio (*RMBC*), yield changes (*DY*), and currency depreciation rates (*DS*). Note that both the market and industry portfolios show negative mean returns over the whole sample and show lower mean returns in the second sub-sample. Note also that compared to the first period the volatility of currency depreciation rate increased substantially in the second sub-period

[12] In June 1993, the Korean government announced a comprehensive blueprint for Korea's financial deregulation and market opening over the following years. Starting from 1994, in accordance with the plan, Korea implemented a series of deregulatory measures and in December 1996, Korea finally attained membership in the Organization for Economic Cooperation and Development (OECD) satisfying most of the deregulation and market opening requirements.

as exchange rate was increasingly liberalized in the second half of 1990s.

Table 1-2 shows cross-correlation matrices among the variables above. As expected, the market portfolio return is positively correlated with banking and merchant banking industry returns, and the stock returns are generally negatively correlated with interest rate changes or currency depreciation rates. Note also that the positive correlation among stock returns becomes weaker in the second sub-sample and the negative correlation between stock returns and interest rate changes or exchange rate changes become stronger in the second sub-sample.

[Insert Table 1-2 here]

B. Estimation of Industry Exposures

In this section we estimate the exposures of commercial banking and merchant banking industries to the interest rate and exchange rate risks. We use two distinct but closely related approaches to estimate the magnitude of industry exposures. As represented by equations (2-1) and (2-2), the first approach we adopt is the time-series estimation using the return on industry portfolio as a dependent variable, that is, using the industry stock returns *RBANK* and *RMBC* above computed from the respective value weighted industry stock price indices.

$$RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_t \quad (2\text{-}1)$$

$$RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_t \quad (2\text{-}2)$$

We estimated above time-series regressions using the ordinary least squares (OLS) method and tables 2-1 and 2-2 show the estimation results for the banking industry.

Table 2-1 reports estimation results using actual interest rate and exchange rate changes as independent variables, while table 2-2 reports results using unanticipated components of interest rate and exchange rate changes as independent variables.[13] Comparing two tables confirms that using actual changes or innovations do not yield significantly different results both qualitatively and quantitatively.

[Insert Table 2-1 here]

[Insert Table 2-2 here]

The estimation results can be summarized as follows: First, as expected, the market return turns out to be always significant in explaining the industry stock returns. The coefficient of market return was always positive and statistically significant at usual significance levels. Second, the results indicate that the banking industry was significantly exposed to both interest rate and exchange rate risks in the second sub-period although it had not been exposed in any significant way to either source of risks in the first sub-period. Third, in the second sub-period the banking industry has been negatively exposed to both interest rate and exchange rates, and on average, a one percentage point increase in interest rate changes was associated with .6 percentage point fall in bank stock returns, and a one percentage point increase in won/dollar exchange rate was associated with .9 percentage point fall in bank stock returns, respectively. Combined, the one percentage point fall in interest rate and exchange rate simultaneously lowers the bank industry stock return by 1.1 percentage point. Fourth, for the entire sample period, the interest rate exposure does not seem to be well captured, while the negative exchange rate exposure could still be captured as the coefficients

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[13] To obtain unanticipated components of interest rate and exchange rate changes, we estimated third order univariate autoregressive model on the first differences in log interest rates and log exchange rates, respectively. The results were not sensitive to the variations in the order of autoregressive models.

remain significantly negative.

Tables 3-1 and 3-2 show analogous estimation results for the merchant banking industry, and the estimated exposures of merchant banking industry yield similar patterns with the banking industry above. First, the market return has a significantly positive effect on the stock returns of merchant banking industry. Second, the merchant banking industry was significantly exposed to both interest rate and exchange rate risks in the second sub-sample period, although it had not been significantly exposed before 1994. Third, the exposure was in the direction that an increase in the exchange rate or interest rate changes has negative impacts on the stock return, and the magnitudes of exposures were slightly larger in merchant banking industry compared to the banking industry. Finally, again in the whole sample period, the interest rate exposure becomes insignificant while the negative exposure to exchange rate changes remains significant.

[Insert Table 3-1 here]

[Insert Table 3-2 here]

Given the relatively short time span of the sample, the exposure may not be well captured by time-series regressions using the weighted industry stock return as a dependent variable. An alternative way of estimating the industry exposure is using the panel data of stock returns on individual banks and merchant banking corporations as summarized in equations (3-1) and (3-2).

$$RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_{it} \tag{3-1}$$

$$RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_{it} \tag{3-2}$$

Note that we allow different means across respective financial institutions. The fixed effect panel estimation results are summarized in tables 4-1 and 4-2 for banking industry and in tables 5-1 and 5-2 for merchant banking industry. Again using actual interest rate and exchange rate changes and using innovations instead do not yield significantly different results.

[Insert Table 4-1 here]

[Insert Table 4-2 here]

[Insert Table 5-1 here]

[Insert Table 5-2 here]

The panel regression results generally confirm our previous findings that, in the second sub-sample period, both the banking industry and merchant banking industry were significantly exposed to interest rate and exchange rate risks, and the direction of the exposures were negative both for the interest rate and exchange rate risks. Note also that compared with previous time-series estimates, the magnitudes of exposures are slightly larger.

In the case of whole sample and especially for the first sub-sample period, the panel regressions yield slightly different results. Both the banking industry and merchant banking industry turned out to be positively exposed to the interest rate risk before 1994, while the overall interest rate exposure was negative for the whole sample. In the case of merchant banking industry, the exchange rate exposure was also positive in the case of first sub-sample.

Regardless of the estimation methodologies, a set of quite robust empirical evidence emerges and the evidence strongly indicates that the acceleration of financial liberalization and market opening in the second half of 1990s has exposed the commercial banking and merchant banking industries to interest rate and exchange rate risks. Furthermore, during this liberalization period, the direction of exposures was such that higher interest rate and exchange rate tend to have negative effect on the net firm value of financial institutions. This strongly suggests that the interest rate and exchange rate exposure of financial institutions may have become a non-trivial channel in propagating initial currency crisis into a full-fledged financial crisis, given the sharp depreciation of Korean won and unprecedented high interest rate at the end of 1997.

C. Exposures of Respective Financial Institutions

Note that the industry exposure estimated above identifies approximately the average exposure of individual financial institutions. In the extreme case, the industry exposure could be zero while individual exposures are significantly different from zero if exposures of individual banks are symmetrically distributed around zero. Indeed and especially for the exchange rate risk, some institutions will be positively exposed while others are negatively exposed depending upon the characteristics of asset and liability portfolios. In this sense, it must be informative to estimate the risk exposure of individual banks and merchant banking corporations and investigate the distribution of exposures. In this section we estimate the following time-series regressions for each bank and merchant banking corporation.

$$RBANK_{it} = \beta_{0i} + \beta_{1i} \cdot RMKT_t + \beta_{2i} \cdot DY_t + \beta_{3i} \cdot DS_t + \varepsilon_{it} \qquad (4\text{-}1)$$

$$RMBC_{it} = \beta_{0i} + \beta_{1i} \cdot RMKT_t + \beta_{2i} \cdot DY_t + \beta_{3i} \cdot DS_t + \varepsilon_{it} \qquad (4\text{-}2)$$

Tables 6 and 7 report the exposure estimates of individual banks and merchant banking corporations respectively. To save space, we only report estimation results on the most conservative three-factor model where both interest rate and exchange rate innovations are included simultaneously in the regression equation. Note that although not reported, in the case of two factor models where either interest rate or exchange rate alone is included in addition to the market factor, we obtained much stronger and significant exposure estimates. In this sense, the results reported in tables 6 and 7 should be interpreted as conservative measures. Again to save space, we report estimation results using interest rate and exchange rate innovations only since the results using actual changes are not significantly different from the results reported here. Note also that we have not reported the coefficient estimates of market factors, which were always significant and positive. Instead, under the column headed by *F*, we report the F-values on the null hypothesis that the coefficients of interest rate and exchange rate innovations are jointly zero.

[Insert Table 6 here]

As can be seen in table 6, there is a dramatic change in the risk exposure of banks before and after 1994. Few banks were significantly exposed to interest rate or exchange rate risk in the first sub-sample period. However in the second sub-sample, at least 19 out of 26 commercial banks (73%) were significantly exposed to interest rate or exchange rate risk on a joint basis. 15 banks were exposed to the interest rate risk and 10 banks were exposed to the exchange rate risk, and most of banks were negatively exposed to both interest rate and exchange rate risk. In the second sub-sample period banking industry's average interest rate sensitivity was –0.6623 and the average exchange rate sensitivity was –0.8055.

The exposures of merchant banking corporations in table 7 show a similar pattern. While only one merchant banking corporation was significantly exposed to the interest rate and exchange rate risk on a joint basis before 1994, at least 17 out of 29 merchant banks (59%) were significantly exposed to the interest rate and exchange rate risk on a joint basis in the second sub-period. Again all of the significant exposure estimates were negative. The merchant banking industry's average interest rate sensitivity was –0.7475 and the average exchange rate sensitivity was –0.7856 in the second sub-sample period.

[Insert Table 7 here]

The overall evidence in this section conforms our previous conclusion that it is in the second half of 90s that domestic financial institutions began to be significantly exposed to interest rate and exchange rate shock, and that most of the financial institutions were negatively exposed to the interest rate and exchange rate shock prior to the currency crisis so that currency crisis would have even more adverse effect on the capital adequacy of financial institutions.

4. Concluding Remarks

It is generally believed that unexpected movements in interest rate and exchange rate should affect the value of financial institutions. They not only directly affect financial institutions whose assets and liabilities are not perfectly hedged in accounting sense, but also indirectly affects by altering expected future profitability and cash flows associated with their assets and liabilities. The magnitude of the direct and indirect exposures of financial institutions could be substantially large in emerging market countries since, while they pursue financial liberalization and market opening, the supervisory and internal risk management infrastructure is not readily established. In addition, emerging market financial institutions are considerably exposed to macroeconomic shocks indirectly through the corporate sector whose profitability and cash flows are significantly affected by interest rate and exchange rate shocks.

This paper investigated the interest rate and exchange rate exposures of Korean commercial banks and merchant banking corporations in the pre-crisis period. Following the asset pricing literature we adopted the sensitivity of firm market values as a measure of risk exposure and estimated it in the context of factor models which include interest rate and exchange rate changes in addition to market portfolio return. We also investigated the direction and pattern of risk exposures across different industries and time-periods employing various time-series and panel regressions.

Quite robust empirical results emerge from the analysis. First, although it seems that commercial banks and merchant banking corporations had not been significantly exposed to either interest rate or exchange rate risk before 1994, both industries began to be significantly exposed to interest rate and exchange rate risks in the 1994-1997 period. The substantial exposure of Korean financial institutions across the board may be attributed to the acceleration of financial liberalization and market opening in the second half of 1990s. Second, during this period, commercial banks and merchant banking corporations were significantly negatively exposed to the interest rate and exchange rate shocks, implying that higher interest rate and exchange rates tend to have negative effect on the firm value of financial institutions. The evidence strongly suggests that, coupled with sharp depreciation of Korean won and subsequent high interest rate policies, the negative exposures may have played a critical role in the propagation of initial currency crisis into a full-fledged financial crisis. In sum, the Korean case highlights again the importance of upgrading financial supervision and risk management infrastructure as a precondition of successful financial liberalization.

Appendix

Lists of Commercial Banks and Merchant Banking Corporations used in the Analysis

(1) Commercial Banks

1. Cho Hung	2. Commercial Bank of Korea	3. Korea First
4. Hanil	5. Seoul	6. Korea Exchange
7. Korea Long-term Credit	8. Daegu	9. Pusan
10. Chung Chong	11. Kwangju	12. Cheju
13. Kyungki	14. Jeonbuk	15. Kangwon
16. Kyongnam	17. Chungbuk	18. Hana
19. Boram	20. Shinhan	21. KorAm
22. Donghwa	23. Dae Dong	24. Dong Nam
25. Kookmin	26. Korea Housing & Commercial	

(2) Merchant Banking Corporations

1. Tongyang	2. Central	3. Daehan	4. Kumho
5. Hansol	6. Korea	7. Hyundai	8. Saehan
9. Korea French	10. Korea First	11. Asian	12. Korea International
13. Taegu	14. Gyongnam	15. Hangil	16. Samyang
17. Ssang Yong	18. Hangdo	19. Cheongsol	20. Ulsan
21. Kyungsu	22. Shinhan	23. Nara	24. Hanwha
25. Samsam	26. Shinsegae	27. Coryo	28. Yeungnam
29. LG			

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<Table 1-1> Basic Statistics: Sample Means & Standard Deviations

(Unit: %)

		Whole Sample 90:3 ~ 97:11	Sub-Sample 90:3 ~ 93:12	Sub-Sample 94:1 ~ 97:11
RMKT	Mean	-0.5126	0.3380	-1.3452
	Std. Dev	7.5682	8.2436	6.8297
RBANK	Mean	-1.1821	-0.1227	-2.2190
	Std. Dev	8.4983	9.0647	7.8638
RMBC	Mean	-0.5742	0.6991	-1.8206
	Std. Dev	10.4567	11.4238	9.3708
DY	Mean	0.1463	-0.2741	0.5578
	Std. Dev	5.2340	5.7723	4.6739
DS	Mean	0.5813	0.3323	0.8249
	Std. Dev	2.3144	0.4251	3.2271

Note: *RMKT*, *RBANK* and *RMBC* denote monthly stock returns computed from the market index, bank industry index and merchant bank industry index portfolios, respectively. *DY* and *DS* denote rate of changes in the 3-year benchmark corporate bond yield and the spot won/$ exchange rate, respectively.

<Table 1-2> Basic Statistics: Cross-Correlation Matrices

A. Whole Sample: 90:3 ~ 97:11

	RMKT	*RBANK*	*RMBC*	*DY*
RBANK	0.7612			
RMBC	0.6677	0.6934		
DY	-0.4177	-0.3945	-0.3386	
DS	-0.3257	-0.3988	-0.3753	0.4023

B. Sub-Sample: 90:3 ~ 93:12

	RMKT	*RBANK*	*RMBC*	*DY*
RBANK	0.8979			
RMBC	0.7102	0.7695		
DY	-0.3363	-0.2493	-0.1266	
DS	-0.2385	-0.1856	-0.0023	0.2800

C. Sub-Sample: 94:1 ~ 97:11

	RMKT	*RBANK*	*RMBC*	*DY*
RBANK	0.5684			
RMBC	0.5948	0.5780		
DY	-0.5236	-0.5820	-0.6334	
DS	-0.4614	-0.5678	-0.5768	0.5885

Note: See note in table 1 for definition of variables.

<Table 2-1> Time-Series Analysis: Banking Industry
(Using Actual Changes in Interest Rate and Exchange Rate)

Regression Model: (A) $RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_t$

(B) $RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_t$

(C) $RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_t$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.8114*** (9.68)	-0.1496 (-1.23)		0.59/2.24
	(B)	0.7927*** (10.07)		-0.6202** (-2.41)	0.60/2.30
	(C)	0.7777*** (9.29)	-0.0677 (-0.54)	-0.5746** (-2.11)	0.61/2.29
Sub-Sample 90:3 ~ 93:12	(A)	1.0085*** (12.93)	0.0929 (0.83)		0.81/1.92
	(B)	0.9908*** (12.98)		0.3339 (0.23)	0.81/1.91
	(C)	1.0091*** (12.61)	0.0917 (0.79)	0.0773 (0.05)	0.81/1.92
Sub-Sample 94:1 ~ 97:11	(A)	0.4182*** (2.73)	-0.6592*** (-2.94)		0.43/1.95
	(B)	0.4482*** (3.07)		-0.9461*** (-3.06)	0.44/2.04
	(C)	0.3518** (2.31)	-0.4395* (-1.08)	-0.6655** (-1.96)	0.48/1.98

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 2-2> Time-Series Analysis: Banking Industry
(Using Interest Rate and Exchange Rate Innovations)

Regression Model: (A) $RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_t$
(B) $RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_t$
(C) $RBANK_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_t$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.8152*** (9.67)	-0.1314 (-1.08)		0.58/2.25
	(B)	0.7987*** (10.01)		-0.5972** (-2.07)	0.60/2.33
	(C)	0.7852*** (9.25)	-0.0611 (-0.48)	-0.5521* (-1.81)	0.60/2.32
Sub-Sample 90:3 ~ 93:12	(A)	1.0061*** (12.88)	0.0989 (0.88)		0.81/1.91
	(B)	0.9873*** (13.17)		0.6123 (0.38)	0.81/1.90
	(C)	1.0062*** (12.73)	0.0956 (0.79)	0.1330 (0.08)	0.81/1.91
Sub-Sample 94:1 ~ 97:11	(A)	0.4280*** (2.74)	-0.6160*** (-2.73)		0.42/1.95
	(B)	0.4504*** (2.99)		-0.9883*** (-2.80)	0.43/2.09
	(C)	0.3505** (2.23)	-0.4285* (-1.78)	-0.7093* (-1.88)	0.46/2.01

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 3-1> Time-Series Analysis: Merchant Banking Industry
(Using Actual Changes in Interest Rate and Exchange Rate)

Regression Model: (A) $RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_t$
(B) $RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_t$
(C) $RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_t$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.8812*** (7.41)	-0.1436 (-0.83)		0.45/1.82
	(B)	0.8431*** (7.54)		-0.7983** (-2.18)	0.47/1.87
	(C)	0.8358*** (7.02)	-0.0330 (-0.19)	-0.7762** (-2.01)	0.47/1.87
Sub-Sample 90:3 ~ 93:12	(A)	1.0439*** (6.71)	0.2495 (1.12)		0.52/1.74
	(B)	1.0385*** (6.94)		4.2502 (1.47)	0.53/1.76
	(C)	1.0765*** (6.87)	0.1896 (0.84)	3.7194 (1.25)	0.54/1.79
Sub-Sample 94:1 ~ 97:11	(A)	0.4974*** (2.89)	-0.8894*** (-3.53)		0.50/1.79
	(B)	0.5729*** (3.38)		-1.1153*** (-3.10)	0.47/1.94
	(C)	0.4282** (2.48)	-0.6605** (-2.39)	-0.6937* (-1.80)	0.53/1.85

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 3-2> Time-Series Analysis: Merchant Banking Industry
(Using Interest Rate and Exchange Rate Innovations)

Regression Model: (A) $RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_t$
(B) $RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_t$
(C) $RMBC_t = \beta_0 + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_t$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.8852*** (7.40)	-0.1243 (-0.72)		0.45/1.82
	(B)	0.8475*** (7.50)		-0.8065** (-1.97)	0.47/1.89
	(C)	0.8423*** (6.99)	-0.0238 (-0.13)	-0.7889* (-1.83)	0.47/1.88
Sub-Sample 90:3 ~ 93:12	(A)	1.0479*** (6.72)	0.2905 (1.29)		0.52/1.74
	(B)	1.0025*** (6.70)		3.3078 (1.03)	0.52/1.77
	(C)	1.0495*** (6.68)	0.2380 (0.99)	2.1154 (0.62)	0.53/1.78
Sub-Sample 94:1 ~ 97:11	(A)	0.4870*** (2.82)	-0.8952*** (-3.58)		0.50/1.76
	(B)	0.5783*** (3.30)		-1.1517*** (-2.81)	0.45/1.97
	(C)	0.4119** (2.34)	-0.7135** (-2.65)	-0.6871 (-1.62)	0.53/1.83

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 4-1> Panel (Fixed Effect) Analysis: Banking Industry
(Using Actual Changes in Interest Rate and Exchange Rate)

Regression Model: (A) $RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_{it}$

(B) $RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_{it}$

(C) $RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_{it}$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.7317*** (26.20)	-0.2611*** (-6.45)		0.35/2.36
	(B)	0.7159*** (26.99)		-0.8079*** (-10.11)	0.37/2.32
	(C)	0.6856*** (24.49)	-0.1404*** (-3.32)	-0.7123*** (-8.40)	0.37/2.32
Sub-Sample 90:3 ~ 93:12	(A)	1.0165*** (39.71)	0.1327*** (3.63)		0.66/2.11
	(B)	0.9980*** (40.01)		1.0728** (2.16)	0.66/2.11
	(C)	1.0223*** (39.45)	0.1212*** (3.24)	0.7142 (1.41)	0.66/2.11
Sub-Sample 94:1 ~ 97:11	(A)	0.3187*** (6.60)	-0.9375*** (-13.51)		0.29/2.35
	(B)	0.3800*** (7.96)		-1.1582*** (-12.12)	0.27/2.31
	(C)	0.2434*** (5.00)	-0.6833*** (-8.76)	-0.7039*** (-6.65)	0.32/2.31

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 4-2> Panel (Fixed Effect) Analysis: Banking Industry
(Using Interest Rate and Exchange Rate Innovations)

Regression Model: (A) $RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_{it}$
(B) $RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_{it}$
(C) $RBANK_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_{it}$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.7363*** (26.30)	-0.2433*** (-6.02)		0.35/2.36
	(B)	0.7258*** (27.12)		-0.7856*** (-8.78)	0.36/2.35
	(C)	0.6947*** (24.60)	-0.1430*** (-3.37)	-0.6802*** (-7.19)	0.37/2.34
Sub-Sample 90:3 ~ 93:12	(A)	1.0177*** (39.87)	0.1414*** (3.85)		0.66/2.11
	(B)	0.9890*** (40.35)		0.5980 (1.14)	0.65/2.11
	(C)	1.0176*** (39.84)	0.1446*** (3.68)	-0.1265 (-0.23)	0.66/2.11
Sub-Sample 94:1 ~ 97:11	(A)	0.3216*** (6.58)	-0.9039*** (-12.98)		0.28/2.34
	(B)	0.3878*** (7.92)		-1.1909*** (-10.94)	0.25/2.36
	(C)	0.2381*** (4.77)	-0.6955*** (-9.10)	-0.7179*** (-6.14)	0.31/2.32

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 5-1> Panel (Fixed Effect) Analysis: Merchant Banking Industry
(Using Actual Changes in Interest Rate and Exchange Rate)

Regression Model: (A) $RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_{it}$

(B) $RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_{it}$

(C) $RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_{it}$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.8483*** (23.65)	-0.2162*** (-4.17)		0.25/2.17
	(B)	0.8170*** (23.94)		-0.8820*** (-8.26)	0.27/2.16
	(C)	0.7973*** (22.05)	-0.0887 (-1.64)	-0.8225*** (-7.30)	0.27/2.15
Sub-Sample 90:3 ~ 93:12	(A)	1.0283*** (27.57)	0.2441*** (4.59)		0.42/1.95
	(B)	1.0326*** (28.95)		5.1656*** (7.27)	0.43/1.95
	(C)	1.0664*** (28.74)	0.1688*** (3.15)	4.6660*** (6.43)	0.44/1.97
Sub-Sample 94:1 ~ 97:11	(A)	0.3948*** (6.42)	-0.9759*** (-11.12)		0.20/2.21
	(B)	0.4617*** (7.71)		-1.2564*** (-10.25)	0.19/2.23
	(C)	0.3094*** (4.96)	-0.7078*** (-7.23)	-0.7998*** (-5.89)	0.23/2.22

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 5-2> Panel (Fixed Effect) Analysis: Merchant Banking Industry
(Using Interest Rate and Exchange Rate Innovations)

Regression Model: (A) $RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \varepsilon_{it}$
(B) $RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DS_t + \varepsilon_{it}$
(C) $RMBC_{it} = \beta_{0i} + \beta_1 \cdot RMKT_t + \beta_2 \cdot DY_t + \beta_3 \cdot DS_t + \varepsilon_{it}$

		RMKT	*DY*	*DS*	R^2/DW
Whole Sample 90:3 ~ 97:11	(A)	0.8559*** (23.82)	-0.1896*** (-3.65)		0.25/2.17
	(B)	0.8193*** (23.92)		-0.9346*** (-7.88)	0.26/2.17
	(C)	0.8041*** (22.14)	-0.0684 (-1.26)	-0.8847*** (-7.08)	0.26/2.16
Sub-Sample 90:3 ~ 93:12	(A)	1.0379*** (27.99)	0.2919*** (5.47)		0.42/1.95
	(B)	0.9943*** (28.05)		3.6270*** (4.77)	0.42/1.95
	(C)	1.0398*** (28.15)	0.2305*** (4.06)	2.4721*** (3.06)	0.43/1.97
Sub-Sample 94:1 ~ 97:11	(A)	0.3851*** (6.22)	-0.9745*** (-11.14)		0.20/2.20
	(B)	0.4539*** (7.45)		-1.3608*** (-9.85)	0.19/2.24
	(C)	0.2830*** (4.46)	-0.7400*** (-7.78)	-0.8753*** (-5.88)	0.23/2.22

Note: Numbers in parentheses are t-values. *, **, *** denote that the coefficient estimate is statistically significant at 10%, 5% and 1% level, respectively. *DW* denotes the Durbin-Watson statistic for first-order serial correlation in residuals.

<Table 6> Analysis of Individual Banks
(Using Interest Rate and Exchange Rate Innovations)

Regression Model: $RBANK_{it} = \beta_{0i} + \beta_{1i} \cdot RMKT_t + \beta_{2i} \cdot DY_t + \beta_{3i} \cdot DS_t + \varepsilon_{it}$

ID No.	Sub-Sample 90:3 ~ 93:12			Sub-Sample 94:1 ~ 97:11		
	DY	*DS*	*F*	*DY*	*DS*	*F*
1	0.0888	0.4515	0.25	-0.3463	-0.4348	1.10
2	0.0661	0.2597	0.11	-0.7155*	-0.6876	4.31**
3	0.0509	0.0240	0.07	-0.9008**	-0.6327	5.72***
4	0.0261	-0.1454	0.02	-0.5936	-0.5377	2.62*
5	0.0821	0.8306	0.76	-0.8724**	-1.0021*	8.95**
6	NA	NA	NA	-0.5209	-0.2379	1.99
7	-0.0529	2.1054	0.75	-0.5331*	0.2886	1.51
8	0.2007	-0.2539	0.99	-0.8462***	-1.6190***	19.87***
9	0.2448	-0.8062	1.41	-0.9530**	-0.4920	5.55***
10	0.1973	-0.7567	0.96	-0.7507*	-1.3842**	7.35***
11	0.2948	0.5398	1.71	-1.3489***	-1.3976**	18.10***
12	0.0959	1.0555	0.29	-0.9036**	-0.6740	5.98***
13	0.2174	-1.6273	1.13	-1.1160***	-1.2042**	13.48***
14	0.2217	-0.3501	1.06	-1.2928***	-0.3627	10.67***
15	0.2676	0.1436	1.49	-1.0130**	-1.2230**	9.42***
16	0.2319	-0.4552	1.42	-0.4984	-1.1002*	4.45**
17	0.2631	-1.3587	1.15	-0.5603	-1.6150**	6.83***
18	0.0721	-0.4423	0.04	-0.1692	0.0799	0.16
19	0.0198	0.1301	0.01	-0.6394*	-0.6929	3.74**
20	0.0346	-0.3312	0.03	-0.0496	-0.6391	0.88
21	0.2688*	-1.5430	1.64	-0.3459	-1.0147	1.76
22	NA	NA	NA	-1.3533***	-0.6275	36.53***
23	NA	NA	NA	-1.1339*	-0.4924	7.67***
24	NA	NA	NA	-1.7513	-1.3451*	10.74***
25	NA	NA	NA	0.1999	-0.0817	0.04
26	NA	NA	NA	0.7880	-1.8131**	3.79**
Average	0.1446	-0.1265	–	-0.6623	-0.8055	–
No. of sig Banks	1 / 20	0 / 20	0 / 20	15 / 26	10 / 26	19 / 26

Note: Only coefficient estimates are reported to save space. *, **, *** denote that the coefficient is significant at 10%, 5% and 1% level, respectively. F-values are from the test of null hypothesis that the coefficients of interest rate and exchange rate innovations are jointly zero.

<Table 7> Analysis of Individual Merchant Banking Corporations
(Using Interest Rate and Exchange Rate Innovations)

Regression Model: $RMBC_{it} = \beta_{0i} + \beta_{1i} \cdot RMKT_t + \beta_{2i} \cdot DY_t + \beta_{3i} \cdot DS_t + \varepsilon_{it}$

ID No.	Sub-Sample 90:3 ~ 93:12			Sub-Sample 94:1 ~ 97:11		
	DY	*DS*	*F*	*DY*	*DS*	*F*
1	0.2278	1.0556	0.41	-1.3249^{***}	-1.0228^{*}	13.41^{***}
2	0.2707	1.2321	0.60	-0.8255^{*}	-0.7217	3.99^{**}
3	0.2208	0.2219	0.41	-1.0091^{*}	-0.8274	3.95^{**}
4	0.2079	3.7902	0.88	-2.2568^{***}	-0.9401	19.71^{***}
5	0.2553	4.4686	2.02	-0.4917	-1.6827^{*}	3.28^{**}
6	NA	NA	NA	0.0449	0.3315	0.24
7	0.2901	2.0772	0.95	-1.0442^{*}	0.0495	1.79
8	0.0659	2.0029	0.22	-0.3683	-0.1409	0.23
9	NA	NA	NA	0.1229	-0.2987	0.15
10	0.2143	3.6517	1.71	-0.8239^{**}	-1.3474^{**}	9.58^{***}
11	NA	NA	NA	0.6591	-1.9950^{**}	2.35
12	0.0154	3.5665	0.48	-0.3577	-0.8378	1.60
13	0.6081^{**}	-0.1252	2.79^{*}	0.5490	-1.3570	0.83
14	0.2320	-0.7593	0.70	-0.0009	-2.3693^{**}	4.25^{**}
15	0.3670	2.3241	1.54	-0.5782	0.0747	0.99
16	0.2392	-1.2384	0.28	-1.5029^{***}	0.2311	7.27^{***}
17	0.2175	4.6579	1.42	-0.6835	-1.7880^{*}	3.58^{**}
18	0.2778	3.4517	1.37	0.0845	-0.5999	0.22
19	0.0072	3.4679	0.47	-1.6474^{*}	-0.3009	2.33
20	0.3389	3.4163	1.45	-0.9511^{**}	-0.9531	5.39^{***}
21	0.1851	3.9071	0.85	-1.0466^{*}	-0.4495	2.69^{*}
22	0.3641	1.6104	0.75	-0.8229	0.5580	1.28
23	0.3839	2.5114	1.33	-1.3594^{***}	-0.9845	11.67^{***}
24	0.0837	2.9615	0.52	-0.0664	-2.1225^{**}	3.15^{*}
25	0.1821	2.7656	0.59	-0.9362^{*}	-1.4671^{*}	6.52^{***}
26	0.0625	2.7219	0.30	-1.4580^{**}	-0.7250	5.65^{***}
27	0.2768	2.7494	1.17	-1.2888^{**}	-1.0167	6.65^{***}
28	NA	NA	NA	-0.6733	-0.1341	0.76
29	0.1675	3.7940	0.64	-1.6201^{***}	0.0550	9.54^{***}
Average	0.2305	2.4721	–	-0.7475	-0.7856	–
No. of sig MBCs	1 / 25	0 / 25	1 / 25	15 / 29	8 / 29	17 / 29

Note: Only coefficient estimates are reported to save space. *, **, *** denote that the coefficient is significant at 10%, 5% and 1% level, respectively. F-values are from the test of null hypothesis that the coefficients of interest rate and exchange rate innovations are jointly zero.