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Essays on foreign currency risk management

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ABSTRACT

This dissertation studies on-balance-sheet and off-balance-sheet foreign currency risk management of corporate firms and commercial banks. It is comprised of two essays.

The first essay investigates what determines firms' foreign currency spot net asset positions, derivatives hedging and synthetic hedging positions. We build a model that anticipates a firm's market timing in currency markets and credit markets according to the exchange-rate return and interest rate differential. Using a unique set of data containing complete foreign currency spot and derivatives positions of Korean exporting firms, we empirically find that currency position-squaring firms have significantly higher firm value. We also find evidence that these firms time the currency market when they manage their currency cash position. Meanwhile, firms time the credit market when they determine the use of foreign currency debts. Strikingly, firms still time the market even when they conduct derivatives hedging and synthetic hedging. Our findings are consistent with the market timing theory of capital structure.

The second essay examines what determines banks' exposure to foreign currency risks, their management of these risks, and the relationship to the probability of bank failures. Using a unique data set of Korean banks with detailed information on their foreign currency risk exposures and hedging positions, we find that banks' foreign currency position mismatches, maturity mismatches, and debt roll-over risks are significantly attributed to their dollar carry lending strategy, which is stimulated by market timing of corporate firms, short-maturity dollar borrowings, real estate market booms, and dollar interest rate tightening. We also find that banks' foreign currency exposures significantly increase their financial distress likelihood through dollar carry lending activities. Finally we show that, overall, banks that better match their foreign currency positions and maturities are rewarded with lower probabilities of financial distress.

CHAPTER 1. FOREIGN CURRENCY POSITION AND CORPORATE RISK MANAGEMENT: SQUARING, HEDGING, AND MARKET TIMING

1.1 Introduction

Corporate businesses are becoming more global. For example, in 2010, 46.3 percent of all S&P 500 companies' sales were generated outside of the United States.[1] However, those global firms with active overseas sales create substantial amounts of foreign currency positions, on-balance sheet and off-balance sheet. Managing foreign currency positions is critical since they directly change the firm's net income.[2] Since foreign exchange-rate volatility significantly increased surrounding the recent global financial crisis[3], better understanding firm's foreign currency risk management is essential to equity investors and creditors. It is a critical first step towards understanding the firm's foreign currency risk management to examine what drives its foreign currency positions. However, little has been known about the firm's foreign currency positions partly due to lack of firm level data.

What determines a non-financial global firm's foreign currency positions? This study attempts to investigate which factors influence the firm's management of its foreign currency spot position, derivatives hedging position, and synthetic hedging position[4]. We especially focus on whether firms are attempting to hedge their foreign currency exposures or speculating in the markets by managing such currency positions. If firms seek benefits from hedging as suggested by previous literature[5], they will hedge their foreign currency exposures by squaring on-balance-

[1] See S&P 500 Global Sales (S&P Indices, 2011).
[2] When a firm holds more foreign currency assets than foreign currency liabilities, the change in the firm's net income is calculated by multiplying the difference between foreign currency assets and foreign currency liabilities by the change in the foreign exchange rate.
[3] For example, the Deutsche Bank three-month FX implied volatility index increased to a 24 percent level in 2008 from a one-digit level in 2007 (Bloomberg).
[4] Synthetic hedging indicates a combination of on-balance-sheet spot position squaring and off-balance-sheet derivatives hedging.
[5] The literature on corporate risk management suggests that firms may increase their firm values by hedging their exposures to foreign currency risks (e.g., Froot, Scharfstein, and Stein (1993), and Allayannis and Weston (2001)).

sheet (spot) positions or using off-balance-sheet (derivatives) positions[6]. On the other hand, firms that attempt to obtain capital gains by maintaining their foreign currency positions will time the FX market[7]. Furthermore, if firms attempt to reduce their foreign currency funding costs by adjusting the time of issue of debts, they will time the credit market. We build a simple consumption-based model, which expects that (a) a firm manager with an extreme risk aversion may keep the firm's foreign currency spot net asset position[8] at near zero level (Position squaring hypothesis), (b) a firm manager may choose to hold a positive foreign currency net asset position when the manager anticipates a positive exchange-rate return (FX market timing hypothesis) and, (c) a firm manager may hold a negative foreign currency net asset position when the manager forecasts an increasing interest rate differential between local currency debts and foreign currency debts (credit market timing hypothesis).

Empirically, we use the FX beta to capture a firm's sensitivity to exchange-rate changes as suggested by previous studies (e.g., Adler and Dumas (1985), Jorion (1990), and Allayannis and Ofek (1997)).[9] We also select firms' market-timing variables such as exchange-rate return, interest rate differential, inflation rate differential, term spread differential, and credit spread differential as suggested by previous studies (e.g., Allayannis, Brown and Klapper (2003) and Faulkender (2005)). Since risk-averse firm mangers are more likely to hedge their exposures, if their firm values become more sensitive to exchange-rate changes, they will attempt to significantly reduce their foreign currency exposures. Thus, a hedging firm's FX beta and its foreign currency risk management will be significantly associated. However, if firms time the

[6] Firms square their foreign currency positions by matching currency assets and currency liabilities. Currency position-squaring firms are considered to conduct on-balance-sheet hedging for their currency exposures and a derivative hedge is considered to be an off-balance-sheet hedging.
[7] FX stands for foreign exchange rate.
[8] The foreign currency spot net asset position is computed by subtracting foreign currency liabilities from foreign currency assets on the balance sheet.
[9] The FX beta is a beta coefficient in a regression model that represents a firm's stock price sensitivity to exchange-rate changes. We will discuss how to obtain the FX beta in Section 1.4.

markets, their foreign currency risk management will be primarily driven by the market timing variables instead of the FX beta.

To test whether global firms are hedging or timing the markets, we use a unique data from 101 largest exporting companies in South Korea. Since the 1997 currency crisis, Korean firms have reported their foreign currency assets, liabilities, and uses of derivatives on their audit reports. Using these data, we could construct a complete data set of foreign currency spot positions and derivatives positions during 823 firm years. Then we define foreign currency spot position squaring[10], derivatives hedging[11], and synthetic hedging[12].

Our empirical results suggest evidence supporting the market timing hypotheses. We find that firms' foreign currency cash positions and net working capital positions[13] are significantly positively correlated with the exchange-rate return, consistent with the FX market timing hypothesis. We also find that a firm's foreign currency debt position is significantly positively correlated with the interest rate differential between the local currency and foreign currency[14], consistent with the credit market timing hypothesis. For example, a one-percent increase in the three-month interest rate differential increases the probability of increasing foreign currency debts by 11.2 percent, consistent with the credit market hypothesis.

Overall, our findings suggest that main drivers of a firm's foreign currency spot net asset position is its credit market timing, whereas the FX beta poorly forecasts a firm's selection of its currency spot positions. Strikingly, we also find evidence that firms are still timing the markets

[10] Currency position squaring is defined by the state that the absolute value of a firm's currency spot net asset position is less than 2.5% of its total assets. See Appendix B for more details.
[11] Currency derivatives hedging is defined by the state that a firm's positive currency spot position is covered by a negative currency derivatives position or if a firm's negative currency spot position is covered by a positive currency derivatives position.
[12] Currency synthetic hedging indicates the combination of currency position squaring and derivatives hedging. See Section 1.4 for more details.
[13] Currency net working capital position is calculated by subtracting currency accounts payables from currency accounts receivables.
[14] The interest rate differential is calculated by subtracting the 3-month U.S. dollar LIBOR from the Korean CD rate.

even when they are conducting derivatives hedging and synthetic hedging. A ten percent increase in the won/dollar[15] exchange-rate return is significantly associated with a 16 percent increase in firms' derivatives hedging and a one percent increase in the interest rate differential is significantly correlated with a 14 percent decrease in firms' derivatives hedging and synthetic hedging. However, the firm value sensitivity to exchange-rate return (FX beta) is not significantly associated with firms' hedging decisions. This implies that firms time the markets when they select not only currency spot positions but also derivatives hedging and synthetic hedging positions.

We also find important characteristics of firms' foreign currency risk management. First, we find evidence that firms squaring their foreign currency spot positions show significantly higher firm value measured by Tobin's Q than non-squaring firms. Position-squaring firms also show better liquidity ratios and lower leverage. Those position-squaring firms invest in more research and development (R&D) and advertising activities based on good fundamentals. This finding is consistent with the existing literature on corporate risk management in the sense that (on-balance-sheet) hedging helps to increase firm value. Second, we find that firms substitute their local currency borrowing for foreign currency borrowing when the foreign currency funding cost is lower relative to the local currency funding cost. Our empirical results suggest that a one percent increase in the interest rate differential increases the probability of substituting local currency borrowing for foreign currency borrowing by 11 percent. This finding is consistent with findings in Allayannis, Brown and Klapper (2003), which suggests a trade-off theory of capital structure between local currency and foreign currency. Third, we find that currency forward hedging is significantly positively associated with firms' currency assets, whereas currency swap hedging is significantly positively correlated with firms' currency debts.

[15] The won/dollar exchange rate indicates the value of Korean won per unit U.S. dollar (i.e., KRW/USD).

Our findings contribute to the literature in several ways. Even though investigating foreign currency positions is essential to better understand firms' foreign currency risk management, previous studies have paid little attention to firms' management of foreign currency positions. One possible explanation is that foreign currency position data are mostly unavailable. Hence, previous studies measured firms' foreign exchange-rate exposures using their stock price sensitivity to exchange-rate returns (i.e., FX beta). However, since stock prices are significantly influenced by other factors and the market return generally does not fully capture those factors[16], the FX beta may not be able to entirely measure firms' foreign currency exposures. On the other hand, using foreign currency positions enables us to directly estimate the effects of exchange-rate changes on the firm's net profits. By investigating those currency positions, we could better understand firms' management of foreign currency exposures and their risk management. Another contribution is that, to the best of our knowledge, this study is the first to find that foreign currency spot position squaring is significantly positively associated with higher firm value and that firms' currency cash and net working capital management are significantly affected by the FX market movements. This study may also be the first to find that firms are timing the markets even when they are trying to hedge their foreign currency positions. We also introduce a concept of foreign currency synthetic hedging to measure the combined effects of currency spot position squaring and derivatives hedging.

Our findings are consistent with those in the existing literature. Allayannis, Brown and Klapper (2003) find that the interest rate differential drives firms' use of foreign currency debts. This finding suggests the static trade-off theory of capital structure in the sense that firms attempt to find an optimal level of their use of foreign currency debts according to the interest rate differential. Our study extends their findings to the determinants of other foreign currency

[16] For more details, see Fama and French (1992)

balance-sheet positions such as foreign currency cash position and net working capital position. Allayannis et al. (2003) extend the pecking order hypothesis of Myers and Majluf (1984) to the preferred currency denomination of financing in the sense that firms would first choose their local currency debt and then their foreign currency debt. We also find that the credit spread differential between local currency debts and foreign currency debts [17] are significantly negatively correlated with the selection of foreign currency debts. Faulkender (2005) examines whether firms are hedging or timing the market when selecting the interest rate exposure of their new debt issuances. He finds that interest rate risk management practices are primarily driven by market timing, not hedging considerations. Our study extends his research to firms' foreign currency risk management. Consistent with his finding, we find that firms are timing the credit markets when they are deciding their foreign currency hedging.

The recent currency crisis in Korea provides an opportunity to make natural experiments in which we can test the market timing hypotheses. We find that firms' foreign currency spot net asset positions strikingly decreased by 83 percent from 2007 to 2008. One possible explanation is that firms time the credit market as the interest rate differential between the Korean won and the dollar increases from 0.75 percent to 2.85 percent during the period. This natural experiment result is consistent with the credit market timing hypothesis. Baker and Wurgler (2002) aruge that firms' capital structures are cumulative results of market timing in the capital markets. Our findings are also consistent with the market timing theory of capital structure.

The rest of the paper is organized as follows; Section 1.2 briefly reviews the previous literature. In section 1.3, we build a theoretical model that expects firms' market timing and hedging. Section 1.4 provides a brief description of the data and the empirical methodology. We provide empirical findings in Section 1.5, followed by the conclusion in Section 1.6.

[17] The credit spread differential measures the difference between Korean credit spread and U.S. credit spread.

1.2 Literature Review

Adler and Dumas (1985) demonstrate how to measure the economic exposure of firms' market prices to exchange-rate changes. They argue that the exposure may be captured by the regression coefficient when an asset's price is regressed on exchange rates. Also, Jorion (1990) and Allayannis and Ofek (1998) estimate the exchange-rate exposure from a regression model that includes market returns and exchange-rate returns to explain the variability of firms' stock returns. Existing literatures mostly use similar methodology to measure firms' exchange-rate exposures (e.g., Bodnar and Gentry (1993), He and Ng (1998), Bodnar, Dumas and Marston (2002), Kolari, Moorman and Sorescu (2008), and Aggarwal and Harper (2010)). We also use the method suggested by Allayannis and Ofek (1998) along with the Fama-MacBeth regression to measure firms' stock return sensitivity to exchange-rate return.[18]

However, since the market return may not fully capture all the effects on stock prices other than exchange-rate changes, the FX beta measured by the regression model may have limitations. Even though the industry and regulatory bodies widely employ foreign currency positions to measure the effects of exchange-rate changes, the literature rarely analyzed the foreign currency positions. There are only a few studies that analyzed foreign currency positions. For instance, Grammatikos, Saunders and Swary (1986) analyze U.S. banks' foreign currency positions and Chamberlain, Howe and Popper (1997) attempt to measure U.S. banks' net foreign assets as the sum of foreign currency assets less foreign currency deposits. We could collect foreign currency position data on Korean firms so that we could extensively study those currency positions.

The existing literatures also documents the incentives for a firm's hedging. Smith and Stulz (1985) argue that there exists a positive relation between managerial wealth invested in the

[18] See Fama and MacBeth (1974) for more details.

firm and the use of derivatives. Also, they demonstrate that financial distress costs stimulate firms to hedge by reducing the variability of a firm's cash flows. Froot, Sharfstein and Stein (1993) formalize a general framework for analyzing corporate risk management. They document that if external sources of finance are more costly than internally generated funds, there will be a benefit to hedging. Geczy, Minton, and Schrand (1997) extensively examine the motivations of a firm's use of currency derivatives. They document that firms with greater growth opportunities and tighter financial constraints are more likely to use currency derivatives. Also, they argue that firms with extensive exchange-rate exposure and economies of scale are more likely to use currency derivates. Nance, Smith, and Smithson (1993) use survey data on firms' use of foreign currency derivatives and document that firms that hedge have more growth options in their investment opportunity set. Allayannis and Weston (2001) examine the use of foreign currency derivatives and its potential impact on firm value using Tobin's Q as a proxy for firm value. They find a positive relation between firm value and the use of currency derivatives. Carter, Rogers and Simkins (2006) document that jet fuel hedging is positively related to airline firm value. Our findings are consistent with the previous literature in the sense that foreign currency spot position squaring firms (i.e., on-balance-sheet hedgers) have higher firm values and actively invest in research & development activities.

However, contrary to those previous studies, Jin and Jorion (2006) find that hedging does not seem to affect market values of the U.S. oil and gas industry. In this regard, some literature documents that firms are actually timing the markets instead of hedging. Faulkender (2005) examines whether firms are hedging or timing the markets when they select the interest rate exposures of their new debt issuances. He measures firm's interest rate exposures by combining the initial exposure of newly issued debts with their use of interest rate swaps. He finds that the

final interest rate exposure is largely driven by the firms' market timing, not by hedging intentions. Allayannis, Brown, and Klapper (2003) examine a firm's choice between local and foreign currency debt using a data set of East Asian firms surrounding 1998 financial crisis. They find that the interest rate differentials between local currency and foreign currency are important determinants for debt use. Those papers focus on the determinants of local and foreign currency debts. This study extends their studies and investigates what determines currency assets, liabilities, and net asset positions, as well as derivatives hedging and synthetic hedging.

1.3 Model

We consider a simple consumption based model with time horizon $[t_0, T]$. A firm manager owns a sole proprietorship company that exports all the products. The company can sell its cash generated from foreign sales in the currency market whenever it wishes. It can also adjust the collection period of trade receivables and payment period of trade payables at its own discretion. Furthermore, the firm can freely borrow foreign-currency denominated debts and local-currency denominated debts. The firm manager seeks more utility from consumption under the constraints on assets and liabilities.

In the first stage, we assume that the firm does not use foreign currency derivatives. We model a risk-averse firm manager's selection of the optimal level of its currency position by a CRRA power utility function in a similar way to Hansen and Singleton (1983),

$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma} \tag{1}$$

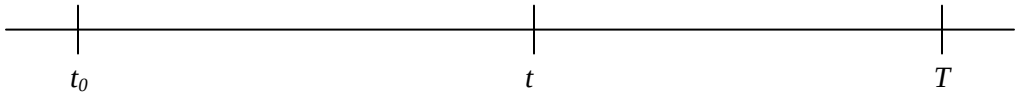
where c_t is the manager's consumption at time t.

We also assume that the firm manager maximizes his time-additive expected utility over current and future combinations of consumptions,

$$u(c_t) + E_t\left[\beta u(c_{t+1})\right] \quad (2)$$

where β denotes the subjective discount factor.

There are three important decisions in managing the firm's foreign currency cash flows. The first one is a net working capital management decision. The firm manager adjusts the collection periods of trade receivables and the payment periods of trade payables. For instance, the manager leads (lags) collection periods of currency trade receivables and lags (leads) payment periods of currency trade payables to increase (decrease) the foreign currency net asset position. The manager also attempts to match currency collection periods and currency payment periods to square the currency net asset position.[19] In words, the manager leads or lags currency collection and payment periods to maximize his utility. The second one is a cash management decision. The firm manager decides to hold or sell its currency cash position when it initially gets it at time t_0. The third one is a currency capital structure decision. We assume that the firm's stock is trading on the stock market but it does not offer a seasoned equity issue in the sample time horizon. We also assume that the firm is not in financial distress. Then the firm finds its optimal capital structure by selecting between local currency debts and foreign currency debts.



i. collection period decision:	collect currency cash	
ii. payment period decision:	pay currency cash	
iii. cash management decision:		sell currency cash
iv. capital structure decision:	borrow currency debts	repay currency debts

[19] We survey firm's currency risk management strategies on their annual reports. Most of the firms state that they use matching, leading, and lagging to manage currency new working capital position. They express these strategies as "inside risk management" comparing to the use of currency derivatives as "outside risk management".

A firm manager substitutes current consumption for future consumption in three ways. A manager may extend the receivables collection period or shorten the payables payment period. The manager may also defer selling the currency cash position. A firm manager increases future consumptions in two ways. A manager consumes more if the manager has more local currency cash in the future after he or she converts foreign currency cash inflows into local currency cash inflows. A manager also consumes more if the manager decreases local currency cash outflows after he or she repays foreign currency debts. Three market variables such as the foreign exchange-rate return ($r_{f,t}$), the foreign currency interest rate ($i_{f,t}$), and the local currency interest rate ($i_{l,t}$) impact a firm's cash flows.

	Cash inflows	Cash outflows
$r_{f,T} > r_{f,t}$	(+) after selling FC cash	(–) after repaying FC debts
$i_{f,T} > i_{f,t}$	(+) after receiving FC interest income	(–) after paying FC interest expenses
$i_{l,T} > i_{l,t}$		(–) after paying LC interest expenses

We assume that a firm manager maintains N foreign currency positions. For instance, the manager builds up positive currency positions by holding currency assets generated from foreign sales at time *t* and then squares the positions at time *T*. The manager gets a positive exchange-rage return (cash inflow) when a holding currency appreciates relative to local currency. Similarly, the manager holds negative currency positions by borrowing foreign currency debts at present and then liquidates the position at a future date. The manager generates a negative exchange-rate return (cash outflow) from the negative currency position when the value of a borrowing currency goes up relative to that of the local currency over the holding period. Also, the firm's net cash flow may be hurt as interest rates increase. Let **A**(t) denote the vector of holdings of currency assets and **B**(t) denote the holdings of currency debts at time *t*. Then the

foreign currency spot net asset position **φ**(t) is defined by **A**(t) – **B**(t). Let $\mathbf{q}_t$ denote the vector of exchange rates of the currencies in **φ**(t) and $r_{i,t+1}$ denote the holding period return on the *i*th currency position.

A feasible consumption and currency investment plan satisfies the budget constraints,

$$c_t = y_t - q_t \varphi_t \tag{3}$$

$$c_{t+1} = y_{t+1} + r_{i,t+1} q_t \varphi_t, \ i = 1, 2, \ldots, N \tag{4}$$

Now consider an information set $Y_t = \{X_t, R_{1t}, R_{2t}, ..., R_{Nt}\}$ and assume $\{Y_t\}$ follows a stationary Gaussian process. Denote $\{Y_{t-1}, Y_{t-2}, Y_{t-3}, ...\}$ by I_{t-1} and let $X_t \equiv \ln x_t$, $R_{it} \equiv \ln r_{it}$, and $U_{it} \equiv \ln u_{it}$. Then the conditional random variable $U_{it} \mid I_{t-1}$ is normally distributed with a constant variable σ_i^2 and a mean $\mu_{i,t-1}$.

(Proposition 1) Under the budget constraints

$$E(X_t \mid I_{t-1}) = \frac{1}{\gamma}\left[E(R_{it} \mid I_{t-1}) + \ln \beta + (\sigma_i^2 / 2) \right] \tag{5}$$

Proof. See Appendix A. □

(Proposition 2) A risk-averse firm manager with $\gamma > 0$ holds a positive currency net asset position when the manager expects a positive exchange-rate return, ceteris paribus. (FX market timing hypothesis)

Proof. In Proposition 1, if $E(R_{it} \mid I_{t-1}) > 0$ then $E(X_t \mid I_{t-1}) > 0$, which indicates that $E\left[\ln(c_{t+1} / c_t) \mid I_{t-1}\right] > 0$ and thus $E\left[\ln(c_{t+1}) \mid I_{t-1}\right] > E\left[\ln(c_t) \mid I_{t-1}\right]$. Therefore, from the budget constraints (3) and (4), under the assumption that the firm's production level is unchanged between time *t* and time *t+1* (i.e. $y_t = y_{t+1}$), $E(X_t \mid I_{t-1}) > 0$ implies that the currency net asset position is positive (i.e. $\varphi_t > 0$), and vice versa. □

(Proposition 3) A risk-averse firm manager with $\gamma > 0$ holds a negative currency net asset position when the manager expects an increasing interest rate differential between local currency debts and foreign currency debts. (Credit market timing hypothesis)

Proof. In Proposition 1, the discount factor $\beta = 1/(1+i_t)$ and is assumed to be determined by local currency interest rates. Assume that the foreign currency interest rate stays the same. Hence, if $i_{l,t}$ increases, ß decreases and thus the currency net asset position becomes negative. □

(Proposition 4) A firm manager with extreme risk aversion keeps his currency position at near zero level, ceteris paribus.

Proof. In Proposition 1, as γ tends to infinity, the currency net asset position approaches zero. □

In sum, when a firm does not use foreign currency derivatives and times FX markets and credit markets, the firm's net asset currency position may be positively affected by the exchange-rate return, and negatively affected by the interest rate differential between the local currency and foreign currency. However, a firm may carry a low currency net asset position if the firm manager has high risk aversion.

In the second stage, we assume that the firm can use foreign currency derivatives.[20] We also assume that the firm hedges its positive (negative) foreign currency net asset position using a negative (positive) currency derivatives position,

$$z_t = \varphi_t + \delta_t; \ \varphi_t \delta_t < 0 \tag{6}$$

where z_t is a covered currency position, φ_t is a spot (net asset) position and δ_t is a currency derivatives position.

[20] Our survey on firms' annual reports suggests that firms typically use currency forwards to hedge positive foreign currency net asset positions generated from foreign sales. Firms also use currency swaps to hedge negative foreign currency net asset positions generated from borrowings. A small number of firms state that they use currency futures or options.

A firm hedging with currency derivatives may be exposed to less exchange-rate risk than a firm holding outright spot positions because $z_t < \varphi_t$. Therefore, a hedging firm's manager may be more risk averse than a non-hedging firm's manager.

A firm that has a high sensitivity to exchange-rate exposure may square its foreign currency net asset position or hedge using derivatives. A firm that has a low sensitivity to exchange-rate exposure may time the markets if it believes that market timing is effective. Suppose that a firm times the currency markets. Then its currency cash position and currency net working capital position may be positively, and its currency debt position may be negatively, associated with the exchange-rate return. Now suppose that a firm times the credit markets. Then its currency cash position and net working capital position may be negatively, and its currency debt position may be positively, associated with the interest rate differential between local currency and foreign currency.

	Risk avoider	Currency market timer	Credit market timer
exhcnage-rate exposure	high sensitivity	low sensitivity	low sensitivity
$r_{f,T} > r_{f,t}$	squaring or hedging	(+) FC asset (–) FC debts	
$i_{f,T} > i_{f,t}$	squaring or hedging		(–) FC debts (+) LC debts
$i_{l,T} > i_{l,t}$	squaring or hedging		(+) FC debts (–) LC debts

1.4 Data Description and Empirical Methodology

1.4.1 Data Descriptions

The main purpose of this study is to investigate which factors determine firms' foreign currency positions and hedging. We build a unique data set for currency balance sheets, income statement items, and derivatives positions. Our data set contains currency cash, receivables, payables, and borrowings. From this data we can construct complete foreign currency net asset positions. Also, our data set includes foreign sales, currency related profits (losses), forward, swap, and option positions. To the best of our knowledge, this is the first study that simultaneously employs currency spot positions and derivatives positions. We collect those data for 101 largest non-financial exporting firms in Korea that have foreign sales larger than five percent of their total sales and also have asset sizes greater than 1 trillion Korean won ($836 million)[21]. The firms are also required to be listed on the Korea Exchange. We summarize financial characteristics of sample firms in Table 1.1. We collect currency spot and derivatives positions from external auditor's reports that are more reliable than annual reports. We use data on large firms with foreign sales because small domestic firms do not have enough currency assets and liabilities. Those large firms also have good lending relationships and ability to borrow in international credit markets. Also the firms have expertise to hedge currency risks using derivatives at low transaction costs. Under the constraints, we find 823 firm-year observations from 2000 to 2009. The firms hold $289 million currency assets (6.6 percent of total assets), $605 million currency liabilities (27 percent of total liabilities), and -$316 million currency net asset position (-15 percent of total shareholder's equity) on average.

[21] Table 1.1 indicates that the average foreign sales of sample firms accounts for 50 percent of their total sales. Two firms export all of their products to overseas countries. Although our theoretical model assumes that firms export all products, the model may also have implications for our sample firms because about fifty percent of the firms' total sales (i.e., U$2.64 billion) is exposed to exchange-rate changes.

Table 1.1 Summary of Financial Characteristics of Sample Firms

(U.S. dollar thousand, ratio)

Variables	Mean	Median	Std Dev
Total assets	4,787,426	2,267,130	7,606,722
Total liabilities	2,461,726	1,225,433	3,069,689
Exports	2,939,000	915,665	6,239,874
EBIT	345,527	110,208	950,506
Net income	253,267	63,664	985,480
FC assets	287,739	86,278	561,174
FC liabilities	600,463	206,903	1,156,145
FC spot net asset position	-312,753	-82,629	864,876
FC transaction gain	82,441	18,024	296,443
FC transaction loss	86,661	15,106	328,443
FC net transaction gain	-4,221	535	62,404
FC translation gain	26,896	5,381	77,487
FC translation loss	29,818	4,260	107,708
Exports over sale	0.5072	0.4953	0.2800
FC assets over total assets	0.0682	0.0449	0.0814
FC liabilities over total assets	0.1384	0.0928	0.1420
FC spot net assets over total assets	-0.0703	-0.0442	0.1319
EBIT over sale	0.0625	0.0623	0.0777
FC transaction gain over EBIT	0.3604	0.1282	2.0400
FC transaction loss over EBIT	0.3328	0.1141	1.9435
FC net transaction gain over EBIT	0.0276	0.0036	0.6416
FC translation gain over EBIT	0.2038	0.0310	1.5258
FC translation loss over EBIT	0.1313	0.0272	1.1641
FC net translation gain over EBIT	0.0725	0.0000	1.5167

Notes: This table provides the descriptive statistics of financial variables and financial ratios of sample firms for the fiscal year ending between December 2000 and December 2009. We select the 101 largest exporting companies listed on the Korea Exchange with 823 firm years. FC stands for foreign currency. FC spot net asset position is calculated by subtracting FC liabilities from FC assets. Leverage is computed by dividing long-term debt by total assets. Tobin's Q is calculated by dividing (market value of stock + book value of debt + book value of preferred stock) by book value of total assets.

Firms' fiscal year-end accounting data are primarily collected from the Compustat Global database. Some accounting data missing in the Compustat Global (i.e., advertising expenses, currency transaction or translation gain (loss) are collected from firms' external auditors' reports. Stock prices and number of shares are also collected from the Compustat Global. We collected off-balance-sheet data such as annual foreign sales and R&D expenses from the firms' annual reports posted on the DART (data analysis, retrieval and transfer system) website regulated by the FSS (Financial Supervisory Service) in South Korea. We collect other macroeconomic time series data such as monthly exchange rates, local currency interest rates, and inflation rates from the Economic Statistics System (ECOS) of the Bank of Korea. Monthly U.S. macroeconomic data are collected from the Federal Reserve Board website and the U.S. Bureau of Labor Statistics. We obtain the daily LIBOR (London Interbank Offer Rate) data from the British Bankers' Association (BBA) and the Economagic database. From the daily or monthly data, we compute average annual or year-end exchange-rate returns, interest rates, and inflation rates.

1.4.2 Empirical Methodology

We first define a foreign currency position-squaring firm as a firm that holds the absolute value of the foreign currency spot net asset positions less than 2.5 percent of its total assets. We provide a detailed discussion on the selection of this criterion in Appendix B. The firms that have the absolute value of the foreign currency net asset position more than 2.5 percent of their total assets are defined as non-squaring firms[22]. If a firm covers its currency net asset position with currency derivatives, the firm is classified as a currency derivatives-hedging firm.[23] Otherwise, the firms are classified as non-hedging firms.

[22] The position-squaring firms account for 26% of all sample firms. See Appendix B.

[23] A firm covers a spot net asset currency position with derivatives when the firm takes derivatives position in the opposite direction to the spot position. For instance, a positive net asset currency position can be covered by a negative currency derivatives position such as a short forward position.

Exchange-rate exposure is important because every firm's stock price in an open economy is exposed to exchange-rate movements. Previous studies have defined a firm's economic exposure to exchange-rate movements as the sensitivity of firm value to exchange-rate changes across states of nature (Adler and Dumas (1984) and Allayannis and Ofek (1998)). Specifically, the literature uses a firm's stock-return sensitivity to exchange-rate changes in order to proxy for the firm's exchange-rate exposure. In a similar way, we estimate a firm's economic exposure to exchange-rate risks using the following regression model:

$$R_{\mathrm{it}} = \alpha_i + \beta_{1i} R_{mt} + \beta_{2i} R_{ft} + \varepsilon_{it} \tag{7}$$

where R_{it} is the monthly rate of return on the i^{th} firm's stock at date t, R_{mt} is the monthly rate of return on the market portfolio at time t, and R_{ft} is the monthly rate of return on the exchange rate at time t. We use the past 60 monthly common stock returns, Korea Composite Stock Price Index (KOSPI) returns and the return on KRW/USD (South Korean won per unit of U.S. dollar) exchange rate and run the Fama-MacBeth regression to obtain the coefficients.[24] Then, the β_{2i} proxies for the i^{th} firm's stock price sensitivity to exchange-rate changes or its economic exposure. We express β_{2i} as the FX beta in this study. In particular, we employ Tobin's Q as a proxy for firm value. In a similar way to Lang and Stulz (1994), we compute each firm's Tobin's Q using the following formula,

$$Tobin's\ Q = \frac{\text{Market value of commonstock + Book value of debt and preferred stock}}{\text{Book value of assets}} \tag{8}$$

[24] We use the KRW/USD return because the U.S. dollar is a dominant foreign currency in Korean FX and credit markets as well as in international trade.

A firm's income statement is directly affected by the holding of its currency net asset position in the form of currency transaction profit (loss) and currency translation profit (loss). If a firm's currency net asset position is zero, the firm's currency related profit (loss) is also zero. Therefore, investigating the determinants of the net asset currency positions is worthwhile.

Before we find them, we focus on the firm's foreign currency assets. Foreign currency assets just like local currency assets consist of currency cash and cash equivalents, marketable securities, trade receivables, and others. Then we look at foreign currency liabilities. Foreign currency liabilities comprise currency trade payables, debts, and others. We investigate the determinants of the foreign currency cash position, net working capital position, debts, and net asset position using the following panel logistic regression model:

$$y_t = \alpha_t + \beta_{1t} \text{FX beta}_t + \beta_{2t} \text{MTV}_t + \beta_{3t} \text{CV}_t + \varepsilon_t \quad (9)$$

where the binary variable y_t takes the value one if a firm's foreign currency position increases from the previous year, and is 0 otherwise; the FX beta is the coefficient computed by (7); and MTV is a market timing variable (interest rate differential, inflation rate differential, or exchange-rate return)[25]; and CVs are control variables such as leverage, foreign sales, research and development, advertising expenses, capital expenditures, firm sizes and return on assets.

We also examine which factors determine the firms' currency derivatives hedging. We use the same panel logistic regressions in (9). The dependent variables now take value of 1 if a firm's positive currency net asset position is covered by a negative currency derivatives position or if a firm's negative net asset currency position is covered by a positive currency derivatives position, and is 0 otherwise.

[25] The interest rate differential is computed by subtracting the three-month U.S. dollar LIBOR from the Korean CD rates, and the inflation rate differential is calculated as the Korean CPI minus the U.S. CPI. The exchange-rate return is computed as $(S_1 - S_0)/S_0$ where S_1 and S_0 are spot exchange rates (i.e., KRW/USD).

We now test which factors affect a firm's currency synthetic hedging. Both the squaring currency net asset position and hedging with currency derivatives are classified as synthetic hedging. Specifically, in (9) the dependent variable (synthetic hedging dummy) takes the value of 1 if a firm's absolute value of its currency net asset position is less than 2.5 percent of its total assets, or a firm holding a positive currency net asset position greater than 2.5 percent of its total assets covers it using a negative currency derivatives, or a firm holding a negative currency net asset position less than -2.5 percent of its total assets covers it using a positive currency derivatives, and is 0 otherwise.

To check the robustness of the empirical results we use the absolute value of the FX beta (|FX beta|), exchange-rate return, 1-year and 10-year term spread differential between Korean Treasury Bond (KTB) and US Treasury Note (UST), and credit spread differential between Korean credit spread and US credit spread[26].

We also examine whether corporate governance variables have effects on the likelihood of increasing synthetic hedging. The existence of stock options, foreign equity listing, and largest shareholder's shareholding are employed as governance variables. To conduct robustness tests using groups of different firms, we divide sample firms into two groups according to their foreign sales over total sales. The first group shows foreign sales less than 50 percent of their total sales and the second group exhibits foreign sales more than or equal to 50 percent of their total sales[27]. The recent global financial crisis gives an opportunity to make a natural experiment. We compare firms' foreign currency positions in year-end 2007 (before the crisis) and those in year-end 2008 (in the middle of the crisis). We also compare firms' foreign currency positions in year-end 2008 to those in year-end 2009 (past the crisis).

[26] The credit spread differential measures the difference between the Korean credit spread (BBB^- rated bond yield – AA^- rated bond yield) and the U.S. credit spread (Baa rated bond yield – AAA rated bond yield).
[27] Median percent of the foreign sales over total sales in the sample is 49.5 percent.

1.5 Empirical Findings

1.5.1 Position Squaring versus Non-squaring Firms

We examine whether firms' on-balance-sheet foreign currency risk management (i.e., currency position squaring) is positively correlated with firm value. Table 1.2 provides difference in financial characteristics between the foreign currency spot position-squaring firms and non-squaring firms.

Table 1.2 Financial Characteristics of Position Squaring versus Non-squaring Firms

	Squaring Firms		Non-squaring Firms		
Variable	Mean	Std Dev	Mean	Std Dev	t-stat
Log(TA)	14.6565	0.9319	**14.7977**	1.0936	-1.68 *
Log(Sale)	14.5400	0.9931	**14.7104**	1.2431	-1.81 *
EBIT/Sale	**0.0710**	0.0728	0.0596	0.0792	1.84 *
ROA	**0.0478**	0.0745	0.0325	0.0833	2.37 **
Tobin's Q	**1.1206**	0.5435	1.0305	0.4783	2.27 **
FCA/TA	0.0478	0.0393	**0.0752**	0.0906	-4.28 ***
FCL/TA	0.0484	0.0393	**0.1696**	0.1512	-11.53 ***
FCP/TA	-0.0007	0.0140	**-0.0944**	0.1452	9.38 ***
Export/Sale	0.4159	0.2757	**0.5389**	0.2746	-5.61 ***
R&D/Sale	**0.0211**	0.0226	0.0149	0.0241	3.33 ***
Ad/Sale	**0.0102**	0.0198	0.0049	0.0101	5.02 ***
CapEx/Sale	0.0588	0.0664	0.0637	0.0792	-0.80
Leverage	0.1272	0.1003	**0.1491**	0.1223	-2.35 **
Current ratio	**1.2541**	0.6720	1.1035	0.6767	2.80 ***
Dividend payout ratio	0.1600	0.1835	0.2856	1.2239	-1.49
N	212		611		

*** (**) {*} significant at the 1% (5%) {10%} significance level for a two-tailed test.

Notes: This table provides financial characteristics of foreign currency spot position squaring firms and non-squaring firms. A firm is classified as a position squaring firm if the firm takes the absolute value of the foreign currency spot net asset position less than 2.5 percent of its total assets. If a firm's foreign currency spot net asset position is less than or equal to -2.5 percent of its total assets or greater than or equal to 2.5 percent of its total assets, the firm is classified as a position non-squaring firm. TA, ROA, FCA, FCL, and FCP stand for total assets, return on assets, foreign currency assets, foreign currency liabilities, and foreign currency spot net asset position, respectively. Ad/Sale indicates advertising expenses scaled by total sales and CapEx/Sale is capital expenditures over total sales. The t-values for the tests of the equality of means between the two groups of firms under the assumption of equal variances are presented in the last column. N on the bottom line is the number of observations.

The figures in the table indicate that foreign currency position squaring firms have significantly higher operating profit margin measured by EBIT divided by sales, return on assets, and Tobin's Q than position non-squaring firms. It is also apparent from these figures that currency position-squaring firms show significantly lower leverage ratios and higher current ratios than non-squaring firms. The position-squaring firms spend significantly larger research and development (R&D) expenses and advertising expenses than non-squaring firms. Stabilized cash flows due to currency position squaring may contribute to higher firm value. Thus, the evidence from the differences in financial characteristics between currency position-squaring firms and non-squaring firms suggests that (a) position-squaring firms show better performance from their operations, (b) they invest more in research and development and marketing activities and, (c) their firm values may benefit from their on-balance-sheet hedge for foreign currency risks by squaring their currency spot net asset position.

To the best of our knowledge, this study is the first to find that currency position-squaring firms have significantly higher firm value than non-squaring firms. Our results are consistent with previous studies in that hedgers show significantly higher firm values. For instance, Allayannis and Weston (2001) find a positive relation between foreign currency hedging and Tobin's Q.

1.5.2 Determinants of Foreign Currency Cash Position

Table 1.3 presents the panel regression results of the probability of increasing currency cash position and net working position on the FX beta, market timing variables, and firm specific variables. The results imply that a ten percent increase in the exchange-rate return is significantly associated with 28 percent increases in the probability of increasing currency cash position. Currency net working capital position, which is computed by subtracting currency accounts

payables from currency accounts receivables, also significantly increases as the dollar appreciates vis-à-vis the won. This implies that firms are speculating on the exchange rate movements when they manage their foreign currency net liquid assets. If firm managers time the FX markets in order to obtain speculative capital gains, the exchange-rate return should be positively correlated with the foreign currency liquid assets. Table 1.3 presents evidence that firms are timing the FX markets through their currency cash and net working capital positions.

Table 1.3 Determinants of Foreign Currency Cash and Net Working Capital Position

	Dependent Variable = ΔFC cash		Dependent Variable = ΔFC cash		Dependent Variable = ΔFC NWC		Dependent Variable = ΔFC NWC	
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure								
FX beta	-0.0091	*-0.25*	-0.0112	*-0.31*	0.0511	*1.32*	0.0508	*1.31*
Market timing								
Exchange-rate ret.	**2.8211**	*5.51* ***			**0.8810**	*1.85* *		
Interest rate dif.			7.4263	*1.46*			3.0990	*0.61*
Control variables								
Size (log TA)	-0.0767	*-0.97*	-0.0493	*-0.64*	**-0.1585**	*-1.98* **	**-0.1490**	*-1.86* *
EBIT / Sale	**2.2178**	*1.81* *	**2.0205**	*1.69* *	1.4001	*1.19*	1.3494	*1.15*
Leverage	-0.0718	*-0.10*	-0.1759	*-0.24*	-0.9879	*-1.31*	-1.0325	*-1.36*
Export / Sale	**0.8279**	*2.56* ***	**0.7812**	*2.47* **	-0.3790	*-1.16*	-0.3796	*-1.16*
R&D / Sale	0.9766	*0.24*	1.4537	*0.37*	4.9692	*1.22*	5.0970	*1.25*
Advertising / Sale	-5.5879	*-0.82*	-4.8922	*-0.74*	0.2926	*0.04*	0.5162	*0.08*
CapEx / Sale	-1.2982	*-1.01*	-1.0974	*-0.88*	1.0944	*0.88*	1.1515	*0.92*
N	707		707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents panel logistic regression results for the determinants of the firm's foreign currency cash position and net working capital position. The net working capital position (NWC) is calculated by subtracting the accounts payable (A/P) position from the accounts receivable (A/R) position. The first dependent variable (FC cash dummy) in models (1) and (2) takes the value 1 if a firm's holding of the foreign currency cash position increases from the previous year, and is 0 otherwise. The second dependent variable (FC NWC dummy) in models (3) and (4) takes the value 1 if a firm's FC NWC increases from the previous year, and is 0 otherwise. The explanatory variables are as follows: The FX beta measures the firm's stock return sensitivity to exchange-rate return; The exchange-rate return indicates the return on the year-end KRW/USD exchange rate; The interest rate differential indicates the year-end difference between the three-month Korean CD rate and dollar LIBOR; Size measures the log of the firm's total assets (TA); The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of increasing the FC cash position and FC net working capital position along with t-values are presented.

1.5.3 Determinants of Foreign Currency Debt Position

Table 1.4 presents the panel regression results for the determinants of the foreign currency debt position and the foreign currency debt to total debt ratio. The figures in the table show that the interest rate differential between local currency and foreign currency is significantly positively correlated with the use of foreign currency debts.

Table 1.4 Determinants of Foreign Currency Borrowing Position and FC Debt Ratio

	Dependent Variable = ΔFC borrowing (1)		Dependent Variable = ΔFC borrowing (2)		Dependent Variable = ΔFC debt ratio (3)		Dependent Variable = ΔFC debt ratio (4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure								
FX beta	-0.0518	*-1.04*	-0.0512	*-1.02*	0.0312	*0.70*	0.0348	*0.77*
Market timing								
Interest rate dif.	**11.1965**	*1.93* *			**10.6146**	*1.87* *		
Credit spread dif.			**15.8477**	*2.74* ***			**19.4774**	*3.39* ***
Control variables								
Size (log TA)	0.1712	*1.40*	0.1546	*1.26*	0.0567	*0.55*	0.0454	*0.44*
EBIT / Sale	**-4.0071**	*-2.62* ***	**-4.0384**	*-2.62* ***	-2.1697	*-1.56*	-2.1817	*-1.55*
Leverage	1.0277	*1.07*	1.1141	*1.16*	**-2.0387**	*-2.20* **	**-1.9973**	*-2.14* **
Export / Sale	-0.4295	*-0.88*	-0.4388	*-0.89*	**1.2088**	*2.93* ***	**1.2303**	*2.96* ***
R&D / Sale	**-20.882**	*-3.21* ***	**-21.301**	*-3.25* ***	-6.3212	*-1.29*	-6.6327	*-1.34*
Advertising / Sale	-4.7467	*-0.45*	-5.3180	*-0.50*	4.1562	*0.42*	3.2556	*0.33*
CapEx / Sale	0.5184	*0.33*	0.4312	*0.28*	0.2624	*0.19*	0.2235	*0.16*
N	707		707		643		643	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents panel logistic regression results for the determinants of the foreign currency (FC) borrowing position and the FC debt ratio. The first dependent variable (FC borrowing dummy) in models (1) and (2) takes the value 1 if a firm's FC borrowing increases from the previous year, and is 0 otherwise. The second dependent variable (FC debt ratio dummy) in models (3) and (4) takes the value 1 if a firm's FC debt ratio increases from the previous year, and is 0 otherwise. The explanatory variables are as follows: The FX beta measures the firm's stock return sensitivity to exchange-rate return; The interest rate differential indicates the year-end difference between the three-month Korean CD rate and dollar LIBOR; The credit spread differential measures the difference between the Korean credit spread (BBB^- rated bond yield – AA^- rated bond yield) and the U.S. credit spread (Baa rated bond yield – AAA rated bond yield); Size measures the log of the firm's total assets (TA); R&D, Advertising, and CapEx indicate the firm's research & development expenses, advertising expenses, and capital expenditures, respectively. All these expenses are scaled by total sales. N on the bottom line is the number of observations. The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of increasing the FC borrowing position and the FC debt ratio along with t-values are presented.

In Table 1.4, for example, a one percent increase in the 3-month interest rate differential between local currency and foreign currency is associated with a 11.2 percent increase in the probability of increasing the use of foreign currency debts. Similarly, the interest rate differential also has a positive impact on the foreign currency debt to total debt ratio. The credit spread differential, however, has a negative influence on the use of foreign currency debts, suggesting that as the local currency credit spread widens, firms may substitute foreign currency debts for local currency debts. These large firms have advantages in local currency credit markets when they face widening credit spread. However, research and development (R&D) expenses and operating profit margin (EBIT/Sale) appear to be negatively associated with foreign currency borrowing, suggesting that firms with active R&D activities and with more profits may use first local currency debts instead of foreign currency debts. Issuing and managing foreign currency debts may require more efforts than local currency debts. This implies that large exporting firms use relatively more local currency on R&D. This result supports the pecking order hypothesis of capital structure. Models (3) and (4) in Table 1.4 provide the regression results for the determinants of the long-term foreign currency debts to total debt ratio. A one percent increase in the interest rate differential is associated with a 10.6 percent increase in the likelihood of increasing foreign currency debt to total debt ratio. This implies that firms substitute local currency borrowing for foreign currency borrowing when the foreign currency interest rate is lower relative to local currency. This result supports the credit market timing hypothesis. Also, it is consistent with the trade-off theory of capital structure. A firm with more foreign sales may also use more foreign currency debts. However, more levered firms may have difficulty in raising foreign currency debts. Also, more profitable firms may not need to raise foreign currency debts since they generally produce enough internal cash flows.

1.5.4 Determinants of Foreign Currency Spot Net Asset Position

The results of the panel regression of the likelihood of increasing the foreign currency net asset position on the FX beta, market timing variables, and control variables are presented on Table 1.5. We employ the U.S. dollar spot net asset position to proxy for the foreign currency spot net asset position.

Table 1.5 Determinants of Foreign Currency Spot Net Asset Position

	Dependent variable = Δ Foreign Currency Spot Net Asset Position					
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.0334	*0.92*	0.0331	*0.91*	0.0325	*0.90*
Market timing						
Interest rate differential	-6.4315	*-1.27*				
Average interest rate different.			**-12.0329**	*-2.09* **		
Inflation rate differential					**-10.6311**	*-2.06* **
Control variables						
Size (log TA)	0.0360	*0.47*	0.0327	*0.42*	0.0420	*0.54*
EBIT / Sale	**3.0747**	*2.50* **	**3.2032**	*2.59* ***	**3.0673**	*2.49* **
Leverage	0.7774	*1.05*	0.7745	*1.04*	0.7500	*1.01*
Export / Sale	**0.6029**	*1.91* *	**0.6058**	*1.91* *	**0.5992**	*1.89* *
R&D / Sale	**6.8395**	*1.71* *	**6.9264**	*1.73* *	**6.9668**	*1.74* *
Advertising / Sale	6.9256	*1.05*	6.7083	*1.01*	7.0708	*1.07*
CapEx / Sale	**-3.9428**	*-2.99* ***	**-4.0415**	*-3.06* ***	**-3.9154**	*-2.98* ***
N	707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents panel logistic regression results for the determinants of the foreign currency (FC) spot net asset position. The year-end balances of U.S. dollar denominated net asset positions are employed as a proxy for the FC net asset position. The dependent variable (FC spot net asset position dummy) takes the value 1 if a firm's FC net asset increases from the previous year, and is 0 otherwise. A firm's FC net asset position is its FC assets minus FC liabilities. The explanatory variables are as follows: The FX beta measures the firm's stock return sensitivity to exchange-rate return; The interest rate differential indicates the year-end difference between the three-month Korean CD rate and dollar LIBOR; The average interest rate differential is the annual average of the monthly interest rate differential; The inflation rate differential indicates the year-end difference between the 12-month Korean CPI growth rate and the U.S. CPI growth rate; Size measures the log of the firm's total assets (TA); EBIT/Sale measures the firm's operating profit; Leverage is calculated as firm's long-term debts scaled by total assets; Export/Sale indicates the firm's sales to foreign countries scaled by total sales; R&D, Advertising, and CapEx indicate the firm's research & development expenses, advertising expenses, and capital expenditures, respectively. All these expenses are scaled by total sales. N on the bottom line is the number of observations. The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of increasing the foreign currency spot net asset position along with t-values are presented.

Since the interest rate differential has positive effects both on the currency cash position and the currency debt position, the trade-offs between the two effects on the balance sheet may cause the results that the interest rate differential is insignificantly associated with the concurrent currency spot net asset position. However, the annual average interest rate differential[28] appears to significantly negatively affect the currency spot net asset position. A one percent increase in the average interest rate differential is significantly correlated with 12.03 percent decrease in the probability of increasing the currency spot net asset position. The currency spot net asset position also decreases by 10.6 percent as the inflation differential between the Korean CPI[29] and the U.S. CPI increases by one percent (i.e., the U.S. inflation rate gets lower relative to Korea). Decreases in the U.S. inflation rate may yield a lower dollar interest rate and contribute to increases in dollar appreciation. However, firms' stock price sensitivity to exchange-rate changes (the FX beta) appears to have no significant effects on the currency spot net asset position.

In sum, the empirical results on the determinants of the currency net asset position support the credit market timing hypothesis. Thus, firms may increase the negative currency net asset position by increasing their foreign currency debts as the interest rate differential widens (i.e., foreign currency interest rates fall relative to local currency interest rates).

Our findings are consistent with capital structure hypotheses. The FX market timing by using foreign currency cash position and net working capital position and the credit market timing by employing foreign currency debt position are consistent with the market timing theory of capital structure. However, substituting between foreign currency debts and local currency debts according to the interest rate differential supports the static trade-off theory of capital structure.

[28] The annual average interest rate differential indicates the annual average of the monthly difference between the Korean CD rate and the dollar LIBOR.
[29] CPI indicates consumer price index.

1.5.5 Determinants of Foreign Currency Derivatives Hedging

Table 1.6 presents the panel regression results of the tests of whether currency derivatives hedging is associated with market timing. A firm's currency derivatives hedging is defined as the state that the firm's positive currency spot net asset position is covered by a negative derivatives position or the firm's negative currency spot net asset position is covered by a positive derivatives position.

Table 1.6 Determinants of Foreign Currency Forward and Swap Hedging

	Dependent Variable = Forward Hedging		Dependent Variable = Forward Hedging		Dependent Variable = Swap Hedging		Dependent Variable = Swap Hedging	
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure								
FX beta	0.0441	*0.55*	0.0416	*0.50*	0.1857	*1.75* *	0.1956	*1.68* *
Market timing								
Interest rate dif.	-9.8481	*-1.29*	-5.2666	*-0.68*	1.5610	*0.17*	-8.8747	*-0.93*
Balance sheet								
FCA / TA	**6.7534**	*2.41* **			**-19.0048**	*-3.01* ***		
FCL / TA			**-7.3142**	*-3.62* ***			**8.8967**	*3.18* ***
Control variables								
Size (log TA)	**0.5619**	*2.56* ***	**0.5324**	*2.36* **	**1.2682**	*3.14* ***	**1.4745**	*3.22* ***
EBIT / Sale	1.4959	*0.65*	0.0829	*0.04*	-2.4117	*-0.82*	-1.7040	*-0.57*
Leverage	-1.1160	*-0.73*			1.1587	*0.67*		
Export / Sale			**3.0011**	*3.09* ***			**-3.6896**	*-2.66* ***
R&D / Sale	3.3116	*0.30*	-12.5933	*-1.06*	-25.5991	*-1.64*	-9.7644	*-0.57*
Advertising / Sale	-30.8846	*-1.42*	-18.3807	*-0.82*	2.9019	*0.13*	-2.5128	*-0.10*
CapEx / Sale	-1.3221	*-0.57*	-3.0791	*-1.26*	0.9792	*0.39*	3.3911	*1.31*
N	707		707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents panel logistic regression results for the determinants of foreign currency (FC) forward and swap hedging. The first dependent variable (FC forward hedging dummy) takes the value 1 if a firm's positive FC spot position is covered by a negative FC forward position or if a firm's negative FC spot position is covered by a positive FC forward position, and is 0 otherwise. The second dependent variable (FC swap hedging dummy) takes the value 1 if a firm's positive FC spot position is covered by a negative FC swap position or if a firm's negative FC spot position is covered by a positive FC swap position, and is 0 otherwise. FCA/TA and FCL/TA measures total foreign currency assets and total foreign currency liabilities scaled by total assets (TA), respectively; Size measures the log of the firm's total assets. The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of conducting foreign currency forward hedging and swap hedging along with t-values are presented.

The results in Table 1.6 suggest that currency forward hedging is significantly associated with neither the FX beta nor the market-timing variable. Forward hedging, however, appears to be significantly positively associated with foreign currency assets and significantly negatively associated with foreign currency liabilities. Table 1.6 exhibits the opposite results in relation to currency swap hedging. Foreign currency assets are significantly negatively associated with the use of currency swap hedging and foreign currency liabilities are significantly positively associated with currency swap hedging. These results imply that more forwards hedging is employed when foreign currency assets increase and that more currency swap hedging is employed when foreign currency debts increase. Table 1.6 also shows that forward hedging and swap hedging are significantly positively associated with firm size, which is consistent with findings in Geczy, Minton, and Schrand (1997) who document that larger and more profitable firms use more currency derivatives. Since firms' exports are closely associated with currency assets, they are also significantly positively correlated with currency forward hedging and significantly negatively associated with currency swap hedging.

Table 1.7 presents the results of the tests of whether overall currency derivatives (e.g., forward, swap and option) hedging is determined by market timing. The empirical results in Table 1.7 support the market timing hypothesis. Even when firms conduct currency derivatives hedging, they appear to time the credit market as well as the FX market. As the interest rate differential increases by one percent, a firm's currency derivatives hedging decreases by about 13.6 percent. Also, a ten percent increases in the won/dollar exchange-rate return is significantly positively correlated with 15.6 percent increases in the probability of increasing currency derivatives hedging. However, firms' stock price sensitivity to exchange-rate return (the FX beta) has no significant effects on currency derivatives hedging.

In sum, our findings suggest that firm managers are timing the FX market and credit market even when they choose derivatives hedging, whereas the firm's stock price sensitivity to exchange-rate changes is insignificantly associated with its currency derivatives hedging. Table 1.7 also shows that larger firms are more likely to use derivatives to cover their currency spot positions. Since large firms have more expertise to manage derivatives position and the advantage of low transaction costs, they may be more likely to conduct derivatives hedging.

Table 1.7 Determinants of Foreign Currency Derivatives Hedging

	Dependent variable = Foreign Currency Derivatives Hedging Dummy					
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.1194	*1.47*	0.1039	*1.30*	0.1088	*1.35*
Market timing						
Exchange rate return	**1.5597**	*2.60* ***				
Average interest rate different.			**-13.5493**	*-1.83* *		
Lag inflation rate differential					**-18.8691**	*-2.88* ***
Control variables						
Size (log TA)	**0.5558**	*2.83* ***	**0.6050**	*3.02* ***	**0.5700**	*2.88* ***
EBIT / Sale	1.4153	*0.71*	1.9565	*0.96*	2.1064	*1.03*
Leverage	1.5434	*1.27*	1.6132	*1.32*	1.4747	*1.21*
Export / Sale	0.8413	*1.09*	0.8028	*1.03*	0.7967	*1.03*
R&D / Sale	-11.7368	*-1.23*	-9.9061	*-1.03*	-9.8146	*-1.03*
Advertising / Sale	-11.5372	*-0.68*	-12.7778	*-0.74*	-13.8692	*-0.80*
CapEx / Sale	-1.2472	*-0.62*	-1.5783	*-0.78*	-1.7095	*-0.84*
N	707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents panel logistic regression results for the determinants of foreign currency (FC) derivatives hedge. FC forwards, swaps, and options are used for the FC derivatives hedging. The dependent variable (FC derivatives hedging dummy) takes the value 1 if a firm's positive FC spot position is covered by a negative FC derivatives position or if a firm's negative FC spot position is covered by a positive FC derivatives position, and is 0 otherwise. The explanatory variables are as follows: The FX beta measures the firm's stock return sensitivity to exchange-rate return; The exchange-rate return indicates the return on the year-end KRW/USD exchange rate; The average interest rate differential indicates the annual average of the difference between the three-month Korean CD rate and dollar LIBOR; The lag interest rate differential measures the lagged value of the interest rate differential; Size measures the log of the firm's total assets (TA). N on the bottom line is the number of observations. The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of conducting foreign currency derivatives hedging along with t-values are presented.

1.5.6 Determinants of Foreign Currency Synthetic Hedging

Table 1.8 presents the results of the tests of whether a firm's foreign currency synthetic hedging is determined by market timing variables. Synthetic hedging is the combination of the currency spot position squaring and currency derivatives hedging.

Table 1.8 Determinants of Foreign Currency Synthetic Hedging

	Dependent variable = Foreign Currency Synthetic Hedging Dummy					
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.0738	*1.12*	0.0794	*1.21*	0.0846	*1.29*
Market timing						
Interest rate differential	**-14.3442**	*-2.28* ***				
Average interest rate dif.			**-12.9636**	*-1.85* *		
Lag interest rate dif.					**-12.8628**	*-2.11* **
Control variables						
Size (log TA)	0.2556	*1.46*	0.2395	*1.38*	0.2212	*1.28*
EBIT / Sale	2.8091	*1.51*	2.8938	*1.55*	2.8882	*1.55*
Leverage	0.1248	*0.11*	-1.0923	*-1.55*	-1.0848	*-1.54*
Export / Sale	-1.1331	*-1.60*	-0.0403	*-0.04*	-0.1405	*-0.12*
R&D / Sale	2.4940	*0.30*	2.4509	*0.30*	2.2629	*0.27*
Advertising / Sale	-0.2053	*-0.01*	-0.2010	*-0.01*	-0.5100	*-0.04*
CapEx / Sale	-3.2026	*-1.68*	-3.0669	*-1.62*	-3.0391	*-1.60*
N	707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

This table presents panel logistic regression results for the determinants of foreign currency (FC) synthetic hedging. The dependent variable (FC synthetic hedging dummy) takes the value 1 (a) if a firm's absolute value of the currency spot net asset position (|FCP|) is less than 2.5 percent of its total assets, or (b) a firm holding a positive FC spot net asset position greater than 2.5 percent of its total assets covers it using derivatives, or (c) a firm holding a negative FC spot net asset position less than -2.5 percent of its total assets covers it using derivatives, and is 0 otherwise. The explanatory variables are as follows: The FX beta measures the firm's stock return sensitivity to the exchange-rate return; The interest rate differential indicates the year-end difference between the three-month Korean CD rate and dollar LIBOR; The average interest rate differential is the annual average of the monthly interest rate differential; The lag interest rate differential measures the lagged value of the interest rate differential; Size measures the log of the firm's total assets (TA); EBIT/Sale measures the firm's operating profit; Leverage is calculated as the firm's long-term debts scaled by total assets; Export/Sale indicates firm's sales to foreign countries scaled by total sales; R&D, Advertising, and CapEx indicate the firm's research & development expenses, advertising expenses, and capital expenditures, respectively. All these expenses are scaled by total sales. N on the bottom line is the number of observations. The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of conducting foreign currency synthetic hedging along with t-values are presented.

The results in Table 1.8 suggest that the firm's sensitivity to exchange-rate exposure (i.e., FX beta) has no significant effects on the likelihood of synthetic hedging. Meanwhile, the interest rate differential is significantly negatively associated with synthetic hedging. In Table 1.8, for example, a one percent increase in the 3-month interest rate differential may give rise to a 14.3 percent decrease in the likelihood of synthetic hedging. These results suggest that firms are still timing the credit markets even when they conduct synthetic hedging.

1.5.7 Robustness Testing for Determinants of Foreign Currency Synthetic Hedging

We test whether firms time the markets when they conduct currency synthetic hedging by using a variety of alternative variables such as the absolute value of the FX beta, the exchange-rate return, the term spread differential, and the credit spread differential. Table 1.9 presents the regression results for robustness testing.

Table 1.9 Synthetic Hedging and Macroeconomic Variables: Robustness Tests

[Panel A]	Dependent variable = Foreign Currency Synthetic Hedging Dummy					
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
|FX beta|	0.0069	*0.11*	0.0149	*0.23*	0.0205	*0.32*
Market timing						
Interest rate differential	**-14.9022**	*-2.37* **				
Average interest rate different.			**-13.3287**	*-1.90* *		
Lag inflation rate differential					**-12.8995**	*-2.11* **
Control variables						
Size (log TA)	0.2589	*1.47*	0.2433	*1.39*	0.2259	*1.29*
EBIT / Sale	2.5219	*1.36*	2.5858	*1.40*	2.5501	*1.38*
Leverage	-1.1138	*-1.55*	-1.0746	*-1.50*	-1.0679	*-1.50*
Export / Sale	0.0433	*0.04*	-0.1417	*-0.12*	-0.2537	*-0.22*
R&D / Sale	2.6071	*0.31*	2.6060	*0.31*	2.4274	*0.29*
Advertising / Sale	0.6661	*0.05*	0.7923	*0.06*	0.5997	*0.04*
CapEx / Sale	-3.1676	*-1.66*	-3.0298	*-1.59*	-2.9965	*-1.58*
N	707		707		707	

(Table Continued)

[Panel B]	Dependent variable = Foreign Currency Synthetic Hedging Dummy					
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.0909	*1.37*	0.0797	*1.21*	0.0857	*1.30*
Market timing						
Exchange-rate return	**1.1240**	*1.92* *				
Term spread differential			**26.6491**	*2.62* ***		
Credit spread differential					**-14.0642**	*-1.95* *
Control variables						
Size (log TA)	0.2146	*1.25*	0.2344	*1.35*	0.2415	*1.40*
EBIT / Sale	2.4827	*1.35*	2.9967	*1.60*	2.5358	*1.38*
Leverage	-1.0497	*-1.51*	-1.1325	*-1.59*	-1.0832	*-1.54*
Export / Sale	-0.0962	*-0.08*	0.1171	*0.10*	-0.1551	*-0.14*
R&D / Sale	1.3207	*0.16*	2.5233	*0.30*	1.8968	*0.23*
Advertising / Sale	0.6072	*0.04*	-0.3537	*-0.03*	-0.2238	*-0.02*
CapEx / Sale	-2.6916	*-1.43*	-3.2864	*-1.72*	-2.7683	*-1.46*
N	707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents panel logistic regression results for the determinants of foreign currency synthetic hedging. The dependent variable (synthetic hedging dummy) takes the value 1 (a) if a firm's absolute value of the currency spot net asset position is less than 2.5 percent of its total assets, or (b) a firm holding a positive FC spot net asset position greater than 2.5 percent of its total assets covers it using derivatives, or (c) a firm holding a negative FC spot net asset position less than -2.5 percent of its total assets covers it using FCDs, and is 0 otherwise. The FX beta measures the firm's stock return sensitivity to exchange-rate return; The interest rate differential indicates the difference between the Korean CD rate and dollar LIBOR; The term spread differential measures the difference between the Korean Treasury bond term spread and the U.S. Treasury bond term spread; Size measures the log of the firm's total assets (TA); The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of conducting foreign currency synthetic hedging along with t-values are presented.

The robustness test results in Panel A of Table 1.9 suggest that firms' stock price sensitivity measured by the FX beta as well as the absolute value of the FX beta still poorly forecasts synthetic hedging. However, the estimation results in Panel B of Table 1.9 imply that a firm's foreign currency synthetic hedging is significantly positively correlated with the exchange-rate return and the term spread differential between local currency debts and foreign currency debts. Meanwhile, the credit spread differential is significantly negatively associated with synthetic hedging.

1.5.8 Foreign Currency Synthetic Hedging and Corporate Governance Variables

Table 1.10 presents the results of the tests of whether corporate governance variables have significant effects on synthetic hedging. The existence of foreign equity listing appears to be negatively associated with the likelihood of synthetic hedging. This result suggests that the foreign equity listing may not increase monitoring on firm's currency risk management. The results in Table 10.1 also imply that shareholding of the largest shareholders and the existence of stock options are not significantly associated with synthetic hedging.

Table 1.10 Synthetic Hedging and Corporate Governance: Robustness Tests

	Dependent variable = Foreign Currency Synthetic Hedging Dummy					
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.0747	*1.14*	0.0746	*1.13*	0.0738	*1.12*
Market timing						
Interest rate differential	**-14.8431**	*-2.35* **	**-14.6768**	*-2.33* **	**-14.2871**	*-2.27* **
Corporate Governance						
Foreign listing (dummy)	**-1.1032**	*-2.12* **				
Stock option (dummy)			-0.2233	*-0.65*		
Largest shareholding					-0.0016	*-0.07*
Control variables						
Size (log TA)	**0.4250**	*2.21* **	0.2810	*1.56*	0.2558	*1.47*
EBIT / Sale	**3.1023**	*1.66* *	2.8665	*1.53*	2.7905	*1.50*
Leverage	-1.1536	*-1.64*	-1.1101	*-1.56*	-1.1342	*-1.60*
Export / Sale	0.1392	*0.12*	0.1284	*0.11*	0.1184	*0.10*
R&D / Sale	5.2861	*0.63*	3.2306	*0.38*	2.4441	*0.29*
Advertising / Sale	1.6838	*0.12*	0.4824	*0.03*	-0.1900	*-0.01*
CapEx / Sale	-2.9564	*-1.55*	**-3.2115**	*-1.68* *	**-3.2032**	*-1.68* *
N	707		707		707	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

This table presents panel logistic regression results for the determinants of foreign currency synthetic hedging. The dependent variable (synthetic hedging dummy) takes the value 1 if a firm conducts currency position squaring or derivative hedging, and is 0 otherwise. The FX beta measures the firm's stock return sensitivity to exchange-rate return; The foreign listing dummy takes the value 1 if a firm lists its stock or depository receipts on a foreign exchange, and 0 otherwise; The stock option dummy takes the value 1 if a firm vests executive stock options, and 0 otherwise; Largest shareholding measures the proportion of the largest shareholder's stock holding; The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of conducting foreign currency synthetic hedging along with t-values are presented.

1.5.9 Foreign Currency Synthetic Hedging and Industry Classification

To conduct robustness testing for our main findings in the different types of firms, we divide the sample firms into two groups according to their foreign sales over total sales. The first group shows foreign sales less than 50 percent of their total sales and the second group exhibits foreign sales more than or equal to 50 percent of their total sales. Financial characteristics of the domestic-oriented firms in the first group and the export-intensive firms in the second group are presented in Table 1.11.

Table 1.11 Financial Characteristics of Domestic-oriented versus Export-intensive Firms

	Domestic-oriented Firms		Export-intensive Firms		
Variable	Mean	Std Dev	Mean	Std Dev	t-stat
Log(TA)	14.5867	0.9334	**14.9398**	1.1411	-4.86 ***
Log(Sale)	14.4634	1.0120	**14.8741**	1.3089	-5.04 ***
EBIT/Sale	**0.0701**	0.0677	0.0548	0.0862	2.83 ***
ROA	0.0342	0.0809	0.0387	0.0819	-0.79
Tobin's Q	1.0308	0.5485	1.0795	0.4363	-1.38
FCA/TA	0.0405	0.0673	**0.0964**	0.0849	-10.47 ***
FCL/TA	0.1059	0.1063	**0.1717**	0.1646	-6.83 ***
FCP/TA	-0.0653	0.0967	-0.0753	0.1600	1.09
Export/Sale	0.2737	0.1419	**0.7459**	0.1585	-45.05 ***
R&D/Sale	0.0128	0.0150	**0.0202**	0.0299	-4.48 ***
Ad/Sale	**0.0095**	0.0176	0.0030	0.0054	7.05 ***
CapEx/Sale	0.0511	0.0539	**0.0741**	0.0922	-4.38 ***
Leverage	**0.1526**	0.1166	0.1341	0.1176	2.27 **
Current ratio	1.1720	0.7698	1.1120	0.5692	1.27
Dividend payout ratio	0.2242	0.5637	0.2827	1.3939	-0.79
FX beta	-0.7420	9.0802	**0.0947**	3.7636	-1.69 *
|FX beta|	1.1532	9.0370	1.2662	3.5449	-0.23
N	416		407		

*** (**) {*} significant at the 1% (5%) {10%} significance level for a two-tailed test.

Notes: This table provides financial characteristics of domestic-oriented firms and export-intensive firms. A firm is classified as a domestic-oriented firm if the firm shows foreign sales less than 50 percent of its total sales. If a firm's foreign sales are greater than or equal to 50 percent of its total sales, the firm is classified as an export-intensive firm. TA, ROA, FCA, FCL, and FCP stand for total assets, return on assets, foreign currency assets, foreign currency liabilities, and foreign currency spot net asset position, respectively. Ad/Sale indicates advertising expenses scaled by sales and CapEx/Sale is capital expenditure over sale. The t-values for the tests of the equality of means between the two groups of firms under the assumption of equal variances are presented in the last column. N on the bottom line is the number of observations.

The figures in the table indicate that export-intensive firms are significantly larger in asset and sale size, and they show significantly higher operating profit margin (EBIT/Sale) than domestic-oriented firms. Export-intensive firms also spend more money on research and development activities and incur significantly larger capital expenditures. On the other hand, domestic-oriented firms invest more money in advertising activities. Those figures on the FX beta and the absolute value of the FX beta (|FX beta|) suggest that the two groups' responses to exchange-rate changes are significantly different. In the table, for example, the export-intensive firm's mean FX beta is 0.0947, whereas the domestic-oriented firm's mean FX beta is -0.7420. Those figures indicate that the export-intensive firm's stock prices rise 0.09 percent as the local currency depreciates one percent vis-à-vis the dollar but the domestic-oriented firm's stock prices fall 0.74 percent as the local currency depreciates one percent against the dollar. This finding is consistent with economic theories in that the competitiveness of the export-intensive industry strengthens as its own currency depreciates, whereas the competitiveness of domestic-oriented firms weakens as its domestic currency depreciates. The figures on the absolute FX beta suggest that the export-intensive firm's stock prices are more sensitive to exchange-rate changes than the domestic-intensive firm's stock prices. This may be one possible explanation about recent exchange rate debates between countries.

Robustness test results of the regressions for the determinants of foreign currency borrowings, derivatives hedging, and synthetic hedging are presented in Table 1.12. The figures in Panel A of the table show that export-intensive firms' foreign currency borrowing is significantly associated with the interest rate differential. However, domestic-oriented firms' foreign currency borrowing is insignificantly affected by the interest rate differential. Also, the regression results in Panel B of the table suggest that domestic-oriented firms' foreign currency

derivatives hedging is not significantly affected by the interest rate differential. This result implies that domestic-oriented firms may be less sensitive to exchange-rate risks and foreign interest rate changes since they take relatively smaller exposures than export-intensive firms. Estimation results in Panel C suggest that the effects of the interest rate differential on the foreign currency synthetic hedging of domestic-oriented firms are also insignificant and less than export-intensive firms.

Table 1.12 Foreign Currency Risk Management by Industry Classification

[Panel A]	Dependent variable = Δ Foreign Currency Borrowing					
	(1) all firms		(2) domestic-oriented firms		(3) export-intensive firms	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	-0.0518	*-1.04*	-0.2096	*-1.63*	-0.0730	*-1.13*
Market timing						
Average interest rate dif.	**11.1965**	*1.93* *	7.5320	*0.97*	**16.1975**	*1.78* *
Control variables						
Size (log TA)	0.1712	*1.40*	0.1594	*1.18*	0.1432	*0.75*
EBIT / Sale	**-4.0071**	*-2.62* ***	-2.4635	*-1.12*	**-5.5758**	*-2.60* ***
Leverage	1.0277	*1.07*	0.6425	*0.58*	1.2627	*0.83*
Export / Sale	-0.4295	*-0.88*	**2.5330**	*2.65* ***	**-4.2527**	*-3.37* ***
R&D / Sale	**-20.8815**	*-3.21* ***	**-24.0624**	*-2.62* ***	**-25.8370**	*-2.61* ***
Advertising / Sale	-4.7467	*-0.45*	1.4267	*0.15*	42.7945	*1.29*
CapEx / Sale	0.5184	*0.33*	0.9379	*0.42*	1.2979	*0.57*
N	707		360		347	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

This table presents panel logistic regression results for the determinants of the foreign currency (FC) borrowing position of domestic-oriented firms, export-intensive firms, and all sample firms. Sample firms are classified into two groups: A firm is classified as a domestic-oriented firm if the firm shows foreign sales less than 50 percent of its total sales; A firm is classified as an exporting-intensive firm if the firm's foreign sales are greater than or equal to 50 percent of its total sales. Models (1), (2), and (3) estimate regressions for all firms, domestic-oriented firms, and export-intensive firms, respectively. The dependent variable (FC borrowing dummy) takes the value 1 if the FC borrowing increases from the previous year, and is 0 otherwise. The explanatory variables are as follows: The FX beta measures the firm's stock return sensitivity to exchange-rate return; The interest rate differential indicates the year-end difference between the three-month Korean CD rate and dollar LIBOR; N on the bottom line is the number of observations. The marginal effects of the explanatory variables (evaluated at the mean) on the probabilities of increasing the FC borrowing position along with t-values are presented.

(Table Continued)

[Panel B]	Dependent variable = Δ Foreign Currency Derivatives Hedging Dummy					
	(1) all firms		(2) domestic-oriented firms		(3) export-intensive firms	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.1039	*1.30*	0.1239	*0.70*	0.1405	*1.46*
Market timing						
Average interest rate dif.	**-13.5493**	*-1.83* *	-5.2730	*-0.47*	**-18.1894**	*-1.71* *
Control variables						
Size (log TA)	**0.6050**	*3.02* ***	**0.7267**	*2.12* **	**0.5201**	*2.22* **
EBIT / Sale	1.9565	*0.96*	0.4669	*0.13*	4.8264	*1.8*
Leverage	0.8028	*1.03*	0.8099	*0.41*	1.6604	*1.13*
Export / Sale	1.6132	*1.32*	**-3.9489**	*-2.02* **	**6.8630**	*3.58* ***
R&D / Sale	-9.9061	*-1.03*	11.8255	*0.71*	-13.3584	*-1.18*
Advertising / Sale	-12.7778	*-0.74*	-19.8337	*-0.89*	4.7387	*0.12*
CapEx / Sale	-1.5783	*-0.78*	2.4069	*0.74*	**-5.4826**	*-1.97* **
N	707		360		347	

Notes: The dependent variable (FC derivatives hedging dummy) takes the value 1 if a firm's positive FC spot position is covered by a negative FC derivatives position or if a firm's negative FC spot position is covered by a positive FC derivatives position, and is 0 otherwise.

[Panel C]	Dependent variable = Foreign Currency Synthetic Hedging Dummy					
	(1) all firms		(2) domestic-oriented firms		(3) export-intensive firms	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Economic exposure						
FX beta	0.0794	*1.21*	0.1087	*0.60*	0.1103	*1.47*
Market timing						
Average interest rate dif.	**-12.9636**	*-1.85* *	-7.8831	*-0.73*	**-17.7076**	*-1.80* *
Control variables						
Size (log TA)	0.2395	*1.38*	0.2115	*0.69*	0.2726	*1.34*
EBIT / Sale	2.8938	*1.55*	1.1962	*0.34*	**5.6291**	*2.36* **
Leverage	-1.0923	*-1.55*	-2.5951	*-1.34*	-0.3777	*-0.29*
Export / Sale	-0.0403	*-0.04*	**-4.6137**	*-2.48* **	**4.1098**	*2.41* **
R&D / Sale	2.4509	*0.30*	5.7618	*0.36*	5.3226	*0.55*
Advertising / Sale	-0.2010	*-0.01*	-8.5448	*-0.47*	-13.2045	*-0.37*
CapEx / Sale	-3.0669	*-1.62*	1.7714	*0.55*	**-6.0643**	*-2.47* **
N	707		360		347	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: The dependent variable (FC synthetic hedging dummy) takes the value 1 if a firm conducts currency synthetic hedging, and is 0 otherwise.

1.5.10 Natural Experiments Surrounding Recent Currency Crisis

We make a natural experiment surrounding the recent currency crisis by comparing firm's foreign currency positions before the crisis and in the middle of the crisis. The results of the tests for mean differences in the financial characteristics in 2007Q4 (i.e., before the crisis) and those in 2008Q4 (i.e., in the middle of the crisis) are presented in Table 1.13.

Table 1.13 Before-the-Crisis versus In-the-Middle-of-the-Crisis

	2007Q4		2008Q4		
Variable	Mean	Std Dev	Mean	Std Dev	t-value
FCA / TA	0.0523	0.0472	**0.0934**	0.0790	4.05 ***
FCL / TA	0.1027	0.0997	**0.1858**	0.1690	3.84 ***
FC borrowings / TA	0.0552	0.0637	**0.1249**	0.1454	3.98 ***
FCP / TA	**-0.0505**	0.0898	-0.0925	0.1625	-2.05 **
FCD hedging	0.4634	0.5017	0.5060	0.5030	0.54
FC synthetic hedging	**0.5732**	0.4977	0.3614	0.4833	-2.77 ***
FC Transaction gain / Sale	0.0056	0.0035	**0.0313**	0.0231	9.97 ***
FC Transaction loss / Sale	0.0055	0.0035	**0.0398**	0.0269	11.4 ***
Net Transact. gain / Sale	**0.0000**	0.0015	-0.0086	0.0203	-3.84 ***
FC translation gain / Sale	0.0011	0.0013	**0.0108**	0.0270	3.26 ***
FC translation loss / Sale	0.0023	0.0024	**0.0217**	0.0306	5.7 ***
Net translation gain / Sale	**-0.0013**	0.0023	-0.0109	0.0363	-2.39 ***
Total Net FC related gain / Sale	**-0.0012**	0.0025	-0.0195	0.0440	-3.74 ***
N	82		83		

*** (**) {*} significant at the 1% (5%) {10%} significance level for a two-tailed test.

Notes: This table compares firms' characteristics of foreign currency operations and risk management in 2007Q4 (before the currency crisis) with those in 2008Q4 (in the middle of the currency crisis). The variables are as follows: FCA/TA, FCL/TA, FC borrowings/TA, and FCP/TA measure firm's foreign currency assets, liabilities, borrowings, and spot net asset position scaled by total assets, respectively; The FCD hedging dummy takes value 1 if a firm's positive FC spot position is covered by a negative FC derivatives position or if a firm's negative spot position is covered by a positive FC derivatives position, and is 0 otherwise; The FC synthetic hedging dummy takes value 1 (a) if a firm's absolute value of the foreign currency spot net asset position (|FCP|) is less than 2.5 percent of its total assets, or (b) a firm holding a positive FC spot net asset position greater than 2.5 percent of its total assets covers it using derivatives, or (c) a firm holding a negative FC spot net asset position less than -2.5 percent of its total assets covers it using derivatives, and is 0 otherwise; Foreign currency (FC) transaction gain (loss), translation gain (loss), net transaction (translation) gain are scaled by total sales; Total net FC related gain/Sale indicates the sum of the FC net transaction gain and FC net translation gain. The t-values for the tests of the equality of means between the two groups of firms under the assumption of equal variances are presented in the last column. N on the bottom line is the number of observations.

The empirical results in Table 1.13 suggest that both foreign currency assets and foreign currency liabilities increased from 2007Q4 to 2008Q4. Foreign currency assets scaled by total assets increased by 79 percent and foreign currency liabilities scaled by total assets increased by 81 percent on average. Most of the increases in the foreign currency liabilities resulted from dramatic increases in foreign currency borrowings which rose by 126 percent. From 2007Q4 to 2008Q4, the won/dollar exchange rate increased from 938.20 to 1,257.50 (i.e., 34 percent)[30] as can be seen in Figure 1.1.

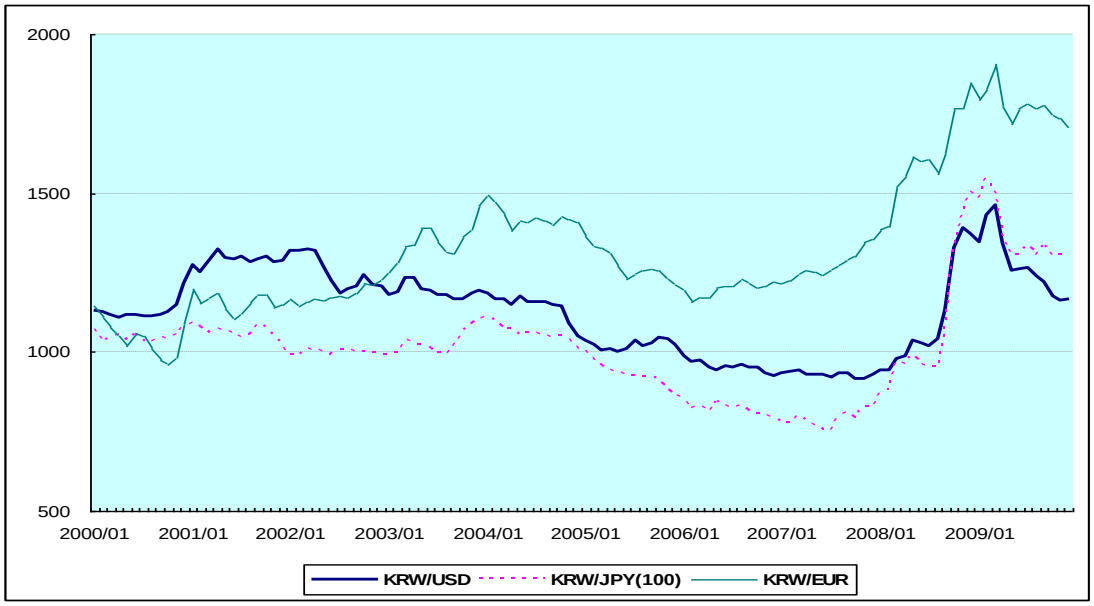


Figure 1.1 Exchange Rates of Korean Won per Dollar, Yen, and Euro

Due to the catastrophic appreciation of the dollar against the won, average foreign currency transaction losses scaled by total sales increased by 624 percent and average foreign currency translation losses scaled by total sales increased by 843 percent. Firms might increase their foreign currency assets in order to diminish negative any effects from depreciation of the local currency after the Lehman Brothers shock hit the global financial markets in 2008Q3.

[30] The KOSPI (Korea Composite Stock Price Index) also decreased 40.1 percent from 1,897.1 to 1,124.47 during 2007Q4 to 2008Q4.

On the other hand, during the period, the 3-month interest rate differential changed from 0.75 percent to 2.85 percent mainly due to the decreases in the U.S. dollar interest rates as can be seen in Figure 1.2.

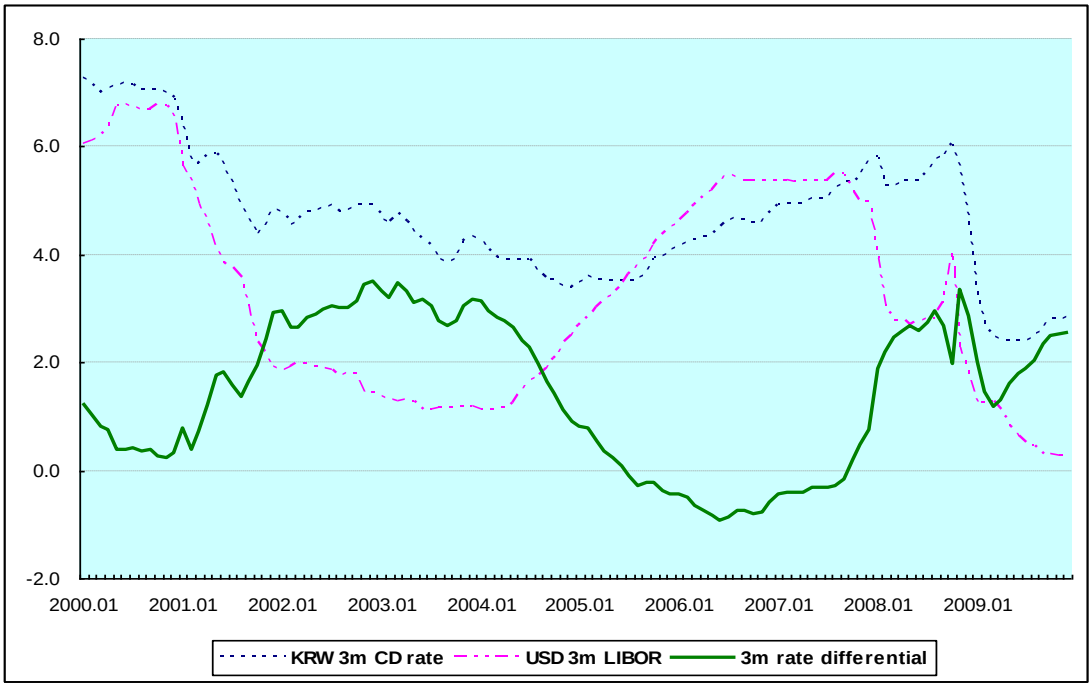


Figure 1.2 Three-month Interest Rate Differential between Korea and the U.S.

Firms that were timing the credit markets might be motivated to increase their foreign currency debts instead of local currency debts. As a result, we find that average net asset currency position scaled by total assets strikingly decreased by 83 percent during the currency crisis period (from -0.0505 to -0.0925). The firms' synthetic hedging was also aggravated. These results of natural experiments are consistent with the FX market timing hypothesis and the credit market timing hypothesis. However, firms' market timing in the credit markets appears to have dominant effects on the net asset currency position than that that in the FX markets. Historical movements of the firms' foreign currency assets, liabilities, and net asset position scaled by their total assets are presented in Figure 1.3.

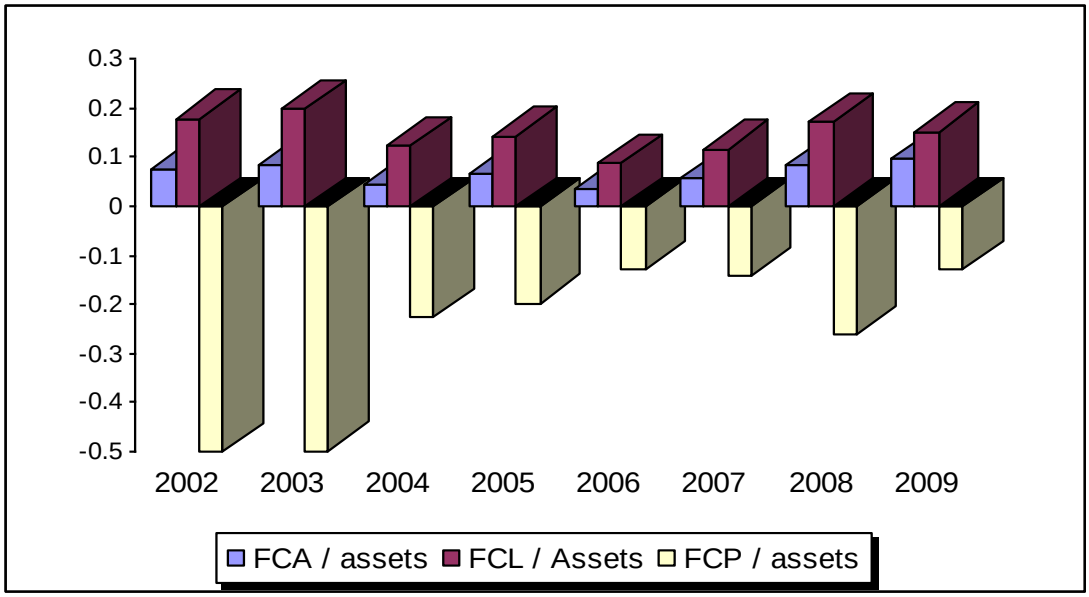


Figure 1.3 FC Assets, Liabilities, and Net Asset Position over Total Assets

Historical movements of the firms' net income, net foreign currency transaction gain, and net foreign currency translation gain are described in Figure 1.4. The sum of the net currency transaction loss and translation loss in 2008 is almost the same to the firms' net income.

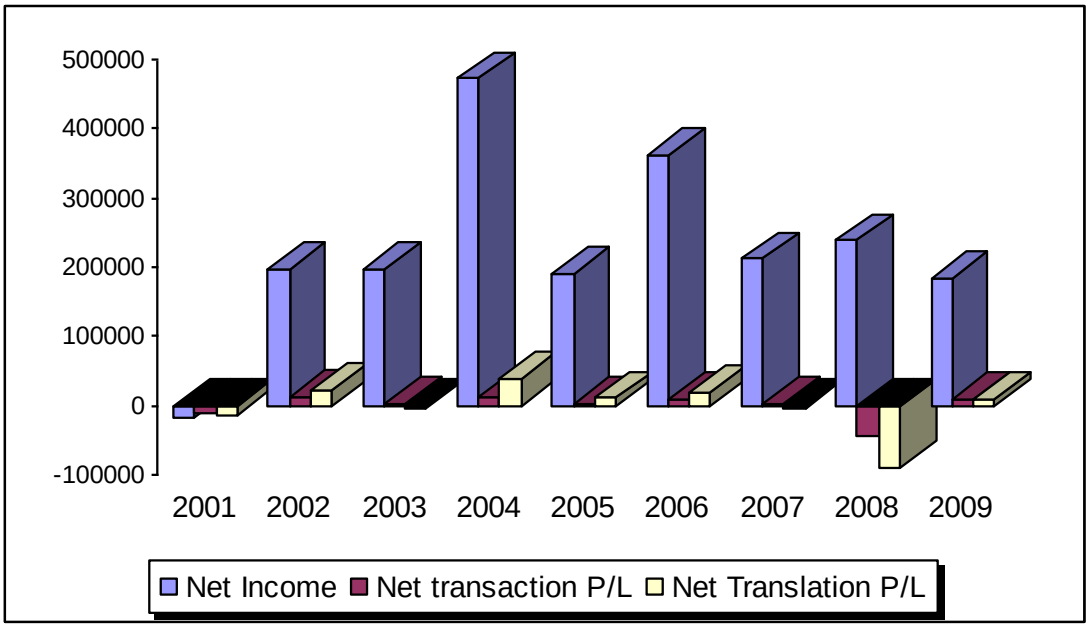


Figure 1.4 Net Income, Net Currency Transaction Profit, and Translation Profit

The results of the tests for mean differences in the financial characteristics in 2008Q4 (i.e., in the middle of the crisis) and those in 2009Q4 (i.e., past the crisis) are presented in Table 1.14. The results imply that foreign currency liabilities scaled by total assets and foreign currency borrowings scaled by total assets decreased by 22 percent and by 28 percent, respectively. The 3-month interest rate differential changed from 2.85 percent to 2.57 percent during the period. Firms that time the credit markets might attempt to decrease foreign currency debts rather than local currency debts. As a result, currency spot net asset position scaled by total assets increased by 44 percent. These results also support the credit market timing hypothesis.

Table 1.14 In-the-Middle-of-the-Crisis versus Past-the-Crisis

	2008Q4		2009Q4		
Variable	Mean	Std Dev	Mean	Std Dev	t-value
FCA / TA	0.0934	0.0790	0.0928	0.0914	-0.04
FCL / TA	**0.1858**	0.1690	0.1441	0.1430	-1.74 *
FC borrowings / TA	**0.1249**	0.1454	0.0898	0.1147	-1.75 *
FCP / TA	-0.0925	0.1625	**-0.0514**	0.1427	1.75 *
FCD hedging	**0.5060**	0.5030	0.4368	0.4989	-0.9
FC synthetic hedging	0.3614	0.4833	**0.5402**	0.5013	2.37 **
FC Transaction gain / Sale	**0.0313**	0.0231	0.0252	0.0172	-1.93 *
FC Transaction loss / Sale	**0.0398**	0.0269	0.0260	0.0178	-3.98 ***
Net Transact. gain / Sale	-0.0086	0.0203	**-0.0007**	0.0100	3.28 ***
FC translation gain / Sale	0.0108	0.0270	0.0080	0.0125	-0.88
FC translation loss / Sale	**0.0217**	0.0306	0.0065	0.0222	-3.71 ***
Net translation gain / Sale	-0.0109	0.0363	**0.0015**	0.0171	2.85 ***
Total Net FC related gain / Sale	-0.0195	0.0440	**0.0007**	0.0177	3.89 ***
N	83		87		

*** (**) {*} significant at the 1% (5%) {10%} significance level for a two-tailed test.

This table compares firms' characteristics of foreign currency operations and risk management in 2008Q4 (in the middle of the currency crisis) with those in 2009Q4 (past the currency crisis). The variables are as follows: FCA/TA, FCL/TA, FC borrowings/TA, and FCP/TA measure firm's foreign currency assets, liabilities, borrowings, and spot net asset position scaled by total assets, respectively; The FCD hedging dummy takes value 1 if a FC spot position is covered by a derivatives position, and is 0 otherwise; The FC synthetic hedging dummy takes value 1 if a firm squares its currency spot net asset currency position or a firm conducts currency derivatives hedging, and is 0 otherwise; Foreign currency (FC) transaction gain (loss), translation gain (loss), net transaction (translation) gain are scaled by total sales; Total net FC related gain/Sale indicates the sum of the FC net transaction gain and FC net translation gain. The t-values for the tests of the equality of means between the two groups of firms under the assumption of equal variances are presented in the last column. N on the bottom line is the number of observations.

1.6 Conclusion

This study investigates what determines global non-financial firms' foreign currency spot net asset positions, derivatives hedging positions, and synthetic hedging positions. We build a theoretical model, which expects that a risk-averse firm manager may hold a positive net asset currency position when he expects a positive exchange-rate return (i.e., FX market timing hypothesis). Also the model expects that a firm manager may hold a negative net asset currency position when he expects an increasing interest rate differential between local currency debts and foreign currency debts (i.e., credit market timing hypothesis). Finally, it expects that a firm manager with an extreme risk aversion may keep his net asset currency position at near zero level and that a derivatives hedging firm's manager may be more risk averse than a non-hedging firm's manager. The primary purpose of this study is to test those market timing hypotheses and examine which factors drive firms' foreign currency position and hedging. We construct a unique data set that contains firms' complete components of spot currency and derivatives positions.

Using this data we explore the differences in financial characteristics between foreign currency spot position-squaring firms and non-squaring firms. We contribute to the literature by finding that position-squaring firms have significantly higher Tobin's Q than non-squaring firms. We also find that the position-squaring firms are significantly more profitable, more liquid, and less levered than non-squaring firms.

Our main findings regarding the determinants of the foreign currency positions and hedging are as follows; (a) The exchange-rate return is significantly positively associated with the likelihood of increasing the foreign currency cash position and net working capital position. This result supports the FX market timing hypothesis. (b) The interest rate differential is

significantly positively associated with the use of foreign currency debts. A one percent increase in the interest rate differential may be associated with a 10.6 percent increase in the likelihood of substituting local currency debts for foreign currency debts. This result also supports the credit marking timing hypothesis and the trade-off theory of capital structure. (c) Both the FX beta and the absolute value of the FX beta poorly forecast the currency net asset position, while the annual average interest rate differential and inflation rate differential has a significantly negative impact on the net asset currency position. The empirical results on the determinants of the currency net asset position (weakly) support the credit market hypothesis. (d) Currency forward hedging appears to be positively significantly associated with foreign currency assets, while foreign currency liabilities are significantly positively associated with currency swap hedging. These results imply that more forward hedging is employed when foreign currency assets increase and that more currency swap hedging is employed when foreign currency debts increase. Overall currency derivatives (forward, swap and option) hedging is determined by firm's market timing. The empirical results support the market timing hypothesis. (e) Firms' stock price sensitivity to exchange-rate exposure (i.e., FX beta) has no significant effects on the likelihood of synthetic hedging. Meanwhile, the interest rate differential is significantly negatively associated with synthetic hedging. These results suggest that strikingly firms are still timing the credit markets and FX markets even when they conduct synthetic hedging.

The recent currency crises in 2008 offer an opportunity to make natural experiments to test the market timing hypotheses. The results of the natural experiments are consistent with the credit market timing hypothesis.

CHAPTER 2. DOLLAR CARRY LENDING STRATEGY AND FINANCIAL DISTRESS: EVIDENCE FROM KOREAN BANKS

2.1 Introduction

Investments and financing activities are becoming more international and take place across borders. For example, a recent Wall Street Journal article reported that Japanese mom-and-pop currency traders holding about $60 billion in Australian assets and $34 billion in Brazil pushed the yen higher as they unwound yen carry trading.[31] Emerging market banks are also becoming globalized by increasing their foreign currency borrowings. For instance, Korean bank's borrowings from foreign countries increased 176 percent for the years, 2000 – 2009.[32]

However, actively engaging in foreign currency operations in global markets exposes banks to a variety of foreign currency risks. Banks' profitability and default probability can be extensively affected by foreign exchange rate changes and foreign interest rate changes through their foreign currency position mismatches and maturity mismatches. Dramatic increases in foreign exchange-rate and interest rate volatility in recent years[33] have intensified concerns over the exposures of international banks to those risks. Since banks' foreign currency exposures could be incorporated into debt roll-over risks and increase bank failure likelihood through financial crises, it is important to explore characteristics and determinants of such exposures. In a frictionless world described in Modigliani and Miller (1958), hedging may not be related to bank distress likelihood. In a real world with various frictions, however, hedging away such risks may be significantly associated with the probability of bank failures. Therefore, investigating whether

[31] See Wall Street Journal article by Tom Lauricella and Jonathan Cheng, "Yen Moves Upward As Retail Investors Exit 'Carry Trade'", March 16, 2011.

[32] Data are from Bank of Korea. Korean banks, including domestic branches of foreign banks, increased their foreign borrowings from $39.06 billion in 2000 to $107.9 billion in 2009Q2.

[33] For example, the U.S. dollar implied volatility measured by the Deutsche Bank 3-month FX implied volatility index increased from an 8 percent level in 2006Q4 to a 20 percent level in 2008Q4. The 3-month U.S. dollar LIBOR decreased from a 5 percent level in 2007Q4 to a zero percent level in 2009Q4.

banks maintain foreign currency exposures and those exposures affect bank failure probability may be essential to better understand bank's risk management. However, very little has been studied on banks' foreign currency exposures by previous literature partly due to limited availability of bank level foreign currency risk management data.[34]

Using a unique data set of Korean banks with detailed information on their foreign currency risk exposures and hedging positions, this study examines what determines international banks' exposures to foreign currency risks, banks' operating strategies, and the relation to the probability of bank failures. Specifically, we concentrate on three important questions.

First, to what specific foreign currency risks are Korean banks exposed? We identify three risks generated from banks' considerable amounts of foreign currency operations.[35] The first risk we address is foreign exchange-rate risk. This risk directly affects banks' net profits through their foreign currency balance sheet mismatches. For example, an increase in dollar value is beneficial to a bank that holds more foreign currency assets than liabilities. We measure banks' exposure to foreign exchange-rate risk using foreign currency positions. We could collect bank level data on foreign currency spot net asset position, forward position, and composite position from Korean banks' quarterly business reports. The foreign currency position is useful since it measures direct effects of exchange-rate changes on banks' net profits.

The second risk we address is foreign interest rate risk. This risk also influences banks' net interest earnings through their asset-liability maturity mismatches. For instance, a decrease in the dollar interest rate may be beneficial to a bank that holds dollar assets with longer maturities

[34] Previous studies used bank stock return sensitivity to exchange-rate changes to measure bank's foreign currency exposures partly due to lack of data. However, this proxy has some limitations. See section 2.2 for more details.
[35] As we will see in section 2.3, Korean bank's average foreign currency loans account for 8.15 percent of their total loans and their average foreign currency borrowings account for 31.33 percent of their total borrowings.

than liabilities since the longer-maturity asset value grows more than the shorter-maturity liability value from the decrease in the dollar interest rate. We measure Korean banks' foreign currency maturity mismatches using dollar maturity gaps.

The third risk we address is foreign currency debt roll-over risk. The amount of banks' holdings of foreign currency short-maturity debts and international money market liquidity affect banks' foreign currency debt roll-over risk. For example, a bank that holds more short-maturity foreign currency debts may be more likely to suffer from roll-over risk under international liquidity crunch situations.

We also examine to what extent Korean banks are exposed to foreign currency risks. We find that Korean banks are significantly exposed to those risks. For example, the average dollar spot position taken by the banks in 2009 amounts to -$1,443.5 million, which accounts for -17 percent of their total dollar assets. The average dollar forward position is $1,948.4 million, which is 22.9 percent of their total dollar assets. Thus, the average dollar composite position amounts to $504.9 million, which accounts for 6 percent of their total dollar assets.

In addition, Korean banks have held deeply negative dollar maturity gaps. For example, banks' average 6-month dollar maturity gap is -3.41 percent during 2001 – 2009. This indicates that Korean banks' average dollar debts maturing within six months are greater than their dollar assets by 3.41 percent of total dollar assets. Since their dollar asset holdings are less than dollar debt holdings, an increase in the dollar interest rate may reduce banks' net interest earnings.

Furthermore, Korean banks sharply increased short-maturity dollar debts during 2006 – 2007. For instance, the average dollar debts maturing within one year increased 129.5 percent, from $7,001.7 million in 2005Q4 to $16,069.7 million in 2007Q4. This dramatic increase in dollar short-maturity debts together with the dollar maturity mismatch significantly increased

banks' dollar debt roll-over risk. We also measure the dollar roll-over risk using the dollar liquidity ratio[36]. We find that the liquidity ratio significantly decreased during 2006 – 2007.

The second question we address is what determines Korean banks' exposure to their foreign exchange rate risks, foreign interest rate risks, and dollar debt roll-over risks. We find that two macroeconomic factors and two bank operating strategic factors mainly drive those foreign currency exposures. For example, foreign exchange-rate changes are primarily associated with banks' foreign currency positions. The dollar had considerably depreciated vis-à-vis the local currency till 2007, which significantly stimulated exporting firms' sell-offs of dollar forwards. Since those firms aggressively sold their dollar forward positions at undervalued prices, banks purchased a huge amount of dollar forward positions from those firms. Banks, however, decided not to resell their long dollar forward positions in the markets. Instead, they borrowed substantial amounts of short-maturity dollar debt in an attempt to cover their long dollar forward positions. Then, banks converted the dollar funds to the local currency funds in order to lend in the local currency. This indicates that Korean banks actively engaged in so-called dollar carry lending transactions[37]. The dollar carry lending strategy decrease banks' dollar spot net asset position[38] since it increases only dollar liabilities. Banks also actively engaged in spot FX speculative trading using their trading networks and low transaction costs. Banks generally conduct FX trading by changing their dollar cash holdings according to exchange-rate movements. This dollar cash holding strategy also changes banks' dollar spot net asset position.

In addition, we find that Korean banks' foreign currency maturity mismatches are mainly driven by the dollar carry lending strategy and foreign interest rate movements. For instance, as

[36] The dollar liquidity ratio is computed as dollar current assets divided by dollar current liabilities.
[37] Dollar carry lending occurs when banks borrow at dollar interest rates and lend at local currency interest rates.
[38] Spot dollar net asset position is computed by subtracting on-balance-sheet dollar liabilities from dollar assets.

the dollar interest rate increases, banks' dollar net interest margin decreases.[39] Banks may consider increasing their dollar asset maturities relative to liability maturities in order to increase their net interest margins especially in the dollar interest rate tightening regime. This results in a decrease in the dollar maturity gap. Banks may also consider engaging in the dollar carry lending transactions to maximize their net profits.[40] However, the dollar carry lending decreases banks' maturity gap since banks' holdings of dollar short-maturity debt increases, while their holdings of dollar assets stay the same. Furthermore, the dollar carry lending strategy also increases banks' dollar debt roll-over risks since it substantially increases banks' short-maturity debts.

Carry trading is recently widely studied in the literature.[41] However, previous studies appear to suffer from measurement problems since measuring the amount of carry trading is challenging. We could measure banks' dollar carry lending transactions using Korean banks' total investments and total funding in both local currency and foreign currency. We compute the difference in banks' net investment in local currency and net investment in foreign currency to proxy for the dollar carry lending strategy. We also calculate banks' due-from-bank deposits to proxy for the dollar cash holding strategy. In this way, we could empirically examine which factors affect banks' dollar carry lending strategy and dollar cash holding strategy. We find that banks' dollar cash holding strategies are significantly positively correlated with the exchange-rate return. We also find that banks' dollar carry lending strategies are significantly negatively associated with the exchange-rate return and significantly positively associated with the dollar interest rate.

[39] We discuss about the relation between the dollar interest rate and the dollar net interest margin in Section 2.4.
[40] Banks may be able to increase their net interest margin by borrowing at a lower dollar rate and lending at a higher local currency rate.
[41] For example, see Gagnon and Chaboud (2007), and Brunnermeier, Nagel and Pedersen (2008).

The third question concerns the relation between banks' foreign currency operating strategy and bank distress likelihood. We investigate whether banks' dollar carry lending strategy has a significant association with their distress probability. We find that banks' foreign currency default probability measured by their credit default swap (CDS) spreads on dollar debts is significantly positively associated with banks' dollar carry lending strategy. Furthermore, we also find that banks' dollar carry lending strategies are significantly positively correlated with their overall distress likelihood measured by Z-score suggested by previous studies[42]. We also examine whether banks' dollar cash holding strategies are significantly associated with their distress likelihood. We find that the dollar cash holding strategy is significantly positively correlated with banks' foreign currency default probability and overall bank distress likelihood. Since banks' dollar carry lending strategy and cash holding strategy are significantly correlated with foreign macroeconomic shocks, those macroeconomic shocks may be associated with bank failure probability. By regressing banks' Z-score on foreign exchange rate and foreign interest rate, we find that bank distress likelihood is also significantly affected by those foreign macroeconomic shocks.

Our findings have important implications. First, we find that not only banks' foreign currency default likelihood but also overall bank distress likelihood may be significantly affected by foreign currency risks during currency crisis times. As currency crisis and banking crisis reinforce each other, so-called 'twin crises' develops. Second, those twin crises are magnified through banks' speculative dollar cash holding strategies and aggressive profit-maximizing dollar carry lending strategies. This implies that conservative risk management strategies instead of aggressive foreign currency operating strategies might decrease bank distress likelihood.

[42] For example, see Stiroh and Rumble (2006) and Lepetit, Nys and Tarazi (2008).

This study contributes to the literature in several ways. First, to the best of our knowledge, this study is the first to present evidence that global banks' dollar carry lending transactions increase their bank distress likelihood. Even though previous literature has studied the relation between bank failures and balance-sheet mismatches, they have not clearly shown that banks' foreign currency operating strategies generate those balance-sheet mismatches. Second, this may be the first to find that the dollar carry lending strategy negatively affects banks' foreign currency maturity mismatches. Even though Purnanandam (2007) measured U.S. banks' domestic currency maturity gaps, foreign currency maturity gaps and the relation with banks' operating strategies have been very rarely studied. Third, this may also be the first to show that foreign macroeconomic shocks influence banks' distress likelihood through their operating strategies. Thus, we contribute to the risk management literature by suggesting that good foreign currency risk management through better matched foreign currency positions and maturity structure may be rewarded by less likelihood of bank distress. Finally, we suggest a method to measure banks' dollar carry lending transactions. This may cast new light on the literature on carry trading.

The rest of this study is organized as follows; Section 2.2 briefly reviews the previous literature. Section 2.3 provides a brief description of the data and sample construction. We provide empirical analysis in Section 2.4, followed by a conclusion in Section 2.5.

2.2 Literature Review

The primary purpose of this paper is to study how bank's foreign currency operations influence their foreign exchange rate and interest rate exposure and the likelihood of financial distress. In order to investigate those relationships, we first explore bank's foreign exchange rate exposure. Following Adler and Dumas (1984), foreign exchange-rate exposures are measured by regressing changes in firm value on changes in exchange rate using two-factor or multi-factor

models (e.g., Jorion (1990), Bodnar and Gentry (1993), He and Ng (1998), Allayannis and Ofek (2001), Bodnar, Dumas, and Marston (2002), Kolari, Moorman, and Sorescu (2008), and Aggarwal and Harper (2010)).

Banks' exchange-rate exposures have also been estimated by the exchange-rate sensitivity of the equity returns of the banks (e.g., Choi, Elyasiani, and Kopecky (1992), Wetmore and Brick (1994), Chamberlain, Howe, and Propper (1997), Martin and Mauer (2003), Martin and Mauer (2005), and Wong, Wong, and Leung (2008)). Although the literature found limited relations between the corporate firm's stock returns and exchange-rate movements, some literature has found that a significant fraction of U.S. banks' stock returns co-moved with exchange rates (e.g., Chamberlain, Howe, and Propper (1997)). Also, Martin and Mauer (2003) found that both internationally oriented and domestically oriented US banks have significant exposure to exchange-rates. [43]

However, measuring exchange-rate exposure by employing market price models ignores cash flow aspects of foreign currency operations. Some studies have also attempted to employ variables that could directly capture changes in cash flows from foreign currency operations but those attempts have been very limited.[44] Hence, industry and financial regulations have widely used foreign currency positions to measure exchange-rate exposures. Some literature has also studied foreign currency positions. For instance, Grammatikos, Saunders and Swary (1986) analyzed US banks' foreign currency positions and estimated the expected returns and risks on those banks' currency positions. Also, Chamberlain, Howe and Popper (1997) attempted to measure US banks' net foreign assets as the sum of foreign currency assets less foreign currency

[43] Wong, Wong, and Leung (2008) found that commercial banks in China showed larger exchange-rate exposures than those banks in Hong Kong.

[44] For example, Geczy, Minton and Schrand (1997) used the ratio of pretax foreign net income to total sales, foreign sales to total sales and foreign assets to total assets.

deposits. Even though the foreign currency position directly captures the influence of exchange-rate changes on banks' net profits, little has been known about banks' foreign currency positions due to lack of data.[45] We could collect foreign currency positions taken by Korean banks, which operate considerable amounts of foreign currency operations. Using this data, we measure foreign exchange-rate exposures of the banks and investigate what determines those exposures.

Banks' interest-rate exposures have also been measured by obtaining the sensitivity of the equity returns on the banks to interest-rate changes (e.g, Flannery and James (1984), Choi, Elyasiani and Kopecky (1992), Wetmore and Brick (1994), Hirtle (1996), Choi and Elyasiani (1997), Sinkey and Carter (2000) Brewer III, Jackson III and Moser (2001), Faulkender (2005), and Pinheiro and Ferreira (2008)). This bank stock return sensitivity to interest rate changes has similar limitations to the stock return sensitivity to exchange-rate changes in the sense that it cannot capture direct effects of interest rate changes on banks' net earnings.

In this regard, some literature used mismatches in banks' maturities of assets and liabilities. Brewer III, Jackson III and Moser (2001) described banks' maturity gaps and developed the duration gap between banks' assets and liabilities. Purnanandam (2007) also employed U.S. banks' maturity gaps to examine the effects of macroeconomic shocks on the interest rate risk management of the U.S. banks. However, banks' exposures to foreign interest rate changes have rarely been studied since those data are mostly unavailable. We could obtain Korean banks' foreign currency maturity gaps and compute the foreign currency duration gaps using those maturity gaps in order to analyze banks' foreign interest rate exposures.

We find that Korean banks have been exposed to substantial amount of foreign exchange rate and interest rate changes. We also find that banks have maintained those exposures to

[45] In order to completely construct banks' foreign currency positions, the data on total foreign currency assets, liabilities, and off-balance-sheet currency mismatches such as forward positions are required.

maximize their net interest earnings through dollar carry lending transactions. Recently, a number of studies have been made to show the relations between currency carry trading and its effects on financial markets. Those studies show that dollar carry trading may result in appreciation of the dollar.[46] The dollar appreciations vis-à-vis emerging market currencies might cause illiquidity in global money markets and hence carry trades are subject to crash risk (e.g., Brunnermeier, Nagel and Pedersen (2008)). Also in financial crises, the deleveraging process could give rise to declines in liquidity (e.g., Hui, Genberg and Chung (2009))[47]. Magee (2008) documents that foreign currency derivatives hedging reduces the probability of financial distress. Consistent with this literature, our analysis shows that exchange-rate exposures and foreign interest rate exposures taken by Korean banks are significantly associated with the default likelihood of foreign currency debts.

Previous literature has analyzed the causes of emerging market currency crises. For example, Chang and Velasco (1998, 2001) argue that international illiquidity of the financial system is the center of the currency crisis problem. Shin (2005) uses a theoretical model to explain the relations among emerging market banks' profitability, dollar carry lending transactions, dollar borrowing roll-over risks, and bank value. Allen, Keller, and Rosenberg (2002) also argue that currency mismatches in emerging market countries have been a major element in a financial crisis. Those studies show that currency mismatches and dollar carry lending are closely related to banks' foreign currency debts. Previous studies have used credit default swap (CDS) spreads on firm's debts to proxy for banks' default probabilities (Longstaff Mithal and Neise (2005)). Historical data on U.S. bank's failures are used by Purnanandam

[46] For instance, Gagnon and Chaboud (2007) argue that yen carry trading might be associated with appreciations in the yen. Adrian, Etula and Shin (2009) also show that expansions in dollar-funded balance sheets is followed by the dollar appreciations.
[47] Hotari and Shin (2008) even documented that yen carry trading has a close relation to the U.S. subprime crisis.

(2007) to proxy for the probability of bank failures. Also, Stiroh and Rumble (2006) and Lepetit, Nys and Tarazi (2008) employ Z-scores to measure the probability of bank distress. We use banks' CDS spreads on dollar debts to measure their foreign currency default probabilities and their Z-scores to measure overall bank distress likelihood.

In addition, Allayannis, Brown and Klapper (2005) show that the interest rate differential between the local currency and the foreign currency determines the use of foreign currency debts in emerging markets. We also measure Korean banks' dollar debt roll-over risks using the dollar short-term borrowing and dollar liquidity ratio. Failures in foreign currency risk management might affect bank values. The significance of foreign currency risk management has been extensively studied by the literature. For example, Allayannis and Weston (2001) find that there is a positive relation between firm values and the use of currency derivatives. Consistent with findings in the literature, we find that banks that better manage their foreign currency risks by better matching foreign currency positions and maturity gaps show less probability of finacial distress.

Since Korea suffered from financial crises in 1998 and 2008, the literature widely analyzed foreign currency risk management of Korean banks. Hahm (2004) empirically investigates foreign exchange rate and local interest rate exposures of Korean banks before the 1998 crisis. He uses bank stock price sensitivities to exchange rates and interest rates. Tsutsumi, Jones, and Cargill (2010) analyzed the overall soundness of Korean financial system surrounding the recent global financial crisis. Chai and Song (2011) study on-balance-sheet foreign currency mismatches and maturity mismatches of Korean banks. However, they do not employ bank level data. Lee, Kim, and Lim (2010) also analyze the soundness of Korean banks' foreign currency risk management and make policy suggestions.

2.3 Data and Sample Construction

In order to investigate the effects of exchange rate shocks and foreign interest rate shocks on the operations and risk managements of commercial banks in an emerging market, we use data for Korean banks since we can obtain unique bank-level foreign currency risk management data such as foreign currency positions and maturity gaps from the quarterly business reports managed by the Korea Federation of Banks (KFB)[48].

We collected thirty domestic banks' accounting data[49] for the years, 1999 – 2009, on the Financial Statistics Information System (FISIS) websites managed by the Financial Supervisory Service (fisis.fss.or.kr)[50]. We then excluded three merchant banks and four specialized banks regulated by special banking acts. Thus, our sample contains twenty three commercial banks during the period 1999 – 2009.

Also we collected credit default swap spreads for the banks' 5-year dollar denominated bonds from Bloomberg. We found seven large banks' credit default swap data. We collected sample banks' stock price data from Samsung FnGuide database and obtained domestic macroeconomic data such as exchange rates, interest rates, and inflation rates from the Economic Statistics System (ECOS) of the Bank of Korea. The U.S. market and macroeconomic data are collected from the Federal Reserve Board website and the US Bureau of Labor Statistics. We collected LIBOR (London Interbank Offer Rate) data from the British Bankers' Association (BBA) and the Economagic database. We also collected futures price data from DataStream and Bloomberg.

[48] Those business reports are different from annual reports and they contain specific data on the banks' operations. They are available on the banks' websites and the KFB's website.

[49] We can also obtain data on derivatives trading, Bank of International Settlement (BIS) capital adequacy ratios, non-performing assets, and liquidity on the FISIS websites.

[50] The Financial Supervisory Service was created by consolidating the Bank Supervisory Service, Insurance Supervisory Service, and Credit Supervisory Fund after the Asian financial crisis broke out. Even though the Bank of Korea and the Korea Deposit Insurance Corporation participate in banking industry regulations, the major roles of financial industry supervision are conducted by the Financial Supervisory Service under the Financial Committee.

As of year end 2009, fifty seven banks operate in the Korean banking industry. Thirty seven foreign banks operate their branches in Korea and the remaining twenty domestic banks include four specialized banks[51], two merchant banks[52], and fourteen commercial banks. Those fourteen commercial banks originated from twenty three banks that existed[53], for the years from 1999 to 2009.

At year end 2009, domestic branches of foreign banks account for 9.9 percent (i.e., $180.7 billion) of total assets in Korean banking industry (i.e., $1,827.2 billion), while domestic banks account for the remaining 90.1 percent (i.e., 1,646.5 billion) of the total banking assets.[54] The fourteen commercial banks account for 77.6 percent (i.e., $1,277.1 billion) of total assets in domestic banks, while specialized banks account for 22.2 percent (i.e., $365.8 billion) and merchant banks account for 0.2 percent (i.e., $3.5 billion) of the domestic bank total assets. Those figures indicate that domestic commercial banks dominate the Korean banking industry. Thus, we employ the domestic commercial bank data for our analysis and exclude domestic branches of foreign banks, specialized banks, and merchant banks. Those domestic commercial banks are further classified into nationwide banks and regional banks.[55] Financial characteristics of commercial banks in Korea are presented in Table 2.1.

[51] Those specialized banks are the National Agricultural Cooperative Federation (Nonghyup), the National Fisheries Cooperative Federation (Suhyup), the National Livestock Cooperative Federation (Chukhyup), and the Korea Development Bank. We classify the Industrial Bank of Korea (IBK) as a commercial bank, which used to be specialized in small and medium industry banking, because the bank has expanded its business area into overall industry since it was privatized and its stocks were listed on the Korea Exchange in 1994.

[52] The Kumho Merchant Bank and the Meritz Investment Banking Corporation survived the 1998 Asian financial crisis although other 28 merchant banks disappeared surrounding the crisis.

[53] The number of banks decreased to 14 primarily due to bank mergers and acquisitions. In 1999, for example, the Chungbook Bank and the Kangwon Bank were consolidated to the Chohung Bank. In 2001, the Kookmin Bank and the Korea Housing Bank merged into the new Kookmin Bank, and the Peace Bank were consolidated to the Woori Bank. In 2002, the Hana Bank and the Seoul Bank merged into new Hana Bank. In 2006, Shinhan Bank and Chohung Bank merged into the new Shinhan Bank.

[54] Those figures in commercial banks and specialized banks include assets in banking accounts only.

[55] Commercial banks in Korea are traditionally classified into nationwide banks and regional banks. The nationwide banks are global banks that are headquartered in Seoul and have nationwide branch networks. Regional banks are headquartered in local areas outside metropolitan Seoul and can open their branches in a certain province.

Table 2.1 Financial Characteristics of Commercial Banks in Korea

Panel A

(U.S. dollar millions, KRW/USD = 1,000)

As of Dec 31, 2009	Total assets	Total deposits	Total loans	Total borrowings
Sample banks	1,277,109	780,838	780,838	304,747
Nationwide banks	1,172,279	712,411	712,411	283,548
Regional banks	104,830	68,427	68,427	21,199

Panel B

(U.S. dollar millions, KRW/USD = 1,000)

Variable	Mean	Std. Dev.	% of total assets
Total assets	54,030	56,497	100.0%
Total loans	32,332	37,900	59.8%
Total deposits	33,056	35,095	61.2%
Total borrowings	12,845	15,151	23.8%
Total liabilities	50,963	52,923	94.3%
Total Equity	3,067	3,665	5.7%
Net income	78	262	0.14%
Total loans / deposits	0.98		

Panel C

(U.S. dollar billions)

	USD	JPY	EUR	HKD	GBP	Others	TOTAL
Assets	66.06	3.14	6.80	0.04	0.71	5.46	82.21
(%)	(80.4%)	(3.8%)	(8.3%)	(0.0%)	(0.9%)	(6.6%)	(100%)
Liabilities	103.01	15.31	6.61	0.07	0.71	14.23	139.93
(%)	(73.6%)	(10.9%)	(4.7%)	(0.0%)	(0.5%)	(10.2%)	(100%)

Notes: This table provides the descriptive statistics of quarter-end financial characteristics of sample banks for the years, 1999 – 2009. The sample includes 684 bank quarters for 23 domestic commercial banks in South Korea but it excludes domestic branches of foreign banks. Borrowings include bonds issued. Panel A provides the descriptive characteristics of sample banks as of December 31, 2009. Those sample banks include 14 commercial banks (8 nationwide banks and 6 regional banks). Panel B provides financial characteristics of all commercial banks during 1999 to 2009. Panel C provides a currency composition of financial assets and liabilities denominated in foreign currencies held by Korean entities including banks and other industries. It presents annual average amounts of foreign currency assets and liabilities for the years, 2002 – 2010.

Panel A of Table 2.1 presents financial characteristics of 14 commercial banks (8 nationwide banks and 6 regional banks) at year end 2009. The figures in Panel A indicate that the nationwide banks dominate the commercial banking industry and account for 91 percent of total assets, deposits, loans, and debts of all commercial banks while the regional banks carry only 9 percent of them.

To better understand Korean banks' financial characteristics, we summarize sample banks' mean values of key financial variables for the years, 1999 – 2009 in Panel B of Table 2.1. The figures in Panel B suggest that the loan-to-deposit ratio is almost 1 but total capital is only 5.7 percent of total assets.[56]

In order to proxy foreign currencies with a certain currency, we investigate the currency composition of financial assets and liabilities in foreign currency in Korea and report it in Panel C of Table 2.1. It is apparent from the figures in the table that the U.S. dollar dominates other currencies both on the asset side and the liability side, which accounts for 80.4 percent of total foreign currency assets and 73.6 percent of total foreign currency liabilities. We employ the dollar to proxy for foreign currency[57] in this study.

2.4 Analysis

2.4.1 Foreign Currency Operations

To better understand foreign currency operations of an emerging market banks, we provide financial characteristics of foreign currency balance sheet operations and profitability ratios in Korean banks in Table 2.2. The table shows that Korean banks engage in remarkable amounts of foreign currency operations.

[56] The average Tier 1 capital ratio of sample banks based on the Basel standard, which is computed as core equity capital divided by risk weighted assets, is 8.14 percent and the average BIS (Bank of International Settlement) capital adequacy ratio of sample banks, which includes Tier II supplementary capital, is 11.87 percent.
[57] Other foreign currencies are converted into the U.S. dollars at exchange rates of the dollar to those currencies.

Table 2.2 Foreign Currency Operations of Commercial Banks in Korea

Panel A

(U.S. dollar millions, KRW/USD = 1,000)

Variable	Mean	Variable	Mean	Variable	Mean
FC total assets (FCA)	5,295.1	FC total liabilities	5,489.8	FC total capital	-194.7
FC loans	2,671.9	FC deposits	1,624.0		
FC securities	586.6	FC borrowings	3,701.6		
FC assets / TA	11.05%	FC liabilities / TL	12.02%	FC capital / total capital	-6.35%
FC loans / TA	4.95%	FC deposits / TL	3.19%		
FC securities / TA	1.09%	FC borrowings / TL	7.26%		
FC loans / total loans	8.15%	FC deposits / total dep.	5.85%		
FC securities / total sec.	5.73%	FC borrowings / total bor.	31.33%		
FC loans / FC deposits	1.65	FC borrowings / FCA	0.70		
Total loans / total deposits	0.98	Total borrowings / TA	0.24		

Panel B

Variable	Mean	Variable	Mean	Variable	Mean
FC total investment return	4.54%	LC total investment return	7.49%		
FC lending return	4.27%	LC lending return	8.07%		
FC securities return	5.59%	LC securities return	8.44%		
FC total funding cost	3.51%	LC total funding cost	4.65%		
FC deposit cost	2.50%	LC deposit cost	4.53%		
FC borrowing cost	3.61%	LC borrowing cost	4.14%		
FC net interest margin	1.03%	LC net interest margin	2.84%	Cross net interest margin	3.98%
FC lending-deposit spread	1.77%	LC lending-deposit spread	3.54%	Cross lending-deposit sp.	5.57%

Notes: This table provides the financial characteristics of sample banks' foreign currency operations for the years, 1999 – 2009. The sample includes 684 bank quarters for 23 domestic commercial banks in Korea but it excludes domestic branches of foreign banks. Assets and liabilities do not include non-interest-earning assets and non-interest-bearing liabilities. Borrowings include bonds issued by sample banks. FC, LC, TA, TL and FCA stand for foreign currency, local currency, total assets, total liabilities, and total foreign currency assets, respectively. Cross (currency) net interest margin is computed by subtracting FC total funding cost from LC total investment cost. Cross (currency) lending-deposit spread is computed by subtracting FC deposit rate from LC lending rate.

In Table 2.2, average foreign currency assets (i.e., $5,295.1 million) of the banks accounts for 11.05 percent of their total assets and average foreign currency liabilities (i.e., $5,489.8 million) of the banks is 12.02 percent of their total liabilities.[58]

Table 2.2 also shows that average foreign currency loans (i.e., $2,671.9 million) of the banks accounts for 8.15 percent of their total loans and average foreign currency securities investments (i.e., $586.6 million) of the banks is 5.73 percent of their total securities investments. On the liabilities side, average foreign currency deposits (i.e., $1,624 million) of the banks accounts for 5.85 percent of their total deposits and average foreign currency borrowings (i.e., $3,701.6 million) is 31.33 percent of their total borrowings. It is apparent from the figures in Table 2.2 that Korean banks are insolvent in terms of foreign currency balance sheet based on interest-earning assets and interest-bearing liabilities. In Panel A, the average foreign currency net asset capital held by Korean banks is -$194.7 million, which accounts for -6.35 percent of their total equity (i.e., $3,067 million). This figure suggests that, if the dollar appreciates 13.3 percent (i.e., 133 won per dollar)[59] vis-à-vis the won, the bank will incur a capital loss of $25.9 million. Thus, a one standard deviation change in the won/dollar exchange rate decreases 0.8 percent of the bank's total equity. Furthermore, in an extreme circumstance like the recent currency crisis during 2007Q4 – 2009Q1, if the won/dollar exchange rate increases by 50 percent (i.e., 500 won per dollar)[60], a capital loss of $97.4 million will be incurred, which will reduce 3 percent of the bank's total equity. It is needless to say that banks can easily improve their foreign currency balance sheet mismatch by purchasing the dollar in the currency market or engaging in currency swap contracts[61].

[58] Assets and liabilities do not include non-interest-earning assets and non-interest-bearing liabilities.
[59] For the years 1999 – 2009, the average monthly won/dollar rate was 1,135.14 and standard deviation was 133.1.
[60] During 2007Q4 – 2009Q1, the won/dollar rate increased by 57.16 percent, from 930.24 to 1,461.98.
[61] An importance difference in foreign currency position management between Korean banks and corporate firms is

Panel A of Table 2.2 also shows that the average foreign currency loan-to-deposit ratio (i.e., 1.65) of Korean banks is much greater than their overall loan-to-deposit ratio (i.e., 0.98) and that the average foreign currency leverage (i.e., 0.70) is also remarkably larger than their overall leverage (i.e., 0.24).[62] It is implied from those figures that Korean banks' foreign currency funding base is not strong in that foreign currency lending is not fully funded by foreign currency deposits and that foreign currency operations heavily depend on foreign currency borrowings. Also, the negative foreign currency net asset capital (i.e., foreign currency total funding > foreign currency total investments) of Korean banks indicates that they invest some portion of foreign currency funds in local currency assets. When emerging market banks borrow money in foreign currency (i.e., the dollar) and invest it in local currency assets, the dollar carry lending transactions occur. It is not desirable for emerging market banks to carry heavy amounts of foreign currency borrowings since if they face a liquidity crunch in international money markets, their default risks on foreign currency debts may be very high. Anecdotal evidence shows that Korean banks had difficulty in rolling over their foreign currency borrowings in financial crisis times. Those roll-over risks might be attributed to the banks' dollar carry lending transactions.[63]

To better understand what motivates emerging market banks to engage in the dollar carry lending activities, we analyze the investment returns and funding costs of Korean banks. Panel B of Table 2.2 presents investment returns, funding costs, and net interest margins generated from foreign currency operations of Korean banks. Funding sources for foreign currency operations of Korean banks primarily consist of foreign currency short-term borrowings, bond issuances, and deposits. Foreign currency deposits are taken mainly from domestic entities. In the international

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that banks can easily buy and sell the spot dollar vis-à-vis other currencies using their inter-bank transaction lines approved by the law.

[62] Foreign currency leverage is computed by dividing foreign currency borrowings by foreign currency total assets.

[63] For instance, Dow Jones Newswires reported on July 13, 2011 that "the rollover rate for offshore borrowing with maturities of less than a year rose to 107.4 percent". However, Yonhap News Agency reported on February 18, 1998 that the rollover rate for short-term foreign currency borrowings was 30 percent in December, 1997.

money market[64], the banks borrow short-term dollar funds based on LIBOR and a spread reflecting their creditworthiness. For instance, if three-month LIBOR is 0.25 percent and a lending bank requires a 25 basis point[65] of the spread, the bank's cost for three-month dollar funding is 0.5 percent. Floating-rate notes (FRNs) issued by banks to raise foreign currency funds are generally based on LIBOR. On the other hand, foreign currency deposits, long-term borrowings and bonds are generally based on fixed rates. On investment side, foreign currency lending to local firms are generally made for a long-term period and based on fixed rates, while foreign currency securities investments are based on floating or fixed rates.

Net interest margin (NIM) generated from Korean banks' foreign currency operations is smaller than local currency net interest margin. In Panel B of Table 2.2, foreign currency net interest margin is just 1.03 percent, while local currency net interest margin amounts to 2.84 percent. The figures in Panel B also indicate that the foreign currency lending-deposit rate spread is only 1.77 percent, which is much less than its local currency counterpart (i.e., 3.54 percent). Panel also shows that the average return on foreign currency investments of Korean banks is 4.54 percent and their average cost for foreign currency funding is 3.51 percent. Whereas, the average return on local currency investments of the banks is 7.49 percent and their average cost for local currency funding[66] is 4.65 percent. It is implied from these figures that, if Korean banks borrow in foreign currency and invest in local currency, they will increase their net interest earnings, which is the dollar carry lending. In Panel B of Table 2.2, for instance, the average cross currency net interest margin of Korean banks between local currency investments and foreign currency funding is 3.98 percent, and their average cross currency lending-deposit rate spread

[64] Lending banks located in financial centers such as Tokyo, Hong Kong, Singapore, and London assign credit limits on committed lines to emerging market banks and offer foreign currency funds within those limits. However, in a credit crunch, the lending banks squeeze the funding by reducing credit limits and refusing to roll over the funds.
[65] One basis point is equal to 0.01% in the international money market.
[66] Local currency funding of Korean banks is mainly based on deposit rates and CD rates, which are fixed rates.

between local currency lending and foreign currency deposits is 5.57 percent, which is much higher than their foreign currency net interest margin and lending-deposit rate spread. Thus, the dollar carry lending activities might be attributed to profit maximization attempts of Korean banks. Weak capital bases of Korean banks might also motivate them to engage in dollar carry lending transactions. However, engagement in dollar carry lending transactions increases the probability of foreign currency insolvency in Korean banks since it increases short-term dollar borrowings from foreign lending banks.

2.4.2 Foreign Currency Risk Exposure

(1) Foreign Currency Position Mismatch

On-balance-sheet and off-balance-sheet operations of banks influence their foreign currency positions. The effects of exchange-rate changes on the net profits of banks are directly measured by their foreign currency composite net asset position. The foreign currency composite net asset position can be decomposed into a foreign currency spot net asset position (i.e., dollar assets – dollar liabilities) and a foreign currency forward net asset position (i.e., dollar forward contracts bought – dollar forward contracts sold). Unfortunately, little is known about the foreign currency position in the literature due to a lack of data. We could collect Korean banks' foreign currency position data from the banks' business reports.

The dollar spot net asset position (i.e., on-balance-sheet currency mismatch), forward net asset position (i.e., off-balance-sheet currency mismatch[67]), and composite net asset position (i.e., combined currency mismatch) taken by nationwide banks, regional banks, and all commercial banks in Korea are presented in Table 2.3. Panel A of the table shows the extent to which Korean banks are exposed to foreign exchange rate risks.

[67] Banks may use other foreign currency derivatives such as futures, options, and swaps but they mainly use forwards to hedge their foreign currency spot position.

Table 2.3 Korean Bank On-balance-sheet and Off-balance-sheet Currency Positions

Panel A

(U.S. dollar millions, KRW/USD = 1,000)

	Nationwide banks	Regional banks	All banks
Spot net asset position	58.14	-67.70	6.13
(% of total dollar assets)	(0.49%)	(-9.71%)	(0.08%)
Forward net asset position	153.86	65.33	117.27
(% of total dollar assets)	(1.31%)	(9.37%)	(1.60%)
Composite net asset position	211.37	-2.36	123.20
(% of total dollar assets)	(1.79%)	(-0.34%)	(1.68%)

Panel B

(U.S. dollar millions, KRW/USD = 1,000)

Year	Spot Net Asset Position (% of total dollar assets)	Forward Net Asset Position (% of total dollar assets)	Composite Net Asset Position (% of total dollar assets)
2001Q4	358.00	-361.43	-3.43
	(9.80)	(-9.89)	(-0.09)
2002Q4	331.45	-348.33	-16.88
	(8.20)	(-8.61)	(-0.42)
2003Q4	286.63	-348.00	-61.38
	(6.54)	(-7.94)	(-1.40)
2004Q4	390.44	-313.44	77.00
	(8.14)	(-6.54)	(1.61)
2005Q4	188.71	-7.44	181.27
	(3.67)	(-0.15)	(3.52)
2006Q4	382.14	-128.35	253.79
	(5.17)	(-1.74)	(3.44)
2007Q4	-387.27	840.90	586.38
	(-4.41)	(9.58)	(6.68)
2008Q4	475.88	229.13	705.00
	(4.81)	(2.32)	(7.13)
2009Q4	-1,443.50	1,948.38	594.38
	(-16.99)	(22.93)	(6.00)

Notes: This table provides the average of the quarter-end on-balance-sheet foreign currency mismatch (dollar spot net asset position), the off-balance-sheet foreign currency mismatch (dollar forward net asset position), and the combined net exposure to foreign exchange rate risks (dollar composite net asset position) taken by Korean commercial banks, for the years, 2001 – 2009. Panel B presents the historical breakdown of the positions taken by nationwide banks. (N = 15 nationwide banks, 6 regional banks, and 21 commercial banks). In 2008Q3, in which Lehman Brothers shock broke out, the banks held $573.0 million spot, -333.9 million forward, and $239.1 million composite position.

In the first column of the table in Panel A, the average dollar net asset position ($58.14 million) taken by nationwide banks[68] in Korea for the years, 2001 – 2009, accounts for 0.49 percent of their total assets in foreign currency, their dollar forward net asset position ($153.86 million) is 1.31 percent of their total foreign currency assets, and thus their dollar composite net asset position ($211.37 million) accounts for 1.79 percent of their total assets in foreign currency.

In the second column of the table in Panel A, we provide the average dollar spot, forward, and composite position of regional banks. The figures in the second column show that regional banks, which have considerably smaller asset sizes than nationwide banks, hold an average dollar spot position accounting for -9.71 percent of their total assets in dollars (i.e., -$67.70 million), a forward position accounting for 9.37 percent of their total dollar assets (i.e., $65.33 million), and a composite position accounting for -0.34 percent of the total dollar assets (i.e., -$2.36 million). The figures in Panel A indicate that regional banks hold markedly smaller amounts of dollar composite position than nationwide banks. Consistent with the previous literature[69], banks with smaller asset sizes and narrower international credit market networks more aggressively hedge their dollar spot position with forward position.

The third column of the table in Panel A of Table 2.3 shows that the average dollar spot net asset position[70] taken by commercial banks in Korea ($6.13 million) is much larger than the average on-balance-sheet foreign currency mismatch (-$194.7 million) based on interest-earning

[68] As we have seen in Table 2.1, nationwide banks account for 91 percent of total assets in all commercial banks in Korea. The remaining 9 percent of total assets are held by regional banks.

[69] For instance, Purnanandam (2007) argues that banks with higher probability of financial distress more aggressively manage their foreign currency risks. Even though Panel A shows that long-term average dollar spot position taken by nationwide banks ($58.14 million) appears to be larger than that held by regional banks (-$67.70 million), the figures in Panel B indicate that, historically, nationwide banks held considerably large amount of the absolute value of the dollar spot position (i.e., $-1,443.50 million in 2009Q4 and $390.44 million in 2004Q4). Thus, regional banks, which have higher likelihood of default in dollar debts due to their smaller sizes and limited global networks, are less exposed to foreign exchange risks by taking less on-balance-sheet currency mismatches and by using derivatives hedge.

[70] The dollar spot net asset position includes all dollar assets and liabilities including non-interest-earning assets and non-interest-bearing liabilities.

assets and interest-bearing liabilities. Since the dollar spot net asset position reflects all dollar assets and liabilities, the difference between those two balance sheet dollar mismatches also indicates the extents to which Korean banks carry non-interest-earning assets such as dollar cash and other non-interest bearing accounts.

To better understand the relation between banks' foreign currency operations and their foreign currency risk management, we provide historical breakdowns of the dollar spot, forward, and composite net asset positions in Panel B of Table 2.3.

The figures in Panel B indicate that Korean banks substantially varied their dollar spot net asset positions during 2001 to 2009. Banks were consistently long in spot dollars till 2006Q4 ($382.14 million). Beginning 2007, the spot position varied between short (-$387.27 million in 2007, and -$1,443.5 million in 2009) and long ($475.88 million in 2008).

The dollar forward position also significantly varied in the same period but it was taken in an opposite direction to the spot position except in 2008. Hence, the absolute value of the dollar composite position was less than the spot position except for 2007 and 2008. However, over time, the composite net asset position increased. The third column in Panel B shows that the composite position was less than 2.5 percent of total dollar assets before 2005 but it consistently increased after 2005 and reached 7.13 percent of total dollar assets in 2008.

Panel A Table 2.3 indicates that the average dollar composite net asset position taken by nationwide banks is $211.37 million, which implies that, if the dollar depreciates by 133 won, those banks will incur capital loss of 28.1 million dollars. Furthermore, in 2008Q4, the average composite net asset position was $705 million, which can incur a capital loss of $93.8 million from a 133 won depreciation of the dollar against the won, which amounts to -3.06 percent of the average total equity of Korean banks.

In sum, the evidence from the quarterly business report data of Korean banks suggests, historically, that (a) Korean banks have taken substantial amount of the dollar spot net asset position, which remarkably varied and, (b) they imperfectly hedged their dollar spot position using derivatives, which considerably increased their dollar composite position, exposing them to exchange rate risks.

(2) Foreign Currency Maturity Mismatch

Foreign interest rate risk arises whenever the maturities of banks' foreign currency assets and liabilities are mismatched. If the average maturity of a bank's assets is greater than its liabilities, then a downward shift in foreign interest rates will increase the bank's net interest earnings. Those increases in a bank's net interest earnings are largely attributed to widened spreads in the bank's lending rate and funding cost.

We use the dollar maturity gap (MGAP) and duration gap (DGAP) to measure the bank's exposure to the foreign interest rate risk. The *T*-period dollar net asset maturity gap is computed by the following equation:

$$MGAP = \left(A_T - L_T \right) / A \tag{1}$$

where A_T is a dollar asset maturing within T years, L_T is dollar liabilities within T years, and A is total dollar assets.

Thus, the MGAP increases as a bank increases the maturity of its foreign currency assets or reduces the maturity of its foreign currency liabilities. The maturity gap can be used to measure the dollar liquidity risk of the banks. If a bank holds foreign currency assets larger than foreign currency liabilities within a certain maturity, the likelihood of defaults on its foreign currency debts within the maturity may be low. Hence, the larger the maturity gap, the less the liquidity risk.

Korean bank supervisory regulations employ the foreign currency liquidity ratio, and seven-day and one-month foreign currency maturity gaps in order to check the soundness of banks' foreign currency liquidity risks. The foreign currency liquidity ratio is defined by [foreign currency assets maturing within three months] divided by [foreign currency liabilities maturing within 3 months]. The banks are required to maintain the liquidity ratio of at least 85 percent.

Korean banks are also required to maintain a seven-day foreign currency maturity gap at least -3 percent. The regulation for the 1-month maturity gap requires the banks to keep the maturity at least -10 percent. Basically the liquidity ratio can be easily converted to the three-month maturity gap. However, banks can also easily window dress the seven-day maturity gap. They can increase the seven-day maturity gap by engaging in a currency swap contract or purchasing the dollar in the FX market around the date of reporting (Lee, Kim, and Lim, 2010).

Once the seven-day maturity gap is inflated, other longer-term maturity gaps are accordingly inflated by the definition of the maturity gap. Hence, we need to find methods to modify the originally released maturity gap on the bank's quarterly business reports in order to consider the possibility of window dressing. A method to modify the maturity gap is to simply subtract the problematic seven-day maturity gap from each longer-term maturity gap so that we can construct a new maturity gap between seven-day and one month, between seven-day and three months, between seven-day and six months, and so on. We use this modified maturity gap as one of the main proxies to capture the bank's foreign interest rate exposure.

We can also use the foreign currency duration gap (DGAP) defined by the following equation:

$$DGAP = D_A - (L/A) D_L \tag{2}$$

where D_A is the duration of the foreign currency assets, D_L is the duration of the foreign currency liabilities, A indicates total foreign currency assets, and L indicates total foreign currency liabilities. We can derive the foreign currency duration gap from the foreign currency maturity gap. As we have seen in equation (1), the foreign currency maturity gap is defined by $MGAP = (A_T - L_T)/A$. We then get foreign currency assets and liabilities maturing between $T\text{-}1$ and T such that $A_t = (A_T - A_{T-1})$ and $L_t = (L_T - L_{T-1})$. Then, we can rewrite the DGAP in equation (2) as $DGAP = \sum tA_t / A - (L/A) \sum tL_t / L$. This leads to $\sum (A_t - L_t) t / A$. Thus, we can construct the DGAP from the MGAP by obtaining net assets maturing in the period ($T\text{-}1$, T), multiplying by t and summing up, and dividing by the total foreign currency assets, A.

Also, the change in a bank's net interest earnings due to a change in the foreign interest rate can be written as $\Delta NE = (A - L) \Delta i^{\$} = \sum (A_t - L_t)\ t\ \Delta i^{\$}$. Since $DGAP = \sum (A_t - L_t) t / A$, we have $\Delta NE = DGAP\ (A)\ \Delta i^{\$}$. Thus, we can compute the effects of foreign interest rate changes on a bank's net earnings using the bank's dollar duration gap.

The average quarter-end dollar maturity gap taken by nationwide banks, regional banks, and all commercial banks in Korea are presented in Panels A – C in Table 2.4, for the years 2001 – 2009. The MGAP originally reported in the quarterly bank business reports is shown in the first row, and the modified maturity gap generated by subtracting the seven-day MGAP from the other MGAP is shown in the second row. As can be seen in each panel, the MGAPs originally reported are mostly positive but after modification, Korean banks have been deeply short in the dollar maturity gap. In Panel A, for example, the average six-month MGAP originally reported by nationwide banks is 0.26 but the modified six-month maturity gap is -3.558. Hence, on average, 3.558 percent more foreign currency debts will mature than assets within six months. Panels B and C also show the similar patterns.

Table 2.4 Korean Bank Dollar Maturity Gap

Panel A: Nationwide banks

(%)

	≤ 1 m	≤ 3 m	≤ 6 m	≤ 12 m	≤ 36 m	> 36 m
MGAP as reported by quarterly bank business reports.	1.192	0.742	0.260	0.194	0.022	-0.748
$MGAP_T$ – 7-day MGAP, T = 1 month, 3 months, 6 months, etc.	-2.655	-3.071	-3.558	-3.624	-3.800	-0.748

Panel B: Regional banks

(%)

	≤ 1 m	≤ 3 m	≤ 6 m	≤ 12 m	≤ 36 m	> 36 m
MGAP as reported by quarterly bank business reports.	9.095	9.523	6.466	1.758	-2.842	0.585
$MGAP_T$ – 7-day MGAP, T = 1 month, 3 months, 6 months, etc.	-0.555	-0.127	-3.183	-7.892	-12.492	0.585

Panel C: All banks

(%)

	≤ 1 m	≤ 3 m	≤ 6 m	≤ 12 m	≤ 36 m	> 36 m
MGAP as reported by quarterly bank business reports.	4.402	4.254	2.742	0.820	-1.124	-0.247
$MGAP_T$ – 7-day MGAP, T = 1 month, 3 months, 6 months, etc.	-1.787	-1.884	-3.407	-5.344	-7.303	-0.247

Panel D

(%)

	≤ 1 m	≤ 3 m	≤ 6 m	≤ 12 m	≤ 36 m	> 36 m
2001Q4	-3.334	-4.893	-8.716	-11.834	-12.307	-2.276
2002Q4	-2.461	-5.751	-7.341	-6.889	-9.020	-1.553
2003Q4	-3.353	-5.291	-4.851	-4.951	-6.560	-0.763
2004Q4	-0.668	-0.225	-0.035	0.154	-0.013	-3.465
2005Q4	-2.540	-1.281	-0.362	0.841	0.268	-2.173
2006Q4	-2.040	-3.809	-4.446	-4.169	-1.835	-1.305
2007Q4	-1.663	-3.648	-3.738	-5.499	-4.769	0.541
2008Q4	-3.530	-4.700	-2.643	-2.011	-3.568	1.919
2009Q4	-1.560	0.436	0.755	0.231	-2.610	0.975

Notes: This table provides the average dollar maturity gaps of commercial banks in Korea for the years, 2001 – 2009. The t-month dollar net asset maturity gap (MGAP) is computed by [dollar assets maturing within t months – dollar liabilities maturing within t months] divided by [total dollar assets]. Panel C presents a historical breakdown of the dollar maturity gaps taken by nationwide banks. (N = 15 nationwide banks, 6 regional banks, and 21 commercial banks)

The MGAP and the dollar maturity gap taken by nationwide banks are presented in Panel A and those taken by regional banks are provided in Panel B of Table 2.4. The figures in Panels A and B indicate that average amount of short-term (i.e., less than 12 months) dollar maturity gap taken by regional banks is greater than that taken by nationwide banks. This result also implies that the regional banks, which have higher probabilities of financial distress due to small asset sizes and limited global networks, more aggressively manage their dollar liquidity risks.

The average quarter-end dollar duration gaps taken by nationwide banks, regional banks, and all commercial banks in Korea are presented in Panel A of Table 2.5. As can be seen in the table, the average dollar duration gap is negative. For instance, the average duration gap taken by large nationwide banks is -0.056 years while that taken by all commercial banks is -0.075 years. These results imply that banks hold larger amount of dollar liabilities than dollar assets. Since the maturity of the bank's dollar assets is generally longer than that of its dollar liabilities, the negative duration gap indicates the larger size of dollar debts relative to dollar assets. Also, since the average foreign currency assets held by Korean banks is $5,295.1 million and their dollar duration gap is -0.075, a two percent[71] increase in the dollar interest rate will give rise to a decrease of $7.94 million in their net interest earnings, which accounts for 0.26 percent of the average net asset capital of the banks. This figure implies that the direct effects of the dollar interest rate increase on the bank's net earnings are not significant. However, indirect effects of the dollar interest rate increase through the dollar carry lending on the bank's net earnings can be more significant.

Historical breakdown of the dollar maturity gaps for assets and liabilities maturing within 1, 3, 6, 12, and 36 months, and those maturing in longer than 36 months is presented in Panel D of Table 2.4.

[71] The standard deviation of the three-month quarterly dollar LIBOR during 1999 to 2009 is approximately 2%.

Table 2.5 Korean Bank Dollar Duration Gap

Panel A

(Year)

	Nationwide banks	Regional banks	All banks
Duration gap	-0.056	-0.103	-0.075
(Std. Deviation)	(0.242)	(0.295)	(0.266)

Panel B

(Year, percent)

	Dollar Duration Gap	3-month USD LIBOR (%)
2001Q4	-0.198	1.92
2002Q4	-0.173	1.41
2003Q4	-0.084	1.17
2004Q4	-0.226	2.50
2005Q4	-0.139	4.49
2006Q4	-0.042	5.36
2007Q4	0.016	4.98
2008Q4	0.082	1.83
2009Q4	0.003	0.25

Notes: This table provides average dollar duration gaps of commercial banks in Korea for the years, 2001 – 2009. The duration gap (DGAP) is computed by $DGAP = D_A - (L/A)D_L$ where D_A is duration of assets, D_L is duration of liabilities, A is total assets, and L is total liabilities. Panel B presents a historical breakdown of the dollar duration gap taken by nationwide banks. (N = 15 nationwide banks, 6 regional banks, and 21 commercial banks)

The results in each column in Panel D of Table 2.4 indicate that that the dollar maturity gaps taken by Korean banks substantially varied. In Panel D, for example, the 6-month maturity gap increased for the years 2001Q4 – 2004Q4 from -8.716 percent to -0.362 percent but it decreased for the years 2004Q4 – 2006Q4 from -0.362 percent to -4.446 percent. Then it increased again. Historical data on other short-term dollar maturity gaps show similar patterns. Historical breakdown of the dollar duration gap presented in Panel B of Table 2.5 indicates that the dollar duration gap taken by nationwide banks also substantially varied. In Panel B, for example, the dollar duration gap decreased for the years 2003Q4 – 2004Q4 from -0.084 years to -0.226 years but it increased for the years 2004Q4 – 2008Q4 from -0.226 years to 0.082 years.

Thus, the evidence from banks' foreign currency risk management data suggest that, historically, (a) Korean banks maintained a considerably negative dollar maturity gap and, (b) their dollar maturity gap and duration gap substantially varied over time.

(3) Foreign Currency Debt Roll-over Exposure

Foreign currency maturity mismatches expose banks to roll-over risks on foreign currency debts. For example, consider a bank with a negative three-month maturity gap. This indicates that the bank holds less dollar assets than dollar debts maturing in three months. Even though the bank sells out all dollar assets in three months, it may not be able to repay all dollar debts unless the bank rolls over shorter maturity debts (i.e., one-month debts). Thus, it is required for a bank with maturity mismatches to roll-over short-maturity debts to avoid defaults. Hence, the more the maturity mismatches, the more the roll-over risks.

We can measure banks' exposure to foreign currency roll-over risks using banks' dollar liquidity ratio, which is computed by dividing banks' total dollar assets maturing within one year by its total dollar debts maturing in one year. Korean banks' dollar liquidity ratios are presented in Table 2.6. Panel A shows that, for the years 2001 – 2009, the average liquidity ratio of nationwide banks is 1.068, that of regional banks is 1.340, and that of all commercial banks are 1.173. These figures show that the nine-year average liquidity ratio is greater than one. Hence, it seems that Korean bank's long-term average roll-over exposures are not significant.

However, historical breakdown of the dollar liquidity ratio presented in Panel B of Table 2.6, indicates that Korean banks have been substantially exposed to dollar roll-over risks since 2006. The figures in the second column in Panel B show that banks' dollar roll-over exposures increased until 2008Q4. The third column in Panel B provides historical changes in Korean banks' dollar short-maturity debts, which are debts that mature within one year.

Table 2.6 Korean Bank Dollar Liquidity Ratio

Panel A

(Year)

	Nationwide Banks	Regional Banks	All Banks
Dollar liquidity ratio	1.068	1.340	1.173
(Std. Deviation)	(0.176)	(0.523)	(0.377)

Panel B

(Ratio, U.S. dollar millions)

	Dollar Liquidity Ratio	Dollar Short-maturity Debts
2001Q4	1.047	2,102.0
2002Q4	0.983	2,964.8
2003Q4	1.003	4,492.3
2004Q4	1.020	6,289.4
2005Q4	1.035	7,001.7
2006Q4	0.997	10,218.9
2007Q4	0.993	16,069.7
2008Q4	0.981	14,201.3
2009Q4	1.052	14,535.9

Notes: This table provides the average dollar liquidity ratio of commercial banks in Korea for the years, 2001 – 2009. The dollar liquidity ratio is computed by dividing total dollar short-maturity debts by dollar short -maturity assets, where short-maturity debts and assets mature within 12 months. Panel B presents a historical breakdown of the dollar liquidity ratio taken by Korean banks. (N = 15 nationwide banks, 6 regional banks, and 21 commercial banks)

The figures in the third column suggest that the decrease in the dollar liquidity ratio after 2005 is mainly attributed to sharp increases in dollar short-maturity debts. In 2006, for example, banks' dollar short-maturity debts increased by 46 percent (i.e., from $7,001.7 million to $10,218.9 million). Furthermore, dollar short-maturity debts increased 57.3 percent in 2007. There was an every 130 percent increase in Korean banks' dollar short-maturity debts during 2006 – 2007. Korean bank's aggressive dollar carry lending transactions in those periods might have induced dramatic increases in short-maturity dollar borrowings and thus exacerbated their dollar roll-over risks. Table 2.4 also shows that Korean banks' dollar maturity mismatches

sharply increased in 2006. For instance, the 3-month maturity gap decreased from -1.281 to -3.809 and the 6-month maturity gap declined from -0.362 to -4.446. As we discussed early, the increases in dollar maturity mismatches also imply an increase in dollar debt roll-over risks.

Panel B of Table 2.6 also showed that Korean banks' short-term dollar debts decreased in 2008 after the break-out of the Lehman Brothers shocks. This implies that Korean banks' dollar borrowing was hampered by global financial crisis. However, the first column in Panel B shows that the dollar liquidity ratio also decreased in 2008. The concurrent decline in dollar liquidity ratio in 2008 suggests that Korean banks' short-term dollar assets decreased more rapidly than their short-term dollar debts. This indicates that banks sold their dollar assets in order to meet its dollar debt repayments[72]. In 2009, banks increased their short-term dollar debts and liquidity ratios to improve their roll-over ability after the currency crisis passed.

Thus, historical data on Korean bank's foreign currency operations imply that (a) Korean banks have sharply increased their foreign currency debts since 2006 due to active engagements in dollar carry lending transactions, (b) they have been significantly exposed to foreign currency debt roll-over risks and, (c) their dollar borrowings were severely hampered in crisis times.

2.4.3 Determinants of Foreign Currency Exposure

Figure 2.1 graphically describes the historical movements of the dollar spot, forward, and composite positions. The dollar composite position (COM/FCA) remained stable around zero before 2005Q4 since the dollar spot position (FCP/FCA) was well matched with the dollar forward position (FWD/FCA). However, the composite position significantly varied and consistently increased since 2005Q4 because the dollar spot position was imperfectly hedged with the dollar forward position, which suddenly increased in 2007. Now we must consider what determines the foreign currency positions taken by Korean banks.

[72] Shin (2005) theoretically analyzes this issue.

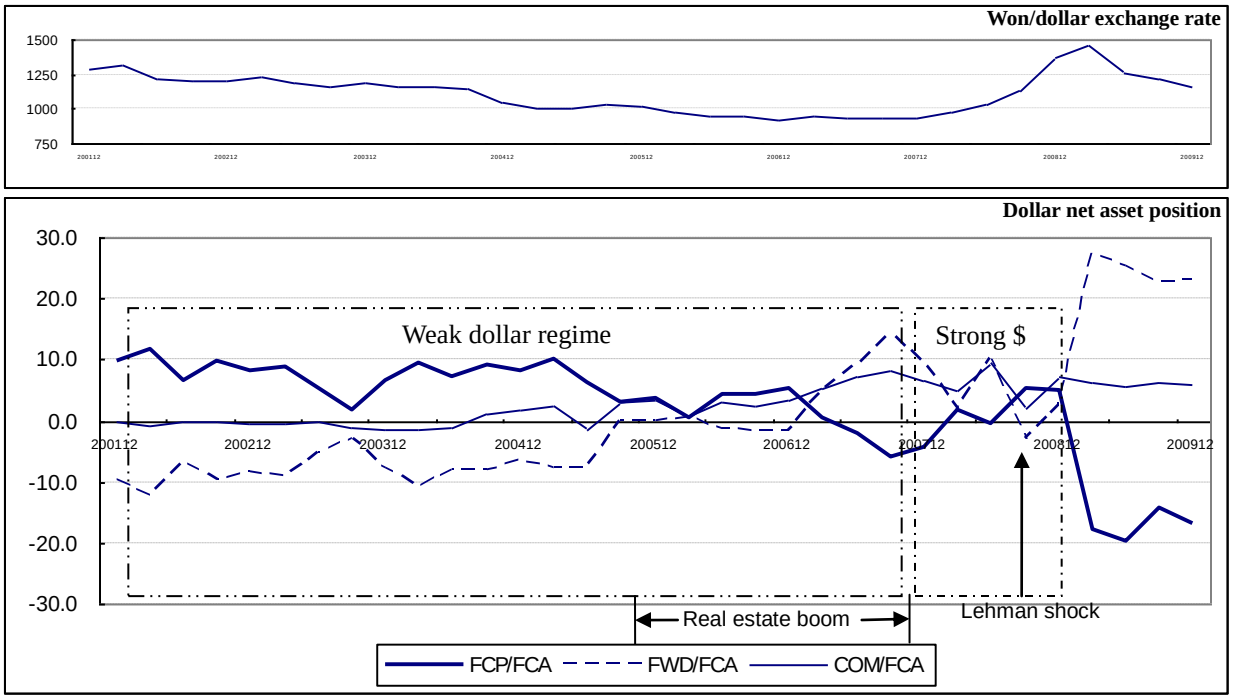

Figure 2.1 Dollar Spot, Forward, and Composite Position Scaled by Total Dollar Assets

To investigate the determinants of the dollar composite position, we explore the determinants of the dollar spot position and then those of the forward position.

(1) Determinants of Foreign Currency Positions

The foreign currency spot position is directly affected by foreign exchange-rate variation and indirectly influenced by the interest rate differential between the local currency and the foreign currency. We measure the foreign exchange rate using the won/dollar exchange rate. We also compute the interest rate differential as the three-month Korean bank CD rate minus dollar LIBOR. The foreign exchange rate directly changes the values of foreign currency assets and liabilities. For instance, the value of dollar assets increases as the dollar appreciates vis-à-vis the local currency[73]. On the other hand, if the dollar depreciates vis-à-vis the local currency, then the value of dollar liabilities decreases. Hence, banks holding more dollar assets and fewer dollar

[73] If the dollar appreciates vis-à-vis the won, then the won/dollar exchange rate increases.

liabilities will benefit from the dollar appreciation, whereas the dollar depreciation will be beneficial to banks holding fewer dollar assets and more dollar liabilities. In this regard, we expect that weakness of the dollar value may result in a decrease in dollar assets and an increase in dollar liabilities through speculative trading. In Figure 2.1, the top panel shows historical movements of the won/dollar exchange rate. Using the chart, we divide the sample period into a weak dollar regime (2002Q1 – 2007Q4) and a strong dollar regime (2007Q4 – 2009Q1)[74]. As can be seen in the chart, the dollar spot net asset position (FCP/FCA) decreased during the weak dollar regime and then increased during the strong dollar regime. Also, banks might increase their holdings of dollar cash in an attempt to realize foreign exchange capital gains in the strong dollar regime.[75]

The foreign currency spot position can also be indirectly influenced by the corporate firm's speculations in the currency market. As we have seen, firms time the market when they decide their foreign currency hedging. Consider that risk-averse exporting firm managers expect the dollar to depreciate. Then they will actively take short dollar forward positions to hedge their future cash inflows generated from foreign sales. Since banks generally become counterparties of the firms' forward transactions, banks' long dollar forward positions will increase. Hence, the banks need to hedge the long forward positions in order to avoid capital losses. When a bank sells the forward position to another bank just like a broker, the bank's dollar position will not change. However, if the bank tries to hedge its long forward position with a short spot position (i.e., by borrowing the dollar), the bank's spot position will decrease.

[74] The won/dollar rate was 1,322.51 at the end of 2002Q3, 930.24 at the end of 2007Q4, and 1,461.98 at the end of 2009Q1.

[75] Given the advantages of high speed and low transaction costs in inter-bank markets, banks actively engage in speculative FX trading. Although, technically, banks can use both spot trading and derivatives trading for speculative purposes, banks prefer spot trading since inter-bank spot trading, which is supported by FX brokerage companies, is faster and incurs lower costs than derivatives trading. Dollar forward trading, which takes place in over-the-counter (OTC) markets, is not considered to be appropriate for speculative trading. The dollar futures trading can also be used by the banks but it requires the banks to cost initial and maintenance margins.

Suppose that the benchmark dollar interest rate is higher than the local interest rate. Then the forward won/dollar exchange rate (F) must be lower than the spot exchange rate (S) and the gains from buying a cheap forward dollar and selling an expensive spot dollar must be equal to the loss incurred from borrowing at a higher dollar rate and lending at a lower local currency rate in order to avoid an arbitrage opportunity. However, if the forward rate (F) is significantly undervalued due to large selloffs of exporters, banks may be able to obtain arbitrage profits. Under these circumstances, banks may actively engage in dollar carry trading. Furthermore, if banks lend at a higher local currency rate for a long-term period, their profits will increase. The dollar carry lending transactions, however, decrease the dollar spot position since the dollar liabilities increase, whereas the dollar assets stay the same.

The bottom panel of Figure 2.1 show that as the won/dollar rate consistently fell until 2007, the dollar spot position (FCP/FCA) decreased. This decrease in the dollar spot position resulted from two sources. First, banks might decrease their dollar cash holdings to avoid capital losses. Second, banks might increase their dollar borrowings by engaging in dollar carry lending transactions. The panel showed that the dollar forward position (FWD/FCA) sharply increased in 2006 – 2007, which might induce banks' dollar carry lending. The dollar carry lending has also been boosted by strong demands for local currency loans during the years in which real estate markets boomed (e.g., 2006 – 2007) [76].

Those two strategies (the dollar cash holding strategy and the dollar carry lending strategy) are described in Figure 2.2. We use a bank's foreign currency due-from-bank deposit asset to proxy for the bank's dollar cash holding strategy. Banks generally keep their dollar cash holdings on another bank's due-from-bank deposit account after they purchase the dollar.

[76] The housing price index provided by KB show that housing prices in Korea increased by 4 percent (2005), 11.6 percent (2006) and 3.1 percent (2007) during the period. Moreover, housing prices in the Seoul metropolitan area increased by 5.1 percent (2005), 20.3 percent (2006), and 5.6 percent (2007).

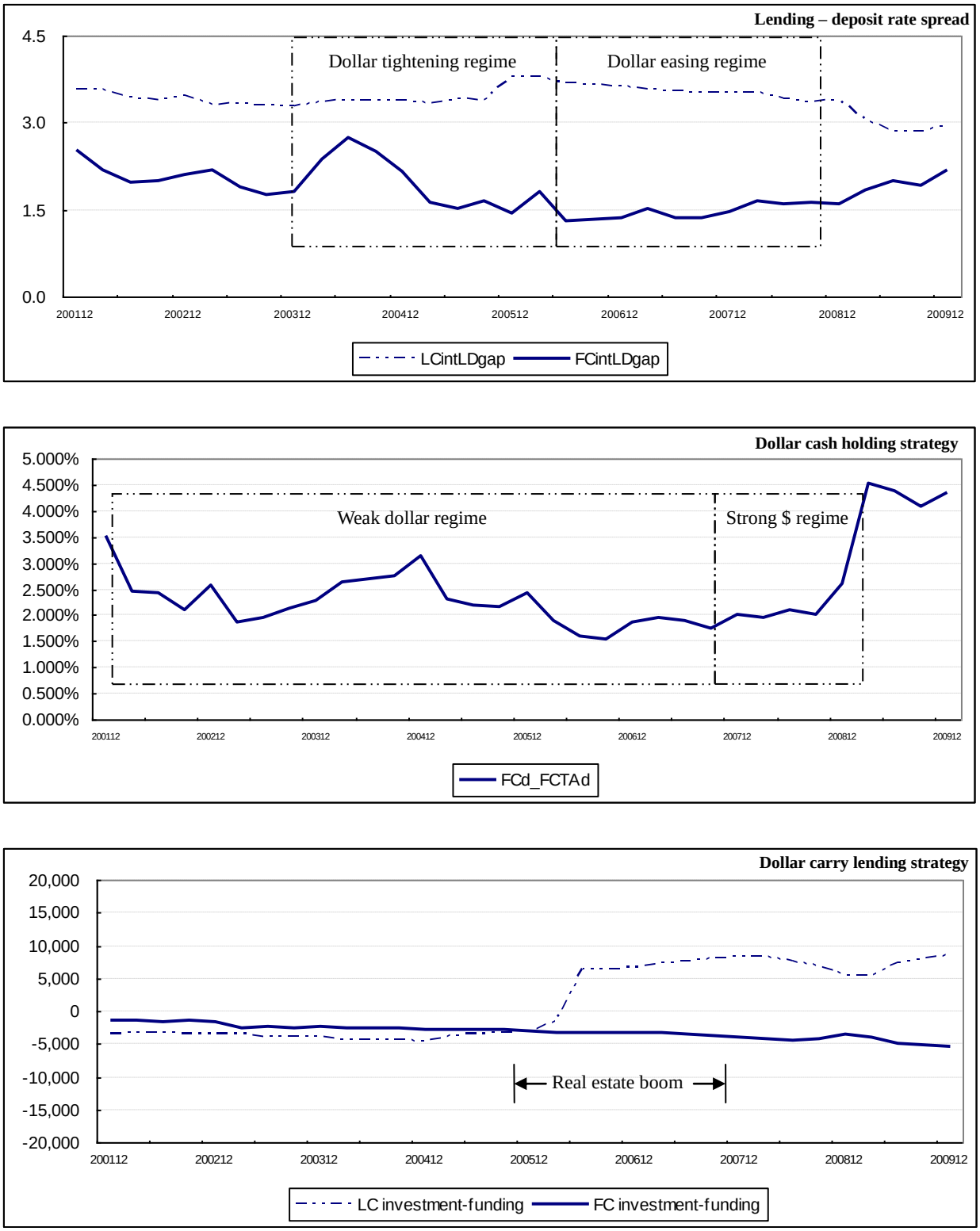

Figure 2.2 Foreign Currency Operating Strategies

We also employ the difference between a bank's local currency net total investment and foreign currency net total investment in order to proxy for the bank's dollar carry lending transactions. A bank's net total investment is calculated by subtracting its total funding from total investment. Hence, if a bank's total investment in local currency is greater than its total funding in local currency while the bank's foreign currency funding is larger than its total foreign currency investment, the bank may have used its foreign currency funds to invest in local currency assets.

The second panel in Figure 2.2 shows that the dollar cash holding strategy has been driven by the won/dollar exchange-rate movements. The bank's dollar cash holdings (FCd_FCAd) decreased in the weak dollar regime and sharply increased in the strong dollar regime.

The bottom panel in Figure 2.2 provides evidence showing that Korean banks actively engaged in dollar carry lending in those real estate boom periods. The bottom panel indicates that Korean banks' local currency investments increased more rapidly than their local currency funding, whereas their dollar funding increased more rapidly than the dollar investments during 2005 to 2007.[77] Dollar carry lending strikingly increased in 2006 when housing prices in Korea rose more than 10 percent. It is implied from the panel that the banks' dollar carry lending strategies were mainly driven by the dollar depreciation and strong demand for local currency loans. The panel shows that dollar carry lending increased in the weak dollar regime and the real estate market boom. The increase in dollar carry lending, however, decreased banks' dollar spot net asset position. The bottom panel of Figure 2.1 shows that banks' dollar spot position decreased during the real estate boom periods.

[77] Total investments include deposits, loans, and securities. Total funding includes deposits, borrowings, bonds, etc. Local currency investments and funding are presented in billions of won, and the dollar investments and funding are presented in millions of dollars.

Dollar forwards are widely used to hedge dollar spot positions. However, hedging is beneficial only if banks, which endeavor to hedge their short dollar spot positions, take long dollar forward position for the years in which the dollar appreciates. Banks that take the same amount, of course in short, of forward positions to their spot positions will be fully immune to exchange rate changes. However, if a bank takes a forward position that does not fully cover its spot position, it will be hurt when the dollar depreciates vis-à-vis the local currency.

Figure 2.1 also shows that Korean banks have not fully covered their dollar spot positions with forward positions since 2005. Banks took long dollar forward positions even when the spot position is positive (i.e., in 2008Q4). These overbought forward transactions were prompted by strong demands for short dollar forward position of exporting firms and foreign investment funds.[78] The bankruptcy filing by Lehman Brothers in September 2008 also shocked the currency market and banks' speculation on the won/dollar exchange rate after the shock might influence Korean banks' forward hedging behaviors. Hence, the dollar composite position held by Korean banks consistently increased in 2004Q4 – 2008Q4, considerably exposing the banks to exchange-rate risks.

(2) Determinants of Foreign Currency Maturity Mismatch

To better understand the effects of banks' foreign currency operations on their risk management, we investigate what determines banks' foreign currency maturity gap and their duration gap. Their foreign currency maturity gap and their duration gap are mainly influenced by the interest rate differential between the won and the dollar.

We first investigate the relation between foreign currency net interest margin and the interest rate differential between local currency and foreign currency. Consider that a bank lends

[78] The literature argues that Korean investments in foreign securities markedly increased after deregulations in 2006, which created a large demand for short dollar forward position. (i.e., Lee, Kim, and Lim (2010))

in foreign currency and local currency to firms that can freely choose to borrow between foreign currency and local currency. Hence, firms will choose to borrow in foreign currency if the foreign currency interest rate is lower relative to local currency. If the firm's demand for the foreign currency loan increases as the interest rate differential widens, the bank may be able to increase its lending rate spread. Given a constant deposit rate spread, the lending-deposit spread may be also positively correlated to the interest rate differential. Figure 2.2 graphically describes local currency lending-deposit spreads (LCintLDgap) and the dollar lending-deposit spreads (FCintLDgap) in the top panel. Using historical movements of the dollar interest rates, we divide the sample period into a dollar interest rate tightening regime (2004Q2 – 2007Q3), in which the dollar interest rate went up, and a dollar interest rate easing regimes (2007Q3 – 2009Q4), in which the dollar interest rate went down.[79] The top panel shows that the dollar lending-deposit spread decreased in the dollar interest rate tightening regimes and it increased in the dollar interest rate easing regime. As the dollar net interest margin ($i_L^{\$} - i_F^{\$}$) decreases, banks might be motivated to lengthen their lending maturities and shorten their borrowing maturities in an attempt to increase the dollar net interest margin. This will decrease a bank's short-term dollar maturity gap. When a bank's dollar maturity gap decreases, its dollar duration gap generally increases since banks borrow dollars for a short-term and lend dollars for a long-term period. Thus, this may decrease a bank's dollar maturity gap but increase its dollar duration gap. It does not influence a bank's foreign currency spot position.

The dollar maturity gap may also be influenced by the exchange-rate shocks. As we have seen, dollar depreciation may result in the dollar carry lending through forward contracts between banks and firms. Dollar carry lending may also be boosted as the interest rate

[79] The federal funds rate (3-month dollar LIBOR) was 1.0% (1.17%) in end-2004Q1, 4.75% (5.49%) in end-2007Q3, and 0.25% (0.25%) in end-2009Q4.

differential increases so that banks can borrow at a lower dollar rate and lend at a higher won rate. Banks may attempt to maximize their cross currency net interest margin by engaging in dollar carry lending transactions. Even if dollar carry lending contributes to a bank's net interest earnings, it decreases the bank's dollar spot net asset position as well as the dollar maturity mismatch. In Figure 2.3, for example, if a bank does not engage in dollar carry lending, then the bank's dollar net asset position will be squared ($0) and its maturity mismatch increases by 1 million dollars[80]. Dollar carry lending indirectly decreases the dollar maturity gap and duration gap as can be seen in Figure 2.4. In the figure, the dollar spot net asset position is $-1 million, whereas the dollar maturity mismatch gradually increases toward $-4 million in 12 months. Hence, the bank's dollar maturity gap decreases. However, the dollar duration gap also decreases since the amount of dollar liabilities increases, whereas dollar assets do not increase.[81]

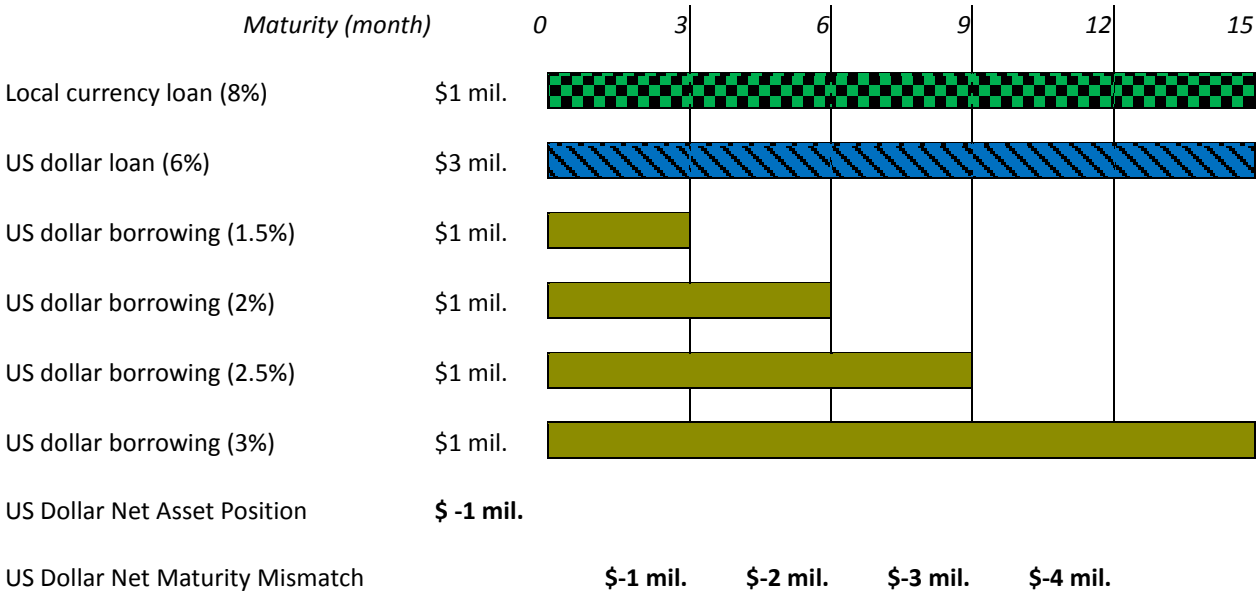

Figure 2.3 Dollar Carry Lending and Maturity Mismatch

[80] We remove a 1 million dollar borrowing and a local currency loan in Figure 2.3.
[81] $DGAP = D_A - (L/A)\, D_L$ decreases if L increases but D_A and A stay the same.

Historical movements of the 3, 6, and 12 month dollar maturity gap and dollar duration gap are presented in Figure 2.4. As can be seen in the figures, dollar maturity gaps generally decreased in the dollar interest rate tightening periods. On the other hand, the dollar duration gap generally increased during the dollar interest rate tightening periods. The middle panel in Figure 2.4 shows that the dollar maturity gap decreased in the real estate boom periods when the dollar carry lending was actively conducted by Korean banks. The dollar maturity gap decreased while the dollar duration gap little increased due to the dollar carry lending transactions.

Thus, the empirical results suggest that (a) the increases in the interest rate differential decreased a bank's dollar maturity gap and increased its dollar duration gap through the dollar direct lending and, (b) the dollar depreciation and the increases in the interest rate differential decreased both the dollar maturity gap and duration gap through the dollar carry lending strategy.

(3) Determinants of Foreign Currency Roll-over Exposure

To better understand bank's foreign currency operations and their foreign currency debt roll-over risks, we investigate which factors influence their roll-over exposures. Historical movements of Korean bank's dollar short-maturity debts and dollar liquidity ratio are graphically described in Figure 2.5. The top panel in Figure 2.5 shows that, historically, bank's dollar short-maturity debts increased till the first half of 2008. However, the short-term debts increased more rapidly in the dollar interest rate tightening regime than in the dollar interest rate easing regime. Especially, in 2006 and 2007, the dollar short-maturity debt dramatically increased when domestic real estate market boomed in Korea. The bottom panel in Figure 6 shows that, in 2006 and 2007, Korean bank's dollar liquidity ratio sharply declined. As we have seen, the banks actively engaged in dollar carry lending transactions in 2006 and 2007 and they increased their dollar maturity mismatches in the dollar interest rate tightening regime.

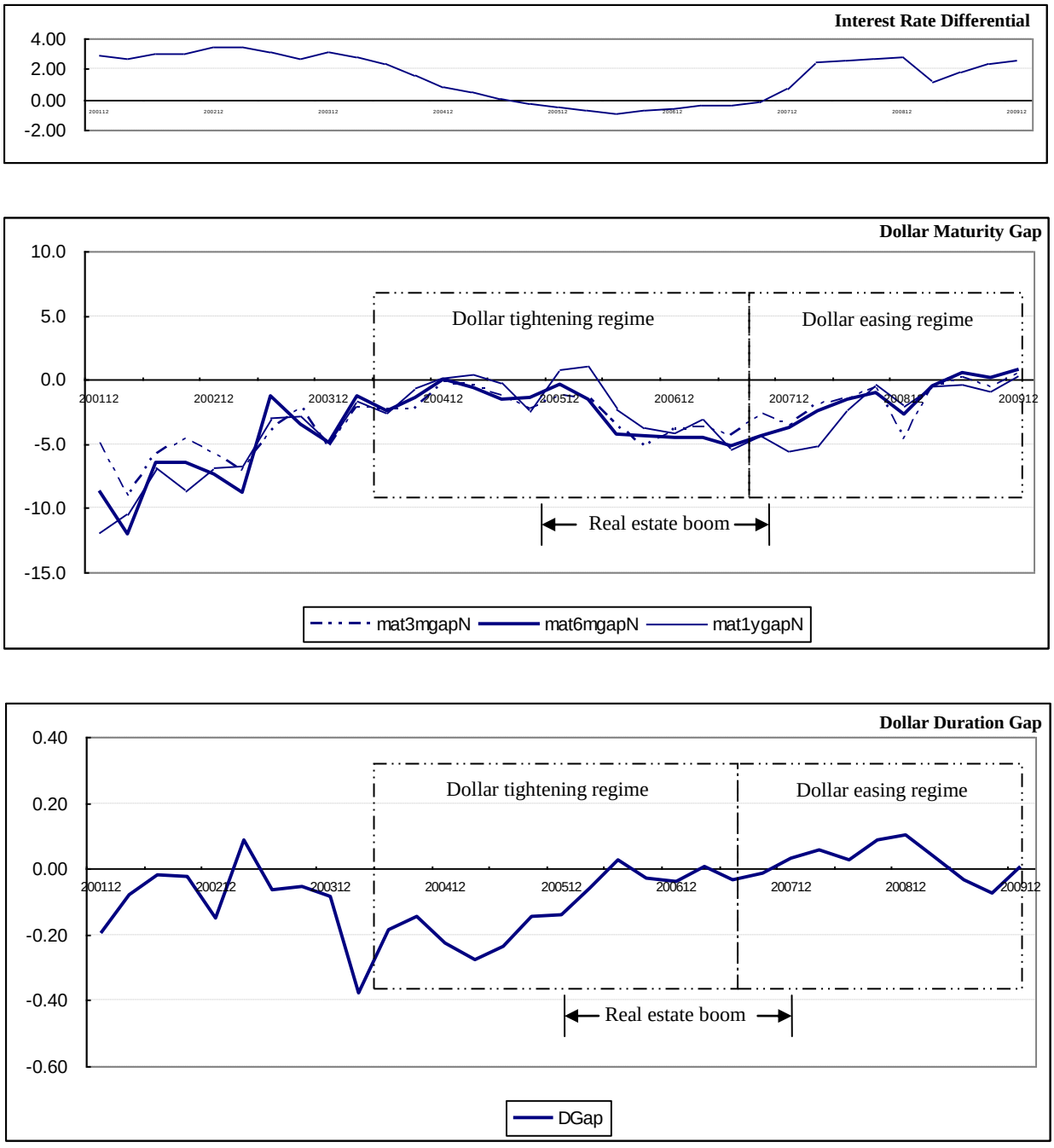

Figure 2.4 Historical Movements of Dollar Maturity Gap and Dollar Duration Gap

This implies that Korean banks' dollar carry lending transactions significantly increased their dollar debt roll-over risks and that the increase in bank's dollar debt roll-over risks is partly attributable to the increase in the dollar interest rate.

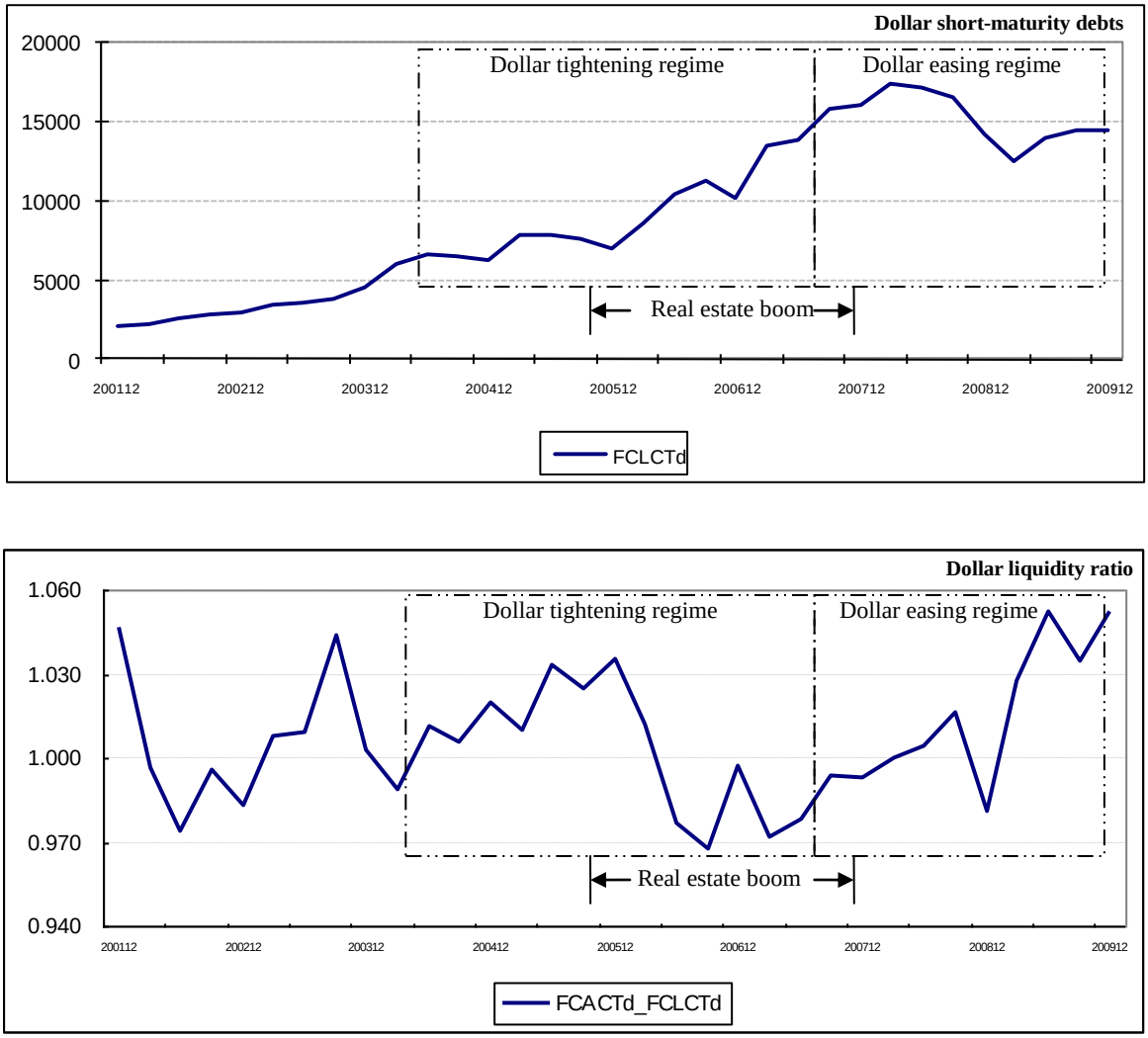

Figure 2.5 Historical Movements of Dollar Liquidity Ratio and Short-Maturity Debt

2.4.4 Determinants of Dollar Cash Holding and Dollar Carry Lending Strategies

To better understand the relationships among banks' foreign currency operating strategies and macroeconomic shocks, we use panel regression analysis. Since we examine the effects of historical changes in the exchange rate and interest rate differentials, panel regression method is better than a pooled cross-sectional regression. Panel regressions enable us to capture time series effects of the shocks as well as bank-specific variations.

We use random effects panel regression models since the random effects regressions produce more efficient results than fixed effects panel regression models. Table 2.7 presents the estimation results from the regressions.

Table 2.7 Determinants of Dollar Cash Holding and Dollar Carry Lending Strategies

	(1)		(2)		(3)	
	Dependent Variable = Dollar cash / TA (log)		Dependent Variable = Net investment dif. / TA		Dependent Variable = Net investment dif. / TA	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Exchange rate	**0.1769**	*8.25* ***	**-0.5844**	*-2.10* **		
Interest rate differential					**-0.8332**	*-3.25* ***
Size (log TA)	**-0.4056**	*-6.13* ***	**13.9224**	*14.39* ***	**13.9445**	*15.02* ***
NI / TA	**-0.0345**	*-3.14* ***	-0.1093	*-0.77*	-0.0976	*-0.69*
Deposits / TA	**-2.6936**	*-5.31* ***	6.3407	*0.94*	8.1687	*1.19*
Current ratio	**0.4902**	*1.74* *	2.4593	*0.67*	1.3368	*0.36*
Growth (TA)	**-0.7947**	*-2.05* **	5.3126	*1.07*	5.6643	*1.13*
N	664		664		664	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents the results of panel regressions for the determinants of Korean banks' foreign currency cash holding strategies, direct lending strategies, and dollar carry lending strategies. The dependent variable in model (1) is the log of a bank's dollar due-from-banks deposits scaled by total assets, the dependent variable in model (2) is the log of a bank's dollar loans scaled by total assets, and the dependent variable in model (3) is the difference between a bank's LC net investment and FC net investment scaled by total assets. The LC (FC) net investment is computed by subtracting a bank's local currency (foreign currency) total funding from local currency (foreign currency) total investment. The exchange rate indicates the won/dollar rate divided by 100. The interest rate differential indicates the difference between three-month Korean CD rate and the dollar LIBOR. TA and NI stand for total assets and net income, respectively. The estimated coefficients along with t-values are presented.

First, we run the regression of the log of the bank's dollar cash scaled by total assets on the won/dollar rate divided by 100 and the interest rate differential between the won and the dollar. We also control for bank specific variables such as size (log total assets), return on assets, deposit to total assets, and current ratio as suggested by previous studies. The estimation results from the model (1) suggest that a bank's dollar cash holding strategy is significantly positively correlated with the exchange rate. It is implied from the results that a 100 won increases in the won/dollar rate may be significantly associated with a 17.7 percent increase in the bank's dollar

cash holding. The regression results in Table 2.7 also suggest that banks with larger asset sizes and deposits, higher profitability, and larger asset growth exhibit relatively lower dollar cash holdings. Hence, smaller, less profitable and low growth banks may be more likely to carry dollar cash to get capital gains from dollar appreciation. However, more liquid banks may carry more dollar cash. Second, we investigate what determines banks' dollar carry lending transactions. We measure a banks' dollar carry lending transactions by computing the difference between the local currency net investments (i.e., total investments – total funding) and the foreign currency net investments scaled by total assets. Then we run the panel regression of the dollar carry lending proxy variable on the won/dollar rate and interest rate differential. The regression results from models (2) and (3) in Table 2.7 suggest that dollar carry lending transactions significantly increase as the dollar depreciates vis-à-vis the won and the interest rate differential decreases (i.e., the dollar interest rate increases). It is implied from these results that banks conduct dollar carry lending activities in order to maximize their net earnings as the dollar interest rate rises and when the dollar value gets lower. The results also indicate that banks with larger asset sizes may be more likely to use the dollar carry lending. Broad global funding networks may help those large banks to increase dollar carry lending transactions. However, it is implied from the results that banks with lower profitability and less deposit base are more likely to engage in dollar carry lending transactions in order to complement their weaknesses in profit sources and funding sources. Thus, the regression results in Table 2.7 show that (a) as the dollar appreciates relative to the local currency, banks' dollar cash holding increases and their dollar carry lending decreases, (b) as the foreign interest rate increases more than the local interest rates, banks' dollar maturity gap decreases and their dollar duration gap increases and, (c) banks' dollar carry lending decreases both their dollar maturity gap and dollar duration gap.

2.4.5. Determinants of Bank's Foreign Currency Default Likelihood

To estimate banks' distress probability, previous studies used historical bank failure data of U.S. banks (i.e., Purnanandam (2007)) and Z-score (i.e., Stiroh and Rumble (2006) and Lepetit, Nys and Tarazi (2008)). We use the credit default swap (CDS) spreads on Korean banks' five-year foreign currency denominated debts to estimate the foreign currency default likelihood[82]. The Z-score is also employed to measure overall bank distress likelihood.

In order to investigate the effects of banks' foreign currency operations on their foreign currency default likelihood, we run regressions of the log of the bank's CDS spread on the bank's foreign currency operating strategies[83]. The estimation results are presented in Table 2.8. The results from the regression of the dollar CDS spread on the bank's dollar cash holding strategy proxy variable in models (1) and (2) suggest that banks' foreign currency default likelihood significantly increases as banks increase their engagements in speculative FX trading through their dollar cash holdings. The results from the regression of the dollar CDS spread on the bank's dollar carry lending strategy proxy variable in models (3) and (4) imply that banks engaging in more dollar carry lending transactions are more likely to have a higher probability of foreign currency default.

The results from models (2) and (4) regressions on control variables address the question of whether banks' foreign currency default likelihood is significantly negatively correlated with the bank's asset size, profitability, and deposit base, consistent with the findings in Purnanandam (2007). Larger banks and more profitable banks may be able to construct better credit networks with foreign lending banks.

[82] Since we obtained CDS spreads of seven banks in Korea, we constructed other banks' CDS spreads by extrapolation using Moody's and S&P credit ratings. Longstaff Mithal and Neise (2005) also argue that the majority of the corporate spread is due to a default risk which we can measure using credit default swap spreads.

[83] As we have seen, we use the log of bank's dollar due-from-bank deposits scaled by assets to proxy for the bank's dollar cash holding strategy. We also use the difference in bank's local currency net investment (total investment – total funding) and its foreign currency net investment to proxy for its dollar carry lending strategy.

Table 2.8 Operating Strategies and Foreign Currency Default Likelihood

	Dependent Variable = CDS spread (log)							
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
$ cash holding / TA	**0.2704**	*3.90* ***	0.2587	*2.61* ***				
$ carry lending / TA					**1.5668**	*2.77* ***	**1.0607**	*1.99* **
Size (log TA)			**-0.2096**	*-2.65* ***			**-0.1463**	*-1.93* **
NI / TA			**-0.5272**	*-5.95* ***			**-0.5394**	*-6.07* ***
Deposits / TA			**-8.3429**	*-5.92* ***			**-8.4876**	*-5.95* ***
Debts / TA			**-6.6859**	*-4.80* ***			**-7.0760**	*-5.09* ***
FC Loans / TA			0.9814	*0.19*			6.7522	*1.38*
Current ratio			**1.8150**	*2.56* ***			**1.8391**	*2.58* ***
Growth (TA)			-0.8103	*-0.97*			-1.2018	*-1.45*
N	300		300		300		300	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents the results of panel regressions for the estimation of Korean banks' foreign currency default likelihood using data from the banks' business reports and five-year CDS spreads on the dollar denominated bonds issued by the banks from the Bloomberg. The dependent variable is the log of the CDS spread on a bank's dollar denominated bonds. The independent variable '$ cash holding/TA' indicates the log of a bank's dollar due-from-bank deposit amounts scaled by total assets. The '$ carry lending/TA' indicates the difference between a bank's LC net investment and FC net investment scaled by total assets. The LC (FC) net investment is computed by subtracting a bank's local currency (foreign currency) total funding from local currency (foreign currency) total investment. TA and NI stand for total assets and net income, respectively. The estimated coefficients along with t-values are presented.

2.4.6 Determinants of Bank Distress Likelihood

Previous studies documented a "twin crises" situation in which a currency crisis and a banking crisis reinforce each other.[84] Given the recent global financial crisis together with currency crisis in emerging markets, we investigate whether bank's foreign currency operating strategies affects their overall distress likelihood.

In order to investigate banks' overall distress likelihood, we run the regressions of banks' Z-scores on their foreign currency operating strategies such as their dollar cash holding strategy

[84] Shin (2005) suggests a theoretical framework that exposits how the twin crises develops in emerging financial markets in crisis times.

and their dollar carry lending strategy. Previous studies have used the Z-score to measure banks' distress likelihood from its operations.[85] We measure the Z-score in a similar way to the banking literature.

$$\text{Z-score} = \frac{\overline{ROA}}{\sigma_{ROA}} + \frac{\overline{TE/TA}}{\sigma_{ROA}} \tag{3}$$

where ROA, TE, and TA indicate bank's return on assets, total equity, and total assets. We use the annual average of the ROA and the equity to asset ratio in the numerator and the standard deviation of the ROA in the denominator. A higher value of the Z-score implies a lower likelihood of bank failure. The estimation results are presented in Table 2.9. The results exhibit similar implications as Table 2.8.

Panel A shows the effects of banks' operating strategies on their concurrent Z-score and Panel B shows the effects of one-quarter lagged strategies on the Z-score. In Panel A, the results from the regression of the Z-score on the bank's dollar cash holding strategy proxy variable in models (1) and (2) suggest that the probability of bank failure significantly increases when the bank's dollar cash holding proxy has larger value. The results from the regression of the Z-score on the banks' dollar carry lending proxy variable in models (3) and (4) imply that the bank's dollar carry lending activities are significantly positively associated with the probability of bank failure.

The results from models (2) and (4) regressions in Panel A of Table 2.9 show that bank's distress likelihood is significantly negatively correlated with the bank's profitability, foreign currency loans, and liquidity, consistent with Purnanandam (2007). However, a bank's distress likelihood is positively associated with bank's deposit to total assets and leverage ratio.

[85] For instance, see Stiroh and Rumble (2006) and Lepetit, Nys and Tarazi (2008).

Table 2.9 Operating Strategies and Bank Distress Likelihood

Panel A

	Dependent Variable = Z-score							
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
$ cash holding / TA	**-0.7104**	*-6.70* ***	**-0.3641**	*-3.64* ***				
$ carry lending / TA					0.4957	*0.67*	**-2.7608**	*-4.27* ***
Size (log TA)			0.1425	*1.33*			-0.0043	*-0.04*
NI / TA			**0.1942**	*4.63* ***			**0.1921**	*4.65* ***
Deposits / TA			**-9.2250**	*-4.86* ***			**-11.795**	*-5.88* ***
Debts / TA			**-6.7453**	*-3.17* ***			**-11.103**	*-4.81* ***
FC Loans / TA			**7.0014**	*6.18* ***			**10.916**	*9.95* ***
Current ratio			**1.5918**	*2.19* **			**1.6135**	*2.20* ***
Growth (TA)			-0.0388	*-0.03*			**0.5850**	*0.54*
N	627		627		627		627	

Panel B

	Dependent Variable = Z-score							
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Lag $ cash holding / TA	**-0.6852**	*-6.66* ***	**-0.3068**	*-3.12* ***				
Lag $ carry lending / TA					0.4399	0.58	**-2.8942**	*-4.40* ***
Size (log TA)			0.1227	*1.12*			0.0011	*0.01*
NI / TA			**0.1973**	*4.69* ***			**0.1930**	*4.67* ***
Deposits / TA			**-8.9749**	*-4.67* ***			**-11.775**	*-5.87* ***
Debts / TA			**-6.6828**	*-3.11* ***			**-11.196**	*-4.85* ***
FC Loans / TA			**7.2347**	*6.19* ***			**11.020**	*10.01* ***
Current ratio			**1.6061**	*2.19* **			**1.6497**	*2.24* **
Growth (TA)			0.8453	*0.52*			0.9901	*0.61*
N	624		624		624		624	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table presents the results of panel regressions for the estimation of Korean banks' distress likelihood using accounting data from the banks' business reports. The dependent variable is the Z-score, which is computed as Z-score = (average ROA + average total capital scaled by total assets) / standard deviation of ROA. The independent variable '$ cash holding/TA' indicates the log of a bank's dollar due-from-bank deposit amounts scaled by total assets. The '$ carry lending/TA' indicates the difference between a bank's LC net investment and FC net investment scaled by total assets. The LC (FC) net investment is computed by subtracting a bank's local currency (foreign currency) total funding from local currency (foreign currency) total investment. Panel B employs quarterly lagged values of those variables. TA and NI stand for total assets and net income, respectively. The estimated coefficients along with t-values are presented.

Panel B shows similar results to Panel A. The concurrent dollar cash holding strategy has slightly greater effects on the Z-score (i.e., -0.7104 percent) than the lagged dollar cash holding strategy (i.e., -0.6852 percent). However, comparing the results from model (4) in Panel A with those in Panel B indicates that one-quarter-lagged dollar carry lending has more effect on banks' failure probability (i.e., -2.8942) than concurrent dollar carry lending (i.e., -2.7608). Thus, the results in Table 2.9 imply that banks' foreign currency operating strategies through dollar cash holdings and dollar carry lending have significant effects on banks' failure probabilities. As we have seen, dollar carry lending might increase banks' dollar debt roll-over risks. Banks' roll-over risks might also affect banks' failure risks as much as the overall economy. Thus, banks' aggressive foreign currency operating strategy increases bank's likelihood of financial distress. This indicates that twin crises may develop through banks' speculative trading strategy. Therefore, in order to reduce bank's distress likelihood, they may need to conduct foreign currency operations in a more conservative way by matching their foreign currency positions and maturities as well as currencies on lending and funding.

2.4.7 Effects of Foreign Currency Shocks on Bank Distress Likelihood

Thus far, we find that bank's foreign currency operating strategies are induced by foreign currency shocks and that those operating strategies are significantly associated with bank distress likelihood. Finally, we now investigate the effects of foreign currency shocks on bank distress likelihood. We run the panel regressions of banks' Z-scores on the exchange-rate return and the foreign interest rate. We use the won/dollar rate divided by 100 to proxy for foreign exchange rate shocks and three-month dollar LIBOR to proxy for foreign interest rate shocks. The regression results are presented in Table 2.10. Panel A provides regression results on the exchange rate risks and Panel B provides regression results on the dollar interest rate risks.

Table 2.10 Foreign Currency Shocks and Bank Distress Likelihood

Panel A

	Dependent Variable = Z-score							
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Exchange rate	**-0.3585**	*-6.02* ***	**-0.1499**	*-2.48* **				
Lag exchange rate					**-0.3560**	*-5.98* ***	**-0.1520**	*-2.50* **
Size (log TA)			0.0180	*0.20*			0.0257	*0.28*
NI / TA			**0.2074**	*4.89* ***			**0.2127**	*5.02* ***
Deposits / TA			**-8.4904**	*-4.47* ***			**-8.1994**	*-4.28* ***
Debts / TA			**-6.2504**	*-2.99* ***			**-6.1040**	*-2.92* ***
FC Loans / TA			**7.6231**	*7.44* ***			**7.6286**	*7.46* ***
Current ratio			**1.9132**	*2.65* ***			**1.9467**	*2.70* ***
Growth (TA)			0.4407	*0.39*			0.3046	*0.27*
N	627		627		627		627	

Panel B

	Dependent Variable = Z-score							
	(1)		(2)		(3)		(4)	
Variable	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*	Est.	*t-value*
Dollar LIBOR	**-0.1882**	*-4.77* ***	**-0.0620**	*-1.56*				
Lag dollar LIBOR					**-0.2286**	*-5.74* ***	**-0.1054**	*-2.57* ***
Size (log TA)			-0.0302	*-0.27*			-0.0441	*-0.40*
NI / TA			**0.1926**	*4.56* ***			**0.1902**	*4.52* ***
Deposits / TA			**-9.2769**	*-4.77* ***			**-9.3170**	*-4.82* ***
Debts / TA			**-7.1419**	*-3.20* ***			**-6.7442**	*-3.05* ***
FC Loans / TA			**8.9540**	*8.12* ***			**8.4190**	*7.61* ***
Current ratio			**1.4147**	*1.91* **			**1.3662**	*1.85* *
Growth (TA)			0.5078	*0.46*			0.5755	*0.52*
N	627		627		627		627	

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

This table presents the results of panel regressions for the estimation of Korean banks' distress likelihood using data from the banks' business reports and macroeconomic variables. Panel A provides the effects of foreign exchange rate shocks on banks' distress likelihood and Panel B provides the effects of foreign interest rate shocks on banks' distress likelihood. The dependent variable is the Z-score, which is computed as Z-score = (average ROA + average total capital scaled by total assets) / standard deviation of ROA. The independent variable exchange rate indicates the won/dollar rate divided by 100. Dollar LIBOR measures the three-month dollar LIBOR. TA and NI stand for total assets and net income, respectively. The estimated coefficients along with t-values are presented.

In Panel A of Table 2.10, the results from models (1) and (3) show that banks' distress likelihood is significantly positively associated with the exchange rate.[86] For example, a hundred won increase in the won/dollar exchange rate is significantly associated with a 0.3585 decrease in a bank's Z-score. In Panel B, the results from models (1) and (3) also indicate that increases in foreign interest rates significantly negatively affect banks' distress likelihood.[87] For example, a one percent increase in dollar LIBOR is significantly correlated with a 0.1882 decrease in banks' Z-score.

It is implied from the results that dollar appreciation and dollar interest rate increases positively influence banks' sustainability in emerging market countries. The negative effects of foreign shocks may be due to increased funding costs of banks. However, as we have seen, those negative effects may be magnified by banks' speculative and aggressive foreign currency operating strategies. Under circumstances that the market environments get worse, aggressive strategies further exacerbate the sustainability of the banks.

2.4.8 Development of Twin Crises in 2008 Korea

In order to investigate the effects of twin crises on Korean banks, we conduct tests of the equality of means between banks' operating characteristics in normal times before the crisis (2004Q4 – 2007Q4) and those in crisis times (2008Q1 – 2009Q4). Table 2.11 presents the results of those t-tests. The results suggest that the average won/dollar exchange rate is 21.5 percent higher in crisis times than in normal times even though the dollar interest rate sharply decreased in the crisis times due to the Fed's aggressive easing policy stance. For instance, the dollar LIBOR decreased from 4.56 percent in normal times to 1.62 percent in crisis times.

[86] The effects of the current exchange rate are greater than those of the lagged exchange rate (i.e., 0.3585 versus 0.3560).
[87] The effects of lagged dollar interest rate are greater than concurrent dollar interest rate (i.e., 0.2286 versus 0.1882).

Table 2.11 Operating Characteristics of Banks in Normal Times versus Crisis Times

Variable	Normal Times		Crisis Times		t-stat
	Mean	Std Dev	Mean	Std Dev	
Dollar LIBOR	**4.5555**	1.0004	1.6173	1.1062	23.64 ***
Korean CD rate	**4.3917**	0.7203	3.9250	1.3849	3.83 ***
Won/dollar rate	976.84	44.9937	**1,187.30**	117.6779	-21.99 ***
ROA	**0.9756**	0.7000	0.6268	0.4413	4.74 ***
Tobin's Q	**1.0227**	0.0260	1.0020	0.0362	4.82 ***
Stock returns	**7.4928**	14.3801	2.3631	28.0223	1.74 ***
CDS premium	40.93	25.7158	**304.78**	179.8517	-19.80 ***
Foreign investor holding	**47.5956**	29.5435	40.6648	27.8736	1.69 *
N	188		112		

*** (**) {*} significant at the 1% (5%) {10%} significance levels, respectively, for a two-tailed test.

Notes: This table provides operating characteristics of Korean banks in normal times (2004Q4 –2007) and those in crisis times (2008 – 2009). Tobin's Q is computed as (market value of common stock + book value of debt + book value of preferred stock) divided by book value of total assets. The t-values for the tests of the equality of means between the two groups of firms under the assumption of equal variances are presented in the last column. N on the bottom line is the number of observations.

While the currency crisis has been developing in Korea, banks also suffered from significant decreases in profitability (ROA) and market value (Tobin's Q and stock returns). For example, the average ROA of Korean banks decreased from 0.9756 in normal times to 0.6268 in crisis times. Also, the average Tobin's Q of the banks declined from 1.0227 to 1.0020. The currency crisis dramatically raised Korean banks' foreign currency default risks through increased dollar roll-over risks. For instance, banks' average CDS spreads increased from 40.93 basis points in the normal times to 304.78 basis points in the crisis times. Also, bank stock returns significantly decreased from 7.49 percent in normal times to 2.36 percent in crisis times. These results suggest that banking risk and currency risk were simultaneously developing in South Korea. Reflecting the twin crises, foreign investors actively sold Korean bank stocks and

thus their bank stock holdings significantly decreased from 47.6 percent in the normal times to 40.7 percent in the crisis time.

In sum, emerging market banks' aggressive profit-maximizing foreign currency operations through dollar carry lending transactions in the place of conservative risk management-oriented operations led to a vulnerability to a currency crisis and a banking crisis, i.e., twin crises.

2.5 Conclusion

In this study, we examine the exposures of Korean banks to foreign currency risks and the relation to their foreign currency operations to better understand the risk of those exposures. Our analysis concentrates on three central questions. First, what specific foreign currency exposures do Korean banks maintain? We find three important exposures generated from Korean banks' considerable amounts of foreign currency operations. For example, Korean banks have taken substantial amount of foreign currency position mismatches. They held significant dollar spot positions and imperfectly hedged them with derivatives, exposing them to exchange-rate risks. In addition, Korean banks maintained considerable amounts of foreign currency maturity mismatches. They held deeply negative dollar maturity gaps, which exposed them to foreign interest rate risks. Furthermore, Korean banks dramatically increased short-term foreign currency debts in 2006 – 2007, which significantly exposed them to dollar debt roll-over risks.

Second, which factors determine Korean banks exposure to foreign exchange rate risks, foreign interest rate risks, and foreign currency debt roll-over risks? We find two outside macroeconomic factors and two inside-bank strategic factors. For instance, banks' foreign currency positions are primarily related to exchange-rate movements. Dollar depreciation stimulated corporate firms' strong demands for short dollar forward positions. As a counterparty

of forward transactions, banks took huge amounts of long dollar forward positions. To hedge those long forward positions, banks sharply increased their dollar short-term borrowings, which reduced banks' spot positions. Since banks imperfectly covered their long forward positions, their composite positions consistently increased. Banks' foreign currency positions are also concerned with banks' dollar cash holding strategies and dollar carry lending strategies. Banks engaged in speculative spot FX trading by adjusting their dollar cash holdings according to exchange-rate movements. Banks also engaged in dollar carry lending by borrowing in the dollar and lending in the local currency. Dollar carry lending decreases banks' dollar spot positions since it does not increase dollar assets. Banks' foreign currency maturity mismatches are mainly driven by foreign interest rate movements and banks' dollar carry lending transactions. As the foreign interest rate goes up, banks' foreign currency net interest margin goes down. To increase banks' net interest margin, they increase the maturity of their foreign currency assets and engage in dollar carry lending, which decrease banks' foreign currency maturity gaps. However, the dollar carry lending transactions increase banks' dollar debt roll-over risks since it entails increases in short-maturity dollar debts.

The third question we address concerns the relationship between banks' foreign currency operations and bank distress likelihood. We test whether banks' dollar cash holding strategies and dollar carry lending strategies are associated with bank distress. We find that those dollar cash holding and dollar carry lending strategies are significantly positively associated with banks' foreign currency debt default probability measured by CDS spreads. Further, we also find that those two foreign currency operating strategies taken by Korean banks significantly decrease their Z-scores, suggesting that the strategies considerably increase banks' overall distress likelihood. Since bank's dollar cash holding strategies and dollar carry lending strategies are

significantly driven by foreign exchange-rate movements and foreign interest-rate movements, we also test whether banks' Z-scores are associated with those foreign macroeconomic shocks. We find a significantly positive relation between bank distress likelihood and foreign shocks.

Our findings have several important implications. First, foreign macroeconomic shocks influence not only emerging market banks' default probabilities on foreign currency debts but also their overall distress likelihood. As the banking crisis and currency crisis reinforce each other, emerging market banks suffer from a so-called twin crises situation. We find evidence that implies a twin crises situation has recently developed in the Korean banking industry. Second, those twin crises are magnified through banks' aggressive and speculative profit-maximizing operations. Since banks increased their speculative positions under the circumstances in which negative foreign shocks strengthened through dollar appreciation and dollar interest rate increases, banks got more vulnerable to dollar roll-over risks, while increasing overall distress likelihood. If banks selected more conservative risk management policies, their loss of bank value due to increases in distress likelihood might be significantly reduced. Finally, for both banks and regulators, the recent crises gave important lessons that a good risk management system will be significantly rewarded at bad times such as in financial crises.

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APPENDIX A. DERIVATION OF EXPECTED CONSUMPTION GROWTH

The first-order condition for the maximization of (2) with respect to φ(t) subject to the budget constraints (3) and (4) is

$$u'(c_t) = \beta E_t\left[u'(c_{t+1})r_{i,t+1}\right],\ i = 1, 2, \ldots, N \qquad (5)^*$$

Substituting (5)* into (1) we get

$$c_t^{-\gamma} = \beta E_t\left[c_{t+1}^{-\gamma} r_{i,t+1}\right],\ i = 1, 2, \ldots, N \qquad (6)^*$$

Denote consumption growth by $x_{t+1} \equiv c_{t+1}/c_t$ and $u_{i,t+1} \equiv x_{t+1}^{-\gamma} r_{i,t+1}$. Then we can rewrite (6)* as

$$E_t\left[u_{i,t+1}\right] = 1/\beta,\ i = 1, 2, \ldots, N \qquad (7)^*$$

Consider an information set $Y_t = \{X_t, R_{1t}, R_{2t}, \ldots, R_{Nt}\}$ and assume $\{Y_t\}$ follows a stationary Gaussian process. Denote $\{Y_{t-1}, Y_{t-2}, Y_{t-3}, \ldots\}$ by I_{t-1} and let $X_t \equiv \ln x_t$, $R_{it} \equiv \ln r_{it}$, and $U_{it} \equiv \ln u_{it}$. Then the conditional random variable $U_{it} \mid I_{t-1}$ is normally distributed with a constant variable σ_i^2 and a mean $\mu_{i,t-1}$. Therefore,

$$E_t\left[u_{it} \mid I_{t-1}\right] = \exp[\mu_{i,t-1} + (\sigma_i^2/2)] \qquad (8)^*$$

Rearranging the right hand sides of (7)* and (8)* gives

$$\mu_{i,t-1} = -\ln\beta - \sigma_i^2/2 \qquad (9)^*$$

Then, $E(U_{it} \mid I_{t-1}) = \mu_{i,t-1}$ and thus

$$E(-\gamma X_t + R_{it} \mid I_{t-1}) = \mu_{i,t-1} \qquad (10)^*$$

Substituting (10)* into (9)* leads to

$$E(X_t \mid I_{t-1}) = \frac{1}{\gamma}\left[E(R_{it} \mid I_{t-1}) + \ln\beta + (\sigma_i^2/2)\right] \qquad (11)^*$$

APPENDIX B. DISTRIBUTION OF THE CURRENCY SPOT NET ASSET POSITION

To define "squaring" we may consider variables such as the absolute value of the firm's foreign currency spot net asset position (|FCP|), the absolute value of the firm's foreign currency spot net asset position scaled by their total assets (|FCP|/TA), and the absolute value of the firm's foreign currency spot net asset position scaled by its foreign sales. However, we select the absolute value of the firm's currency spot net asset position scaled by its total assets since this variable shows a more balanced distribution than other alternative variables. The distribution of the firm's currency spot net asset position scaled by its total assets (FCP/TA) and that of the absolute value of the firm's currency spot net asset position scaled by its total assets (|FCP|/TA) are described in the following two figures.

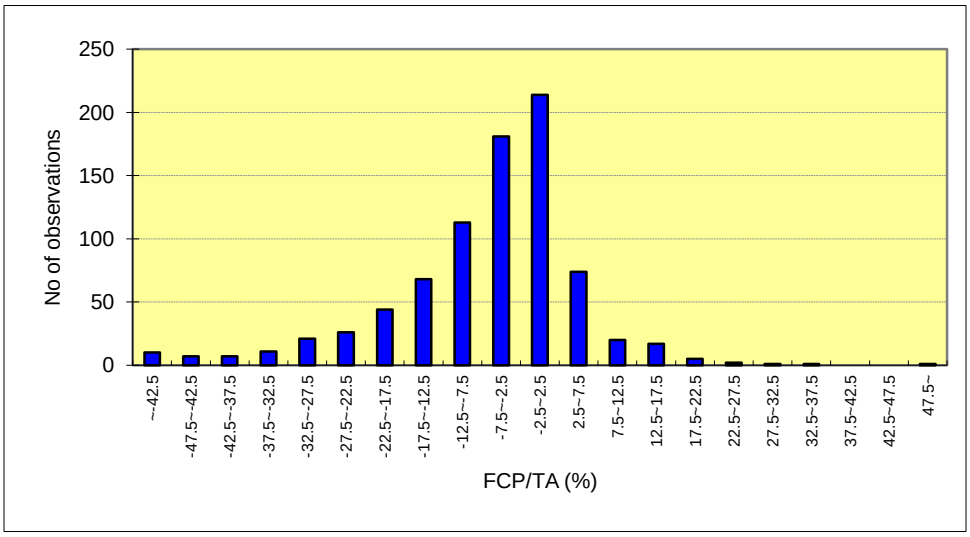

Figure A.1 Distribution of the Spot Net Asset Position Scaled by Total Assets

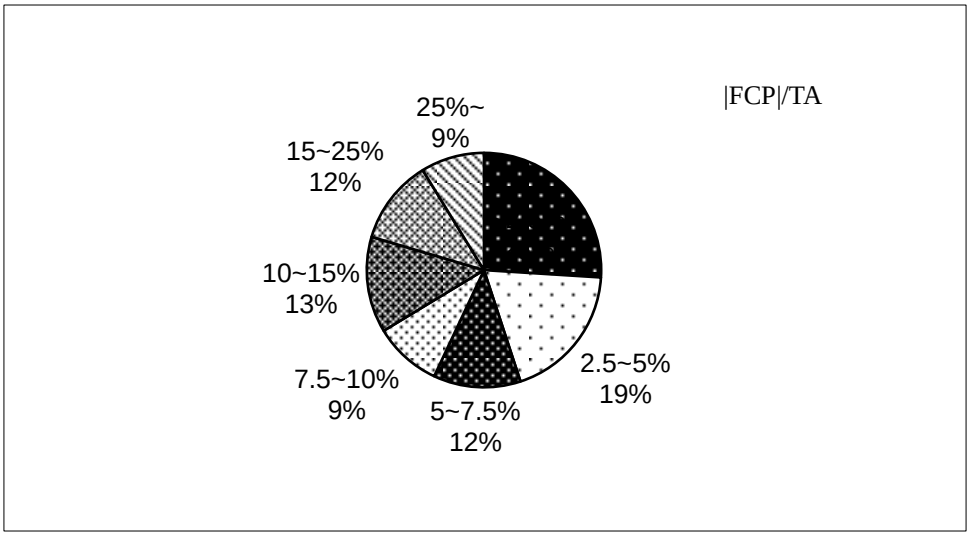

Figure A.2 Distribution of Absolute Current Net Asset Position / Total Assets

The bar chart in Figure A.1 shows firms taking currency spot net asset positions scaled by total assets between -2.5 percent and 2.5 percent come to the center of the distribution of the FCP/TA. The pie chart in Figure A.2 suggests that firms taking an absolute value of the currency spot net asset position scaled by total assets less than 2.5 percent accounts for 26 percent of all sample firms, which is near the lowest quartile of the |FCP|/TA. From the distributions of the firms' foreign currency spot positions scaled by total assets, we can identify the firms in the lowest quartile of the |FCP|/TA as currency position-squaring firms and those in other three high quartiles of the |FCP|/TA as foreign currency position non-squaring firms.

Thus, considering the foreign currency position distribution of the firms, we classify a firm as a currency position-squaring firm if the firm has an absolute value of the currency spot net asset position less than 2.5 percent of its total assets. If a firm's currency spot net asset position is less than or equal to -2.5 percent of its total assets or greater than or equal to 2.5 percent of its total assets, the firm is classified as a position non-squaring firm.

VITA

Sungjae Francis Kim was born in South Korea. He obtained his Bachelor of Arts in Economics in 1994 from Seoul National University. After graduating from college, he joined Asian Banking Corporation, a merchant banking corporation in Seoul, Korea. In the company, he traded foreign currencies and derivatives, invested in international bonds, and managed foreign assets. In early 2000, he joined H&S Investment Bank in Seoul and managed equity and futures portfolio funds. In November 2000, he was invited to join the Korea Deposit Insurance Corporation (KDIC) as a financial market researcher. The KDIC, equivalent of the FDIC in the United States, has been playing a key role in the country's financial industry reforms since the 1997 Asian financial crisis. He served the company as a financial industry reform manager and a senior secretary to its Chairman and President. The company recognized his efforts and enthusiasm and decided to support his study abroad. In 2005, he started his study in the Department of Applied Economics and Management at Cornell University and obtained his master's degree in January 2008. He joined the doctoral program in finance at Louisiana State University in January 2008. He expects to obtain his Doctor of Philosophy degree in December 2011.