Foreign Exchange Risk Management in Japanese and Australian Commercial Banks

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1. Introduction

The volatile changes in currency rates during late 1990s created havoc for managers of bank asset portfolios, particularly for those responsible for bank investments in all marketable securities. When exchange rates catapulted to record low levels, the market value of bank bonds plummeted, forcing many institutions to accept substantial losses on any securities that had to be sold — a potent example of what financial analysts call market risk. Both rising and falling exchange rates can do damage to any bank that is unprepared for them, though falling exchange rates of foreign currencies usually create more problems than rising ones. If foreign currency rates fall (and interest rates increase), the market value of fixed-income securities (such as bonds) and fixed-rate loans will fall. A bank faced with the need to sell these assets in a falling-rate market will take losses when translating them into home currency. Rising exchange rate (and falling interest rates), in contrast, will increase the value of fixed-income securities and fixed-rate loans, resulting in capital gains when they are sold overseas.

Falling overseas currency rates can also have potent effect on bank's profit margin of revenues over operating costs. For example, falling rates can lower bank's margin of profit if the structure of the bank's assets is such that currency expenses on borrowed money increase more rapidly than currency revenues on loans and security investments. If a bank has an excess of flexible-rate assets loans, for example) over flexible-rate liabilities (certificates of deposits

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and money market borrowings, for example), depreciation of home currency will further erode the bank's profit margin.

A substantial body of evidence indicates that banks respond to adverse financial shocks by growing more slowly and, in many instances, shrinking (Bernanke and Lown, 1991; Hall, 1993; Hancock and Wilcox, 1995; Peek and Rosengren, 1995). While investigators have found a positive relationship between bank foreign exposure and either asset growth (Frankel and Morgan, 1992) or bank lending (Kim and Moreno, 1994), for Japanese banks after the mid 1980s, prior to that date the relationship was much weaker or non-existing. This was consistent with a change in the regulatory environment in Japan in the mid and late 1980s, including the Basle Accord, that placed greater emphasis on the role of bank foreign exposure.

Until the mid 1980s, Japanese banks were not subject to explicit capital ratio requirements. Rather, the Bank of Japan often controlled bank lending through 'window guidance' (Moriyama, 1994; Hoshi, Scharfstein, and Singleton, 1993).

The introduction of the Basle Accord (international agreement that set common standards by which evaluate banks' financial exposure) in 1988 set the stage for the dramatic fluctuations in Japanese stock prices to have a substantial impact on Japanese bank capital at home and abroad.[1)] The rapid growth of Japanese banks was relatively unaffected initially by the adoption of the Basle Accord because of the boost in their tier 2 capital that came from the substantial accrued capital gains on their shareholdings associated with the dramatic rise in Japanese stock prices. Furthermore, higher stock prices enabled Japanese banks to increase tier 1 capital by issuing new equity shares and debt securities at favourable prices, as well as by selling some of their stock holdings in other companies that had substantial unrealized gains (Moriyama, 1994).

The subsequent decline in Japanese stock prices caused a dramatic decline in tier 2 capital, given that Japanese banks hold approximately 20 percent of Japanese common stock. The tier 2 risk-based capital ratio of many Japanese banks including 7 of the 10 largest banks in the world,

1) The Basle Accord tried to create a 'level playing field' by providing standardized capital regulations so that all international banks would satisfy the same two minimum risk-based capital ratios. The new regulations required tier 1 (core) capital to equal at least 4 percent of risk-weighted assets. The broader measure, tier 2 capital, which includes tier 1 capital as well as subordinated debt and revaluation reserves, must be equal to at least 8 percent of risk-weighted assets. Despite the Basle Accord, national differences remain. In particular, differences remain in the designation of the set of assets allowable for tier 1 and tier 2 capital. There are differences in categorization of assets placed in particular risk classifications. There are still differences in reserving procedures for possible loan losses (failure to fully reserve for expected loan losses may reduce the comparability of capital ratios when non-performing loans are increasing and collateral values are decreasing.

in the early 1990s fell below 8 percent minimum required under the Basle Accord. As a result of the widespread decline in Japanese bank capital, the total assets of Japanese banks declined steadily after 1990. The slowing in loan growth (including overseas loans) and the eventual shrinkage of overall banking operations overseas seems to be consistent with earlier experience on the response of US banks to adverse financial shocks.

The effect on bank lending of the decline in Japanese stock prices is exacerbated by the deteriorating quality of bank assets, in particular real estate loans. Though the problem is widely acknowledged, the lack of transparency of the Japanese banking system make it difficult to quantify the bad loan problem. The timing of both the write-down of the bad loans and the associated additions to loan loss reserves can be managed by banks and by regulators, as was done by many developing countries during the recent Asian financial crisis.

The purpose of this paper is to investigate one particular aspect of the instability in financial markets i.e. — the issue of foreign exchange exposure as an element of financial strategy of commercial banks in Japan and Australia.

Exchange risk is simple in concept: a potential gain or loss that occurs as a result of an exchange rate change.[2] Yet from this simple question several more arise. First, whose gain or loss? Clearly not just those of a subsidiary, for they may be offset by positions taken elsewhere in the firm. And not just gains or losses on current transactions, for the firm's value consists of anticipated future cash flows as well as currently contracted ones (Kawamoto, 1990; Kawamoto, 1995). What counts, modern finance tells us, is shareholder value; yet the impact of any given currency change on shareholder value is difficult to assess, so proxies have to be used. The academic evidence linking exchange rate changes to stock prices has been, so far, weak.

Finally, risk is not risk if it is anticipated. In most currencies there are futures or forward exchange contracts whose prices give firms an indication of where the market expects currencies to go. And these contracts offer the ability to lock in the anticipated change. So perhaps a better concept of exchange risk is *unanticipated* exchange rate changes.

2) Some empirical studies have confirmed that certain currencies exhibit greater risk than another. Madura and Nosari (1984) analyzed the standard deviations of eight foreign currencies using monthly data for the period 1970–1983. The results have shown that the German DM exhibited standard deviation of 3.97 percent which was four times as great as the Canadian dollar (0.99 percent). Thus, international banks need not to be concerned too much in hedging in C$. The other finding was that the variability of each currency was not stationary for the whole period, and the introduction of the (almost) universal floating exchange rate system resulted in increased foreign exchange exposure.

1.1 Measuring Foreign Exchange Risk

There are significant differences in the internal and external views of what is a satisfactory foreign exchange risk measure. Internally, bank managers need a measure that allows active, efficient management of the bank's risk position. Bank regulators want to be sure a bank's potential for catastrophic net worth loss is accurately measured and that the bank's capital is sufficient to survive such a loss. Consider the differences in desired risk measure characteristics that these two views engender.[3)]

Timeliness and Scope

Both managers and regulators want up-to-date measures of risk. For banks active in trading, this may mean selective intraday risk measurement as well as a daily measurement of the total risk of the bank. Note, however, that the intraday measures that are relevant for asset allocation and hedging decisions are measures of the marginal effect of a trade on total bank risk and not the stand-alone riskiness of the trade. Regulators, on the other hand, are concerned with the overall riskiness of a bank and have less concern with the risk of individual portfolio components (Kawamoto, 1990). Nonetheless, given the ability of a sophisticated manager to "window dress" a bank's position on short notice, regulators might also like to monitor the intraday total risk. As a practical matter, they probably must be satisfied with a daily measure of total bank risk.

The need for a total risk measure implies that risk measurement cannot be decentralized. For parametric measures of risk, such as standard deviation, this follows from the theory of portfolio selection (Markowitz, 1952) and the well-known fact that the risk of a portfolio is not, in general, the sum of the component risks. More generally, imperfect correlation among portfolio components implies that simulations of portfolio risk must be driven by the portfolio return distribution, which will not be invariant to changes in portfolio composition. Finally, given costly regulatory capital requirements, choices among alternative assets require managers to consider risk/return or risk/cost trade-offs where risk is measured as the change in portfolio risk resulting from a given change in portfolio composition. The appropriate risk scaling measure depends on the type of change being made. For example, the pertinent choice criterion for pure hedging transactions might be to maximize the marginal risk reduction to transaction cost ratio over the available instruments while the choice among proprietary transactions would involve

3) See D. H. Pyle, 1997, "Bank Risk Management: Theory", Conference Paper, International Conference on Risk Management, Jerusalem, May 17–19.

minimizing marginal risk per unit of excess return.

Efficiency

Risk measurement is costly and time consuming. Consequently, bank managers compromise between measurement precision on the one hand and the cost and timeliness of reporting on the other.[4] This trade-off will have a profound effect on the risk measurement method a bank will adopt. Bank regulators have their own problem with the cost of accurate risk measurement which is probably one reason they have chosen to monitor and stress test bank risk measurement systems rather than undertaking their own risk measurements.

Information Content

Bank regulators have a singular risk measurement goal. They want to know, to a high degree of precision, the maximum loss a bank is likely to experience over a given horizon. They then can set the bank's required capital (i.e. its economic net worth) to be greater than the estimated maximum loss and be almost sure that the bank will not fail over that horizon. In other words, regulators should focus on the extreme tail of the bank's return distribution and on the size of that tail in adverse circumstances. Bank managers have a more complex set of risk information needs. In addition to shared concerns over sustainable losses, they must consider risk/return trade-offs. That calls for a different risk measure than the "tail" statistic, a different horizon, and a focus on more usual market conditions. Furthermore, even when concerned with the level of sustainable losses, the bank manager may want to monitor on the basis of a probability of loss that can be observed with some frequency (e.g. over a month rather than over a year).

This allows managers to use the risk measurement model to answer questions such as:

> Is the model currently valid? For example, if the loss probability is set at 5%, do we observe a violation once every 20 days on average? Are traders correctly motivated to manage and not just avoid risk? How often does Trader 1's position violate his risk limit relative to the likelihood of that event?

Market Risk Measurement — Two Different Approaches

There are two principle approaches to risk measurement, scenario analysis and value-at-risk analysis.

4) See Prisker (1996).

Scenario analysis: In scenario analysis, the analyst postulates changes in the underlying determinants of portfolio value (e.g. interest rates, exchange rates, equity prices, and commodity prices) and revalues the portfolio given those changes. The resulting change in value is the loss estimate. A typical procedure, often called stress testing, is to use a scenario based on an historically adverse market move. This approach has the advantage of not requiring a distributional assumption for the risk calculation. On the other hand, it is subjective and incorporates a strong assumption that future financial upsets will strongly resemble those of the past. Given the earlier discussion, it should be clear that stress testing can provide regulators with the desired lower tail estimates, but is of limited utility in day-to-day risk management.[5] It should also be clear that meaningful scenario analysis is dependent on having valuation models that are accurate over a wide range of input parameters, a characteristic that is shared to a considerable extent by value-at-risk models. Pioneering research on capital asset pricing (Sharpe, 1964), option pricing (Black and Scholes, 1973), Merton, 1973), and term structure modeling (Vasicek, 1977) has provided the basis for reliable valuation models, models that have become increasingly accurate and applicable with subsequent modification and extension by other researchers.

Value-at-Risk (VaR) analyses use asset return distributions and predicted return parameters to estimate potential portfolio losses. The specific measure used is the loss in value over X days that will not be exceeded more than Y% of the time. The Basle Committee on Banking Supervision's rule sets Y equal to 1% and X equal to 10 days. In contrast, the standard in RiskMetrics™ (the J. P. Morgan/Reuters VaR method) is 5% over a horizon sufficiently long for the position to be unwound which, in many cases, is 1 day. The difference in probability levels reflects the differences in informational objectives discussed above. The differences in horizon might appear to reflect differences in the uses to which the risk measure is put, in particular the desire of regulators to set capital rules that provide protection from failure over a longer period. This conclusion may be correct, but it is somewhat contradicted by the arbitrary multiplication of the resulting VaR figure by 3 to get regulatory required capital. The Basle Committee could have gotten about the same result using a 1-day horizon and multiplying by 9.5. Perhaps order of magnitude arbitrariness is less palatable than single digit arbitrariness.

There are two principle methods for estimating VaR — the analytical method and Monte

5) Even for the regulators, reliance on a given scenario carries the risk of establishing a "Maginot line" defense against catastrophe.

Carlo simulation ... each with advantages and disadvantages.[6] There are implementation problems common to both methods, namely choosing appropriate return distributions for the instruments in the portfolio and obtaining good forecasts of their parameters. The literature on volatility estimation is large and seemingly subject to unending growth, especially in acronyms (Arch, Grach, Egarch, et. al.). Since I am not an expert on forecasting, it will be safest and perhaps sufficient to make two comments on forecasting for VaR analysis. Firstly, the risk manager with a large book to manage needs daily and, in some cases, intraday forecasts of the relevant parameters. This puts a premium on using a forecasting method that can be quickly and economically updated. Secondly, forecasting models that incorporate sound economic theory, including market microstructure factors, are likely to outperform purely mechanical models.[7]

Modeling portfolio returns as a multivariate normal distribution has many advantages in terms of computational efficiency and tractability. Unfortunately, there is evidence going back to Mandelbrot (1963) and beyond that some asset returns display non-normal characteristic. The fact that they display "fat" tails ... more extreme values than would be predicted for a normal variate ... is particularly disturbing when one is trying to estimate potential value loss. To some degree, these fat tails in unconditional return distributions reflect the inconstancy of return volatility and the problem can be mitigated by modeling individual returns as a function of volatility as in the RiskMetrics™ model:

$$r_{i,t} = \sigma_{i,t}\varepsilon_{i,t} \quad \textit{where } \varepsilon_{i,t} \textit{ is } N(0,1).$$

Another alternative is to assume that returns follow a non-normal distribution with fat tails (e.g. the Student's t distribution), but only if one is prepared to accept the concomitant portfolio return computation problems. Danielson and deVries (1997) have proposed a method for explicit modeling of the tails of financial returns. Since VaR analysis is intended to describe the behavior of portfolio returns in the lower tail, this is obviously an intriguing approach. Furthermore, the authors show that the tail behavior of data from almost any distribution follows a single limit law, which adds to the attractiveness of the method. However, estimating tail densities is not a trivial matter so, while promising, there are computational issues to be resolved if this is to become a mainstream VaR method.

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6) It is also possible to use the Cox-Ross-Rubinstein (1979) tree-based methods to generate a VaR estimate, but the use of this method is limited to a small number of risk sources and thus it is an unlikely candidate for use in bank risk management.

7) See Figleski (1997) for evidence on the relative accuracy of various volatility forecasting methods.

Analytical VaR: The analytical method for VaR uses standard portfolio theory. The portfolio in question is described in terms of a position vector containing cash flow present values representing all components of the portfolio. The return distribution is described in terms of a matrix of variance and covariance forecasts (covariance matrix) representing the risk attributes of the portfolio over the chosen horizon. The standard deviation of portfolio value (v) is obtained by pre- and post-multiplying the covariance matrix (Q) by the position vector (p) and taking the square root of the resulting scalar:[8)]

$$v = \sqrt{p'Qp}\,.$$

This standard deviation is then scaled to find the desired centile of portfolio value that is the predicted maximum loss for the portfolio or VaR:

$VaR = vf(\mathrm{Y})$
where: $f(Y)$ *is the scale factor for centile Y.*

For example, for a multivariate normal return distribution, $f(Y) = 1.65$ for Y = 5% or 2.33 for Y = 1%. Analytical VaR is attractive in that it is fast and not terribly demanding of computational resources. As the following algebra demonstrates, analytical VaR also lends itself readily to the calculation of the marginal risk of candidate trades:[9)]

$$\Delta v_i = \frac{p'Q}{v} a_i \quad \textit{where } a_i \textit{ is a given candidate trade and } \Delta v_i \textit{ is its marginal risk..}$$

Given trade cashflow descriptions, the information needed to calculate the marginal risk of any candidate trade can be accumulated during a single calculation of v.

Analytical VaR has a number of weaknesses. In its simplest form, options and other non-linear instruments are delta-approximated which is to say the representative cash flow vector is a linear approximation of position that is inherently non-linear. In some cases, this approximation can be improved by including a second-order term in the cash flow representation.[10)]

8) To keep this method manageable in terms of parameter estimation and speed of calculation, the size of the covariance matrix can be constrained and the portfolio position vector described in terms of a subset of the actual risks being faced. For example, in the RiskMetrics data base, equity risk appears as the variances and covariances of 32 equity indices and a given equity position is made to correspond to this description by scaling its present values by the equity's "beta".

9) Incremental VaR, as defined here, is a first order approximation of the change in risk due to a candidate trade and is applicable when the cashflows for such trades are small relative to the aggregate cash flow of the existing portfolio. See Garman (1996).

10) See Fallon (1996) and JP Morgan (1996).

However, this does not always improve the risk estimate and can only be done with the sacrifice of some of the computational efficiency that recommends analytical VaR to bank managers.

Monte Carlo Simulation: Monte Carlo simulation of VaR begins with a random draw on all the distributions describing price and rate movements taking into account the correlations among these variates. Mark-to-model and maturation values for all portfolio components at the VaR horizon are determined based on that price/rate path. This process is repeated enough times to achieve significance in the resulting end-of-horizon portfolio values. Then the differences between the initial portfolio value and these end-of-horizon values are ranked and the loss level at the Yth centile is reported as the VaR of the portfolio.

To avoid bias in this calculation, the analyst must use risk-neutral equivalent distributions and, if the horizon is sufficiently long, be concerned with bias introduced by the return on capital. If model error is not significant, the use of Monte Carlo simulation solves the problem of non-linearity though there are some technical difficulties such as how to deal with time-varying parameters and how to generate maturation values for instruments that mature before the VaR horizon. From the risk manager's viewpoint, the main problem is the cost of this method and the time it takes to get reliable estimates.

Modern principles of the theory of finance suggest *prima facie* that the management of corporate foreign exchange exposure may neither be an important nor a legitimate concern. It has been argued, in the tradition of the Modigliani-Miller Theorem, that the firm cannot improve shareholder value by financial manipulations: specifically, investors themselves can hedge corporate exchange exposure by taking out forward contracts in accordance with their ownership in a firm. Managers do not serve them by second-guessing what risks shareholders want to hedge.

One counter-argument is that transaction costs are typically greater for individual investors than firms. Yet there are deeper reasons why foreign exchange risk should be managed at the firm level. As will be shown in the material that follows, the assessment of exposure to exchange rate fluctuations requires detailed estimates of the susceptibility of net cash flows to unexpected exchange rate changes (Dufey and Srinivasulu, 1983). Operating managers can make such estimates with much more precision than shareholders who typically lack the detailed knowledge of competition, markets, and the relevant technologies. Furthermore, in all but the most perfect financial markets, the firm has considerable advantages over investors in obtaining relatively inexpensive debt at home and abroad, taking maximum advantage of interest subsidies and minimizing the effect of taxes and political risk.

The first step in management of corporate foreign exchange risk is to acknowledge that such

risk does exist and that managing it is in the interest of the firm and its shareholders. The next step, however, is much more difficult: the identification of the nature and magnitude of foreign exchange exposure. In other words, identifying what is at risk, and in what way.

The focus of the recent research was on the exposure of non-financial corporations, or rather the value of their assets. This reminder is necessary because most commonly accepted notions of foreign exchange risk hedging deal with assets, i.e., they are pertinent to (simple) financial institutions where the bulk of the assets consists of (paper) assets that have with contractually fixed returns, i.e., fixed income claims, not equities.[11] Clearly, such a definition of assets in the currency in which they are denominated" applies in general to banks and similar firms. Non-financial business firms, on the other hand, have, as a rule, only a relatively small proportion of their total assets in the form of receivables and other financial claims. Their core assets consist of inventories, equipment, special purpose buildings and other tangible assets, often closely related to technological capabilities that give them earnings power and thus value. Unfortunately, real assets (as compared to paper assets) are not labeled with currency signs that make foreign exchange exposure analysis easy. Most importantly, the location of an asset in a country is an all too fallible indicator of their foreign exchange exposure.

While this traditional analysis of transactions exposure is correct in a narrow, formal sense, it is really relevant for financial institutions, only. With returns from financial assets and liabilities being fixed in nominal terms, they can be shielded from losses with relative ease through cash payments in advance (with appropriate discounts), through the factoring of receivables, or via the use of forward exchange contracts, unless unexpected exchange rate changes have a systematic effect on credit risk. However, the essential assets of non-financial firms have *noncontractual* returns, i.e. revenue and cost streams from the production and sale of their goods and services which can respond to exchange rate changes in very different ways. Consequently, they are characterized by foreign exchange exposure very different from that of

11) An emerging literature on off-balance sheet banking has investigated the effect of traditional off-balance activities on bank operations and risk, without focussing on derivatives and their impact on interest rate and exchange risk. For example, Choi, Elyasiani and Kopecky (1992) as well as Grammatikos, Saunders and Swary 91986) examined the sensitivity of bank returns and profits to interest rate and exchange rate risks through traditional on-balance sheet operations. Gorton and Rosen (1995) examined the interest rate sensitivity of banks regarding their use of interest rate swaps. Chen (1996) studied the joint effect of derivative bank operations on both risks (interest and exchange rate) using monthly data. The other studies investigated the impact of traditional off-balance sheet activities on bank risk and profits in general, For example, Boot and Thakor (1991), Brewer and Koppenhaver, Hassan, Karel and Peterson (1994).

firms with contractual returns.[12)]

Accounting exposure in commercial banks

The concept of accounting exposure arises from the need to translate accounts that are denominated in foreign currencies into the home currency of the reporting entity. Most commonly the problem arises when a bank has foreign affiliates keeping books in the respective local currency. For purposes of consolidation these accounts must somehow be *translated* into the reporting currency of the parent company. In doing this, a decision must be made as to the exchange rate that is to be used for the translation of the various accounts. While income statements of foreign affiliated banks are typically translated at a periodic *average* rate, balance sheets pose a more serious challenge.

Even with the increased flexibility of the current Australian accounting standards, users of accounting information must be aware that there are three system sources of error that can mislead those responsible for exchange risk management (Adler, 1982):

1. Accounting data do not capture all commitments of the firm that give rise to exchange risk.
2. Because of the historical cost principle, accounting values of assets and liabilities do not reflect the respective contribution to total expected net cash flow of the firm.
3. Translation rules do not distinguish between expected and unexpected exchange rate changes.

Regarding the first point, it must be recognized that normally, commitments entered into by the bank in terms of foreign exchange, a purchase or a sales of financial assets, for example, will not be booked until the transaction has been finalized. At best, such obligations are shown as contingent liabilities. More importantly, accounting data reveals very little about the ability of the bank to change costs, prices and financial markets quickly. Alternatively, the bank may be committed by strategic decisions such as long term foreign investment. Such "commitments" are important criteria in determining the existence and magnitude of exchange risk.

12) The same refers to the distinction between balance and off-balance sheet activities. The latter ones include: direct credit substitutes (financial guarantees and standby letters of credit), trade and performance related contingent items (performance bonds, warranties, documentary letters of credit), long-term commitments (formal credit lines with a residual maturity exceeding one year), and market-related transactions (foreign exchange contracts, currency and interest rate swaps, and forward rate agreements).

The second point: whenever asset values differ from market values, translation — however sophisticated — will not redress this original shortcoming. Thus, many of the perceived problems of current accounting standards had their roots not so much in translation, but in the fact that in an environment of inflation and exchange rate changes, the lack of current value accounting frustrates the best translation efforts.

Finally, translation rules do not take account of the fact that exchange rate changes have two components: (1) *expected* changes that are already reflected in the prices of financial assets and the costs of financial liabilities (relative interest rates); and (2) the *real goods and services*, the basic rationale for bank foreign exchange exposure management is to shield net cash flows, and thus the value of the bank, from unanticipated exchange rate changes.

An assessment of the nature of the bank's assets and liabilities and their respective cash flows shows that some are contractual, i.e. fixed in nominal, monetary terms. Such returns, earnings from fixed interest securities and receivables, for example, and the negative returns on various liabilities are relatively easy to analyze with respect to exchange rate changes: when they are denominated in terms of foreign currency, their terminal value changes directly in proportion to the exchange rate change. Thus, with respect to financial items banks are concerned only about *net* assets or liabilities denominated in foreign currency, to the extent that maturities (actually, "durations" of asset classes) are matched.

What is much more difficult, however, is to gauge the impact of an exchange rate change on assets with non-contractual returns. While conventional discussions of exchange risk focus almost exclusively on financial assets, for trading and manufacturing firms at least, such assets are relatively less important than others. Indeed, equipment, real estate, buildings and inventories make the decisive contribution to the total cash flow of those firms. (Indeed companies frequently sell financial assets to banks, factors, or "captive" finance companies in order to leave banking to bankers and instead focus on the management of core assets!) And returns on such assets are affected in quite complex ways by changes in exchange rates. The most essential consideration is how the prices and costs of the firm will react in response to an unexpected exchange rate change. For example, if prices and costs react immediately and fully to offset exchange rate changes, the firm's cash flows are not exposed to exchange risk since they will not be affected in terms of the base currency.

In this paper we shall investigate the currency exposure in the commercial banking corporation. The focus will be on the size and significance of the currency risk and on various methods used for the assessment of the risk. Following the conventional methodology (Howe,

Popper, Chamberlain, 1995; Adler & Dumas, 1980) we shall estimate the currency sensitivity to the stock returns of a sample of Australian and Japanese banks. We shall also build on the more recent relevant literature on banks' interest rate exposure (Collins, 1966; Chen and Chan, 1989; Mitchell, 1989) as well on very few more studies which focused on currency exposure in the banking industry (Choi, Elyasiani and Kopecky, 1992). These studies used high-degree aggregation which limited their empirical applications (estimated currency risks could not be linked to individual characteristics of individual banks).

Next, we shall study the currency sensitivity of the Australian and Japanese commercial banks by linking the estimates cross-sectionally to accounting indicators of foreign exchange risk.

The study will follow the recommendations of the Australian Accounting Foundation (ED63), "Additional Disclosures by Financial Institutions', which is consistent with the standard issued on the same subject by the International Accounting Standards Board, IA30, "Disclosures in the Financial Statements of banks and Similar Financial Institutions". The data collected are in line with the ED65, another Australian Accounting Foundation recommendation which provided a framework for reporting financial statements held or issues and the financial risks arising therefrom. The following recommendations, ED67, ED71, ED73 were also incorporated into data collection.

The Australian accounting standards are generally harmonized with international standards. The remaining (insignificant) differences refer to the reporting of the impairment of long-lived assets, accounting for mortgage servicing rights, accounting for stock based compensation, and accounting for transfers and servicing of financial assets and extinguishing of liabilities and are not expected to have any significant impact on our study.[13)]

The original methodology of risk measurement has been modified in 1997 by giving banks the choice of evaluating their risk through two methods — building block approach or through their own internal risk management tools (more flexibility allowed here). Consequently, in this paper currency risk is gauged in its broader context i.e. in terms of the sensitivity of the bank's total value to changes in exchange rate. This, in turn, allows to incorporate the covariance among all of the activities of the bank into a gauge of its total exchange risk

The use of daily data increased the power of our tests when compared with the conventional

13) The development of new Australian accounting standards will follow the recommendations of the Basle Committee on Banking Supervision on the uniform measurement of currency risk. In our study we shall use the method suggested by the Committee i.e. to the tallying up net open positions across currencies, including positions arising both from foreign assets and liabilities, and from off-balance sheet instruments.

monthly data analysis. This is why our study regarding the evidence of exposure at individual bank contrasts with the previous published research. Moreover we linked our estimates from the daily data to cross-sectional data collected from required bank holding company reports. This helps understand better the practical usefulness of accounting methods of risk measurement in the Australian banking corporations. Finally, the estimation of the currency risk for the Japanese banks compared with the risk for the Australian banks gives a useful insight into differences in risk perception and sensitivity to foreign exchange risk in both countries.

The study is organized in four distinctive chapters. In chapter 2, we estimate the sensitivity of stock returns to changes in the exchange rate. Chapter 3 deals with the correlation between the measure of total currency exposure and the available accounting indicators, and chapter 4 presents the cross-sectional analysis. The final chapter offers conclusions

2. Estimation of Foreign Currency Exposure

The estimation of the sensitivity of returns to the currency changes will be conducted within the framework of an augmented market model. The previous research indicated that exchange rate, although important, is not the only factor in the determination of bank return. Therefore the stochastically viable model resulting with good estimate of bank's sensitivity to currency risk would not be feasible by estimating this sensitivity in an equation that leaves unexplained the preponderance of the variability in the return. Therefore, market return as well as portfolio returns are included in the estimation of the equations. This, in turn, provides some insight into other sources of variation in returns such as interest rate changes and price fluctuations (we compare the results with the estimation without the bank portfolio).

The estimation begins with the regression of the returns of each bank, **Ri**, on a market return **rm**, on a portfolio of bank returns, **rb**, and on the appreciation of the exchange rate, **s**. Bank's currency exposure of the **i*** bank is measured using the estimated coefficient, **βis**, from the following time-series regression:

(1) $\mathbf{R}it = \beta io + \beta imrmt + \beta i\mathbf{brb}t + \beta\mathbf{is}St + \mathbf{u}it$[14)]

14) The basic model in this paper is a three-factor model. Rit can also be defined as an excess rate of return of stock i over the risk-free rate q at time t. The percentage rate of changes in risk-free rate is (qt-qt-1)/qt-1 when q is three month Treasury bond rate and et is the exchange rate risk factor measured by the percentage rate of change in currency rate, i.e., (fr-ft-1)/ft-1, where f is the value of the Australian dollar against a basket of foreign currencies

where **t** denotes time, and **βio** is a constant that varies across banks.

As st is expressed in terms of domestic currency, a bank with a net long foreign currency position would have a negative exchange rate coefficient **βis**. The opposite would occur of a bank with a short foreign currency position. Consequently, **βis** will vary across banking industry, size of the bank, its financial structure etc.

Risk betas (β) can be defined in the following way:

Suppose that an Australian bank has a net basic balance-sheet exposure of β, and a net derivative off-balance sheet exposure β, with respect to both interest rate and exchange rate risks. The return on stocks, **Ri** can be redefined as:

(2) $\mathbf{Rit = \beta i\ \beta t + b1\ \beta it + \beta it}$

where **βi** and **b1** are arbitrary parameters, and **βit** is a component related to other risks as well as measurement errors.

Exchange risk factor β can be defined:

(3) $\mathbf{\beta im = cov(RiRm)/var(Rm).}$

And the expected bank's share returns are:

(4) $\mathbf{E(Ri) = Ai\ E(r) + Ai\ E(xr) — Ai\ E(x^2) + \beta ai\ E(x)}$

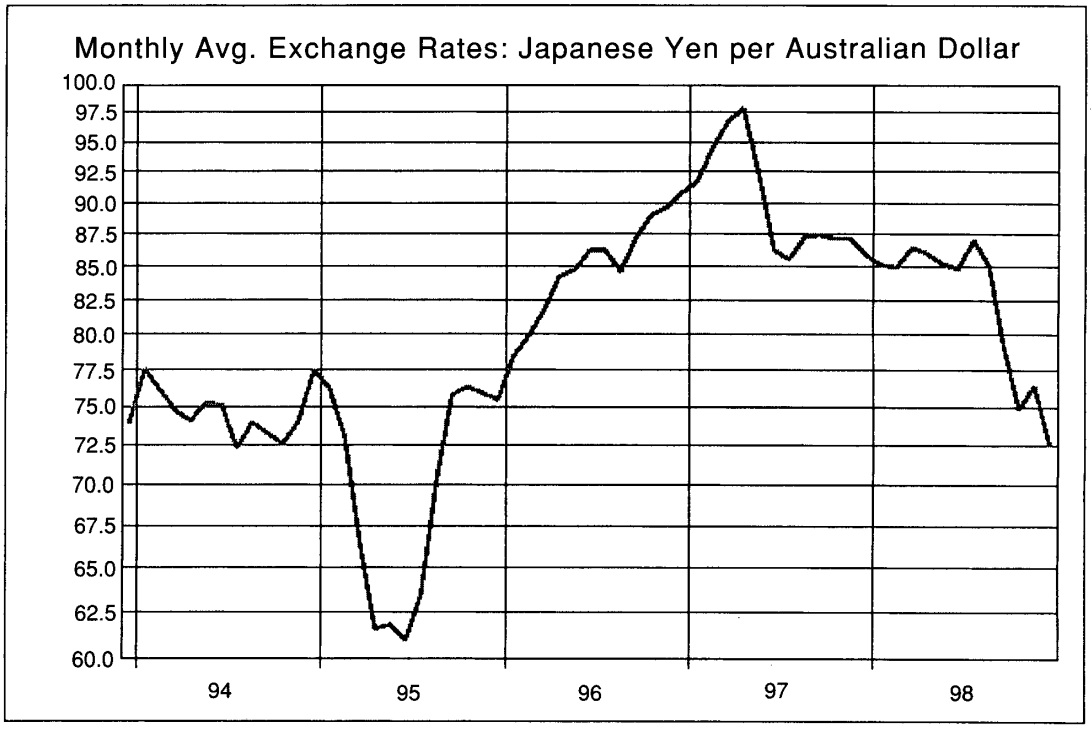
Where the exchange rate, g, as well as its rate of change, **x**. Are stochastic and **(q* = q – x + β)**. β is a deviation from uncovered interest rate parity and is assumed to have a distribution of **N(0, β)**.

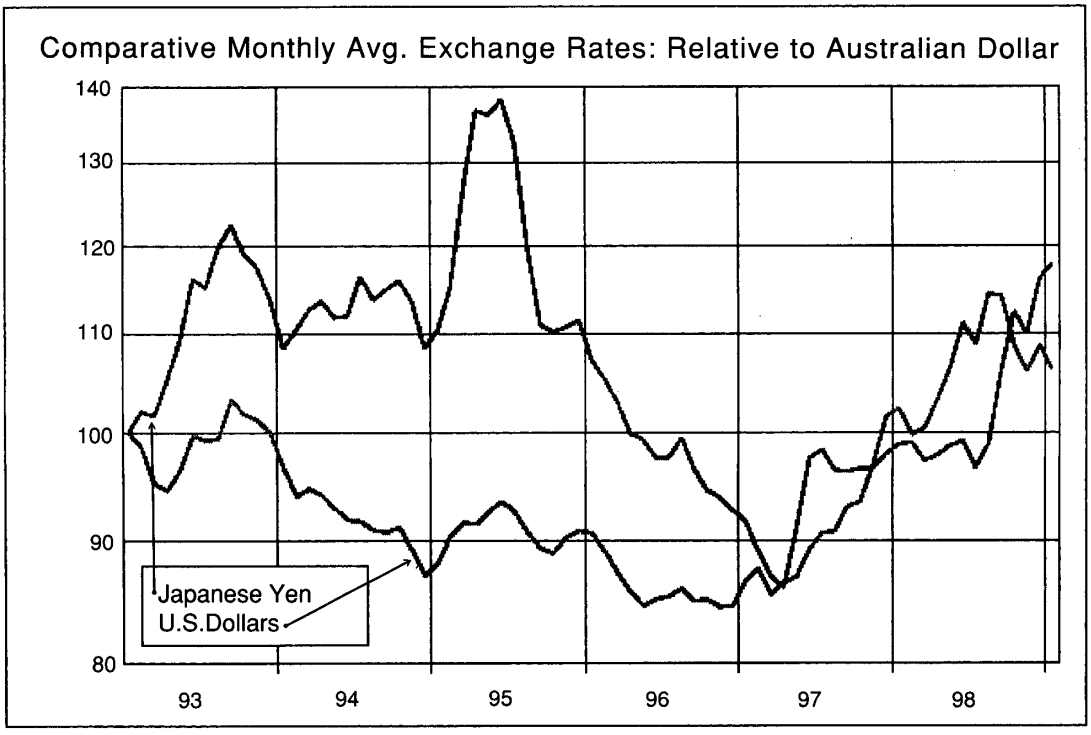
In this study we estimate the equation (1) using daily and monthly data[15] In the diagram below we present the volatility and changes (log scale) of the Australian dollar and the Japanese yen for the period under study.

15) The two-step estimation method is consistent with the method used by Fama and French (1992). To adjust for possible bias due to cross-equation dependencies, the return equations in each group are estimated as a simultaneous equation system, using a modified Seemingly Unrelated Technique (SUR) developed by Chamberlain (1982) and Macurdy (1981) and modified by Chen (1996) in a way to produce asymptotically efficient estimates without imposing either conditional homoskedasticity or serial independence restrictions on disturbance terms.

Diagram 1

Japanese Yen and Australian Dollar in the Period 1993–1997 (linear and log)





The Australian sample consisted of 23 banking corporations, as measured by asset size and reported by the Reserve Bank of Australia. All those banks traded continuously on the Sydney Stock Exchange and were able to provide us with the detailed financial reports. Our sample was then narrowed to 15.[16] The inclusion of only the biggest banking corporations has been justified by three main reasons: *First*, we tried to keep a sample at par with the Japanese representation which consists mainly of big multinational banking corporations; *Second*, only those banks seem to have significant international activities; *Third*, big banks are likely to be perceived as potentially important contributors to systemic risk and therefore worthy of closer scrutiny (Appendix 1 provides a list of all Australian banks included in the sample).

The Japanese sample includes data of the largest 31 banking corporations measured in terms of their asset size according to the Japanese Ministry of Finance statistics. This includes all major Japanese banks with significant operations overseas but excludes approximately 30 other banks that have very small overseas operations and for which we have no parent capital data. The total assets of those omitted institutions together represents less than 2% of all banking capital in Japan.[17] Appendix 2 lists all banks included in this sample. Monthly stock returns for this sample are taken from the Nanyang data. We elected to use Nanyang data because other sources (for example WorldScope and Wharton Econometrics) do not report ex-dividend dates. Daily data on Japanese stock returns also include dividends.

For our study, we have consolidated the branches of each parent company. Thus, we have one branch observation per period for each parent bank, which indicates all branch activities overseas by that parent bank. The aggregation of data was justified by two main reasons. First, all aggregated branches are capitalized by the same parent. Second, branch openings and closings can result in large changes in individual branch data associated with the transfer of assets between branches of the parent bank, even if no significant change in overall branch activity has occurred.

Agencies are included in the branch total. They operate like branches in terms of their assets but, unlike branches, are prohibited from accepting deposits. Because the capital of a subsidiary, rather than the capital of the parent bank, is relevant for meeting capital requirements, subsidiaries of each bank remain as independent data, and separate regressions can be estimated

14) While all major trust banks were included here, we have not included two smallest which have no significant presence overseas (do not have any branches or subsidiaries overseas, although they have 3 small agencies). The largest regional banks are also included, each of which has at least one branch in the US, Asia, or Europe.

for the set of subsidiaries.[18)]

As the proxies for the market return, **rn**, we use the Financial Australian value-weighted index for Australia, and the Nikkei index for Japan. Banking returns, ***rb***, are obtained from the Sydney Stock Exchange financial index for Australia, and the Nikkei bank index for Japan.

With regard to the selection of the appropriate exchange rate movement (appreciation or depreciation) measure three issues were of certain concern. *First*, the choice between nominal and real exchange rates; *Second*, the choice between many bilateral and multilateral exchange rates and; *Third*, distinction between its anticipated and non-anticipated components. We decided to use nominal rates because they are readily available and because both rates (real and nominal) are highly correlated. With regard to the bilateral-multilateral rates, we first estimated the equation using trade-weighted foreign exchange rates, then estimated it with several other of the bilateral rates.

The conventional augmented market model calls for *non-anticipated* changes in the exchange rate (Czerkawski & Kawamoto, 1997). Expected changes over time should not affect significantly returns, as they should be adequately reflected in the stock price. The strong evidence provided by Meese and Rogoff (1983) that the current exchange rate outperforms standard exchange rate models in predicting the future exchange rate has been additionally supported by Chinn and Meese in their later research (1955). Hence, we assume here that the actual exchange rate changes are largely unpredictable and we use the actual changes as an indicator of the unanticipated changes.[19)]

In table 1 we present the results of the estimation. Here the statistics that describe the distribution of the estimated exchange rate exposure measures, **β*is***, including the mean and median estimates and the standard deviation of the estimates, some aspects of its range, and the

18) The distinction between Japanese subsidiaries and branches is significant. Japanese subsidiaries have much larger retail operations (than Australian banks) and are separately capitalized. They are not included in the capital or assets of their Japanese parent. On the other hand, Japanese branches (and agencies) are not separately capitalized, relying on the capital of their parent. Branch activity should be more sensitive to capital problems of the parent, since their size and portfolio composition affect the risk-based capital ratios, the overall percentage contraction by the well-capitalized subsidiaries is, on average, of the same magnitude as that for the branches, which rely on rather poorly capitalized parents.

19) Note that the linkage between bank's risk and its use of off-balance derivative transactions is not analyzed her. We assume that exchange risk betas are a function of both firm's balance sheet exposure as well as derivative off-balance sheet exposure. We note that the interest rate betas and exchange rate betas are interdependent, which suggests that a simultaneous analytical framework is necessary to estimate bank-specific determinants of betas.

Table 1 Estimated Exchange Rate Exposure for Australian and Japanese Commercial Banks (1)

Statistic	Australian estimate (monthly)	Australian estimate (daily)	Japanese estimate (monthly)	Japanese estimate (daily)
Median	0.022	0.032	–0.212	0.009
Mean	0.059	0.072	–0.210	0.101
Standard Deviation	0.109	0.107	0.291	0.203
Minimum	–0.131	–0.103	–0.819	–0.225
First Quartile	0.030	–0.109	–0.108	–0.103
Third Quartile	0.039	0.285	0.300	–0.271
Maximum	0.211	0.432	0.437	0.120
Significant at 5% (2)				
Number of Banks	4	6	17	22
Percent of Total	27	40	55	71
Significant at 10%				
Number of Banks	7	9	21	25
Percent of Total	47	60	68	81
FIRMS in SAMPLE	15	15	31	31

Notes:

(1) Distribution of estimates of **βis** from the regression equation (1) with **βit**, **βmt**, **βbt**, returns to the bank, to the market, and to the portfolio of bank stock in the period **t**. **S** denotes the appreciation of the trade-weighted exchange rate in period t.

(2) The number and percent at the 5% and 10% levels refer to the number of banks whose exchange rate coefficients were found to differ statistically from zero at those confidence levels using the White-adjusted standard errors.

(3) Sample period, from 1 July, 1992 to 30 June, 1997

number of firms whose risk is found to be statistically significant.

In the table above we present the results for the Japanese and Australian samples. All data obtained here have statistically significant effects that are of the predicted sign and the magnitude.

The first two columns present the results for the monthly and daily estimates for the Australian commercial banks, and the last two for the Japanese banks. Accordingly to our expectations that the exchange rate should vary across the banking sector, the estimates of **βis** include both

positive and negative values for both countries. For Australia, the risk exposure range from −0.13 to 0.21 at the monthly intervals, and from −0.10 to 0.42 at the daily frequency with over most of the point estimates being positive. The range of estimates for the Japanese firms is greater, with monthly frequencies from −0.23 to 0.43 and daily frequencies from −0.10 to 0.42.

The corresponding 5% and 10% significance levels indicate the number of banks in each sample for which we reject the null hypothesis that the coefficient on the exchange rate is zero. According to our data, the number of such banks rises when we move from monthly do daily data. Moreover, the fraction of such banks is significantly greater in the Australian sample than in the Japanese one. At the 5% level, we can reject the hypothesis that the coefficient is zero for 4 of the Australian banks and for 17 of the Japanese banks. This represents 27% of the Australian sample, and 55% of the Japanese sample. At the 10% level, the numbers rise to 7 for Australia and 21 for Japan, representing 47% of the Australian sample and 68% of the Japanese sample.

At the daily intervals, the number of banks for which we can reject the hypothesis that sis equals zero rises. At the 5% level, it rises to 6 Australian and 22 Japanese banks. This represents 40 percent of the Australian sample and 71 percent of the Japanese banks. At the 10% level, we can reject the hypothesis for 9 Australian banks and for 25 Japanese banks, representing 60% of the Australian sample and 81% of the Japanese sample.

The findings that Japanese banks are more sensitive (or more frequently display sensitivity to exchange rate fluctuations) than the Australian banks may be influenced by the distinctive features of banking in both countries.[20] For example, the Australian sample is weighted less heavily by money center and dealer banks than the Japanese sample (23% of all Australian banks can be characterized as money center banks, whereas 32% of the Japanese sample belong to the same group).

To ensure that the results for the sample are robust, we also considered a number of alternative specifications. To compensate for the structural inadequacy between Japanese and Australian sample we calculated the percentage of significant exchange rate parameters for sixteen major city, trust and long-term credit banks in Japan. The results in each case were rather dissimilar to those reported in the table 1. Consequently, within this more narrow sample only three banks or 18% of the sample have foreign exchange parameters that differ significantly

20) These findings are not consistent with the study by Chamberlain (1997) on currency exposure in the US and Japanese corporations. This may be explained by a different time horizon and significant changes which have taken place in the Japanese financial system in the mid 1990s.

from zero at the 10% level. And this is much lower than the original 81% found in the full sample. On the other hand, 48% of the Australian money center banks have significant coefficients at the 10% level. This can again be explained by significant differences in the operations of these banks in the two countries such as different structure of ownership, different securities and derivatives laws, differences in banking supervision, in foreign ownership (Australian banks own much higher shares of foreign assets than Australian banks) and in hedging strategies.

Foreign currency positions of the banks change every year so the currency exposure parameters will also change. Re-estimation of the equation (1) year by year should yield a better result than of the whole period. On the other hand, several estimations (for each year separately) will rise the standard error quite significantly. The number of banks for which the hypothesis that the exchange rate coefficient is zero will fall and the results of this estimation are shown in table 2.

Interestingly enough most of the past studies in this area failed to reject the hypothesis that

Table 2 Year-by-Year Estimates of Exchange Rate Exposure for Australian Banks

Year	**1993**	**1994**	**1995**	**1996**
Median	–0.008	0.034	0.121	–0.105
Mean	0.134	0.231	0.721	0.003
Standard Deviation	0.142	0.412	0.810	0.133
Minimum	–0.671	–0.442	–0.972	–0.116
First Quartile	–0.227	–0.091	0.652	0.449
Third Quartile	0.721	0.171	0.140	0.091
Maximum	0.812	0.611	0.868	0.819
Significant at 5% Number of Firms	3	5	4	6
Significant at 5% Percent of Total	20	30	27	40
BANKS in THE Sample	**15**	**15**	**15**	**15**

- **rit**, **rmt**, **rbt** are daily returns to the banks, to the market, and to the portfolio of bank stocks in period **t**. The **st**, denotes the appreciation of the trade weighted exchange rate in period **t**.
- The number and percent recorded as significant at the 5% level refer to the number of banks whose exchange rate coefficients were found to differ statistically from zero at that confidence level using White-adjusted standard errors.

the exchange rate coefficient is zero. In trying to explain these failures at the individual bank's level, it was often suggested that the exchange rate coefficient appears indistinguishable from zero because firms largely hedge their exchange rate exposure.

The findings presented here are certainly less indicative of complete hedging. Instead, they lend support to another explanation, namely, that some of the failures to reject the hypothesis came from tests with low power. Moving from monthly to daily data made it easier to discern firm level exchange rate exposure. The use of higher frequency data might also contribute to this type of analysis.

The net effect of the parent bank foreign exchange exposure was to reduce total Japanese lending presence overseas. There is little evidence of loans shifting from branches to subsidiaries if only because most Japanese banks have only branch presence overseas. Given the size of

Table 3 Year by Year Estimates of Exchange Rate Exposure for Japanese Banks

Parameter/year	1994	1995	1996	1997
Median	0.010	0.090	0.021	0.011
Mean	0.094	0.174	0.431	0.180
Minimum	–0.432	–0.121	–0.029	–0.103
Standard deviation	0.200	0.218	0.221	0.198
First Quartile	–0.331	–0.091	–0.004	–0.083
Third Quartile	0.211	0.312	0.289	0.119
Maximum	0.619	0.711	0.569	0.615
Significant at 5 percent				
Number of banks	8	6	11	8
Percent of total	26	19	35	26
Banks in sample	31	31	31	31

Notes:
(1) The variables **rit**, **rmt**, and **rbt** are daily returns to the firms, to the market, and to a portfolio of banks' stocks in the period **t**. The variable **s**, is the appreciation of the trade weighted exchange rate in period **t**.
(2) The number and percent recorded at the 5 percent level refers to the number of banks whose exchange coefficients were found to differ statistically from zero at that confidence level using White-adjusted standard errors.

branch operations relative to those of subsidiaries, it is doubtful that the significant shrinkage found in branches could be explained by shifting between branches and subsidiaries. On the other hand, Australian banks quite extensively use loan shifting in the time of foreign exchange shocks.

3. Measurement of Foreign Exchange Exposure

The most common source of currency risk are all bank's holdings (assets and liabilities) denominated in foreign currency. The other sources are more subtle yet could be even more important. For example, the profitability of domestic operations which can be affected by foreign exchange fluctuations. The most obvious illustration of this particular risk is the loan extended to local exporter who suffers losses due to currency devaluation. The risk of default or bankruptcy will surely affect the value of the loan and the profitability of the bank.

In this section we use data from financial statements of Australian companies in order to define the accounting indicators of currency risk. These reports are prepared according to the Australian accounting standards and contain assets and liabilities from overseas. Foreign assets include here debt securities, foreign stocks, and foreign commercial loans. Foreign liabilities include interest bearing and non-interest bearing deposits held overseas. The difference between foreign assets and foreign liabilities, net assets, will provide a measure of foreign exchange exposure here.

Australian data provide also some information on the extent of off-balance sheet foreign exchange operations, which can also contribute to currency exposure. In this sample the off-balance sheet disclosures include the notional value of all foreign exchange transactions held by bank and the market value of these transactions, when the market value is positive.[21)]

With regard to the Australian sample, we built a dummy variable, 'representing' truncated

21) According to Gorton and Rosen (1995) these data truncate the true market values, which could be either positive or negative. They also point out that there is no clear relationship between the market value and the notional value. In USA FAS 107, which has been updated by FAS 119, was adopted as GAAP in 1993 and requires all firms to provide disclosures on the market value of financial assets and liabilities, and on off-balance sheet disclosures. In principal, according to Chamberlain (1996), these disclosures might be used to form better measures of off-balance sheet activities with respect to hedging or speculating in foreign currencies than those provided by the Y-9 reports. This point is accepted by Collins and Venkatachelam (1966) in their analysis of interest rate risk in banks. According to F. Gul, the above remarks characterize also Australian financial companies (Hong Kong Chinese University Seminar, 1997).

market value or the notional value, which would indicate whether such transactions are used by these banks.[22] Then, the relationship between foreign exposure and the dummy variable will be estimated. Should these transactions be risky, i.e. used primarily for speculation purposes, the relationship between exposure and the use of such transactions would be positive. On the other hand, if these transactions are used to hedge, then their use would be negatively related to the exposure.

The other indicators of foreign exchange exposure discussed in this section include the cumulative foreign currency translation and foreign loans charged off. The former item can be defined as the conversion to A$ (Australian dollars) of the value of assets and liabilities of a foreign business unit. In Australian practice this refers to a subsidiary or branch whose functional currency differs from A$. In that case in each period the value of assets and liabilities is measured in A$. This extra foreign exchange gain or loss is added to the cumulative foreign currency translation exposure, which adjusts shareholders' stock but not his income.[23]

In table 4 and the following diagrams the Australian sample is summarized for the period 1993–1996.

Table 4 Exposure Proxies as a percent of Total Assets for 15 Australian banks

Item\Year	1993	1994	1995	1996
Foreign Debt and Equity Median	0.114	0.031	0.144	0.192
Mean	0.561	0.742	0.811	1.671
Standard Deviation	2.981	1.998	2.562	2.101
Number Of Observations	15	15	15	15

22) Dummies are used frequently in forex models to investigate whether there is a possibility that the structure of the model may have changed because of changes in market environment and external shocks. Dummies are also introduced for exchange rates given a wide secular swing in exchange rates during particularly long period in which a sample is investigated. For example, a dummy variable 1 for a strong currency period, 2 for the weak currency period, and 0 for the rest of the sample period. The three-way dummies imply that the resulting coefficients should be interpreted qualitatively rather than numerically. Dummies are introduced in both intercept and the slope of interest rate and exchange rate betas.

23) When bank sells such assets and liabilities, the gain or loss then becomes a art of net income. Revenues and expenses denominated in foreign currencies are also translated into A$-effectively recognizing a gain or loss in current income.

Foreign Commercial Loans Median	1.144	1.965	0.963	1.299
Mean	4.002	3.116	3.854	2.543
Standard deviation	4.649	4.473	4.011	3.893
Number Of Observations	15	15	15	15
Foreign Deposits Median	3.160	2.884	2.170	2.091
Mean	9.019	11.228	10.176	8.330
Standard Deviation	10.675	12.516	11.344	9.771
Number Of Observations	15	15	15	15
Net Asset/deposit Median	0.988	0.101	2.781	1.652
Mean	–7.542	–5.551	–4.641	–7.501
Standard Deviation	9.111	8.482	8.561	6.777
Number Of Observations	15	15	15	15
Foreign Currency Translation Median	0.001	0.000	0.000	0.001
Mean	–0.002	–0.007	–0.010	–0.001
Standard Deviation	0.054	0.033	0.021	0.009
Number of Observations	15	15	15	15
Foreign Income Median	0.511	0.449	0.572	0.371
Mean	1.211	1.525	1.718	1.297
Standard Deviation	1.396	1.762	1.899	1.481
Number of Observations	15	15	15	15
Foreign Interest Expenditure Median	0.384	0.228	0.162	0.090
Mean	0.422	0.384	0.552	0.217
Standard Deviation	1.211	1.562	1.318	1.552
Number of Observations	15	15	15	15

Table 4 and 5 give a short summary of banks' exposure for the period 1993–1996. For example, the median values for foreign deposits declined from 3.1% in 1993 to 2.0% in

Table 5 Exposure Proxies as a percent of Total assets for 15 Australian Banks (Off-Balance Sheet Foreign Exchange Transactions and Charge-offs)

Item/Year	1994	1995	1996	1997
Foreign Charge-Offs Median	0.094	0.099	0.085	0.079
Mean	0.121	0.165	0.153	0.117
Standard Deviation	0.138	0.199	0.332	0.312
Number of Observations	15	15	15	15
FOREX Contracts at MV* Median			0.219	0.045
Mean			3.340	3.184
Standard Deviation			4.902	4.967
Number of Observations			15	15
FX Contracts < 1 year Median			0.918	1.763
Mean			32.674	56,654
Standard Deviation			69.551	131.517
Number of Observations			15	15
FX Contracts > 1 year Median			0.421	0.331
Mean			8.116	6.448
Standard Deviation			14.611	12.663
Number of Observations			15	15

Notes:

a is the dollar value of foreign debt securities and foreign stock held in investment portfolio;

b is the interest and non-interest bearing deposits held in foreign branches;

c is the sum of foreign investment assets and foreign commercial loans less interest and non-interest bearing deposits;

d is the cumulative translation effects of exchange rates on assets and liabilities held by the company in foreign branches and subsidiaries with functional currencies other than A$;

e is the income on foreign debt and equity securities;

f is the interest expense paid on deposits held in foreign branches and subsidiaries;

g is the foreign exchange transactions reported at market value (as long as market value is not negative;

h is the foreign exchange transactions maturing in less than one year, reported at their notional values;

i is the foreign exchange transactions maturing in more than one year, reported at their notional values.

1996. Median foreign income fell down from 0.5% to 0.3%. There was a slight increase in foreign commercial loans from 1.1% to 1.3% and in foreign debt and equity from 0.11% to 0.19%.

Table 6 Australian Banks Affected by Exchange Rate Shocks[24] (The Effects of Dummy variable)

Three Groups of Banks	StrongA$		WeakA$	
	INTERCEPT	SLOPE	INTERCEPT	SLOPE
Four Largest Banks	2	1	2	1
Second 6 Banks	6	0	3	1
Third 5 Banks	0	3	0	5
TOTAL	**8**	**4**	**5**	**7**

Periods of weak A$: 03-05 1993; 11-01 1995; 05-12 1996
Periods of strong A$: 08-12 1993; 05-08 1995; 05-12 1996

Notes:

Below the list of banks in three groups

In the first group (banks affected by exchange rate shock):
National Australia Bank, ANZ, Commonwealth (strong A$); Westpac, NAB, Commonwealth (weak A$)

In the second group:
Bank West, Bank of NSW, Advance, Challenge, Queensland, Macquerie (strong dollar); Macquarie, Advance, Challenge, Queensland (weak dollar);

In the third group:
Metway, St George, Bank of South Australia (strong dollar); Metway, St George, Bank of South Australia, Bank of Melbourne, Primary Industry Bank (weak dollar)

The result from the exchange rate dummy shows that a total of 15 Australian banks are significantly affected by changes in exchange rate. They also demonstrate that Australian banks reduced their foreign commercial lending and their deposits during the period 1993–1997. In particular:

24) The numbers in the table are the number of banks that are affected significantly (ten percent level, two-tail test) by the exchange rate policy shocks. The exchange rate dummies are the strong dollar (one period in 1973, 1995, 1996), weak dollar (1993, 1995, 1996) and trendless (1994). All exchange rate dummies are positive and no single bank is affected through the intercept and slope dummies simultaneously for a given external shock.

1. Their median foreign commercial lending fell significantly from ... in 1994 to ... in 1996, and their median foreign deposits also declined. In the same time they more than doubled the percentage of their assets held in foreign debt and equity securities.
2. The differential response to the strong dollar and weak dollar period is likely to be related to a bank's basic and derivative exposure positions. If a bank has a net positive asset exposure, then a strong A$ will lower the value of the bank's stock in dollar terms, while a weak dollar may raise it.[25)]
3. Banks that showed significant exchange rate dummies include the largest Australian banks such as National Australia bank, Westpac, and the Commonwealth Bank. Though these results are not completely conclusive they may support the conclusion that bigger banks are usually less susceptible to external policy shocks than smaller banks because their superior hedging efficiency with regard to the use of derivatives.[26)]
4. Table (7) shows Net, i.e. the sum of all foreign commercial loans and foreign debt and equity securities less foreign deposits. Net tends to be negative for the sample of Australian banks, and it was the most negative in 1996. To the extent that foreign assets and liabilities are denominated in foreign currency, a negative value of net means a short foreign currency position (long A$ dollar). In the absence of complete hedging, such a position would suggest that these banking firms as a whole would suffer translation losses with depreciating A$. The short foreign currency position would also suggest that these banks would have positive foreign currency exposure parameters.

Table 7 shows also the income and expense data for Australian banks extracted from their financial statements. Normally these statements are less inclusive than the balance sheet data provided on normalized financial reports, hence, this study emphasizes the balance sheet data.

25) The effect of currency translation can be partially modified by an economic effect of exchange rate changes on operational cash flows (for example, a strong dollar or weak foreign currency may help increase revenue from foreign operations. Bank's use of derivatives for hedging, speculation and trading purposes will also affect its exchange rate (and interest rate) levels).

26) Similar results (with regard to the US banks) were obtained by Gunther and Siems (1995) and Chen (1996) who also reported a positive correlation between derivative activities and the capitalization of a bank.

Table 7

(a) Foreign Charge-offs Minus Recoveries as a Percent of Total Assets, 1993–1997
(median values for 15 banks)

Year	1993	1994	1995	1996	1997*
Percent	0.02	0.03	0.07	0.08	0.11

(b) Cumulative Foreign Translation as a Percent of Total Assets
(mean values for 15 Australian banks)

Year	1993	1994	1995	1996	1997*
Percent	0.01	0.03	0.10	0.08	0.09

(c) Foreign Income and Expense as a Percent of Total Assets
(median values for 15 Australian banks)

Year	1993	1994	1995	1996	1997*
Income on Foreign Debt and Equities	0.1	0.2	0.2	0.4	0.2
Interest Paid on Foreign Deposits	0.0	0.0	0.0	0.1	0.0

* preliminary data for fiscal 1997 show decline due to the aftermath of the Asian financial crisis

Note: Net foreign assets are the sum of foreign commercial loans and foreign debt and equity securities minus interest and non-interest bearing foreign deposits.

5. Cross-sectional Analysis

In this section we shall use the total foreign exchange exposure estimates calculated in section 2 for the assessment of the range and the extent to which they can be explained by the accounting indicators (discussed in section 3).

The analysis will explain the adequacy of the accounting disclosures as indicators of foreign exchange risk and into risk management strategies of our sample. We are particularly interested whether, and in what way, a bank's off-balance sheet foreign exchange strategy contributes to the overall exposure. Although, theoretically regarded as risky these operations can reduce currency exposure. The possibility of hedging exposure through off-balance sheet activities

will be examined here. The possibility will be positively confirmed if such activities are linked to the estimates of the total currency exposure.

Again, although the method of estimating currency risk allows for exposure measure to be changed each year — in our study we restrict the exchange parameters to be constant for a given bank for the whole period. We adopt more restrictive assumption because of concerns regarding the reliability of the annual currency risk estimates. In accordance with the assumption that exchange rate exposures are the same across years, we have also to assume that the accounting measures are constant over the same period (averaged accounting measures used across the four year period of the sample).

In table 8 we show the simple corelations of various accounting measures and estimated exchange rate exposure. The estimated exposure is positively correlated with most of the accounting measures, and it is most highly correlated with the size of the firm. The simple correlation between the estimated exposure and accounting measures of the share of foreign assets, of foreign liabilities, of Net, and of foreign charge-offs — all lie between 0.23 and 0.45 in absolute values (Net has negative sign). The correlation among these variables are also strong, with the correlation between foreign assets and foreign liabilities equal to 0.87.

Table 8 Simple Correlation of Exchange Exposure Measures*

	Exchange rate estimate	Exchange rate Estimate Absolute	Size	Foreign assets	Foreign Liabilities	Net	Foreign Charge Offs	Dummy Exchange Transac-tions	Foreign currency Transla-tion
Foreign exchange estimate	1 0 15	0.621 0.000 15	0.645 0.002 14	0.448 0.007 15	0.671 0.004 15	–0.231 0.005 15	0.871 0.010 15	0.119 0.822 15	–0.322 0.399 12
Foreign exchange Estimate Absolute		1.000 0 15	0.776 0.000 14	0.561 0.100 15	0.441 0.120 15	–0.126 0.109 15	0.881 0.021 15	0.219 0.771 15	–0.128 0.283 12
Size			1 0 14	0.950 0.021 15	0.328 0.007 15	0.003 0.003 15	0.294 0.031 15	0.482 0.006 15	0.138 0.002 12
Foreign assets				1 0 15	0.869 0.004 15	–0.990 0.020 15	0.331 0.001 15	0.328 0.411 15	–0.176 0.066 12
Foreign Liabilities				0	1 0.007 15	0.908 0.000 15	0.610 0.001 15	0.490 0.101 15	–0.882 12

Net						1 0 15	–0.911 0.006 15	–0.424 0.001 15	–0.020 0.277 12
Foreign Charge Offs							1 0 15	0.577 0.032 15	0.322 0.217 12
Dummy Exchange Transactions								1 0 15	–0.412 0.661 12

* Notes: Data in the table above include the Spearman correlation index, significance level, and number of observations used to calculate the correlation. All variables are scaled by total assets prior to calculation of correlations. The definition of exchange rate estimate and the estimated βis from the regression: **rit = βio + βimrmt + βibrbt + βisst + uit**

Foreign Assets — is the dollar value of foreign debt and foreign equity securities held in the investment portfolio and foreign commercial banks;

Foreign Liabilities is the dollar value of interest and non-interest bearing deposits held in foreign branches;

Foreign charge offs is foreign loans charged-off;

Dummy exchange transactions — takes a value of one (1) if the company reports non-zero values of the notional value of foreign exchange contracts which mature in one year or less;

Foreign Currency Translation — the cumulative effects of exchange rates on assets and liabilities held by the bank in foreign branches with functional currencies other than A$;

Size is the log of total assets;

Absolute exchange rate estimate is the absolute value of the foreign exchange rate estimate.

The correlation between the estimated exposure and total assets is also very strong (0.64). The correlation between exposure and the measure of foreign currency translation and the dummy for transactions are much weaker; 0.12 for the dummy variable, and 0.32 for translation.

The simple correlation between the estimated exposure and Net is negative. This is consistent with the results obtained earlier (table 1 and 2). The estimated exposure was definitely positive indicating a total long-term positions. Any reduction in such a position would result in the acquisition of foreign currency assets or a decline in foreign currency liabilities (a lower exposure can come form increase in Net).

The multiple correlation regression framework explores this correlation, in particular the ability of the accounting measures to explain the estimates of total currency exposure, more closely. In table 9 the results of seven regressions of the estimated total exposure are presented. In column 1 and 2 the results from univariate regressions of estimated exposure on asset size and on the Net; in column 3, the results from both asset size and net; in column 4 to 7, the results from regressions that include Net and one more variable.

Table 9 Regressions of Estimated Exchange Rate Parameters on Accounting Indicators for 15 Australian banks

Parameters and Estimated Coefficients	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	–0.763 –3.41	0.122 3.66	–0.344 –2.18	0.451 2.91	0.771 1.45	0.192 3.22	0.022 3.51
Size	0.191 4.11		0.006 2.55				
Net		–0.355 –3.17	–0.671 –2.18	–0.320 –1.17	–0.417 –2.41	–0.329 –3.68	–0.199 –2.12
Foreign Charge Offs				18.510 2.391			32.301 3.15
Foreign Exchange Dummy					–0.169 –2.18		–0.228 –3.53
Foreign Currency Translation						–21.229 –0.599	
Number of Observations **Adjusted R^2**	15 0.33	15 0.22	15 0.29	15 0.21	15 0.19	15 0.24	12 0.31

Notes:

All parameters reported are the estimated coefficient and its t-statistics. All variables are scaled by total assets before calculating correlation (except size).

The estimated β is from the regression:

Rit = βio + βimrmt + βibrbt + βisst + uit

Size is the log of total assets of a bank;

Net is the dollar value of foreign securities and foreign equities held in banking portfolio and commercial loans minus the dollar value of interest and non-interest bearing deposits held in foreign branches;

Foreign charge-offs is foreign loans charged off;

Foreign Exchange Dummy is a dummy variable taking on a value of 1 if the company has foreign exchange transactions which mature in one year or less and zero otherwise;

Foreign Currency Translation is the cumulative translation effects of exchange rates and liabilities held by the company in business units with functional currencies other than A$.

As might have been expected the results confirm a strong correlation between various accounting variables. For example, the estimated currency exposure is strongly correlated with the remaining parameters, in particular with the foreign charge-offs, the size, and the liabilities of the bank (within the range of 0.45 to 0.87). The correlation between foreign assets and liabilities is also very high (0.87) as is the correlation between the size and the remaining accounting measures. The correlation between the estimated foreign exchange exposure and the measure of foreign currency translation and the dummy is lower; 0.12 for the dummy and −0.32 for the foreign translation measure.

In line with the previous research, the correlation between the estimated exposure and the Net is negative here. This should be consistent with the results from the table (1) which suggested that a reduction in an overall long-A$ dollar position would bring about an increase in foreign currency assets or a reduction in foreign currency liabilities. I.e. a reduction of foreign exchange exposure can come from an increase in the Net.[27)]

The correlation reported in table 8 suggested that multicollinearity does not allow for the separate identification of the individual effects of the accounting factors. Columns one to three show this by the reduction in the t-statistics on Net and on Size which occurs when both are included in the same regression. Despite the multicollinearity, the sign of the coefficient on Net is negative in all six regressions in which it is included, and it differs significantly from zero in two of them. Its estimated value ranges from −0.19 to −0.67 hence, a one percent change in the short position relative to total assets implies roughly a 0.20 percent to 67 percent change in the estimated exchange rate parameter. The negative coefficients suggest that the larger the short foreign currency position a bank holds, the larger (more positive) is the exchange rate exposure parameter.

Compared with some earlier studies we found out that Australian banks can significantly redude their foreign exchange exposure by using hedging. Columns 5 and 7 show the coefficient on the dummy indicating that the reported use of forex contracts is visibly and significantly negative. This is also consistent with the conventional wisdom of bank executives who use hedge contracts to minimize the exposure. The adjusted R^2 of each regression range from 0.19 to 0.33 which also suggests that accounting data are able to explain a non-trivial portion of the exchange rate exposure of the banks.

Table 8 and 9 suggest that exchange exposure is very closely correlated (positively) with the

27) According to Chamberlain (1997) it would require an increase in the Net to the extent that foreign assets and liabilities are denominated in foreign currency.

size of the bank. The largest banks (National Australia Bank, Westpac Banking Corporation) have also the largest foreign exchange exposure. These banks maintain the largest short positions in foreign exchange. At the same time they are actively involved into derivative contracts such as currency swaps, ... As these activities contribute significantly to foreign exchange risk, they offer another potential explanation of the link between exposure and the size. On the other hand, the evidence from the off-balance sheet forex activities (reported use of forex contracts) suggests rather lower and not greater forex exposure. There is also no final evidence that the cumulative foreign currency translation balance provides a useful benchmark of foreign exchange exposure.

The study has confirmed that to some extent banks do reduce part of their forex exposure through the use of foreign exchange contracts. It also suggests that it is largely misleading to judge these contracts in isolation from the banks' underlying activities. Another finding of more practical significance is that accounting disclosures only partially explain the forex sensitivity of our banking sample.

Conclusions

In this study we have analyzed the foreign exchange sensitivities of the Australian and Japanese banks based on daily and monthly data. In addition, the degree to which forex sensitivity can be explained by accounting measures was also investigated with regard to Australian banks.

We have concluded that there are significant variations in exchange rate risk betas across banks and across periods. This can be interpreted as a result of different exposure position of banks in sample. Changes in market conditions also have different influences on bank risk and share returns.

The cross-section estimation of the foreign exchange risk betas revealed the importance of traditional financial statement variables and derivative contract variables as bank-specific determinants of exchange rate risk. This also suggests that the use of financial engineering creates an additional systematic risk beyond the level that reflects a bank's traditional financial statement exposures.

Using daily data, we concluded that the share returns of approximately 45% of Australian banks are sensitive to exchange rate fluctuations. This is in contrast with most of recent studies in this area which have found rather little evidence of such sensitivity. On the other hand, this study is consistent with the findings by Chamberlain (1995) in her analysis of the US commercial

banking sector for the period of 1986–1992. This may be attributed to the use of daily data rather than to the differences in hedging activities of banks in both samples.

Another interesting finding is that after the Basle Accord, the activities of Japanese banks overseas became more sensitive to market shocks. In the same time banking activity outside Japan also became more sensitive to Japan-specific shocks given the importance of Japanese banks. The aftermath of the Asian currency crisis confirmed how closely are correlated the Japanese yen, on one side and the Australian dollar and other South-East Asian currencies.[28] Because these banks account for nearly one-fifth of commercial and industrial loans in the USA (and over 70% of all loans to South-East Asian countries), the international transmission of market shocks has potentially large effect on these countries as well as on banks themselves. Australian banks, internationally relatively insignificant, remained also vulnerable to the financial market-induces risks from overseas due to its specific economy dependent on world commodity prices.

Interestingly, Japanese banks still seem to be much less sensitive to exchange rate fluctuations. This may be attributable to a number of factors including different ownership structure, differences in profitability strategies (long-term versus short-term), more emphasis on market expansion than on short term foreign exchange considerations. Various derivatives laws, and the use of different hedging strategies.

The other factors that contribute to the differences between Japanese and Australian banking exposure include large cross-holdings of Japanese corporate shares which makes Japanese banks susceptible to downturns in the stock market (no matter how close related to foreign exchange shocks). Then, banking regulatory changes in Japan in the 1990s both enhanced enforcement of capital requirements and allowed changes in the value of bank stock holdings to directly affect bank capital, thus, setting the stage for the banking sector to transmit an adverse share price shock through reductions in credit availability. Furthermore, Japanese bank-firm lending relationships are particularly strong and important in Japan (much less in Australia). Finally, the large international presence of Japanese banks allowed them to shift much of the assets and loan shrinkage overseas, thus, insulating domestic businesses from much of the market shock.

28) Only few of the big losers during the recent Russian currency crisis were these Japanese banks which invested in hedge funds and some smaller banks which invested in high-risk securities. The biggest loss experienced by an Australian bank was that of Westpac (assumed) to be in the range of $ 15 million A$. This hardly compares with the record loss by the Credit Suisse First Boston which lost over $A400 million (Barclays lost over A$380 million).

Using cross-sectional analysis, we concluded that the reported accounting indicators of forex exposure explain, in s significant way, the extent of forex exposure in Australian banks. Our study suggests that approximately ... to .... of the estimated forex exposure may be explained by accounting indicators. We find also an evidence of a negative relationship between the net foreign asset position of Australian bank and its foreign exchange exposure. Among similar banks, those with off-balance sheet activities in foreign exchange contacts exhibit less forex exposure. This is consistent with the conventional wisdom and the practice of off-balance hedging. Further, it suggests that, data on such contracts provide inconclusive if not contradictory evidence with off-balance hedging. The findings suggest rather the necessity of a comprehensive view of a bank when evaluating its forex exposure.

This paper addressed only one aspect of the international transmission of banking risks, and not the effects of the disruptions of these risks on borrowers or lenders. However, several previous studies have suggested or documented that even large customers of Japanese banks overseas can be adversely affected by foreign exchange exposure (Czerkawski and Kawamoto, 1997; Gibson 1995). This evidence highlights the fact that the globalization of banking require policymakers to monitor more closely both banking conditions and policy responses to shocks overseas, which are now more easily transmitted overseas.

Appendix 1 Australian Banks Included in this Study

Bank	Estimated Exchange Rate Coefficient	Significance Level White-Adjusted
Advance Bank Australia Limited	–0.151	0.871
Australia & New Zealand Banking Group Limited	–0.031	0.021
Bank of Melbourne Limited	–0.073	0.226
Bank of Queensland Limited	–0.128	0.051
Bank of South Australia Limited	–0.003	0.970
Bank of Western Australia Limited (trading as Bank West)	0.018	0.090
Challenge Bank Limited	0.127	0.441
Commonwealth Bank Limited	0.011	0.089
Macquarie Bank Limited	0.262	0,001
Metway bank Limited	–0.037	0.012
National Australia Bank Limited	0.121	0.016
Primary Industry Bank of Australia Limited	–0.012	0.782
St George Bank Limited	–0.066	0.671
State Bank of New South Wales Limited	0.210	0.001
Westpac Banking Corporation	0.155	0.014

Appendix 2 Japanese Banks Included in this Study

Dai Ichi Kangyo
Sakura
Fuji
Bank of Tokyo-Mitsubishi
Asahi
Sanwa
Sumitomo
Tokai
Hokkaido Takushoku
Daiwa
Industrial Bank of Japan
Long-term Credit Bank
Nippon Credit Bank
Mitsui Trust and Banking Corporation
Mitsubishi Trust and Banking Corporation
Yasuda Trust and Banking Corporation
Toyo Trust and Banking Company
Chuo Trust and Banking Company
Nippon Trust Bank
Norinchukkin Trust and Banking Co.Ltd
Dai-Ichi Kangyo Trust and Banking Co.Ltd
Fuji Trust and banking Co.Ltd
Tokyo Trust Bank
Asahi Trust Bank
SB Trust Bank
Tokai Trust Bank
Nippon Credit Trust Bank
Nomura Trust and Banking Co.Ltd
Nikko Trust and banking Co.Ltd
Yamaichi Trust and Bank. Ltd
Daiwa International Trust Bank Ltd

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