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Three Japan Premiums in Autumn 1997 and Autumn 1998

— Why did premiums differ between markets? —

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Tetsuro Hanajiri*

This paper analyzes developments in the Japan premium in three markets – the dollar market, the yen market, and the dollar/yen swap market – in the autumn of both 1997 and 1998, when concern increased with respect to the creditworthiness of Japanese banks. Among the three Japan premiums, the relationship that "the Japan premium in the dollar currency market = the Japan premium in the yen currency market + the Japan premium in the dollar/yen swap market" generally holds. However, in the autumn of both 1997 and 1998, there were times when this relationship did not hold.

Possible reasons for the divergence of the swap rate from the theoretical value derived from its underlying assets (dollar interest rate, yen interest rate, dollar/yen spot rate) are two-fold: First, the price of underlying assets might not fully reflect risk premium implicitly existing in the market. Second, the widening of the information gap (asymmetry) concerning the creditworthiness of Japanese banks among market participants could have a bearing. The results support the possibility of both. When information concerning the creditworthiness of domestic banks in foreign and domestic markets widens, the foreign exchange swap market may function more as a foreign currency funding market than the foreign currency cash market. Based on these understandings, it is important to carefully monitor the foreign exchange swap market as well as to make efforts to improve its functioning. Information gaps between domestic and foreign market participants should be narrowed in order to reduce risk premium attached to the foreign currency funding cost of domestic banks.

Key terms: Japan premium, foreign exchange swap market, information gap, financial crisis

JEL classification: E58, F31, F34, G15

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Introduction

This paper analyzes developments in the Japan premium in three markets – the dollar market, the yen market, and the dollar/yen swap market – in autumn 1997[1] and autumn 1998.[2] [3]

During both periods, the collapse of major Japanese financial institutions led to an increase in risk premiums (the Japan premium) attaching to the transactions of Japanese banks, thereby considerably reducing their access to uncollateralized foreign currency funds. Against this backdrop, Japanese banks tried to meet their immediate dollar funding needs by first obtaining yen funds and then converting them into dollars in the dollar/yen swap market. The swap operations conducted by Japanese banks were a combination of dollar buy/yen sell transactions in the spot market and dollar sell/yen buy transactions in the forward market, which can be regarded as funding foreign currencies by using yen as collateral.

The Japan premium observed in the dollar market was also seen in the yen market and in the dollar/yen swap market. To understand the mechanism generating the premium in the dollar/yen swap market, this paper focuses on (i) divergence of the swap rate from theoretical value, which is based on the normal arbitrage relationships among the dollar/yen swap market, the dollar currency market, and the yen currency market, and (ii) widening of the information gap among market participants with respect to the creditworthiness of Japanese banks.

Sections 1-3 summarize the development of the Japan premium in autumn 1997 and autumn 1998, Section 4 illustrates how it is generated, and Section 5 refers to issues that need to be explored in the future.

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[1] On November 13, Sanyo Securities filed for protection under the Corporate Reconstruction Law. On November 17, Hokkaido-Takushoku Bank decided to transfer its businesses to Hokuyo Bank. On November 23, the management of Yamaichi Securities decided to dissolve the company.

[2] On October 23, the Long-Term Credit Bank of Japan was temporarily nationalized based on the Financial Reconstruction Law.

[3] Although the Japan premium generally refers to the premium attached to individual banks in the dollar cash market, “the Japan premium” in this paper represents premium attached to Japanese banks not only in the dollar cash market but also in other markets.

The Japan premium in this paper represents the difference between the interest rates observed in a market with a relatively large share of Japanese banks and that with a relatively small share of Japanese banks. For analysis of the information gap among market participants in Section 4, we used the data of each reference bank for dollar LIBOR and yen TIBOR during both periods.

Boxes give technical details which readers can skip if they wish since they are not integral to the flow of the text.

Box 1 Data Used for Analysis

Our analysis uses the following 3-month rates. While funding cost for a bank should be measured by bid rates that it proposes to lenders in the money market, our analysis uses ask (offer) rates due to the inaccessibility of bid rates. For approximation, we assume that each bank presents ask rates reflecting its funding cost and that bid-ask spreads are the same among all banks in the money market.

Dollar short-term interest rates

- Average Interest rate in a market mainly composed of Japanese banks: the euro-dollar interest rate in the Japan Offshore Market (JOM)

  Comparable to LIBOR (London interbank offered rate), TIBOR (Tokyo interbank offered rate) is collected and aggregated by *Zenginkyou (the Japanese Bankers Association)*. Since TIBOR for euro-dollars is not published, as a proxy we used the euro-dollar interest rate indication in JOM. JOM was established in December 1986; each participating bank opens a special account which is exclusively for offshore transactions and managed separately from other accounts. Out of the 223 banks which had special accounts with JOM as of the end of 1995, 127 were Japanese (57% share).

- Average interest rate in a market mainly composed of foreign banks: dollar LIBOR

  LIBOR is the interest rate offered by banks providing funds in interbank transactions in the London market. The British Bankers Association (BBA) designates 16 banks as reference banks and calculates and announces a fixing rate by excluding the highest four and lowest four banks, and taking the average of the remaining eight banks. Among the reference banks, three were Japanese (19% share) as of July 1999. Throughout this paper, LIBOR refers to a rate for an individual bank, and averaged LIBOR is one calculated by BBA.

Yen short-term interest rates

- Average interest rate in a market mainly composed of Japanese banks: yen TIBOR

  Yen TIBOR is announced by *Zenginkyou*. From individual interest rates offered by 18 reference banks, *Zenginkyou* calculates and announces a fixing rate by excluding the highest four and lowest four,

and taking the average of the remaining ten banks. Among the reference banks, 16[4] were Japanese banks (89% share) as of July 1999. The fixing rate is termed averaged TIBOR, and TIBOR is one for individual bank.

- Average interest rate in a market mainly composed of foreign banks: yen LIBOR

As in the case with dollar LIBOR, the highest four rates and lowest four are excluded and the average of the remaining eight banks is calculated. Among BBA's reference banks, seven[5] were Japanese banks(44% share) as of July 1999.

Dollar/yen swap rate

- Average transaction rate in a market composed of both Japanese and foreign banks: Dollar/yen swap rate (mid rate of best-bid and best-ask) indications at 15:30 in the Tokyo market

Of Tokyo foreign exchange interbank transactions, Japanese banks accounted for 46% and foreign banks 54% as of April 1998.

[4] The total number of reference banks decreased to 17 (15 were Japanese) when the Long-Term Credit Bank of Japan withdrew on November 16, 1998, and then went up to 18 (16 were Japanese) when The Shoko Chukin Bank was designated on July1, 1999.

[5] Reference bank members were reviewed on January 20, 1999, and the number of Japanese banks decreased from eight to seven.

1. Development of the Japan premium in the dollar market

Figure 1 shows developments in average euro-dollar LIBOR and euro-dollar interest rates in Japan's off-shore market (JOM). We see that rates are higher in the latter, clearly suggesting the existence of a Japan premium.

We also see a similar relationship between dollar LIBOR at individual banks (Figure 2), namely dollar LIBOR offered by a Japanese bank (Bank of Tokyo-Mitsubishi) was higher than dollar LIBOR offered by a foreign bank (Barclays Bank). It should be noted that, due to the Bank of Tokyo-Mitsubishi's high credit rating compared with other Japanese banks, the extent of increase in the Japan premium (difference between the euro-dollar interest rate in JOM and dollar LIBOR) was smaller than that observed between average euro-dollar LIBOR and average euro-dollar interest rate in JOM.

When we compare the increase in the Japan premium on a whole bank basis (average JOM dollar interest rate minus average dollar LIBOR) with that on an individual bank basis (Bank of Tokyo-Mitsubishi dollar LIBOR minus Barclays Bank dollar LIBOR) during the autumn of both 1997 and 1998, that on an individual bank basis increased rather moderately in autumn 1998, thereby diverging from that on a whole bank basis (maximum difference between both was 9bp in 1997 but 42bp in 1998). This implies that in 1998 market participants had become more conscious of differentiating counterparty creditworthiness when setting interest rates.

2. Development of the Japan premium in the yen market

Average euro-yen TIBOR was higher than average euro-yen LIBOR during both periods, also suggesting the existence of a Japan premium in the yen currency market (Figure 3).

While premium in dollar markets increased and decreased almost simultaneously as premium in yen markets, that in dollar markets was higher (Figure 4).

When looking at the data on individual banks, an increase in the interest rates offered to high-rated Japanese banks was contained, although the Japan premium itself did increase due to a decline in the funding costs of high-rated foreign banks (Figure 5). Such decline in yen funding costs can be attributed to the Bank of Japan's ample supply of yen in the domestic market under an accommodative monetary policy and lack of safe short-term yen-denominated assets, such as short-term government bonds, in which to invest.

3. Development of the Japan premium in the dollar/yen swap market

To understand the mechanism generating the premium in the dollar/yen swap market, we first show the divergence of the swap rate from theoretical value, which is based on normal arbitrage relationships between the dollar/yen swap market and underlying asset markets. Then we overview transaction volume in the dollar/yen swap market as an indicator to see whether the market had been functioning during both periods.

(1) Divergence of the dollar/yen swap rate from theoretical value derived from underlying asset prices

The dollar/yen swap is a derivatives transaction involving a dollar/yen spot transaction and a yen and a dollar interest rate transaction, and prices are theoretically decided by those of the three underlying assets.[6] Figure 6 shows

[6] The foreign exchange swap rate can be handily calculated by the following equation (see Box 2 for more detailed calculation): Given that,
interest rate on currency A: annual rate r_A (360-day basis),
interest rate on currency B: annual rate r_B (360-day basis),
foreign exchange spot rate (A against B): S,
foreign exchange forward rate which will be settled t days after the spot settlement date: F,
then foreign exchange swap rate: F-S

$$= \frac{1 + r_B \times \frac{t}{360}}{1 + r_A \times \frac{t}{360}} \times S - S$$

$$= \frac{S \times (r_B - r_A) \times t}{360 + r_A \times t}$$

the price movements of the three underlying assets (as for the dollar and yen interest rate, the difference between them is shown). Figure 7 shows the movement of the dollar/yen swap rate, namely the mid rate of best bid and best ask prices. Figure 8 shows the relationship between the swap rate and theoretical value derived from underlying asset rates. In the autumn of both 1997 and 1998, swap rates were higher than theoretical value, which means that their movement in these periods cannot be solely explained by movements in underlying asset rates.

Figure 9 summarizes the relationship between the divergence of the swap rate from the theoretical value derived from the underlying asset rate and Japan premium in the yen and dollar markets. Theoretically, the relationship that "the Japan premium in the dollar market = the Japan premium in the yen currency market + the Japan premium in the dollar/yen swap market" holds (see Figure 9-A, Box 3). Such a theoretical relationship, however, does not necessarily hold as shown in Figure 8, i.e., the left box can be higher than the right box in Figure 9-B. We should note that there is a possibility that the Japan premium in the dollar market might not fully reflect the risk premium implicitly attached. In other words, observed dollar LIBOR might be lower than it actually is, but it cannot emerge due to the Japan premium in the dollar market being prohibitively high for Japanese banks (see Figure 9-C)[7].

(2) Transaction volume in the dollar/yen swap market

Divergence in dollar/yen swap rates from theoretical values might have been induced by (i) observed dollar LIBOR perhaps not reflecting the prohibitive increase in the Japan premium in the market and (ii) a possible widening of the information gap among market participants in the dollar/yen swap market. These issues are analyzed in detail in the next section. Higher transaction volume may suggest that the dollar/yen swap market had been functioning during both periods.

[7] Also, observed yen LIBOR might be lower than the actual one due to a decline in the yen funding costs of high-rated foreign banks. Hence, the Japan premium in the yen market might not fully reflect the risk premium implicitly attached, i.e., the bottom part of the left box can be higher.

Looking at dollar/yen swap transaction volume (via brokers) in the Tokyo market, there were times, in both the autumn of 1997 and 1998, when volume increased while spot transaction volume did not. This seems to imply that, during both periods, swap transactions might have been conducted actively for different reasons from that for spot transactions (Figure 10).

In autumn 1997 (Figure 10-A), the Japan premium increased in two stages from the beginning of November to the beginning of December. Especially in the latter stage, from end-November to the beginning of December, swap transaction volume by far exceeded that of spot transactions, implying that Japanese banks' dollar funding requirement had become acute.

In autumn 1998 (Figure 10-B), spot transaction volume had been showing stable movement after peaking in the beginning of October, when the dollar/yen spot rate plunged sharply, while that of swap transactions increased from mid-October to the beginning of December in tandem with an increase in the Japan premium.

Except for autumn 1997 and autumn 1998, the volume of spot transactions and swap transactions had generally been related, as is seen from Figure 11.

Figure 12 shows movement in the ratio of dollar/yen swap transaction volume to dollar/yen spot transaction volume and also the Japan premium in the dollar market. Swap transaction volume exceeded spot transaction volume when the Japan premium increased (Figure 12).

4. Background to the premium difference between markets

This section explores reasons why three rates (yen interest rate, dollar interest rate, and dollar/yen swap rate), which are priced in a consistent way in normal times, show different movement in a stress situation as illustrated by the emergence of the large Japan premium (Box3 gives a theoretical explanation of the relationship among the three Japan premiums).

(1) Observed facts in the autumn of both 1997 and 1998

The facts observed during the autumn of both 1997 and 1998 are summarized as follows (Figure 13).

First, except for a period at the beginning of September to the beginning of November 1997, the dollar/yen swap rate was higher than theoretical value derived from rates on underlying assets (foreign exchange spot rate, yen interest rate, and dollar interest rate). Given that dollar/yen swap transaction volume was high, dollar LIBOR might not fully reflect the Japan premium in the dollar market where rate could be prohibitively high. Information gap among market participants, which might have widened during the period could have contributed to the divergence between the dollar/yen swap rate and theoretical value.

Second, the Japan premium in the yen market and dollar market did not move in parallel. For example, in autumn 1997, the Japan premium in the dollar market started to increase from mid-October, but in the yen market did not increase until November. In autumn 1998, while the Japan premium in the dollar market increased rapidly towards the beginning of November, that in the yen market increased only rather moderately.

(2) Background to divergence of the dollar/yen swap rate from its theoretical value derived from underlying asset prices

Divergence of the dollar/yen swap rate from its theoretical value derived from rates on underlying assets seems to be explained by observed underlying assets not fully reflecting the Japan premium and the information gap among market participants.

Given that dollar/yen swap transaction volume was high during both autumn 1997 and autumn 1998, dollar LIBOR might not reflect the Japan premium in the dollar market where interest rate could be prohibitively high. Market participants pointed out that such a phenomenon did occur, although it could not be quantitatively supported due to lack of data.

Next, we examine the possibility that the information gap among market participants widened. A foreign exchange swap transaction is the reverse trade of two different currencies of different delivery date. Following is a hypothetical dollar/yen swap transaction between Bank A and Bank B for period *t*: (a) in the spot market, Bank A buys dollars and sells yen, while Bank B sells dollars and buys yen, and (b) in the forward market, Bank A sells dollars and buys yen, while Bank B buys dollars and sells yen.

In the swap transaction just illustrated, Bank A is essentially extending yen credit to Bank B for period *t* while receiving dollar credit from Bank B for the same period. When spot transactions are settled, obligations to extend credit to the counterparty disappear and the obligation of Bank A to return dollars and that of Bank B to return yen remain. Since it is unlikely that either bank will default between the swap transaction date and spot settlement date (two days), of importance to both banks on the swap transaction date is whether the credit extended on the spot settlement date will be repaid by the counterparty on the forward transaction due date.

The liability relationship between the two banks on the forward transaction due date is bilateral. Namely, if Bank A does not repay dollars, Bank B will not deliver yen, and, in this sense, Bank B is using its yen repayment obligation to Bank A as collateral to secure Bank A’s dollar repayment. Such a collateral

characteristic makes swap transactions different from uncollateralized dollar credit, and seems to have helped low-rated banks secure dollar funding through the dollar/yen swap market in times of stress.

However, it should be noted that such a collateral characteristic does not necessarily cover the entire risk of foreign exchange swap transactions. Bank B may not receive dollar repayment from Bank A due to reasons such as Bank A's default on the forward transaction due date or sudden liquidity shrinkage in the dollar market.[8] Such a risk will increase as the estimated default ratio of counterparties and volatility of underlying asset prices rise. Since the estimated default ratio and volatility of both interest rates and foreign exchange rates were all increasing in the autumn of both 1997 and 1998, market participants seemed to have been very conscious of such risks (Box 2 gives a brief explanation about the mechanism through which pricing stance becomes more severe when collateral value declines).

Another factor which might have eroded the value of collateral, i.e., induced a premium increase on the dollar/yen swap rate, is that there were not sufficient low-risk short-term yen currency assets. Uncertainty regarding the credit rating of Japanese banks reduced the safety of yen-denominated interbank assets. However, since alternative short-term government bond markets to complement the interbank market are inadequate, the incentive of foreign banks to receive yen credit was diminished which might have led to a further increase in the Japan premium in the dollar/yen swap market.

Such an increase in uncertainty in dollar/yen swap transactions may to some extent be seen in the increase in the bid-ask spread during both periods (Figure 14).

[8] Such risks may be amplified by time difference risk involved in settlement between currencies and also a lack of low credit risk assets in which to invest.

Box 2 Mechanism Whereby Pricing Stance Becomes More Severe Because of a Decline in Collateral Value

The divergence of the dollar/yen swap rate from its theoretical value in the autumn of both 1997 and 1998 might have been caused by the fact that the collateral characteristic of foreign exchange swap transactions was considered not to sufficiently reduce credit risk. Namely, a decline in the credibility of Japanese banks reduced collateral value of the yen to be extended in exchange for dollars, thereby likely making the pricing stance of dollar providing banks more severe.[9]

This situation can also be sensed in the actual calculation equation of the dollar/yen swap rate:[10]

Bid rate = [Bid rate for Spot * (Bid rate for yen interest rate – Ask rate for dollar interest rate)]
/ (1+Ask rate for dollar interest rate)

Ask rate = [Ask rate for Spot * (Ask rate for yen interest rate – Bid rate for dollar interest rate)]
/ (1+Bid rate for dollar interest rate)

For example, when foreign banks present prices to Japanese banks in DD transactions, the ask rate is calculated based on (a) the spot rate foreign banks offer Japanese banks (ask rate for spot), (b) the interest rate foreign banks accept in receiving yen credit from Japanese banks (ask rate for the yen interest rate), and (c) the interest rate on dollar credit to Japanese banks (bid rate for the dollar interest rate), and reflects the creditworthiness of Japanese banks.

Namely, since pricing of the dollar/yen swap rate is effected for each transaction

[9] There are various ways to conduct a swap transaction, which is a combination of 'spot dollar buy/yen sell' and 'forward dollar sell/yen buy': (a) request a counterparty for pricing through a DD transaction and execute at the ask price, (b) request pricing from a counterparty and execute the transaction at the bid rate, (c) secure an ask rate through a broker, or (d) present a bid rate through a broker. In the autumn of both 1997 and 1998, Japanese banks seem to have actively requested pricing by method (a) and (c), in which cases the impact of foreign banks on pricing seems to have especially increased.

[10] To make the calculation process simple, we assume the swap transaction term as one year.

based on the foreign exchange rate, dollar interest rate, and yen interest rate agreed by counterparties and not mechanically determined based on average rates on underlying assets in the market, there is room for recognition of the creditworthiness of counterparties to be reflected in the pricing. In particular, during a crisis, the information gap among market participants will likely widen compared with a normal situation, hence the above phenomenon seems to easily emerge.

(3) Information gap among market participants vis-à-vis the creditworthiness of Japanese banks

As to reasons for the increase in the premium in the dollar/yen swap market, a widening information gap among market participants vis-à-vis the creditworthiness of Japanese banks might have played an important role. Such an information gap might also have induced different movement of the Japan premium in the yen and dollar markets. To verify such a possibility, we used an implied default ratio derived from interbank interest rates as a measure to capture market participants' view of Japanese banks, and examined how Japanese banks and foreign banks viewed the creditworthiness of Japanese banks.

Figure 15 depicts the implied default ratio derived from euro-yen TIBOR and euro-dollar LIBOR (see note to Figure 15 for estimation method) and gives a general picture of how Japanese banks (vertical axis) and foreign banks (horizontal axis) viewed the creditworthiness of Japanese banks. The implied default ratios of three Japanese banks which were the reference banks for LIBOR during both periods are examined. Implied default ratio with respect to euro-yen TIBOR can be regarded as a proxy for how Japanese banks, which are in the majority in the euro-yen market, evaluate the default probability of Japanese banks. Implied default ratios in euro-dollar LIBOR can be regarded as a proxy for how foreign banks, which are the majority in the euro-dollar market, evaluate the default probability of Japanese banks.

For both the autumn of 1997 and autumn of 1998, plotted data for all three cases are under the 45-degree line, suggesting that foreign banks had taken a

more severe stance than Japanese banks with respect to the creditworthiness of Japanese banks. Looking at the period average, we see that foreign banks were considering a higher default ratio than Japanese banks, by 45-50bp in 1997 and 66-82bp in 1998.

Next, we turn to examine how Japanese banks and foreign banks revised their default ratios according to a change in creditworthiness.

For the autumn of 1997 (three examples on the left-hand side of Figure 15), plotted data form a band parallel with the 45° line, implying that both Japanese banks and foreign banks reacted similarly to a reduction in the creditworthiness of individual banks. However, after December 5, the implied default ratio of Japanese banks vis-à-vis Japanese banks with a relatively low credit rating rose rapidly, which might imply increased uncertainty in the Japan's domestic market. In addition, as shown in Figure 10-A, dollar/yen swap transaction volume rapidly increased during the same period.

For the autumn of 1998 (three examples on the right-hand side of Figure 15), plotted data are squeezed parallel with the horizontal axis, implying that foreign banks were quite sensitive to changes in the creditworthiness of individual banks, while Japanese banks did not revise their credit rating of individual banks so frequently. This is also apparent in the variance of period average. While variance viewed from Japanese banks was contained below 10bp, that of foreign banks was as high as 24bp.

5. Results and policy implications

Three points became apparent through our analysis of the three Japan premiums during the autumn of both 1997 and 1998.

First, premiums in the dollar and yen markets showed different movement. In the meantime, in the dollar/yen swap market which connects the two currency markets, transaction volume was high and premiums had diverged from theoretical value derived from rates on underlying assets. Given high transaction volume during both periods, what lay behind the divergence of the dollar/yen swap rate from its theoretical value was that, while premiums rose prohibitively, Japanese banks increased their reliance on dollar/yen swap transactions which finance dollars using yen as collateral.

Second, such divergence of the swap rate from its theoretical value seems to illustrate the increased uncertainty pertaining to dollar/yen swap transactions and can also be seen in the expansion of the bid-ask spread. As to reasons why the additional premium was attached in the dollar/yen swap market, a widening information gap among market participants vis-à-vis the creditworthiness of Japanese banks and investment constraints on safe yen assets might have played an important role.

Third, domestic and foreign banks' views on changes in Japanese banks' creditworthiness had been more or less similar in the autumn of 1997, the early stage of the financial crisis, and Japanese banks had been more cautiously assessing counterparty creditworthiness although estimated default ratios had been lower. In contrast, in the autumn of 1998, foreign banks severely and frequently revised their assessment of counterparty creditworthiness, while assessment by Japanese banks generally remained the same.

From these results, we can derive the following three policy implications.

First, in the autumn of both 1997 and 1998, while the Japan premium in the dollar market increased prohibitively, the dollar/yen swap market complemented the money market function of the dollar and yen markets by linking the two. To properly grasp such a situation, one should closely monitor whether the price discovery function is properly working not only in each currency market but also in the foreign exchange swap market, and explore causes when the function is impaired in a stress situation. In monitoring, it becomes important to focus on each market's liquidity and arbitrage relationship.

Second, it is important to secure the function of the foreign exchange swap market. When stress emerges on an international scale, it is highly likely that arbitrage relationships between currency markets will be lost, triggered, in particular, by the malfunctioning of foreign currency cash markets. Therefore, it becomes important to have an infrastructure whereby the foreign exchange swap market can function to supplement functions lost in other markets in a stress situation.

Third is how risk premium emerging under stress is affected by the monetary operations of a central bank. While central banks can affect risk premium in the domestic currency market, there is a limit to reducing risk premium in foreign currency markets by providing the domestic currency. Even though a central bank provides funds in the domestic market in an amount more than needed for reducing risk premium attaching to the domestic currency, premiums on the foreign currency funding of domestic financial institutions in the foreign exchange swap market may not, in theory, decline unless uncertainty regarding counterparty credit risk is eliminated.

Box 3 Relationships Among the Japan Premiums in the Dollar, Yen, and Dollar/yen Swap Markets

A. Theoretical relationship among the three premiums

Assuming complete arbitrage among the markets, our conclusion is that under a dollar discount/yen premium situation: "the Japan premium in the dollar currency market = the Japan premium in the yen currency market + the Japan premium in the dollar/yen swap market."

Variables are as below:[11]

	Japanese banks	Foreign banks
Dollar funding interest rate	r^*_j	r^*_f
Yen funding interest rate	r_j	r_f
Dollar/yen spot rate (dollar buy/yen sell)	S_j	S_f
Dollar/yen forward rate (dollar sell/yen buy)	F_j	F_f
Dollar/yen swap rate (spot dollar buy + forward dollar sell)	$Swap_j$	$Swap_f$

The Japan premium in each market is defined as follows:

Dollar currency market: $Jp^* = r^*_j - r^*_f$ —— (1)

Yen currency market: $Jp = r_j - r_f$ —— (2)

Dollar/yen swap market[12]: $Jp\ (Swap) = -(Swap_j - Swap_f)$

$$= -\{\ln (F_j / S_j) - \ln (F_f / S_f)\} \quad \text{——} \quad (3)$$

When Japanese banks conduct foreign currency funding, the following non-arbitrage condition holds:

$$1 + r^*_j = (1 + r_j) \times (S_j / F_j)$$

[11] We assume the swap transaction term as one year for the sake of simplicity.

[12] The dollar/yen swap rate is normally expressed as F−S (yen), although this paper defines it as Swap = (F−S)/S so as to be consistent with the expression of interest rates. In dollar discount /yen premium situations, the dollar/yen swap rate becomes negative. When conducting swaps combining spot dollar buy with forward dollar sell, the more negative a swap rate the greater the cost and therefore the Japan premium, which is expressed as follows:
$Jp\ (Swap) = -(Swap_j - Swap_f) = -\{(F_j - S_j)/S_j - (F_f - S_f)/S_f\} = -[\ln\{1 + (F_j - S_j)/S_j\} - \ln\{1 + (F_f - S_f)/S_f\}] = -\{\ln (F_j / S_j) - \ln (F_f / S_f)\}$

By taking a logarithm of both sides, the above equation can be approximated as:

$$\ln (1 + r^*_j) = \ln (1 + r_j) + \ln S_j - \ln F_j$$
$$r^*_j = r_j + \ln S_j - \ln F_j \quad \text{——} \quad (4)$$

Also, in the case of foreign banks from the non-arbitrage condition

$$1 + r^*_f = (1 + r_f) \text{ x } (S_f / F_f)$$

holds. The equation gives an approximation,

$$r^*_f = r_f + \ln S_f - \ln F_f . \quad \text{——} \quad (5)$$

From Equations (1) – (5), we can confirm that the following relationship holds among Jp^*, Jp, and Jp (Swap):

$$Jp^* = r^*_j - r^*_f$$
$$= (r_j + \ln S_j - \ln F_j) - (r_f + \ln S_f - \ln F_f)$$
$$= (r_j - r_f) - \{\ln (F_j / S_j) - \ln (F_f / S_f)\}$$
$$= Jp + Jp (Swap) \quad \text{——} \quad (6)$$

B. Presence of factors preventing arbitrage among markets

In the real world, as shown in Figure 13,[13] premiums show different movement from time to time, and the arbitrage relationship in Equation (6) may not hold.
In the above, we assumed that when Japanese banks conduct foreign currency funding, the following non-arbitrage condition holds:

$$1 + r^*_j = (1 + r_j) \text{ x } (S_j / F_j) .$$

From the definition of 'Swap' and the non-arbitrage condition above,

$$Swap_j = F_j / S_j - 1 = (1 + r_j) / (1 + r^*_j) - 1 \quad \text{——} \quad (7)$$

Equation (7) implies that risk premiums in the dollar market and yen market are reflected in the dollar/yen swap rate. In addition, the equation is consistent with an argument that the dollar/yen swap rate is determined by the dollar/yen spot rate and

[13] Figure 13 uses a yen basis (F – S) instead of ratio basis {(F – S) / S}, although the result is the same in that there is a divergence between the actual rate and theoretical value.

interest rate movements in both currencies related to the foreign exchange transaction, and does not often reflect its unique supply and demand situation.

However, if we insert r^*_j and r_j actually observed in the autumn of both 1997 and 1998 to the non-arbitrage Equation (7), there are periods when derived theoretical value diverges from the actual dollar/yen swap rate, as seen in Figure 8. This seems to be the case in that a certain risk premium (x) was reflected in the foreign exchange swap rate. Assuming credit risk (d) and liquidity risk (l) as factors determining risk premium (x), we obtain:

$$F_j / S_j = (1 + r_j) / (1 + r^*_j) + x (d_j, l_j) \quad \text{—— (8)}$$

Since the first term of the right hand side can be approximated as $1+ r_j – r^*_j$, we derive:

$$Swap_j = r_j – r^*_j + x (d_j, l_j) \quad \text{—— (9)}$$

We can similarly express foreign banks' dollar funding as

$$F_f / S_f = (1 + r_f) / (1 + r^*_f) + x (d_f, l_f)$$

Assuming there is no premium for foreign banks, $x (d_f, l_f) = 0$, we derive:

$$Swap_f = r_f – r^*_f \quad \text{—— (10)}$$

From Equations (9) and (10), we obtain:

$$Jp (Swap) = Jp^* – Jp – x (d_j, l_j) .$$

From the last equation we confirm that the dollar/yen swap rate is determined not only by developments in the dollar and yen markets but also, depending on the situation, reflects movements in $x (d_j, l_j)$, i.e. unique credit risks and liquidity risks.

Figure 1　Japan premium in dollar markets

A. Autumn 1997　　B. Autumn 1998

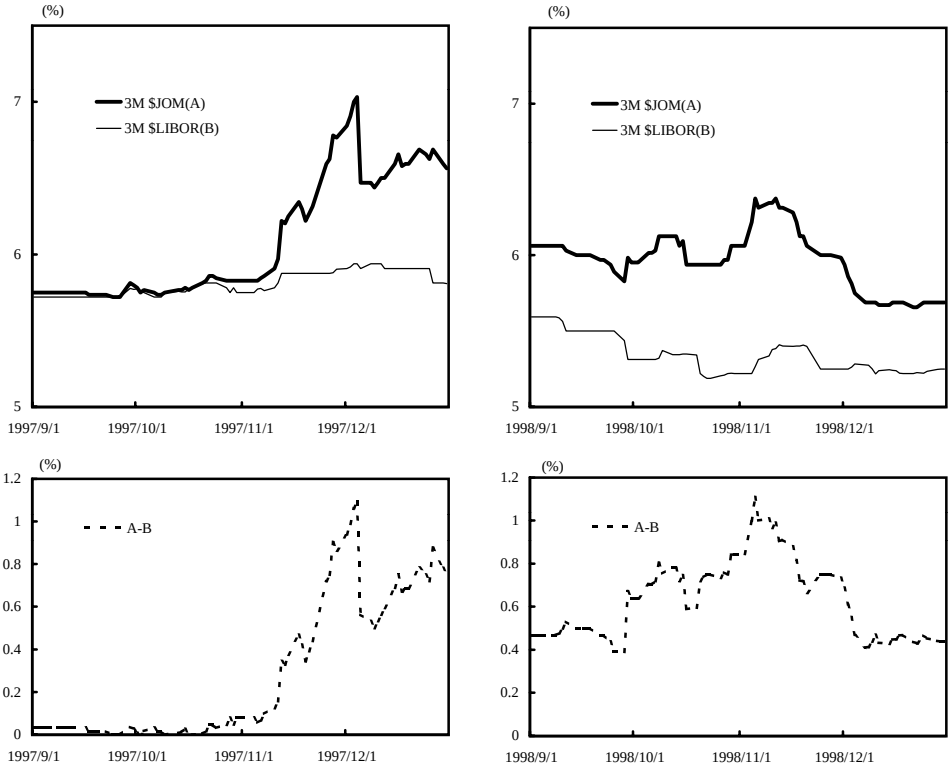


Figure 2　Japan premium in dollar markets (representative banks)

A. Autumn 1997　　B. Autumn 1998

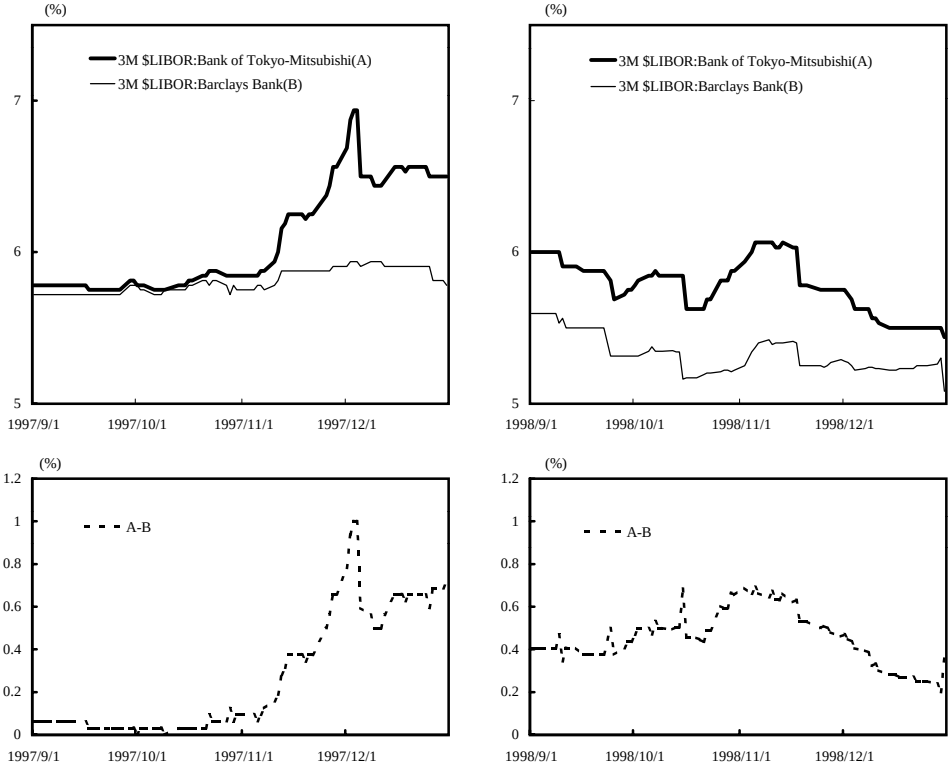


Figure 3　Japan premium in yen markets

A. Autumn 1997　　B. Autumn 1998

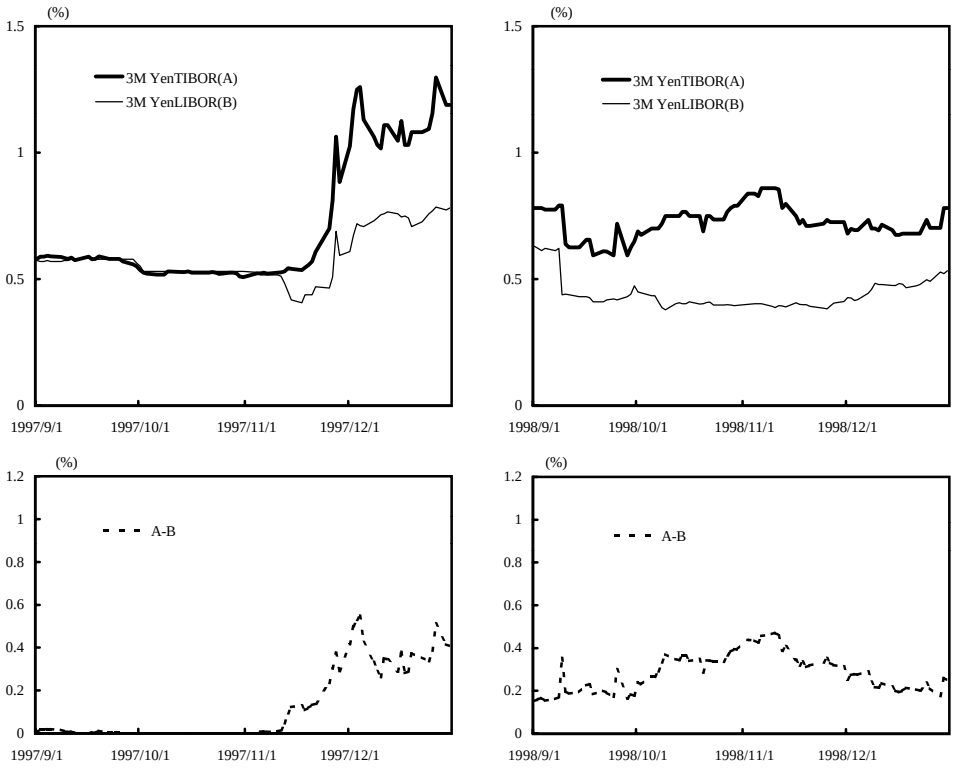


Figure 4　Difference in the Japan premium between dollar and yen markets

A. Autumn 1997　　B. Autumn 1998

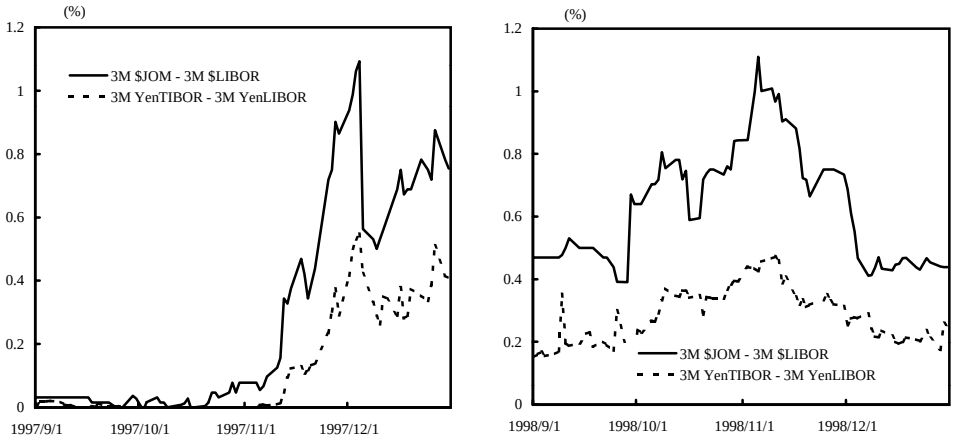


Figure 5　Japan premium in yen market (representative banks)

(Data for Autumn 1997 unavailable)

B. Autumn 1998

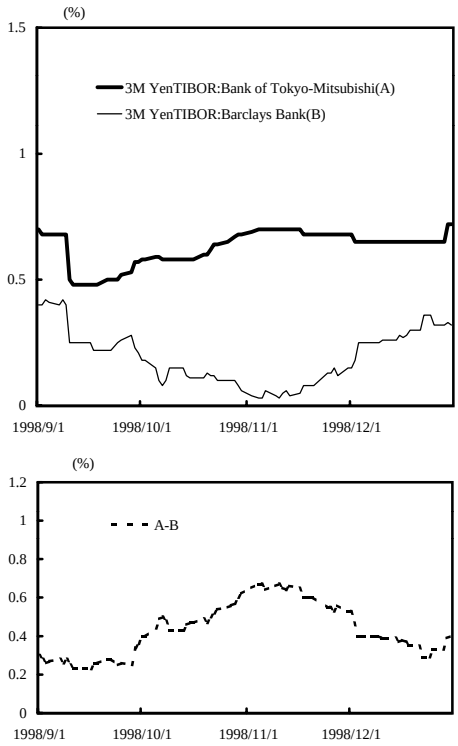
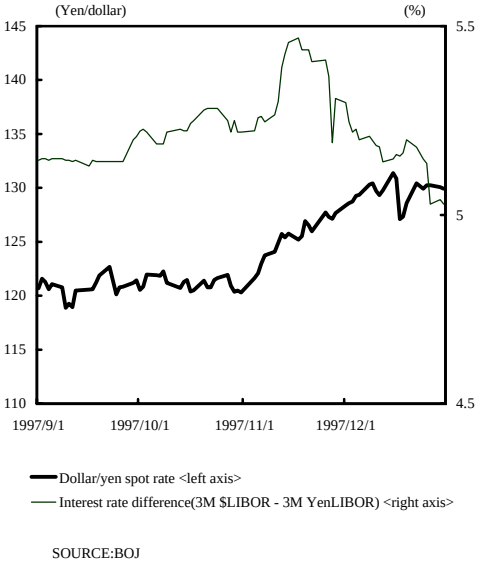


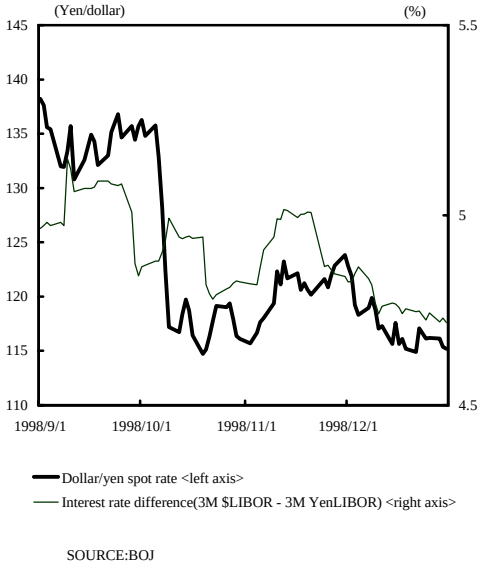
Figure 6　Dollar/yen spot rate and spread between yen and dollar interest rates

A. Autumn 1997



SOURCE:BOJ

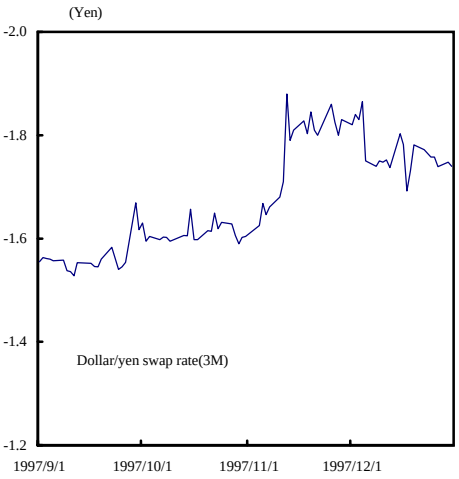
B. Autumn 1998



SOURCE:BOJ

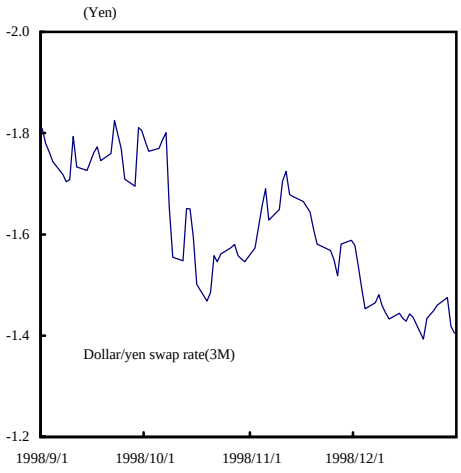
Figure 7　Dollar/yen swap rate

A. Autumn 1997



SOURCE:BOJ

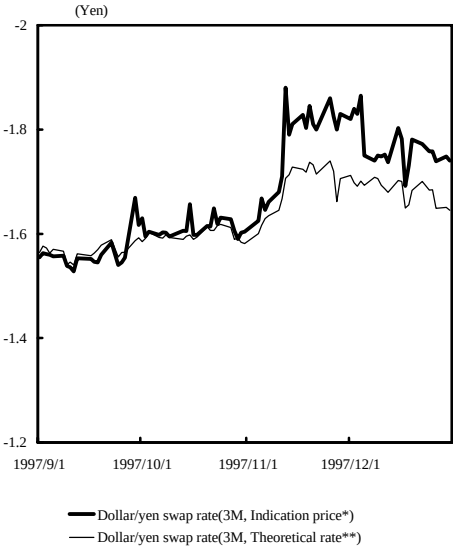
B. Autumn 1998



SOURCE:BOJ

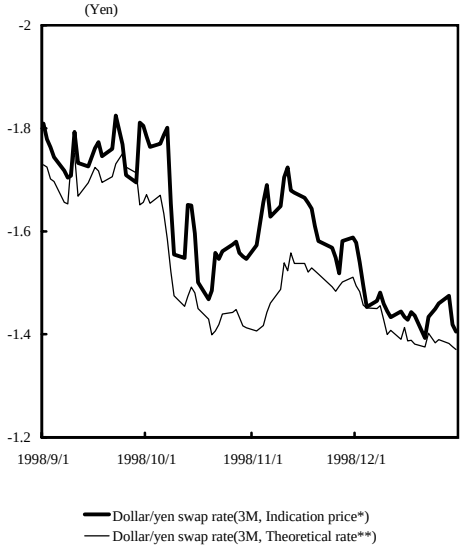
Figure 8　Dollar/yen swap rate and theoretical rate derived from underlying asset prices

A. Autumn 1997



* Indication price is the mid rate of best bid rate and best ask rate.
** Theoretical Rate of Dollar/Yen Swap(3M) =
Dollar/Yen Spot Rate × (3M Yen LIBOR - 3M US$LIBOR) × 92<days>
/ (360<days> + 3M US$LIBOR × 92<days>)

B. Autumn 1998



* Indication price is the mid rate of best bid rate and best ask rate.
** Theoretical Rate of Dollar/Yen Swap(3M) =
Dollar/Yen Spot Rate × (3M Yen LIBOR - 3M US$LIBOR) × 92<days>
/ (360<days> + 3M US$LIBOR × 92<days>)

Figure 9 Relationship between the three Japan premiums

Figure 9-A

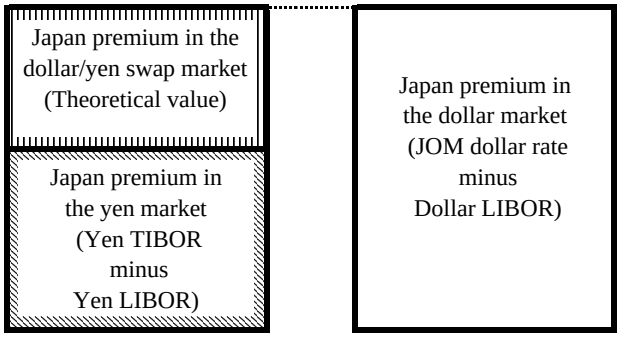


Figure 9-B

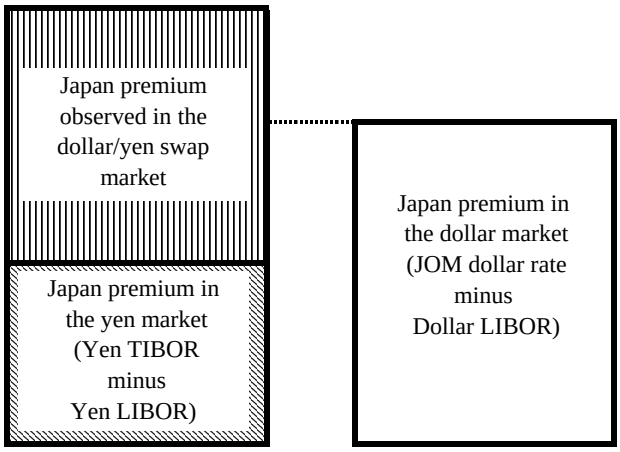


Figure 9-C

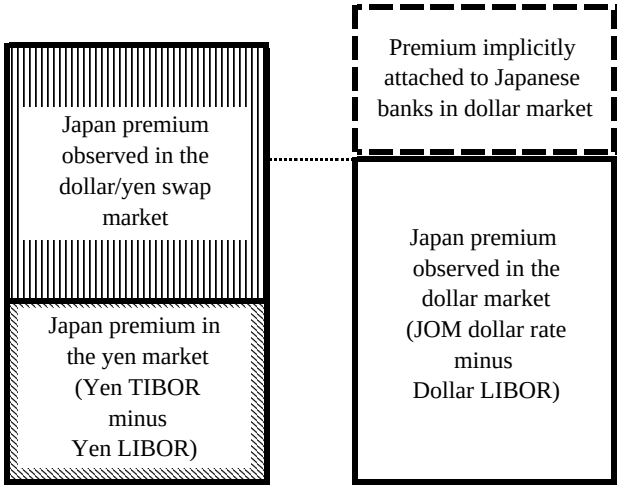
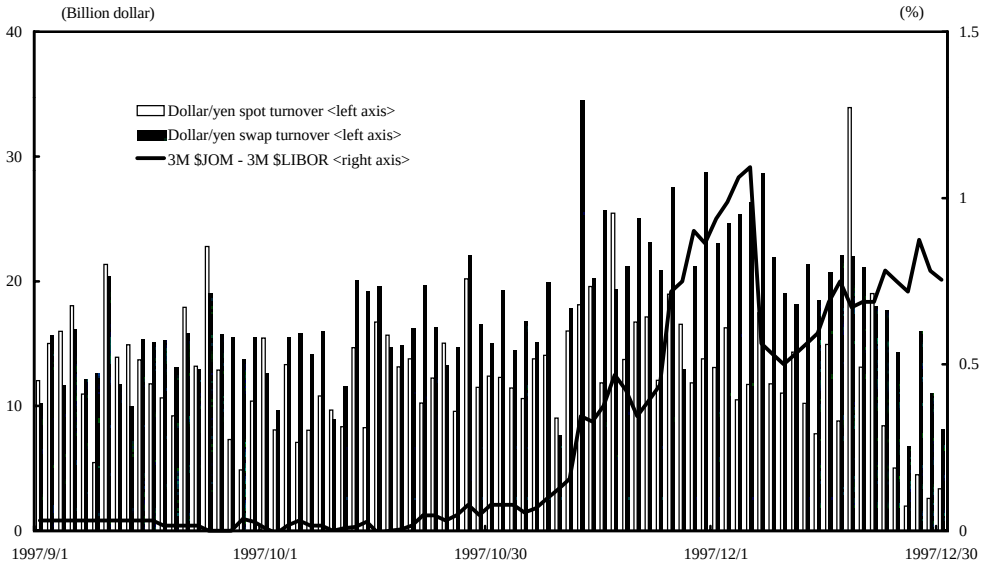


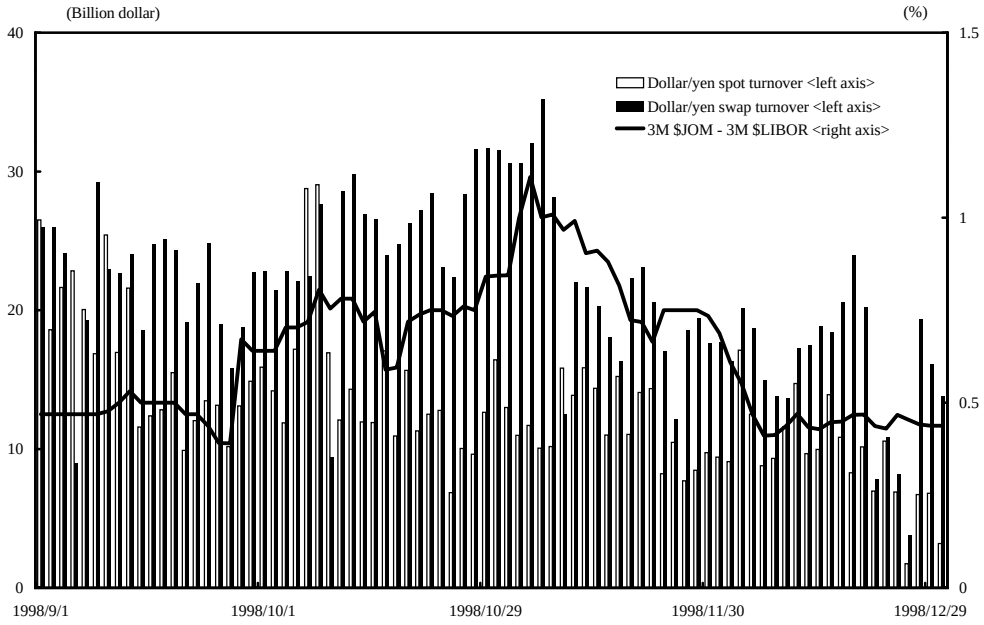
Figure 10 Dollar/yen spot and dollar/yen swap turnover and the Japan premium

A. Autumn 1997



SOURCE:BOJ

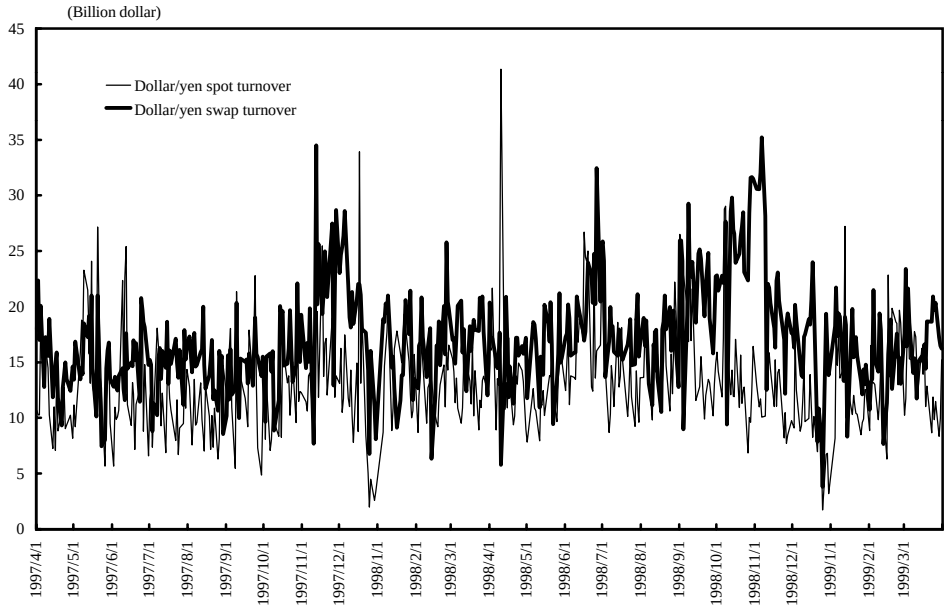
B. Autumn 1998



SOURCE:BOJ

Figure 11　Dollar/yen spot and dollar/yen swap turnover

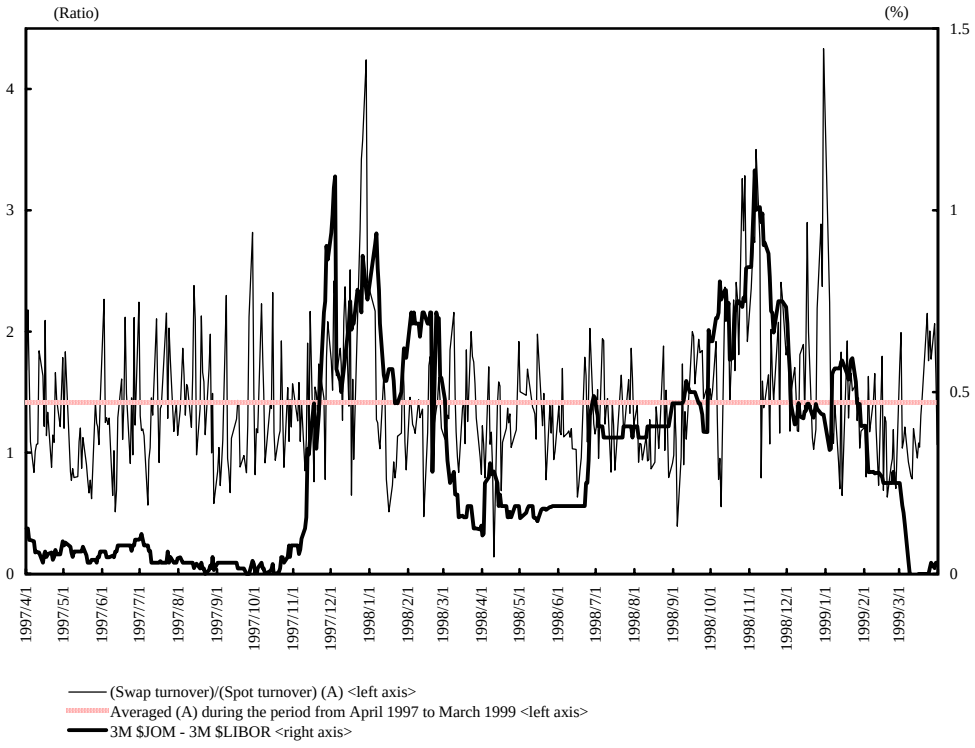
(April 1997 to March 1999)



SOURCE:BOJ

Figure 12　Turnover ratio and the Japan premium

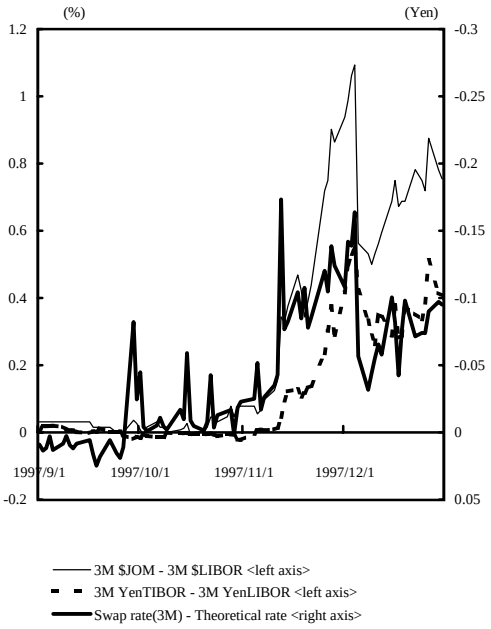
(April 1997 to March 1999)



SOURCE:BOJ

Figure 13 Divergence of swap rate from the theoretical rate and two Japan premium

A. Autumn 1997



B. Autumn 1998

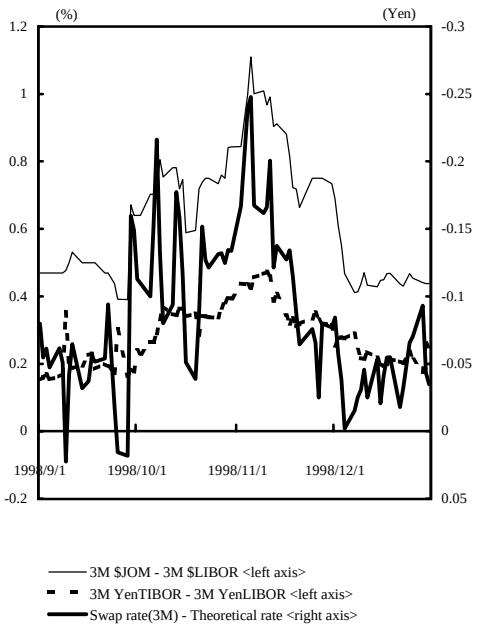
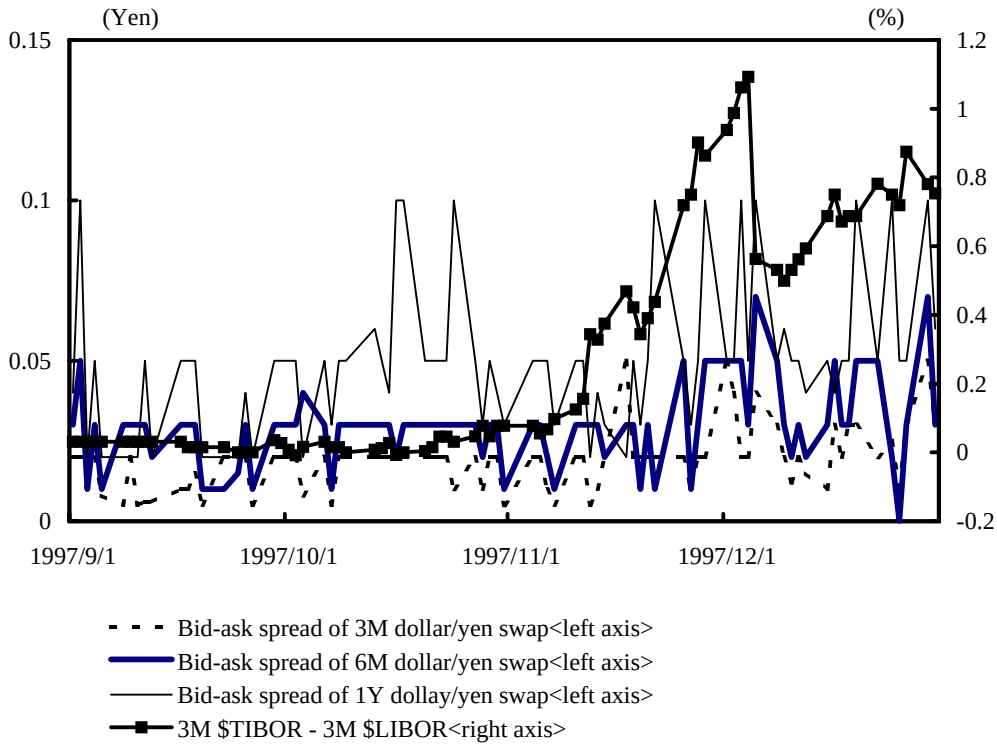


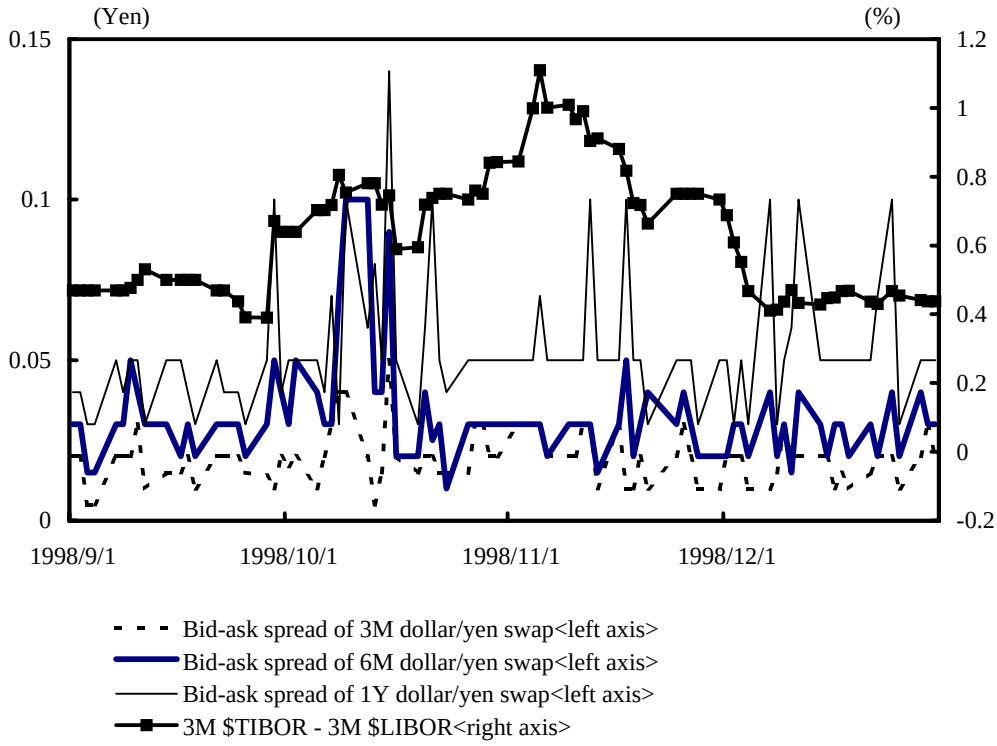
Figure 14 Bid-ask spread in dollar/yen swap and the Japan premium

A. Autumn 1997



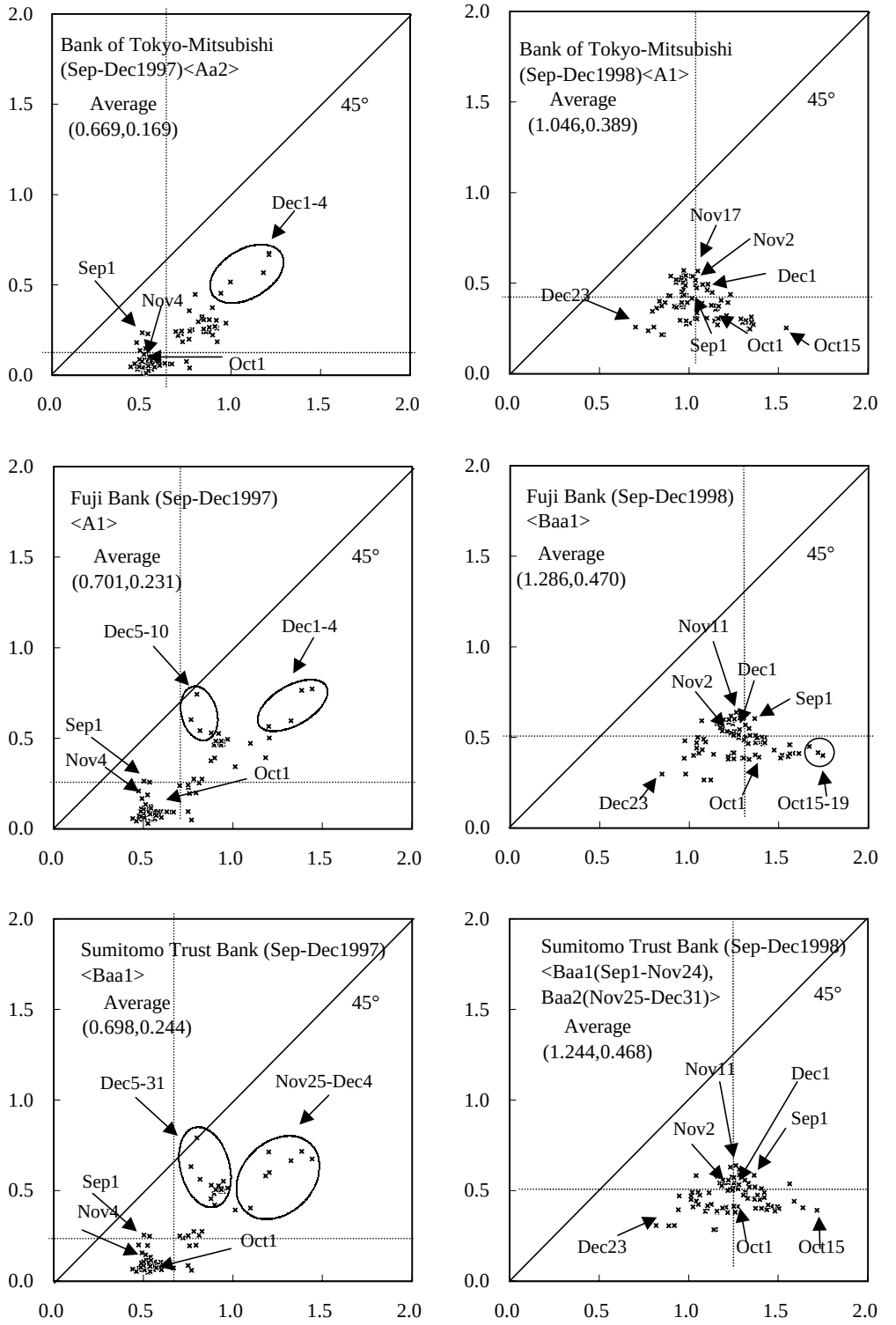
SOURCE:REUTERS

B. Autumn 1998



SOURCE:REUTERS

Figure 15 Implied default ratios (%) derived from TIBOR and LIBOR offered by individual banks



Event day

Nov3:Sanyo Securities filed for protection under the Corporate Reconstruction Law.

Nov17:Hokkaido Takushoku Bank decided to transfer its businesses to Hokuyo Bank.

Nov23:The management of Yamaichi Securities decided to dissolve the company.

Oct23:The Long-Term Credit Bank was temporarily nationalized based on the Financial Reconstruction Law.

Note: Ratings in angle brackets are based on Moody's credit rating of long-term bonds. Average figures are sample means of default probability extracted from dollar LIBOR and yen TIBOR, respectively. The default rate $P = (R-R_f)/(1+R)$, where R is the one-year interest rate in each market, and R_f is the risk-free interest rate (one-year TB in each market). The formula assumes zero recovery rate in the case of default and risk neutrality of the lender.

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