

MAR

The Structure of and Recent Developments in the Short-term Yen Money Markets

~Arbitrage relationship between the uncollateralized call market,
the Euroyen market and the dollar/yen swap market~

Kei-ichiro Inaba · Sayako Konno · Noritaka Fukunaga · Tokiko Shimizu

July 2001

arket Review

Closer relationships are now being observed between the uncollateralized call rate, which is heavily influenced by the Bank of Japan's money market operations, and the Euroyen rate and the yen funding rate in the dollar/yen swap market, reflecting more dynamic arbitrage operations by internationally active financial institutions. Although interest rates in the three markets might diverge for a short period due to supply-demand imbalances and institutional changes, they would converge relatively quickly thereafter. This report explores possible factors which might influence the arbitrage relationships by examining how and why interest rates in the three markets diverged and converged from the end of 2000 to the beginning of 2001. Analyses suggest that it is necessary to comprehensively monitor influences of domestic and overseas factors in order to enhance our understanding of developments in short-term yen interest rates.

Structure of Short-term Money Markets in Yen

Short-term money markets provide the means for financial institutions including institutional investors to fine-tune their cash balances, and raise and invest short-term funds. The most active market segment involves very short-term transactions, such as overnight (O/N) transactions, in which funds are provided on the day of contract and repaid the next day, and tomorrow/next (T/N) transactions, which are overnight transactions starting one business day after contract. Types of transactions include the borrowing and lending of funds with and without collateral, the sale and purchase of short-term securities such as commercial paper (CP) and short-term government bill (TBs and FBs) both outright and with repurchase agreements, and repo transactions (securities lending against cash collateral).

The main short-term yen markets are 1) the call market (both collateralized and uncollateralized), 2) the Euroyen¹ market, 3) the foreign exchange swap market, 4) the repo market, 5) short-term government bills (TBs and FBs) market, and 6) the market for CPs and certificates of deposit (CDs). This report focuses on the uncollateralized call market, the Euroyen market, and the foreign exchange swap market, all of which are important funding channels for very short-term yen funds utilized by both domestic and overseas banks.

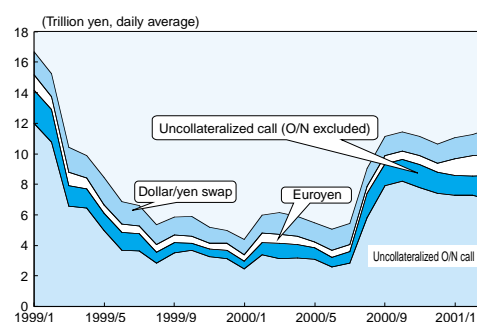
While each of the three markets has unique features in terms of composition of market participants and purpose of transaction, all offer a common function as yen funding channels where it is not required to post collateral securities, such as government bonds. As a result, in normal circumstances, interest rates in these markets converge to almost the same level. In other words, arbitrage relationships exist between these markets².

The uncollateralized call market serves as a market which enables financial institutions to make final adjustments to their daily cash balances. The bulk of transactions are overnight, which is strongly influenced by BOJ's money market operations. In contrast, the Euroyen market and the dollar/yen swap market are influenced by the funding and investment demands of offshore financial institutions more strongly than the uncollateralized call market. Activities in the Euroyen market usually pick up in late afternoon Tokyo time, when the London offices of Japanese and non-Japanese banks open for business. The dollar/yen swap market, also called the "forward market", is a part of the broader foreign exchange market, where yen and dollar funds are exchanged for a certain period of time (BOX 1).

Comparison of Transaction Volume in the Three Markets

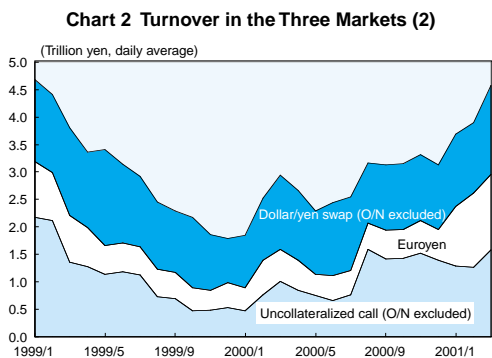
Among the three markets, the uncollateralized call market is the largest in terms of turnover (Tokyo market, via brokers³), followed by the dollar/yen swap market and the Euroyen market (Chart 1). Nevertheless, excluding overnight transactions, the daily turnover of the uncollateralized call market and the

Chart 1 Turnover in the Three Markets (1)



Sources: BOJ (uncollateralized call, Euroyen <JOM>); Money Brokers Association (dollar/yen swap market)

dollar/yen swap market are about the same in terms of size (Chart 2).



Sources: BOJ (uncollateralized call, Euroyen <JOM>); Money Brokers Association (dollar/yen swap market)

	Average daily turnover		
	Uncollateralized call (O/N excluded)	Dollar/yen swap (O/N excluded)	Euroyen
March 2001	1,580.5 billion yen	1,615.5 billion yen	1,373.6 billion yen

Market Participants of the Three Markets

Business units of Japanese and non-Japanese banks located in Japan (onshore Japanese banks and onshore non-Japanese banks respectively hereafter) adjust their cash balances in the uncollateralized call market. In addition, institutional investors, such as investment trusts and life insurance companies directly invest short-term funds in the market. In the Euroyen market, onshore Japanese banks are usually the investors of funds, while business units of Japanese and non-Japanese banks located outside Japan (offshore Japanese banks⁴ and offshore non-Japanese banks respectively hereafter) often borrow funds. In the foreign exchange swap market, Japanese banks tend to raise dollar funds/invest yen funds, while foreign banks raise yen funds/invest dollar funds. Notwithstanding this general picture, foreign banks are more active in two-way trading and they often invest yen funds/raise dollar funds.

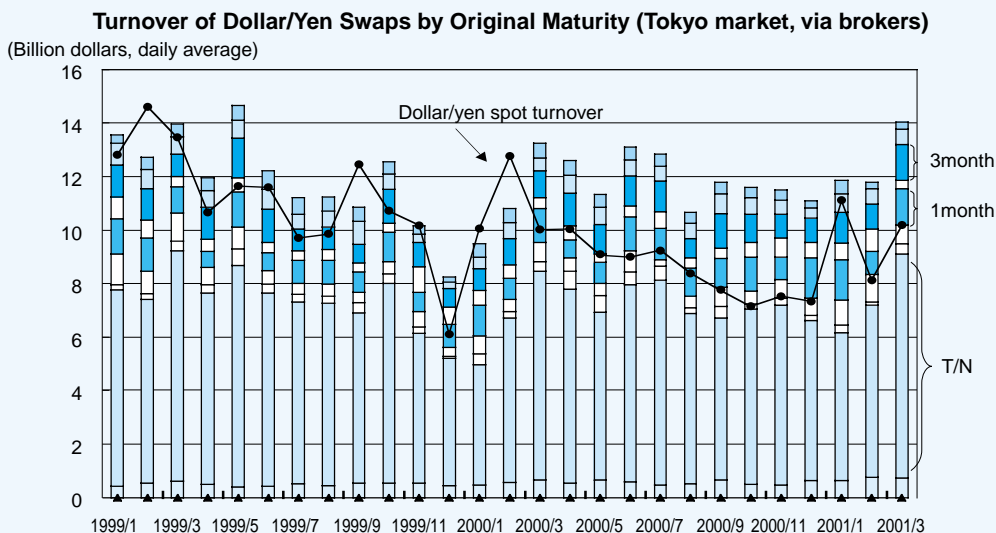
[BOX 1] Foreign Exchange Swap Transaction

Foreign Exchange Swap Transaction

A foreign exchange swap is a transaction where parties simultaneously agree to sell and purchase the same amount of foreign exchange on different settlement dates, for example, a combination of a spot purchase of the dollar against the yen and a forward sale of the dollar against the yen. Swaps are used by banks to 1) fine-tune their foreign exchange positions resulting from forward transactions with customers including exporters and importers, and 2) raise and invest short-term funds. For example, a swap transaction involving a spot sale of the dollar against the yen and a forward purchase of the dollar against the yen can be regarded as a loan of yen funds collateralized by dollar funds. A swap transaction involving a spot purchase of the dollar against the yen and a forward sale of the dollar against the yen can be regarded as dollar borrowing with yen collateral. The chart below shows that the turnover of the dollar/yen swap market is larger than that of the spot market in the same currencies. In terms of original maturity, more than half of transactions are T/N transactions, underscoring the function of the swap market as a short-term money market.

Yen Funding Rate in the Swap Market (Implied yen rate)

When raising funds in the foreign exchange swap market, the yen funding rate (implied yen rate) is calculated from the dollar funding rate and the forward spread, which is a differential between the spot and forward rate. Since the forward spread reflects not only the differential between Japanese and US interest rates, but also expectations regarding future exchange rates, the implied yen rate is affected not only by Japanese interest rates but also by US interest rates and the spot exchange rate. For example, when the market speculates a decline in US interest rates (i.e., the narrowing of Japanese-US interest rate differential), stronger demand for spot sales and forward purchases of US dollars against the yen would be observed in the swap market, leading to temporary upward pressure on the implied yen rate.



Source: Money Brokers Association

Chart 3 Major Market Participants in the Three Markets

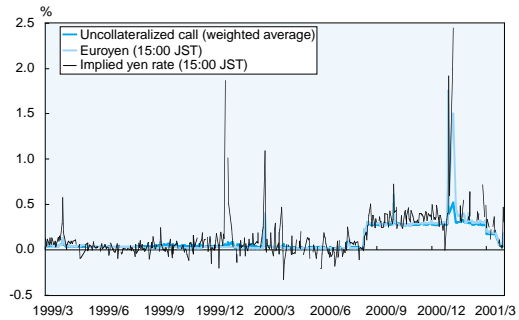
	Institutions raising yen funds	Institutions investing yen funds
Uncollateralized call market	Japanese city banks, onshore non-Japanese banks	Investment trusts, regional banks, Keito (central financing organization for financial cooperatives such as small / medium-sized businesses, and agricultural, forestry and fishery cooperatives), life insurance companies
Euroyen market	Offshore Japanese banks, foreign banks	Onshore Japanese banks
Foreign exchange swap market	Foreign banks	Japanese banks, foreign banks

Yen Funding Rates in the Three Markets

Yen funding rates in the three markets are at similar levels and show similar movements (Chart 4). This implies the existence of arbitrage relationships between the three markets (BOX 2). Although short-lived divergences develop, for example, at around the end of the calendar year and fiscal year (end-March for Japan), the rates converge relatively quickly in a short while.

Divergences between the three market rates develop when the Euroyen rate and/or the implied yen rate in the dollar/yen swap market become more volatile while the uncollateralized overnight call rate remains relatively stable⁵. For example, from the end of 2000 to the beginning of 2001, the divergences between the three rates were more pronounced than under normal market conditions. Looking at the Euroyen and

Chart 4 Yen Funding Rates (T/N rates) in the Three Markets



Sources: BOJ (uncollateralized call rate, Euroyen rate); Implied yen rate calculated from both the yen and dollar interest rates and the foreign exchange rate taken from Telerate.

implied yen rates, at first, the Euroyen rate rose to a higher level than the implied yen rate in mid-December 2000. Subsequently, this was reversed from the end of 2000 to the beginning of 2001, and the implied yen rate rose to a higher level than the Euroyen rate (Chart 5). The developments in these three markets during this period are examined in more detail in the following paragraphs.

Rise in the Euroyen Rate – mid-December 2000

Offshore Japanese banks usually raise dollar funds in the dollar money markets or in the dollar/yen swap

[BOX 2] Arbitrage Relationship Between the Three Markets

Yen funding rates in the three markets (the uncollateralized call market, the Euroyen market, and the dollar/yen swap market) are arbitrated away through the following channels.

Suppose that the implied yen rate in the swap market has risen for some reason. In such a situation, onshore non-Japanese banks would prefer to fund themselves in the domestic yen money markets (most probably the call market) for yen, as long as the call rate is lower than the implied yen rate. Such behavior would result in an increase in the call rate until it reached the level of the implied yen rate (① in the chart below).

On the other hand, a higher implied yen rate means that raising dollar funds in the swap market has become more favorable. Therefore, offshore Japanese banks might increase raising dollar funds in the swap market rather than in the dollar money markets. As some of the yen converted to dollars would be funded in the Euroyen market, the Euroyen rate would rise until it is no longer advantageous to swap yen into dollars, in other words, the divergence between the Euroyen rate and the implied yen rate is arbitrated away (②).

Finally, the uncollateralized call rate and the Euroyen rate would converge through arbitrage transactions by Japanese and foreign banks operating in both markets (③).

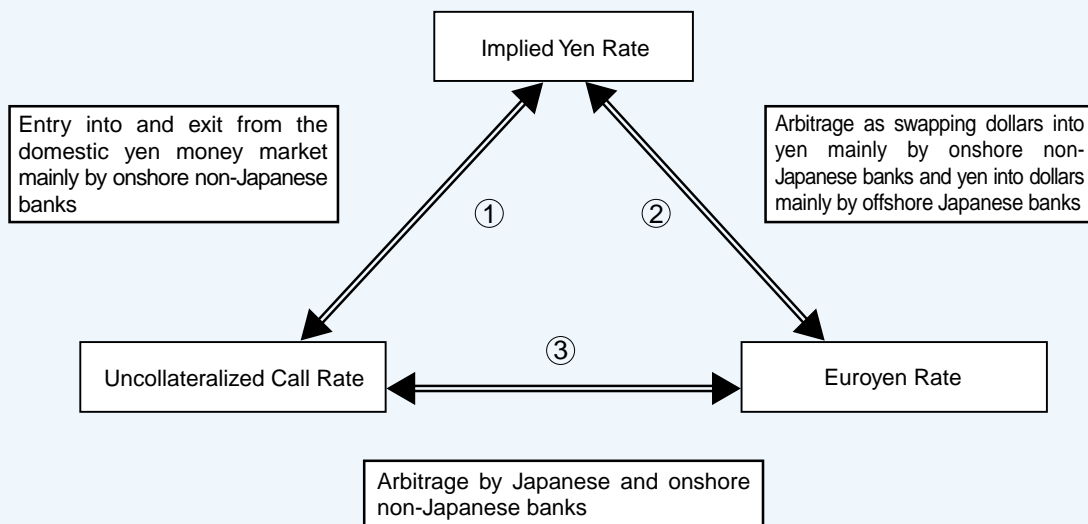
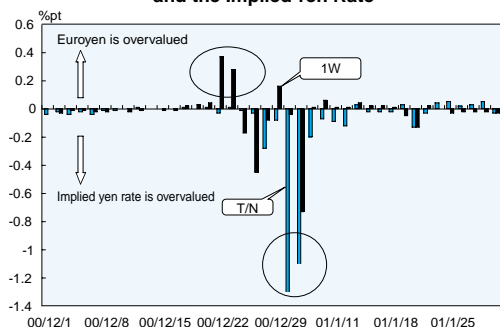


Chart 5 Differentials Between the Euroyen Rate and the Implied Yen Rate



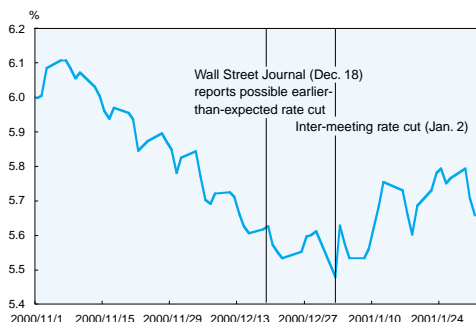
Source: BOJ
 Note: Both rates represent prevailing rates in the market as of 15:00 JST, based on the information from market participants and brokers.

market (by swapping yen into dollars). Yen funding for dollar/yen swap transactions is obtained from onshore business units (being charged in-house rates) or from the Euroyen market. In December 2000, ahead of the introduction of RTGS at the beginning of 2001, onshore units, in an attempt to reduce settlement volume, began to lengthen the maturities of yen funding operations and became somewhat reluctant to provide yen funds to offshore business units. As a result, offshore Japanese banks turned to the Euroyen market to raise the necessary yen funds.

Meanwhile, some institutions became less willing to lend funds in the Euroyen market, viewing that the difference in settlement time between Euroyen transactions and uncollateralized call transactions expanded after the introduction of RTGS (details below). As a result of such increased demands for raising yen funds and declining incentives for investing funds, and against the background of lower market liquidity towards the year-end, the Euroyen rate rose more than the implied yen rate⁶.

The divergences between the rates became less pronounced, when Japanese-US interest rate differential narrowed, which led to a rise in the implied yen rate, as the year-end dollar funding needs of offshore Japanese banks had peaked by Christmas, and as the market expected a lowering of US interest rates (Chart 6).

Chart 6 Fed Fund Futures Rate



FF futures for the most recently maturing contract
 Source: Bloomberg

Rise in the Implied Yen Rate ---- from the end of 2000 to the beginning of 2001

From the end of 2000 to the beginning of 2001, some domestic market participants tended to refrain from

lending yen funds until the impact of the introduction of RTGS on the markets became visible. Some onshore non-Japanese banks refrained from supplying their offshore business units (at in-house interest rates) and others even resorted to secure yen funding from offshore business units. In addition, the yen funding demands of offshore non-Japanese banks were as strong as in recent.

In response to the reluctance of onshore market participants to provide yen funds, offshore non-Japanese banks began to prefer converting dollars into yen in the dollar/yen swap market over funding in the Euroyen market, because the swap market was more liquid and it was possible to utilize dollar funds on hand for yen funding. As a result, the implied yen rate rose to a level higher than the Euroyen rate.

When RTGS was rolled out smoothly, providers of funds returned to the markets. Coupled with more subdued demand for yen funds from offshore non-Japanese banks, the implied yen rate fell and the interest rate differential between the Euroyen market and the swap market almost disappeared. Furthermore, after the US inter-meeting rate cut at the beginning of the year, diminishing expectation of further rate cuts exerted a downward pressure on the implied yen rate.

Factors Affecting the Arbitrage Relationships between the Markets

Based on the cases described above and insights obtained from recent studies, it is possible to identify four factors which influence the arbitrage relationships between the three markets.

First, concerning the funding costs for non-mother currencies, such costs borne by non-residents of the mother country, tend to rise when there are supply-demand imbalances. Such imbalances are sometimes caused by balance sheet constraints for funds providers ahead of the end of the fiscal year. Such a pattern of increasing funding costs has been observed in yen funding rates for some foreign banks at the end of the Japanese fiscal year, and in the dollar funding rate for some Japanese banks at the end of the calendar year⁷. In addition to such end-year patterns, as regards the period from the end of 2000 to the beginning of 2001, the arbitrage relationships between markets were further weakened because some market participants tended to hold greater cash balances in preparation for the change in the settlement system, which resulted in a more than usual decline in funds supplied to the market.

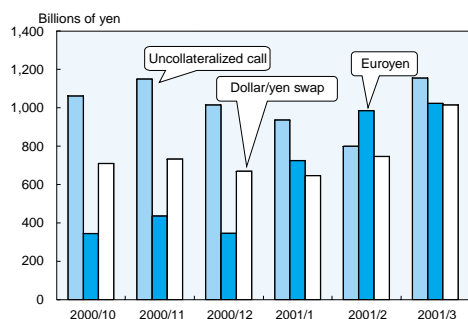
Second, when there is a deterioration in the credit standing of institutions raising funds, the influence of credit risk premium is heightened, and the smooth functioning of uncollateralized funding markets are hindered, resulting in a breakdown of arbitrage relationships. A "Japan premium" was observed in the Euroyen, the Eurodollar and swap markets during the Japanese financial stress between 1997 and 1998. It was difficult for Japanese banks to find counterparties for funding transactions in the Euroyen and the Eurodollar markets. As a result, Japanese banks resorted to raising dollar funds mainly in the foreign exchange swap market, where yen funds could be regarded as quasi collateral, and raising the premium⁸.

In the case of the period described in this note, from the end of 2000 to the beginning of 2001, no premium was observed for short-term funding for Japanese institutions⁹.

Third, developments in non-yen (US dollar etc.) funding costs could influence short-term funding costs in yen. More and more non-Japanese banks choose the most favorable channel for yen funding by comparing the implied yen rate in the foreign exchange swap market with funding rates in yen money markets. Accordingly, interest rate differentials (which influence funding costs) have come to influence domestic yen interest rates more than ever. For example, after the Euroyen and the implied yen rates diverged as described above, expectations regarding US monetary policy, the strengthening and tempering of expectations before and after the Fed policy change, worked to narrow interest rate differentials between the three markets.

Fourth, differences in settlement methods among markets could cause differences in funding rates. Transactions in the Euroyen market and the foreign exchange swap market are settled at 14:30 p.m. through the Foreign Exchange Yen Clearing System (FEYCS) on a net basis. On the other hand, following introduction of RTGS, repayment transactions in the uncollateralized call market, which used to be settled at 1:00 p.m., are as a rule, to be settled by 10:00 a.m.. Some non-Japanese banks, which do not hold sufficient collateral to cover intra-day liquidity, prefer to fund themselves in the Euroyen market and the swap market taking advantage of net settlement and later repayment time of these markets. Funding rates for the same period may not converge if there are differences in cost reflecting differences in settlement practices. After 2001, the market share of the Euroyen and foreign exchange swaps has increased for T/N money market transactions, against the backdrops including banks' behavior avoiding these additional costs (Chart 7).

Chart 7 Turnover of T/N Transactions in the Three Markets



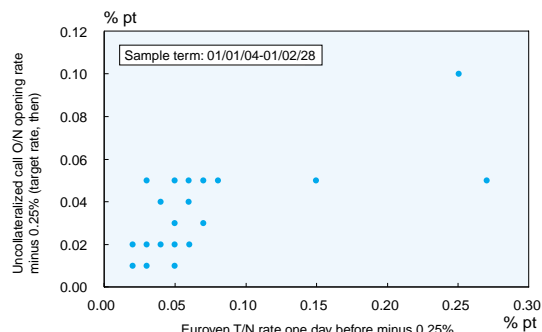
Source: BOJ (uncollateralized call, Euroyen <JOM>); Money Brokers Association (dollar/yen swap market)

Arbitrage Relationships between Uncollateralized Call O/N Rates and Euroyen T/N Rates

In the Euroyen and dollar/yen swap markets, market activity centers on the T/N and not the O/N segment, reflecting the participation of non-residents. Consequently, arbitrage relationships exist not only between T/N rates in each market, but also between T/N rates in dollar/yen swap and Euroyen markets and O/N rates in the uncollateralized call market on the next day.

For instance, as shown in Chart 8, opening rates for uncollateralized O/N call rates tend to nudge upwards when Euroyen T/N rates had jumped in the previous afternoon¹⁰. Nevertheless, the average uncollateralized O/N call rates for the day were in line with the target set by the Bank of Japan (then around 0.25%).

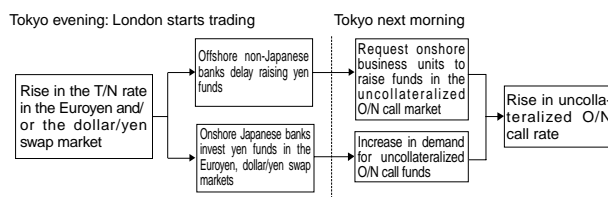
Chart 8 Euroyen Rate (T/N) and Uncollateralized Call Rate (O/N)



Source: BOJ

It is possible to identify two channels, which lead to the above-mentioned arbitrage relationships (Chart 9). First, when the T/N rate rises in the Euroyen market, some market participants would delay funding until the next morning in the uncollateralized O/N call money market. Second, when the Euroyen or the implied yen T/N rate rises, some market participants would invest funds, which are then raised in the uncollateralized O/N call market on the next day.

Chart 9 Arbitrage between T/N and O/N



Monitoring the Yen Money Market from a Global Viewpoint - Conclusion -

The uncollateralized call rate, which reflects the Bank of Japan's money market operations, has been under strongly influenced by yen funding rates in other money markets. In recent years, more market participants are more actively pursuing arbitrage opportunities in short-term interest rates, comparing funding costs in multiple currencies. Due to such increases in global arbitrage transactions, it is becoming ever more inappropriate to neglect the impact on domestic rates of developments in overseas interest rates and the foreign exchange rates. In addition, arbitrage activities between short and long-term interest rates, and between transactions involving collateral such as government securities and uncollateralized transactions are having an ever increasing influence. Furthermore, it is essential to carefully monitor how overseas market participants assess the economic conditions in Japan, and how participants react to changes in domestic institutional arrangements.

The Bank of Japan has transferred its Foreign

Exchange Division from International Department to Financial Markets Department in May 2000, in order to facilitate the more comprehensive monitoring of the foreign exchange market and other domestic financial markets. This institutional change has made it easier to collect and analyze market developments for the Bank's money market operations: for example, observing developments in overseas interest rates and foreign exchange rates; effects of changes in institutional arrangements on market participants' behavior and hence on market liquidity and arbitrage relationships between markets (both domestic and overseas). More attention should be paid to examine the arbitrage relationships between markets, as described in this paper, so as to more accurately capture changes in market participants' behavior and global cash flows, which affect market functioning. Furthermore, in order to identify and resolve remaining issues, the impact of the introduction of RTGS on market functioning will be discussed with market participants based on analyses such as described in this note.

¹ "Euroyen" is Japanese yen traded outside Japan. Euroyen used to be traded only in foreign markets including London, New York, Singapore, etc. Since December 1986, however it has also become possible for Euroyen to be traded in Japan, separated from domestic transactions. Participants in the Tokyo Euroyen market (called "JOM" <Japan Offshore Market>) are non-residents and banks whose offices are located in Japan and which have JOM accounts. Most "offshore" transactions are conducted in this market which features fewer regulatory and tax encumbrances compared to domestic markets. Nevertheless, some banks whose offices are located in Japan use the Euroyen market as a complementary channel for yen funding, taking advantage of rules that allow the transfer of funds from JOM accounts to domestic general accounts under certain conditions.

² The interest rates in these three markets are also arbitrated with interest rates in money markets where collateral, such as government securities, is used ("repo", collateralized call, and repurchase of short-term government bills). Collateral values need to be taken into account when discussing such arbitrage relationships. This is a subject for further study and is not discussed in this paper.

³ It is pointed out that market participants are increasing their market share of DD (direct deal) transactions in short-term fund transactions in order to enhance efficiencies under RTGS by using netting and open-end transactions. In the future, such influences need to be taken into account in order to fully understand the market structure.

⁴ In recent years, Japanese banks have played a less prominent role in the Euroyen market, reflecting Japan's economic slowdown, strengthening of regulations (in 1996) leading to a decrease in Euroyen impact loans (lending to domestic companies by onshore Japanese banks via offshore Japanese banks), and a decline in the dollar funding needs of offshore Japanese banks resulting from cutbacks in overseas business by Japanese banks. As a result, JOM's outstanding amount has shown a downward trend (from 64.2 trillion yen as of end-1995 → 48.7 trillion yen as of end-1998 → 27.9 trillion yen as of end-2000).

⁵ The implied yen rate in Chart 4 is calculated by averaging offers and bids in the Eurodollar interest rates and forward spreads. Therefore, it should be noted that there is some possibility that implied yen rate volatility is exaggerated compared to the other two rates.

⁶ Non-Japanese banks raised more yen funds than usual in December 2000, probably due to demand to finance the purchase of collateral for intra-day O/D after the introduction of RTGS. Some point out that offshore Japanese banks attempted to profit from such demand by increasing Euroyen funding in the short term for lending in the longer term, resulting in stronger

demand for Euroyen funding.

⁷ For further details, see "Risk Premium in Foreign Currency Funding: Does macro structure have bearing on risk premium? - Comparison among Germany, Japan, the United Kingdom, and the United States" (Financial Markets Department Working Paper Series 00-J-5, in Japanese.)

⁸ For further details, see "Three Japan Premiums in Autumn 1997 and Autumn 1998 - Why did premiums differ between markets?" (Financial Markets Department Working Paper Series 99-E-1.)

⁹ A "Japan premium" had been observed in credit default swap transactions with maturity of more than one year since autumn 2000. On the other hand, no "Japan premium" in short-term dollar funding was observed. Thus, although there were concerns about the Japanese economy over the long term such as the downgrading of JGBs, it can be said that no "Japan premium" resulting from uncertainties over the financial system was observed.

¹⁰ Chart 8 seems to show that when Euroyen T/N rates were not diverging significantly from the BOJ target rate (at the time), O/N rates did not seem to have been affected, i.e., the differences were not fully arbitrated. The following are reasons behind this.

1) T/N rates generally tend to be higher than O/N rates as this enables banks to fix funding one day earlier than O/N transactions.

2) When market participants believed that the target rate would be strictly controlled by BOJ's market operations, they tended to take a wait-and-see attitude before the announcement of daily money market operations. Therefore, the rise in the uncollateralized O/N call rate tended to be limited even before the announcement.

3) The T/N rate could edge towards in-house rates at which onshore non-Japanese banks provide funds to their offshore business units, rather than the uncollateralized O/N rate of the next morning.

Market Review is edited and published by the Financial Markets Department of the Bank of Japan in order to stimulate comments and discussions from a wide audience. This report, 2001-E-3, is a translation of an original Japanese issue, 2001-J-5, published in May 2001. The views expressed in the Review are those of authors and do not necessarily represent those of the Bank of Japan. Comments and questions as well as requests for hard copies should be addressed to Tokiko Shimizu, Manager, Financial Markets Department (tokiko.shimizu@boj.or.jp). *Market Review E-series and Financial Markets Department Working Papers E-series* can be obtained through the Bank of Japan's Web site (<http://www.boj.or.jp/>).