

## Arbitrage Activities between Offshore and Domestic Yen Money Markets since the End of the Quantitative Easing Policy

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Transactions in the yen money markets have become active since the end of the quantitative easing policy (QEP) in March 2006. In particular, transactions by foreign financial institutions have been increasing in the offshore markets including the FX swap and euroyen deposit markets, as well as the domestic money markets. This *Review* surveys the spreads and hence the arbitrage relationship between those offshore markets and the domestic money markets. In the short-term money markets, the spreads widened in some phases right after the end of the QEP, but the rates have gradually converged due to increasingly active arbitrage activities among the FX swap, euroyen deposit, and FB/TB markets. In the overnight money markets, although arbitrage activities are conducted between the offshore markets and the uncollateralized call market, particularly when the T/N rates in the offshore FX swap and euroyen deposit markets rise, the arbitrage relationship still has room for improvement. Possible reasons for this are: 1) not a few foreign financial institutions have to rely on T/N funding in the FX swap and euroyen deposit markets as a final funding tool and 2) domestic financial institutions have internal restrictions in conducting arbitrage activities between the offshore and domestic money markets.

### Introduction

Since the Bank of Japan (BOJ) ended the Quantitative Easing Policy (QEP) in March 2006, the Japanese yen money markets have grown in size. Foreign financial institutions, in particular, have been increasing their transactions of yen assets.<sup>1</sup> These foreign financial institutions mainly use offshore markets including the foreign exchange swap market (FX swap market<sup>2</sup>) and euroyen deposit market<sup>3</sup> for their yen-funding.

This *Review* briefly surveys the relationship between FX swap/euroyen deposit markets and domestic money markets, paying particular attention to the spreads and hence the arbitrage activities between these markets.<sup>4</sup>

Non-negligible spreads had been observed in the past between FX swap/euroyen deposit markets and domestic money markets. Specifically, during the period from the introduction of the QEP in March 2001 to 2004, domestic money market rates stayed around zero, while the FX swap implied yen rates for foreign financial institutions were constantly negative, due mainly to the difference in the creditworthiness between foreign and domestic financial institutions.<sup>5</sup> After 2005, as the difference in the creditworthiness diminished, the FX swap implied yen rates gradually rose toward zero. Since the end of the QEP, however, the FX swap implied yen rates have occasionally been higher than domestic money market rates, such as the uncollateralized call rate (overnight, O/N).

Examining the relationship between these offshore and domestic money markets since the end of the QEP more closely, we find that *short-term rates*<sup>6</sup> in both offshore and domestic markets have been gradually converging as arbitrage trading has become active. When we look at *overnight rates*, on the other hand, though the markets have grown in size and their market functioning has been recovering, spreads between the offshore and domestic

markets have widened occasionally. In what follows, we describe the arbitrage relationships across both short-term rates and overnight rates, respectively, in more details.

### Short-term Rates

#### Short-term rates gradually converging

After the end of the QEP, short-term rates began to rise, but not in a consistent way in terms of the degree of rise and volatility across the markets. Note here that even if the trading term is the same, the rate differentials are likely to remain due to the differences in trading costs, market liquidity, and funding costs in investing in a particular asset. Even if we take account of these factors, non-negligible rate differentials were observed in the short-term money markets.<sup>7</sup>

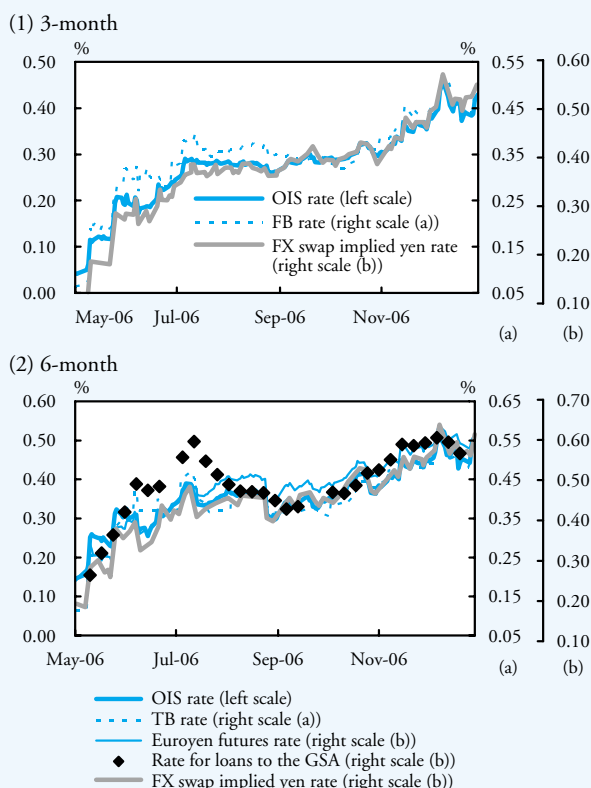
Reflecting the unstable movement of the overnight funding rates, repo (repurchase agreement) rates in particular, “cash” rates such as the FB/TB rates and the average rates on loans to the Government’s Special Account for the Allotment of Local Allocation Tax and Local Transfer Tax<sup>8</sup> (loans to the GSA), stayed higher than the derivatives rates such as the OIS<sup>9</sup> (Overnight Index Swap) rates and the FX swap implied yen rates (Chart 1). This probably reflects market participants’ concern over the yen-funding environment for cash bonds and hence premiums were added to these rates.

After August 2006, the spreads between short-term rates diminished and, until recently, had almost converged to the differentials in funding costs and other transaction costs among each instrument.

The tightening of the spreads among short-term rates is likely to have been caused by the improvement in market liquidity as transactions including arbitrage trading have become active. For instance, some market participants simultaneously constructed long positions of FB/TBs or loans to the GSA and short positions of OIS (paying fixed

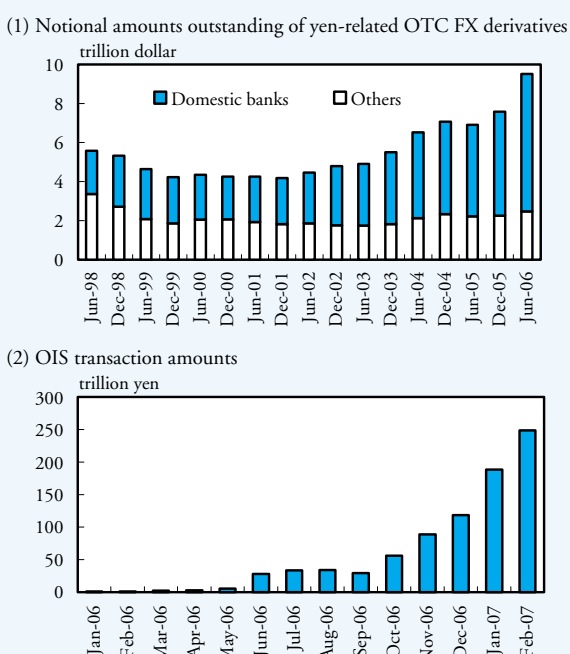
rates) when cash rates rose. Other typical trading includes arbitrage trading among FX swaps, euroyen futures, and OIS. Transaction volumes of yen-related FX derivatives<sup>10</sup> and OIS have been increasing rapidly against the background of these arbitrage activities (Chart 2).

**Chart 1: Short-term rates**



Sources: Japan Bond Trading Co., Ltd., Meitan Tradition Co., Ltd., and Money Brokers Association.

**Chart 2: Short-term derivatives**



Notes: 1. "Domestic banks" is the Japanese reporting dealers of regular OTC derivative statistics. "Others" is the difference between the total reporting dealers and the Japanese reporting dealers. Data of Japanese dealers are not adjusted for inter-dealer double counting.  
2. OIS transaction amounts only include those via brokers.  
Sources: BIS, Money Brokers Association, and Bank of Japan.

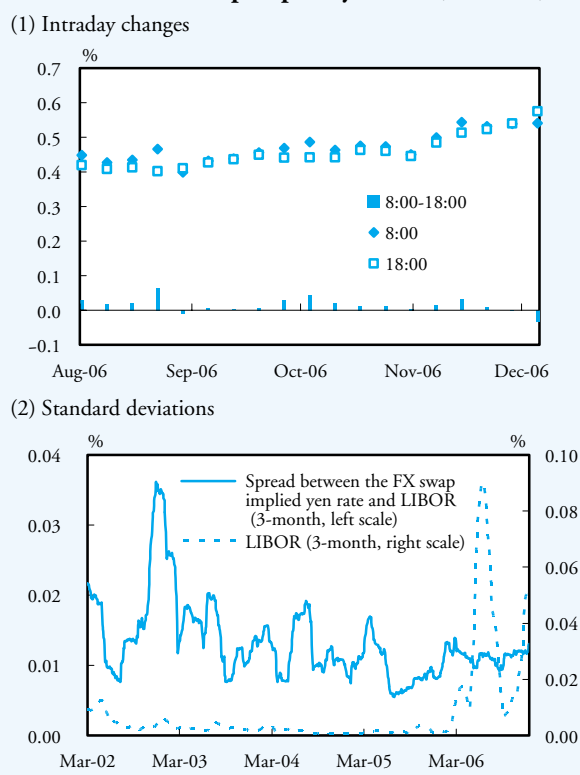
## Fluctuations of interest rate differentials stabilizing as market liquidity improves

Short-term rates in each market reflect market participants' expectations about the BOJ's future monetary policy and other market-specific factors, particularly the temporary supply and demand imbalances. However, such market-specific factors became increasingly insignificant as arbitrage trading became active and market liquidity improved.

The FX swap implied yen rates, for instance, tend to rise in the Tokyo morning, due to high demand for yen funds by the Tokyo offices of foreign financial institutions.

This tendency can still be observed. Recently, however, even if the FX swap implied yen rates rise in the Tokyo morning, the rates return to the level consistent with the OIS rates or LIBOR by the Tokyo evening (London morning) in most cases. In fact, the daily spread between the FX swap implied yen rate and LIBOR<sup>11</sup> has become smaller and less volatile, although LIBOR itself has become much more volatile since the end of the QEP (Chart 3).

**Chart 3: FX swap implied yen rate (3-month)**



Note: Intraday rates are the averages of each week. Time zone is Tokyo.  
Standard deviations are calculated from the close rates of the last 50 days.  
Sources: Reuters, Bloomberg, and Bank of Japan.

In addition, recently, the arbitrage relationship among interest rates of major currencies has been strengthened through FX swap transactions. The expansion of FX swap transactions has improved the yen-funding environment particularly for foreign financial institutions and, as a result, has enhanced market efficiency. On the other hand, the close arbitrage relationship is likely to strengthen the impact of developments in the overseas markets on the yen markets (see Box).

## Foreign financial institutions increasingly taking advantage of the OIS rates

Another important point to note since the end of the QEP is the rapid and substantial expansion of OIS trading,

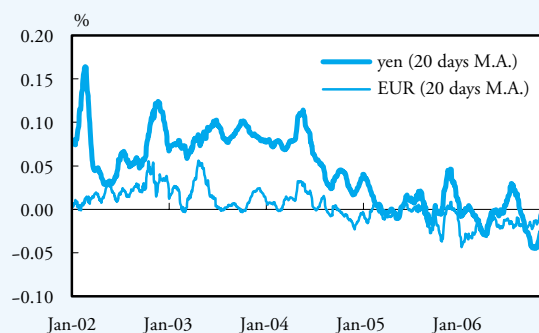
### [BOX] Arbitrage relationship among interest rates of major currencies

Global financial institutions attempt to minimize their total funding costs by comparing funding costs among major currencies. For instance, when they need to raise U.S. dollar (USD) funds, they compare the USD interest rate to the FX swap implied USD rate, which is the total cost when they raise yen or euro (EUR) funds first and then exchange those to USD funds through the FX swaps.

Box chart compares the three forms of USD funding costs. This chart shows that 1) the FX swap implied USD rate calculated from the EUR interest rate and EUR/USD swap points has been almost the same as the USD interest rate, 2) the FX swap implied USD rate calculated from the yen interest rate and the yen/USD swap points had been much higher than the USD interest rate until 2005, mainly reflecting the difference in the creditworthiness between foreign and Japanese financial institutions, and 3) since 2005, however, the spreads between these two rates have been diminishing. This indicates that arbitrage trading among interest rates of major currencies has become active.

On the other hand, the close arbitrage relationship is likely to strengthen the impact of developments in the overseas markets on the yen interest rates. If market participants' expectations about the future course of USD interest rates are factored into the USD market rate and swap points differently, then the FX swap implied yen rate will change without any changes in the domestic yen markets.

**BOX Chart: The FX swap implied USD rate calculated from yen and EUR market interest rate (3-month, spread over USD interest rate)**



Note: M.A. stands for moving average.

Sources: Bloomberg, Meitan Tradition Co., Ltd., and Bank of Japan.

particularly short-term transactions whose terms are one to two months, by foreign financial institutions. The most active trading is the so-called "inter-meeting trading." This is a forward trading in which the contract period corresponds to the interval between the BOJ's Monetary Policy Meetings. They conduct inter-meeting trades based on their own views about the BOJ's future monetary policy stance. In addition, spot transactions, whose terms are usually three to six months, have been increasing.

Term trading has been limited in the call, euroyen deposit or repo markets so far. As a result, the FB/TB rate has been regarded as a representative short-term rate in the yen money markets. FB/TBs have been actively traded, but those rates have occasionally experienced large swings due to temporary market-specific supply and demand imbalances.<sup>12</sup>

Under these circumstances, many market participants, particularly foreign financial institutions, began to use the OIS rate as a complementary reference rate in the short-term zone of the yield curve. The OIS rates are not much influenced by supply and demand imbalances of cash bonds since they are derivatives rates. Some participants also emphasize that arbitrage trading between short-term rates has become easier owing to the development of the OIS market.

It should be noted, however, that most of the participants in the current OIS market are foreign financial institutions and hence the OIS rates may not reflect the market participants' central view of the future course of interest rates. The OIS rates will be priced in a more consistent way with the market participants' central view and become more reliable like the EONIA swap rates in the euro area, if more domestic financial institutions enter and actively trade in the market in the future.<sup>13</sup>

## Overnight Rates

### Foreign financial institutions increasing their demand for overnight yen funds, particularly in the T/N FX swap and euroyen deposit markets

Foreign financial institutions have increased their demand for overnight yen funds since the end of the QEP. They have actively raised yen funds through the FX swap and euroyen deposit markets, in addition to the uncollateralized call market.

The strong demand by foreign financial institutions for these yen funds basically comes from the recent increase in their yen assets. Focusing on the period since the end of the QEP, the increase in short-term instruments resulting from their active arbitrage and speculative trading is likely to be a dominant factor for their demand for overnight yen funds.<sup>14</sup>

When they purchase FB/TBs or raise short-term USD funds through the FX swap market, they typically raise yen for funding their positions in the shorter-term markets including the overnight market. This is the so-called "short-funding." Hence, demand for overnight yen funds may rise when foreign financial institutions actively construct arbitrage trading positions.

### Arbitrage trading between offshore and domestic overnight markets becoming active, but not so much as short-term trading

There are different types of overnight fund transactions depending on the settlement dates. For instance, tomorrow/next (T/N) transactions are settled on the next date following the contract date (T+1), and overnight (O/N) transactions are settled on the same date as the contract date (T+0). Except repo funding for cash bond funding, most foreign financial institutions tend to turn first to the FX swap and euroyen deposit markets (T/N) and then use the call market (O/N) for covering the shortfall.

When T/N rates rose in the FX swap and euroyen deposit markets, financial institutions gradually began to invest in these markets.<sup>15</sup> Specifically, domestic financial institutions began to invest in the euroyen deposit market in the Tokyo evening. In the period after Tokyo evening, London/NY offices of foreign financial institutions frequently invested in T/N markets and then they asked their own Tokyo offices to raise yen funds to cover the shortfall on the next date in the O/N call market (Chart 4).

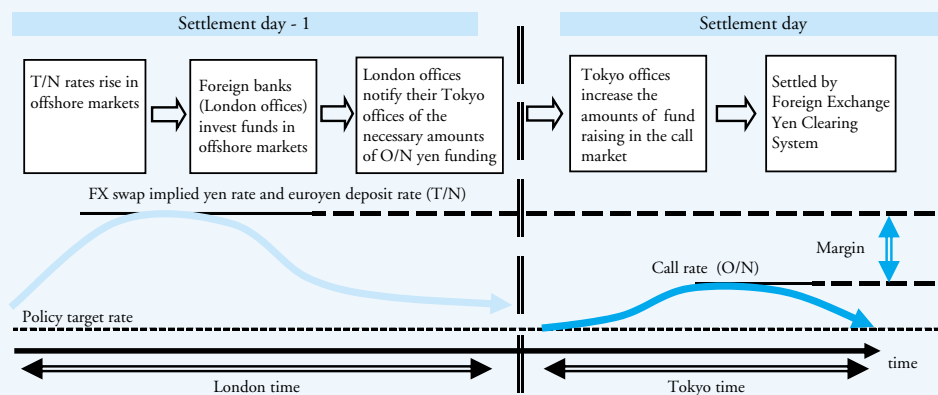
However, though arbitrage trading has become active, the non-negligible spreads have remained between the FX swap/euroyen deposit markets and domestic money markets. When market liquidity lowered and/or the demand for overnight funds markedly increased, T/N rates in the FX swap and euroyen deposit markets rose occasionally over 0.4%, the rate for the complementary lending facility<sup>16</sup> (as of Dec. 2006) provided by the BOJ (Chart 5).

It should be noted here that the FX swap implied yen rates are “calculated” from swap points and FX spot rates and hence are prone to be affected by disturbances specific to the FX market.

For instance, banks’ demands for T/N FX swaps tend to increase when their customers’ FX positions become one-sided. These positions are often constructed based on speculation about future monetary policy, and/or the increase in trades taking advantage of interest rate differentials between currencies. Financial institutions need to cover those customers’ positions. On such occasions, the FX swap implied yen rates tend to fluctuate not only due to their funding activities but also due to their FX positions. Because there is a strong relationship between the FX swap implied yen rates and euroyen deposit rates through arbitrage trading by foreign financial institutions, fluctuations of the FX swap implied yen rates tend to spill over to the euroyen deposit rates.

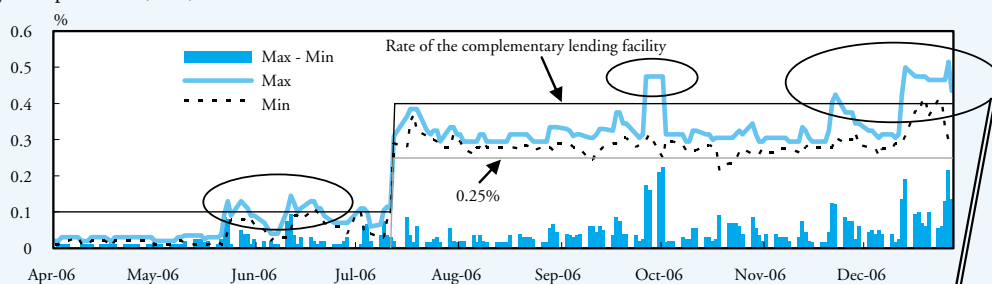
However, even if we consider these market-specific factors, T/N rates in the FX swap and euroyen deposit markets have seemed highly volatile, particularly in London/NY time, since the end of the QEP. In the T/N FX swap and euroyen deposit markets, market liquidity is relatively high in the Tokyo evening/London morning, since a relatively large number of financial institutions including

**Chart 4: Arbitrage trading between overnight rates  
(Since the policy rate hike in July 2006)**

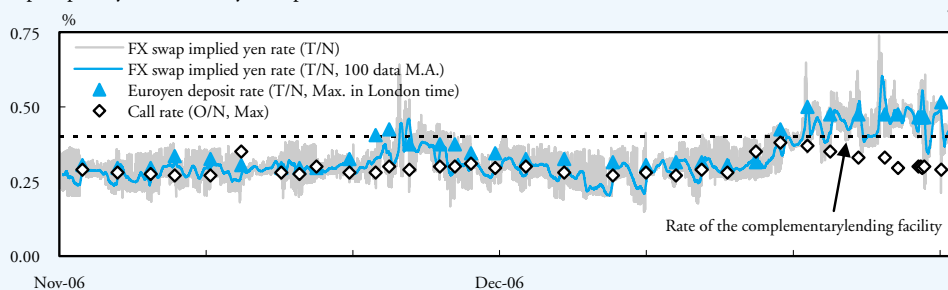


**Chart 5: Overnight rates**

(1) Euroyen deposit rate (T/N): London Time



(2) FX swap implied yen rate, euroyen deposit rate (T/N), and call rate (O/N)

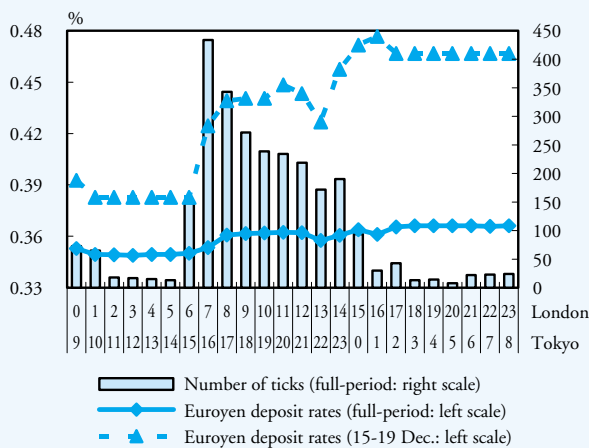


Note: FX swap implied yen rate is calculated from the swap point and spot FX rate (Tick data from Nov. 8 to Dec. 28; London time) under the assumption that the USD rate (T/N) is constant at 5.25%. Euroyen deposit rate (Max) is the highest indication rates in London time and call rate (Max) is the highest contract rate via Tanshi transactions. Horizontal axis is the contract date.

Sources: Reuters, Quick, Bloomberg, and Bank of Japan.

domestic banks, foreign banks' Tokyo offices, and foreign banks' London offices participate in the markets in this time period. However, transaction amounts rapidly decrease after that. Hence, T/N rates tend to rise when foreign financial institutions' needs for yen funds increase after the London morning, as was seen from mid toward the end of December 2006 (Chart 6).<sup>17</sup>

**Chart 6: Intraday euroyen transactions (T/N)**



Notes: 1. "Full-period" is the period from Nov.16 to Jan. 15. Horizontal axis indicates London time (upper) and Tokyo time (bottom).  
 2. "The number of ticks" for each time is the total number of ticks all over the period. "Euroyen deposit rate" for each time is calculated as follows: 1) calculate the hourly averages of euroyen mid deposit rates for each day. If there is no transaction for the time zone, the last mid rate is used. 2) for each time zone, calculate the averages of the hourly averages for each day over the specified period.  
 3. Tick data is the indication by market participants and thus the number of ticks does not necessarily mean the number of contracts.  
 Source: Reuters.

### Possible reasons for high volatility of the FX swap and euroyen deposit rates in London/NY time

The tendency of the FX swap and euroyen deposit rates to be volatile in London/NY time may be inevitable to some extent under the situation that foreign financial institutions actively trade yen assets and hence their funding activities increase in the T/N markets. One additional factor behind the high volatility of the T/N rates is that some foreign financial institutions are not able to rely on the O/N call market for last-minute yen funding, due partly to internal regulations, limited credit lines in the uncollateralized call market, and the time difference between Tokyo and London/NY.

As for the domestic financial institutions, in London/NY time, their Tokyo offices are closed and trading is executed by their overseas offices, particularly ones located in London. Overseas offices tend to face difficulties investing funds beyond the pre-determined limits. In addition, generally, FX swap trading is conducted in a different section from the section for cash management.<sup>18</sup> Hence, many market participants emphasize that it is difficult for them to invest large amounts in the T/N FX swap and euroyen deposit markets, even if they feel almost certain of raising funds at relatively low rates in the O/N call market on the next date.

In addition, from mid toward the end of December 2006, during which some foreign financial institutions temporarily had difficulty in short-term funding and hence

turned to overnight funding instead, they have preferred T/N funding in the FX swap and euroyen deposit markets to O/N funding in the call market.

One reason for this is closely related to the so-called "repayment-first rule (practice of repayment before receiving funds)" in the call market.<sup>19</sup> This is a guideline regarding trading and settlement timing observed in the call market. This rule encourages a borrower to return call loans immediately after 9:00 AM and no later than 10:00 AM. Under this rule, when borrowers roll over their borrowings, they occasionally need to temporarily raise their repayment funds, the so-called "intraday liquidity." If they have enough eligible collateral on their BOJ's accounts, they can use the BOJ's intraday overdraft<sup>20</sup> for intraday liquidity.

If the demand for intraday liquidity exceeds the limit of intraday overdraft, they must temporarily raise their repayment funds by intraday call or raise O/N funds with special provisions such that the repayment time is set at 12:00 PM. These kinds of supplemental markets are not liquid enough and the rates for overnight loans in such markets exceed the ordinary O/N call rates.

In contrast, foreign financial institutions do not usually need intraday liquidity if they opt to raise funds in the euroyen deposit market since euroyen transactions are settled by the Foreign Exchange Yen Clearing System,<sup>21</sup> which is not subject to the repayment-first rule. Hence, as the demand for overnight funds increase, the demand for T/N funds in the euroyen market increases.

### Concluding Remarks

This *Review* has briefly surveyed the relationship between offshore markets including FX swap and euroyen deposit markets and the domestic money markets, paying particular attention to the arbitrage relationship since the end of the QEP in March 2006.

As arbitrage trading has become active, the correlation between the short-term money markets has become higher and, as a result, market liquidity has been improved. The newly developed derivatives, such as OIS, have been actively used for arbitrage and other trading purposes by foreign financial institutions. These trades bring high liquidity to the OIS market, making the OIS rate one of the most useful reference rates. Participants in the current OIS market are still limited in scope and we expect more domestic financial institutions to enter the market, which will enhance market liquidity further.

As for overnight rates, arbitrage trading between offshore markets and the domestic call market has also become more active. However, the trading is not so active as the short-term trading and non-negligible spreads remain between the FX swap/euroyen deposit markets and the call market.

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<sup>1</sup> Foreign commercial and investment banks trade in the money markets for their own dealing and funding, as well as for their customers’ accounts and the associated cover trading. Their customers include non-financial business entities and hedge funds, etc.

<sup>2</sup> An FX swap is a swap contract in which two counterparties agree to exchange two currencies at a particular rate on one date and to reverse payments on a specified subsequent date. Effectively, it is a combination of a spot transaction and an outright forward transaction in opposite directions. The cost of an FX swap is quoted by swap points, or the difference between FX spot and outright forward. Here, 1) the FX swap implied yen rate is defined as the total cost when financial institutions raise funds in foreign currency first and then exchange the funds for yen through the FX swap and 2) the FX swap implied U.S. dollar (USD) rate is defined as the total costs when financial institutions raise funds in yen first and then exchange the funds for USD funds through the FX swap, for instance. For more details, see Nishioka and Baba [2004].

<sup>3</sup> Euroyen deposits refer to Japanese yen traded outside Japan. Euroyen deposits used to be traded only in overseas markets (London, New York, and Singapore). In December 1986, however, the Tokyo euroyen deposit market named JOM (Japan Offshore Market) was established, separated from domestic transactions.

<sup>4</sup> For the developments in markets that this *Review* does not cover, such as the repo markets, see the Financial Markets Department, Bank of Japan [2006, 2007]. For the developments in the money markets prior to the introduction of the QEP, see Inaba, Konno, Fukunaga and Shimizu [2001].

<sup>5</sup> As for the negative FX swap implied yen rates under the QEP, see Nishioka and Baba [2004].

<sup>6</sup> In this *Review*, short-term rates refer to the interest rates whose terms are longer than overnight, such as one-week or three-month.

<sup>7</sup> Taking these factors into account, we use different vertical axes specific to each rate in Chart 1, with the OIS rate whose underlying asset is uncollateralized O/N call rate as a baseline.

<sup>8</sup> “Loans to the GSA” is the temporarily loans extended by the central government for the allotment of local allocation tax and transfer tax. The loan rates, whose maturity is six months in most cases, are determined by auction and the loans are regarded as short-term investment instruments similar to FB/TBs by financial institutions.

<sup>9</sup> An OIS is an interest rate swap contract that involves the exchange of the overnight rate compounded over a specified term and a fixed interest rate. For details of the Japanese OIS market, see Ooka, Nagano and Baba [2006].

<sup>10</sup> Transaction volumes of yen-related FX derivatives in Chart 2 (1) include transactions other than arbitrage activities such as

those associated with hedging of FX risk.

<sup>11</sup> LIBOR stands for the London Interbank Offered Rate.

<sup>12</sup> Euroyen futures rate is regarded as another representative short-term rate in Japan. The euroyen futures market is relatively liquid, but many market participants point out that 1) it is impossible to draw short-end (less than 3-month) yield curves from this rate since its underlying asset is three-month euroyen TIBOR (Tokyo Interbank Offered Rate), and 2) TIBOR itself does not necessarily reflect actual funding costs for Japanese banks.

<sup>13</sup> In the euro area, the EONIA Swap Index, the euro version of the OIS reference rate, is used as one of the most important reference rates in the money markets.

<sup>14</sup> Specifically, foreign financial institutions began to invest actively in the Japanese stock market in 2003 and Japanese interest rate markets, such as government bond and interest rate swap markets, in 2005.

<sup>15</sup> For details, see the Financial Markets Department, Bank of Japan [2007].

<sup>16</sup> In March 2001, the BOJ introduced the complementary lending facility through which the BOJ extends loans at the requests of counterparties with the conditions pre-specified by the BOJ.

<sup>17</sup> The euroyen deposit rates in Chart 5 and 6 are the indication rates by brokers in London. Note here that these rates do not involve DDs (direct deals) and hence may not necessarily represent the market rates actually observed. Some market participants point out that euroyen deposit rates sometimes rise higher than the indications in London time.

<sup>18</sup> Also within the cash management sections, (sub-) sections are often separated between yen and foreign currencies. In addition, the book of overseas offices is generally separated from that of the Tokyo office. Hence, internal coordination across three or more sections may be required for arbitrage trading among the FX swap, euroyen, and call markets.

<sup>19</sup> For more details of this kind of market guidelines, see Imakubo and Chida [2006].

<sup>20</sup> Since January 2001, the BOJ has extended intraday credit to financial institutions without charge in the form of fully collateralized intraday overdrafts.

<sup>21</sup> The Foreign Exchange Yen Clearing System was established in October 1980 as the system for clearing foreign exchange related yen transactions including a dealing in the FX spot markets and yen-denominated remittance. The system is operated by the Tokyo Bankers Association using the BOJ-NET Funds Transfer System for electronic transactions such as sending or receiving of electronic payment instructions and calculating each financial institution’s net balance.

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