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This study is an extension of the recent study by Suzuki (2016) that investigated factors contributing to the deviations from covered interest parity (CIP) in euro/dollar cross-currency swaps during the European debt crisis. The widening of the cross-currency basis or deviations from CIP has traditionally been associated with financial stress or credit risks. This study is unique as it not just looks into these traditional factors, but also investigates the influence of financial regulations, currency volatility and monetary policy divergence between the United States and Japan. While Abenomics urges yield-hungry Japanese investors to buy more U.S. dollar assets, new regulations discourage global banks from extending dollar loans via FX swaps.

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This study is an extension of the recent study by Suzuki (2016) that investigated factors contributing to the deviations from covered interest parity (CIP) in euro/dollar cross-currency swaps during the European debt crisis. The widening of the cross-currency basis or deviations from CIP has traditionally been associated with financial stress or credit risks. However, this study explains new sources of the basis of U.S. dollar/Japanese yen swaps observed mainly in the 2014–2016 period. It assumes that the basis is mainly determined by strong hedge demands by Japanese investors who have increased investment in U.S. dollar assets against the backdrop of Bank of Japan's quantitative easing (QQE). In turn, this resulted in deterioration in the value of the yen or the yen discount.

1. Introduction

Foreign exchange swaps (FX swaps) are often used as instruments of foreign currency funding for overseas investments by banks and institutional investors. In FX swaps, one party borrows one currency and simultaneously lends another currency to a second party, and a relation known as the covered interest parity (CIP) holds, unless there is market stress. CIP assumes that the forward spreads or the cost of FX swaps should perfectly reflect the interest rate gap between the two currencies. However, in Japan, between 2014 and 2016, despite the stable credit indicators of the Japanese banks, the basis or the deviation from CIP, became significantly wider for the dollar/yen swaps, when compared to the euro/dollar swaps, as shown in Figures 1 and 2, respectively. Figure 3 shows the trend in dollar funding costs for Japanese banks using FX swaps, and the yen funding costs for non-Japanese banks using FX swaps.

There are many studies that identify the source of the basis and a number of these studies focus on factors, such as transaction costs, credit risk, or financial stress. However, in recent years, the Japanese swap market participants indicate the influence of external factors, such as the financial regulations globally and of the United States. Meanwhile, Japanese institutional investors state that the unconventional monetary easing by the Bank of Japan (BOJ) and the consequent depreciation of the yen could play a role in influencing the basis. Considering that the relative importance of these new factors is empirically verified, this could supplement existing literature on the basis.

This study investigates the possible determinants of the dollar/yen swap basis in the Abenomics[1] period. It specifically focuses on 1) market risk, namely the dollar/yen volatility and the degree of depreciation of the yen, 2) monetary policy risk arising from policy divergence between the U. S. and Japan, 3) the risk of financial regulations that could lead global banks, who are the dollar suppliers for FX swaps, to become more reluctant in supplying dollars and 4) credit and liquidity risk.

In addition, if the new factors are proved to be important, the significance of Abenomics would also be questioned. Abenomics or more specifically "quantitative and qualitative monetary easing (QQE)" adopted by the BOJ in April 2013 is aimed at rejuvenating the Japanese economy by increasing exports through a weaker yen. The QQE measures pushed down the short-term interest rates on the yen, to ultra-low levels and even to the negatives, which effectively persuaded Japanese investors to search for higher yields overseas, particularly in the U.S. bond market. Japanese Ministry of Finance data[2] shows that the outstanding amount of U.S. bonds held by Japanese investors was 133.98 trillion yen at the end of 2016, which is almost the double of 76.68 trillion yen at the end of 2012. As a result, a strong demand emerged among the Japanese investors to fund the U.S. bond investments using FX swaps.

Meanwhile, the U.S. and European banks, who have traditionally been the key providers of dollar funds for FX swaps, can no longer respond to all the dollar needs of the Japanese investors, mainly owing to the post-Lehman financial regulations that laid constraints on their balance sheets. As a result, market liquidity in the FX swaps has deteriorated, pushing the basis wider.

Given these circumstances, if the QQE is pursued further, the basis or the extra funding cost of the dollar for Japanese banks and investors could escalate, and risk depleting the wealth of the nation. Identifying the source of the basis is worth an empirical effort from a policy perspective as well as to validate the damaging consequences.

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1 Abenomics refers to the economic policies advocated by Prime Minister Shinzo Abe since December 2012. It is based on "three arrows": aggressive monetary easing, flexible fiscal policy, and structural reforms.

2 Japan Ministry of Finance, International Investment Position of Japan

The remainder of this paper is structured as follows. Section 2 outlines the CIP for FX swaps and examines previous studies. Section 3 presents the relationship between the basis and cross-border capital flows. Section 4 explores the determinants of the basis, and presents the methods and the results. Section 5 explains the importance of regulations on the basis. Finally, section 6 concludes the study.

【 Figure 1 】 USD/JPY swap basis (3M)

——2012 ······2013 -··-·2014 ——2015 ·······2016 ——2017
Source：Data Stream

【 Figure 2 】 EUR/USD swap basis (3M)

——2012 ······2013 -··-·2014 ——2015 -----2016 ——2017
Source：Data Stream

【 Figure 3 】 Dollar Funding vs Yen Funding

—— Dollar funding cost for Japanese banks
------- Yen funding cost for non-Japanese banks

Source: Data Stream
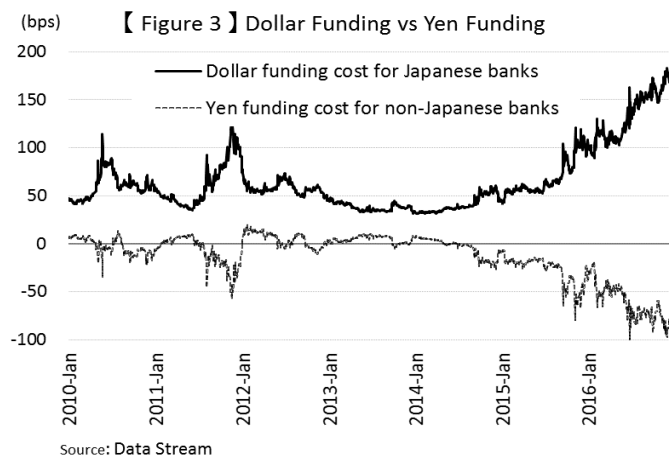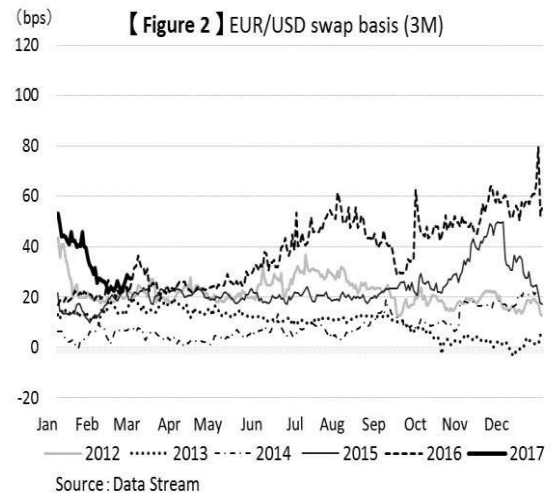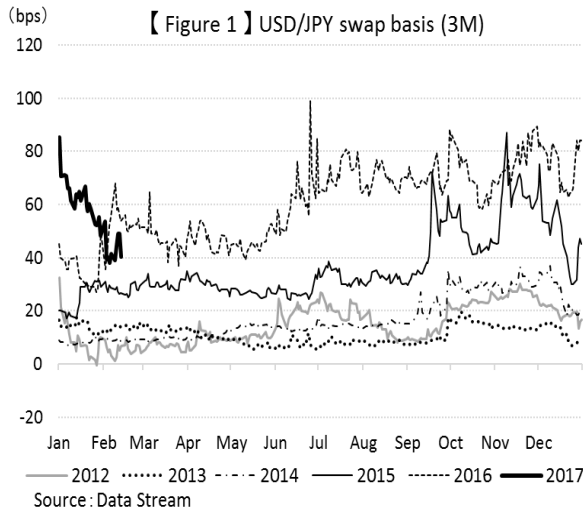
2. CIP and Literature

An FX swap for which JPY (Japanese yen) is the domestic currency is equivalent to the following stream of cash flows: (a) borrow JPY, exchange it for USD (U.S. dollar) at the spot rate (S_t), and invest at $\left(r_{t,t+s}^{USD}\right)$; (b) at maturity, receive proceeds $(1+r_{t,t+s}^{USD})$; (c) convert proceeds from USD back into JPY at the forward rate $(F_{t,t+s})$; and (d) repay the loan $\left(1 + r_{t,t+s}^{JPY}\right)$. CIP assumes that the FX forward discount rate should perfectly reflect the interest rate gap between two currencies. Therefore, equality between dollar rates and FX swap-implied dollar rates from the yen defines a condition of indifference, as shown in (1). Conversely, equality between yen rates and FX swap-implied yen rates from the dollar defines a condition of indifference, as shown in (2):

$$1 + r^{USD} = \frac{S_t}{F_{t,t+s}} \ (1 + r^{JPY}), \qquad\qquad (1)$$

$$1 + r^{JPY} = \frac{F_{t,t+s}}{S_t}(1 + r^{USD}) \ . \tag{2}$$

However, it is widely known that the FX swap cost deviates from the theoretical value during periods of uncertainty. These deviations or the basis can be expressed as follows:

$$Basis_t^{JPY,USD} = \frac{S_t}{F_{t,t+s}}\left(1 + r_t^{jpy}\right) - \left(1 + r_t^{USD}\right) \ . \tag{3}$$

Basis is a type of anomaly in the efficient market hypothesis established by Markowitz (1952) and Sharpe (1964). Numerous studies have indicated various determinants of basis, such as transaction costs, credit risk, and liquidity constraints. Demsetz (1968), Frenkel and Levich (1977), and Taylor (1987; 1989) focused on the role of transaction costs. Levi (1977) considered tax rate differentials, while Aliber (1973) emphasized political risk. Blenman (1991) posited capital market imperfections as a source of basis. This study focuses on transaction costs in aspects such as exchange rate volatility instead of the costs incurred from taxation or political risk.

In terms of credit risk, Covrig (2004) indicated that the LIBOR/TIBOR disparity reflects the credit risk of Japanese banks. Hanajiri (1999) revealed the possibility that LIBOR did not reflect funding costs in interbank markets, which became prohibitively high for Japanese banks, or the widening of the information gap among market participants with respect to the creditworthiness of Japanese banks. This study examines the role of credit risk between 2014 and 2016, when the creditworthiness of Japanese banks was higher than that of banks in the U.S. and Europe.

Since the global financial crisis of 2007–2008, many studies on the basis have emphasized the liquidity risk. However, only a few indicators have directly captured this risk. Numerous studies have focused on a central bank's interventions to improve liquidity vis-à-vis whether they contribute to the narrowing of the basis. Baba and Packer (2008) stated that the European Central Bank's dollar supply operation helped reduce the volatility of EUR/USD swap basis. Goldberg *et al*. (2011) stated that the dollar swap facilities established by the Federal Reserve with 14 central banks were effective in reducing dollar funding pressures. On the other hand, in analyzing the effectiveness of the Term Auction Facility, Taylor and Williams (2008a; 2008b) dismissed liquidity concerns and focused instead on the counterparty risk.

This study is unique in that it looks beyond those traditional factors and sheds a light on relatively new factors as a yen's depreciation, monetary policy divergence and post-Lehman financial regulations.

3.   Cross-Border Capital Flows

The CIP conditions essentially hold true, regardless of the amount of cross-border transactions. Thus, investigating the relationship between the transaction amount and the basis does not result in identifying the cause of the basis.

However, possible causes, such as investors' risk perception, regulations, and macro-economic policies should influence the basis through a change in transaction volume. Thus, it is meaningful to investigate the relationship between the transaction volume for each category of cross-border investment and the basis, as a foundation for the following sections.

Cross-border capital flows are disaggregated into six types - net Japanese investments in foreign equities and bonds, foreign direct investments, net foreign investors buying of Japanese stocks and bonds, and direct investments in Japan. This categorization assists in identifying the types of investments that exhibit relatively strong influences on the basis. If a certain foreign investment that has a substantive influence on the basis increased

in the Abenomics period, then the BOJ's QQE policy introduced during the period might be the fundamental cause of the widening of the basis.

As shown in Figure 4, Japanese outward investment, particularly the purchase of foreign stocks and bonds, has increased from the mid-2013 in the wake of the BOJ's QQE policy, which prompted portfolio rebalance effects in foreign securities. This portion of the investment is funded through FX swaps. The impact of portfolio rebalancing, which is a key transmission channel of the QQE, is quantified by Arslanalp and Botman (2015). Foreign direct investment (FDI) is maintained at a high level from mid-2013, at over one trillion yen per month. Notably, data from the Bank for International Settlements (2015) as of the end of June 2015, show that 56% of the Japanese banks' assets and 63% of the debt are denominated in U.S. dollars. This study considers foreign currency funding as U.S. dollar funding.

Meanwhile, Japanese stock purchases by foreign investors increased around the mid-2013 and Japanese bond purchases increased around the end of 2014, as shown in Figure 5.

Source: Japan Ministry of Finance

Source: Japan Ministry of Finance
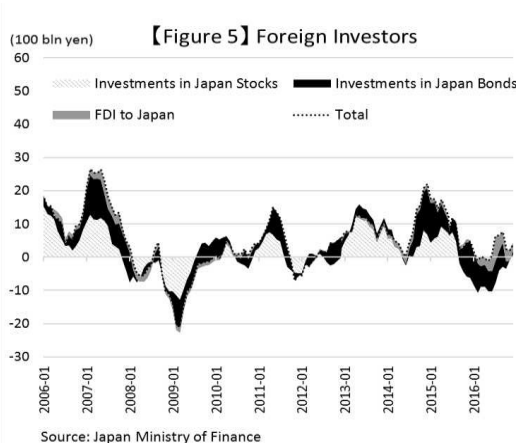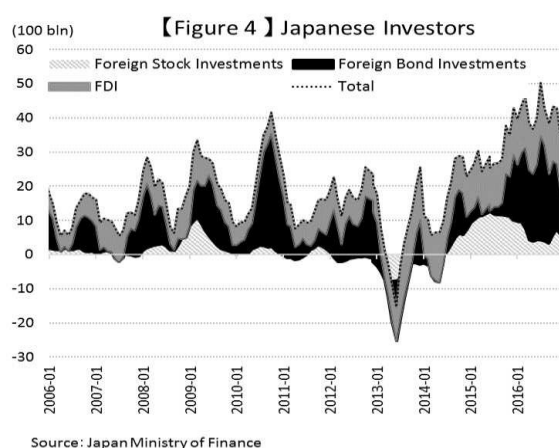
In this section, a pairwise correlation is undertaken to identify if there is any relationship between cross-border capital flows or Japanese foreign investments and the basis. All investment figures are based on a six-month average.

Table 1 shows the result of the pairwise correlation between each of the investment types and the basis. The result shows that in the Abenomics period, there is a significant correlation between the net foreign bond purchases by Japanese investors and the basis. In addition, there is a modestly significant correlation between the basis and the Japanese foreign stock purchases. The result also shows that the net Japanese stock purchases by foreign investors have a strong negative correlation with the basis in the Abenomics period. This implies that when the strong need to swap the yen with the dollar corresponds to an equally strong demand to swap the dollar into the yen (for Japanese stock purchases), the basis tends to fall.

Table 1 Pairwise Correlation - Basis and Investment Types

	2009/12-2016/12 Whole Period	2009/12-2012/9 European Crisis	2012/10-2016/12 Abenomics
Foreign Stock Investments by Japanese Investors	0.5754	0.7930	0.5466
Foreign Bond Investments by Japanese Investors	0.5556	0.1071	0.7326
Foreign Direct Investments by Japanese Investors	0.3720	0.1130	0.4001
Japanese Stock Investments by Foreign Investors	-0.6264	-0.3619	-0.7136
Japanese Bond Investments by Foreign Investors	0.2901	-0.1075	0.3224
Direct Investments to Japan by Foreign Investors	0.4836	0.1908	0.4807

4. Exploring Determinants of the Basis

4.1 Variables and Methodology

This section investigates the influence of the market factors, such as the dollar/yen volatilities and the degree of yen's fall and the monetary policy factor in addition to conventional factors such as credit and liquidity factors.

As in Section 3, data on swap spreads are from Tullet Prebon; FX rates, yen and dollar LIBORs, and Credit Default Swap (CDS) spreads are from Datastream. The analysis covers the period from December 2009 up to December 2016. First, a whole-period estimation is executed; then, analyses proceed in terms of the two periods listed below:

(1) European debt crisis: December 2009 when Greece was downgraded to September 2012 when ECB announced Outright Monetary Transactions.
(2) Abenomics: October 2012 to December 2016, the period of BOJ's QQE interventions.

Variables

Dollar/Yen volatility
The first market-risk variable is computed using the dollar/yen volatility. In options trading, as the price of the underlying asset increases, the option premiums increase. This rule also applies to FX swaps. If the spot price for dollar/yen rises in the direction of a stronger dollar and a weaker yen, then the cost of dollar procurement from the yen should increase. This is because the collateral value of the yen received in exchange for the dollar declines. Historical volatility refers to the actual price changes observed over a specified time period. This study uses three-month (66-trading days) volatility as a proxy that represents foreign exchange risk.

Net yen conversion
The second market-risk variable is computed using the net yen conversion balance of financial institutions. It is likely that the basis tends to widen when the net amount of yen converted into dollars is larger. The net yen conversion balance is calculated by subtracting the sum of inter-office debts held by foreign banks' Tokyo branch and the inter-office assets held by the Japanese banks' overseas branch from the sum of inter-office assets held by the foreign banks' Tokyo branch and the inter-office debts held by the Japanese banks' overseas branch. This data from the BOJ is only available for Japanese banks and not for other institutional investors.

Yen's depreciation
The third market-risk variable is the degree of yen's fall. The Governor of the BOJ Haruhiko Kuroda admits that the excessive strength of the yen has been corrected by the QQE policy[3], but denies that the yen is a direct policy target of the QQE. Meanwhile, market participants and academics, such as Arslanalp and Botman (2015), point that the QQE policy has evidently contributed to the weakening of the yen. This study sets the dollar/yen rate (the monthly average of the central rate of the Tokyo market) at the beginning of the European crisis (December 2009) and the Abenomics (October 2012) as a baseline rate, and observes the degree of depreciation of the yen from the beginning of these specific periods.

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[3] "Comprehensive Assessment of Monetary Easing and QQE with Yield Curve Control", BOJ Governor Haruhiko Kuroda, speech at a meeting with business leaders in Osaka Japan, Sept 26, 2016.

Balance sheet growth gap between the BOJ and the Federal Reserve Board (FRB)
In the U.S. and Japan, it was observed during the sample period that the direct instruments of monetary policy have shifted from short-term interest rates to quantitative measures. When the BOJ adopted the QQE policy for the first time in April 2013, the FRB's third Quantitative Easing (QE) had already been rolled out. However, the former FRB Chairman, Ben Bernanke, showed a tapering scenario in mid-2013, resulting in the FRB reducing the amount of asset purchases from December 2013[4]. Figure 6 shows the three-month dollar/yen basis and the outstanding amount on the balance sheet of the FRB and the BOJ. It is observed that the basis began to prominently widen after December 2013, when the FRB's balance sheet stopped growing owing to the tapering. Note that the expected sign for the difference in growth rate of central banks' balance sheets (i.e. BOJ's B/S growth rate minus FRB's B/S growth rate) is positive in Abenomics. When the growth rate of the BOJ's balance sheet outpaces that for FRB, the interest margin differential is expected to widen, which prompts a hunt for yields investment in U.S. bonds by Japanese investors and bring about a wider dollar/yen basis.

（trln USD or 100trln JPY）【 Figure 6 】Balance Sheet of FRB and BOJ （bps）

Source：Data Stream
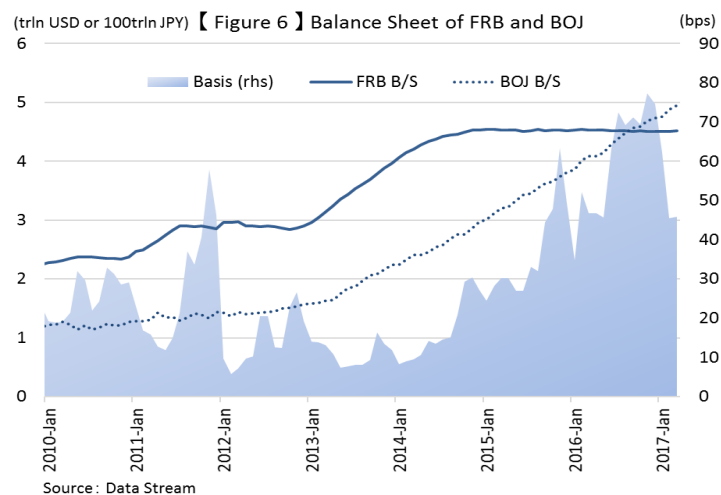
Relative credit risk (banks)
In contrast to the Japan premium era[5], Japanese banks' creditworthiness was generally stable and often better in the Abenomics period, when compared to their U.S. and European counterparts. Using a framework based on those of Baba and Packer (2009) and Coffey *et al.* (2009), global banks that are active participants to dollar/yen swap market are selected and grouped as U.S., European, or Japanese and simple averages of five-year credit default swap (CDS) spreads are used for each. CDS spreads for Japanese banks are subtracted from those for U.S. and European banks to highlight differences in the counterparty risk. In dollar/yen swaps, not just major U.S. banks but globally operating European banks are also frequent providers of dollar funds. The expected sign of the correlation of credit risk with the basis depends on whether the credit risk is greater for non-Japanese banks or for Japanese banks. If the credit risk increases more for Japanese banks, then their dollar

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4 U.S. Federal Reserve Chairman Ben Bernanke said in a press conference following FOMC on June 19, 2013 that if the U.S. economy recovers as expected, the bank could start winding down the $85billion monthly bond purchase program in 2013 and possibly ending it around mid-2014.

5 In the late 1990s, when the creditworthiness of Japanese banks had deteriorated because of the bad loan problem, so-called the Japan premium or the deviation from CIP in FX swaps showed a significant upward swing.

funding rate increases more than $\text{LIBOR}^{\text{USD}}$ and thus the basis increases; in the reverse case, the basis decreases.

LIBOR-OIS spread
A spread between London Interbank Offered Rate (LIBOR) and Overnight Index Swap (OIS) is used as a proxy for financial stress or liquidity risk (Schwarz 2017). In the period from 2014 to 2016, the LIBOR-OIS spread for the yen and the euro was stable at around 10 bps or less against the background of non-traditional monetary easing, including negative interest rates. On the other hand, the dollar LIBOR-OIS spread tended to expand after December 2015 when the Fed raised rates for the first time in almost 8 years.

Methodology
This study tests traditional and new factor's influences by regressing monthly changes in the three-month dollar/yen swap basis on monthly changes in the historical dollar/yen volatilities; on monthly changes in the amount of yen conversion; on monthly changes in the degree of yen's depreciation; on monthly changes in the growth rate gap of the BOJ and FRB's balance sheets; on monthly changes in mean CDS spreads between the U.S.-Japan banks and the European-Japan banks; and on monthly changes in mean LIBOR-OIS;.

It takes the following form:

$$
\begin{aligned}
\Delta Basis_t = \alpha &+ \beta 1 \Delta\left(Volatility^{usd/jpy}\right)t + \beta 2\Delta(Yen\ Conversion)t \\
&+ \beta 3\Delta(Yen\ Fall)t + \beta 4\Delta(BOJ - FRB\ Balance\ Sheet) \\
&+ \beta 5\Delta(Bank\ CDS^{US-JP})t + \beta 6\Delta(Bank\ CDS^{EU-JP})t \\
&+ \beta 7\Delta(LIBOR - OIS^{us})t + \varepsilon t
\end{aligned}
$$

(4)

4.2 Results
Table 2 illustrates the estimation results of equation 4. In terms of market risk, though the historical dollar/yen volatility had a strong negative impact on the basis for the whole period, this was not true for the individual periods. The yen conversion balance of the banks has significant influences on the basis for the whole period and in the Abenomics period. This implies that the reliance of Japanese banks on FX swaps for dollar funding increases as they step up U.S. bond investments. Meanwhile, the yen's depreciation has a strong influence on the basis for the whole period and in the Abenomics period. In FX swaps, if a non-U.S. bank does not repay dollars by the due date, a U.S. bank will not deliver yen, and in this sense, the U.S. bank uses its yen repayment obligation to secure the dollar repayment from the non-U.S. bank. However, the collateral characteristic does not always cover the entire risk of the FX swap. If the yen falls or is likely to fall further from the date of a deal, this could mean a future deterioration of the collateral value of the yen. Consequently, it is likely that swap pricing by the U.S. banks become severer, suggesting higher costs of dollar procurement by the Japanese banks.

The estimation results of the monetary policy divergence indicate that the growth rate gap between the balance sheets of the Japanese and U.S. central banks has a positive and statistically significant influence on the basis in the Abenomics period. The basis tends to widen when the BOJ's balance sheet growth outpaces that of the FRB's. This is because such diverging monetary policies motivate Japanese investors for search-for-yield investment in U.S. bonds and other dollar denominated assets, increasing demand for dollars through FX swaps. In the European crisis era, on the contrary, it has a negative influence on the basis. The basis tends to narrow when the FRB's balance sheet growth outpaces that of

the BOJ's. The European crisis period coincides with FRB's quantitative easing (QE)[6] in which the U.S. bond yields have declined more sharply than Japanese bond yields. This suggests a narrower interest rate margin differential between Japan and the United States, discouraging search-for-yield investment in U.S. bonds by Japanese investors. These estimation results support the hypothesis that new factors, such as the yen's fall and the U.S.-Japan monetary policy divergence, played a role in the widening of the basis in the Abenomics period.

The gap between the U.S. and Japanese bank CDS is significant during the European crisis, suggesting that the perceived credit risk for the U.S. banks increased their dollar funding cost and contributed to the widening of the basis. Meanwhile the gap between the European and Japanese bank CDS is significant only for the whole period. In this analysis, banks' credit risk played limited role in increasing the basis in the Abenomics period.

Finally, LIBOR-OIS has a significant influence on the basis for the whole period and in the Abenomics period, where the basis tends to rise when LIBOR-OIS widens. A wider gap generally implies that there is a dollar shortage in the U.S. money market, which in turn pushes up the cost of dollar procurement through FX swaps.

Table 2 Estimation of Risk on the Basis

	3M USD/JPY swap basis		
	2009/12-2016/12 Whole period	2009/12-2012/9 European Crisis	2012/10-2016/12 Abenomics
USD/JPY Volatility	-3.251**	2.747	-3.298
	(1.482)	(5.417)	(2.586)
Net Yen Conversion	0.299***	0.094	0.191***
	(0.063)	(0.158)	(0.057)
Yen's Fall	5.828***	-2.494	3.732***
	(1.117)	(4.450)	(1.470)
BOJ-FRB Balance Sheet Growth Gap	-0.516	-4.439*	7.290***
	(2.138)	(2.277)	(2.713)
Bank CDS (US-JP)	0.064	0.286***	-0.115
	(0.063)	(0.083)	(0.096)
Bank CDS (Europe-JP)	0.123*	-0.020	0.120
	(0.066)	(0.084)	(0.102)
LIBOR-OIS $_{USD}$	0.123***	-0.342	1.051***
	(0.155)	(0.229)	(0.303)
Samples	85	34	51
Adj R-squared (%)	66.15	53.10	85.33

Notes: Standard erros in parentheses. *Significance, p<0.10; **Significance, p<0.05; ***Significance, p<0.01.

5. Regulation and a Shift of Money

The FX swap market is regarded as a peripheral part of the U.S. money market in the sense that institutional investors such as pension funds do not act as dollar suppliers and

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6 In November 2008, the Fed announced that it would buy the debt of government sponsored enterprises (GSEs), such as Fannie Mae and Freddie Mac, as well as the mortgage backed securities (MBS) that these enterprises sponsored. In March 2009, the Fed committed to buying additional GSE debt and MBS, as well as longer-term U.S. Treasury bonds. These purchases are known collectively as QE1 or the first large-scale asset purchase program (LSAP). The Fed announced additional purchases of longer-term Treasuries in November 2010 and September 2011 as part of QE2 and Operation Twist.

the dollar supply relies on trading and arbitrage activities by the global banks that are mostly major US or European banks.

As noted by Du (2017), before the global financial crisis, banks actively arbitraged funding costs across currencies in the interbank markets and enforced the CIP. However, in the post crisis era, persistent CIP deviation emerged because of (1) costly financial intermediation, which affects the supply of FX forwards and swaps, and (2) international imbalances in investment demand and funding supply across currencies.

Bearing Du's analysis in mind, this section deals with the regulations that make financial intermediation costly for the global banks. In addition, it examines the international imbalances in investment demand and funding supply, which was possibly aggravated by the recent reform of the rules governing the U.S. prime money market funds (MMFs). The regulatory reform may influence the basis because it not only prompts a shift of money by those who are directly regulated (i.e. the U.S. prime MMF), but also has a spillover effect on those who depend on them.

Table 3
Pre-Regulation Balance Sheet of a Bank

A	L
Trading Position, Loans $ 12bln@ (L+100bp)	Short-Term Loans 12bln@ (L+0bp)

$$12 \text{ billion} \times \{(L + 100bp) - (L + 0bp)\} = \$120 \text{ million}$$

Post-Regulation Balance Sheet of a Bank

A	L
Liquidity Buffer (central bank reserve) $3bln@ 25bp Trading Position, Loans $12bln@ (L+100bp)	Long-Term Loans $15bln@ (L+85)

Trading Position: $12 \text{ billion} \times \{(L + 100bp) - (L + 85bp)\} = \$ 18.0 \text{ million}$

Liquidity Buffer: $\$3 \text{ billion} \times \{25bp - (L + 85bp)\} = -\$22.5 \text{ million}$

Total $-\$4.5 \text{ million}$

Table 3 delineates a typical balance sheet of a global bank (arbitrageur) in the pre-regulation and post-regulation periods. In the pre-regulation era, the bank is able to obtain $120 million as profits by raising short-term loans and investing them in financial products or providing loans. However, the financial regulations urge the bank to raise more stable and longer-term money, suggesting higher fund raising costs that could reduce the profit obtainable through the basis in the FX swaps. In fact, Basel 3[7] introduced two types of liquidity requirements - liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) - and the leverage ratio. These regulations made global banks more reluctant in taking part in FX swaps, because cross-currency swaps involve both credit (counterparty) risk and interest rate risk, indicating that they have to set aside ample liquidity buffers against those risks. Liquidity buffers include reserves at the central bank. In this example, the bank sets aside a

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[7] Basel 3 agreed by the members of the Basel Committee on Banking Supervision in 2010-11 is a global regulatory framework on bank capital adequacy, stress testing and market liquidity risk.

quarter of the trading position or $3 billion at the FRB. As a result, the bank incurs $4.5 million in losses, while trying to maintain the positions built in the pre-regulation era.

As noted earlier, Japanese banks and institutional investors often rely on dollar/yen swaps to fund their investments in the U.S. bonds. Issuing dollar denominated short-term debts, such as commercial papers (CPs) and certificates of deposits (CDs), are other popular methods for Japanese banks to fund dollars for their large U.S. bond investments.

However, the U.S. prime MMFs, which have been the key sources of short-term dollar financing for the Japanese banks, have become increasingly constrained by the recent changes in the U.S. Securities and Exchange Commission (SEC) rules. As a result, the prime MMFs are no longer able to buy as many CDs and CPs issued by Japanese banks, as they did previously. Consequently, Japanese banks and investors rely even more on FX swaps to satisfy their dollar funding needs.

In an effort to address the concerns of the financial instability of the U.S. prime MMFs during times of distress, the SEC adopted new rules[8] that require prime MMFs to move from a stable net asset value (NAV) of $1.00 to a floating NAV. On the other hand, the SEC allows the U.S. government MMFs that mainly invest in U.S. government bills and notes, to retain a $1.00 NAV. This has caused a paradigm shift of money from the prime MMFs to the U.S. government MMFs. The SEC's final reform plan was made public on July 23, 2014[9] before the actual implementation in October 2016.

Figure 7 shows that prime MMFs began reducing, albeit gradually, investments in Japanese banks' CDs/CPs a year before the actual implementation of the rule. This means that the Japanese banks had to find another source for dollar funding, unless they planned to reduce the U.S. bond portfolio. However, the Japanese investors, including banks, continued to boost U.S. bond holdings during 2012-2016. Meanwhile, the basis resumed a widening trend from the beginning of 2016, implying the possibilities of Japanese banks shifting funding tools from CDs/CPs to FX swaps in the transition period before the actual implementation of the reform.

【 Figure 7 】Japanese banks' USD funding through prime MMF

Source: OFR
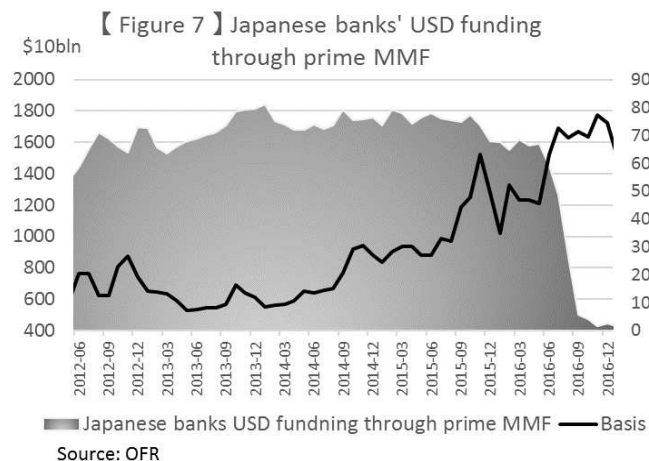
Methodology

Equation 5 tests the influence of the U.S. MMFs' reform by regressing the monthly changes in the three-month dollar/yen swap basis on the difference in the monthly changes in MMFs' outstanding investment amount in the Japanese banks' CDs/CPs. The MMFs' data is derived from the U.S. Office of Financial Research. The sample period is from July 2014,

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8 The new rules also allow MMFs to temporarily suspend investors' ability to make withdrawals and to levy fees on investors who redeem shares.

9 "Money Market Fund Reform; Amendments to Form PF", SEC, Release No.33-9616, July 23rd,2014.

when the SEC announced the MMFs reform plans, to December 2016. In order to quantify the relationship between the prime MMFs' reform and the basis, this study uses a dummy variable that takes the value 0 before October 2015 (period A) and 1 thereafter (period B), to check if there is a structural change in the two periods and jointly test the significance of the dummy variable coefficients.

$$Basis_i = \alpha + \beta MMF_i + \gamma D_i + \delta D_i MMF_i + u_i \tag{5}$$

$$H_0: \gamma = \delta = 0,$$
$$H_1: \gamma \neq 0 \ \ and/or \ \ \delta \neq 0$$

$$F = \frac{1894.873/2}{1925.965/6} = 12.79014$$
$$P(F > 12.79014) = 0.000136$$

F-test results show that the P-value is low enough to reject the null hypothesis using the significance level of 0.01%. The results suggest that there is a structural change between period A and B, and supports the regulation hypothesis that the U.S. MMFs' reform has influenced the basis by prompting a shift of funding tools by the Japanese banks from CDs/CPs to FX swaps. In other words, due to the MMFs' reform, Japanese banks rely more on FX swaps for dollar procurement, which is a potential driver for the widening of the basis.

8. Conclusion

This study investigated the possible determinants of the dollar/yen swap basis in the Abenomics period. Specifically, it focused on 1) market risk, namely the dollar/yen volatility and the degree of depreciation of the yen, 2) monetary policy risk arising from policy divergence between the U. S. and Japan, 3) the risk of financial regulations that could lead global banks, who are the dollar suppliers for FX swaps, to become more reluctant in supplying dollars and 4) credit and liquidity risk.

Empirical results reveal that yen's fall against the dollar in the Abenomics period significantly influences the basis, as it implies a deterioration in the value of the yen as a collateral. The ultimate, but implicit, goal of the BOJ's QQE policy adopted by the Abe administration is to weaken the yen to revive exports, in order to bring the Japanese economy out of deflation. Under the QQE, the dollar/yen rises from below 88 yen to 126 yen. However, in the FX swaps, a weaker yen eventually induced more rigid pricing and a more reluctant stance from the dollar suppliers, such as the U.S. and European banks. This is considered to have laid a foundation for a potential uptick of the dollar/yen basis, which translates to a higher funding cost of the dollar for Japanese banks and investors.

Furthermore, results indicate that monetary policy divergence between the FRB and the BOJ, as gauged by the difference in the pace of balance sheet growth of the two central banks, has a significant influence on the basis in the Abenomics period. The policy divergence prompts the Japanese to search for yield investments in U.S. bonds, which increases the demand for dollars, constituting a dollar demand-side factor in the FX swaps.

Meanwhile, dollar supply in the FX swaps relies on arbitrage and position taking activities of the global banks of the U.S. and Europe. However, these banks are less inclined to take positions because post-crisis, stricter financial regulations made it costly for them to take part in the FX swaps. This constitutes a dollar supply-side factor in the FX swaps. The

basis tends to rise when the LIBOR-OIS widened. Combining the factors of both sides, the dollar/yen basis is susceptible for a widening due to the relative lack of dollar supply. Meanwhile, credit risk factors played limited role in widening the basis in the Abenomics period.

The investigations of this study lead to important points that could be considered for future development of the basis. The BOJ, in its Financial System Report (April, 2017), states that "Financial institutions need to persevere with efforts to secure stable funding bases in major foreign currencies, especially in the U.S. dollar."

However, if the divergence in the monetary policies of the U.S. and Japan is emphasized by the BOJ's QQE policy, then Japanese investors would continue to invest in higher-yielding U.S. bonds using FX swaps, implying a widening of the basis. As the basis gets wider, Japanese investors will have to seek longer-dated and/or riskier U.S. bonds that offer yields high enough to compensate for the basis.

In addition, as a supply-side problem, liquidity of the FX swaps may continue to be low, as various financial regulations are gradually being implemented and banks globally are content in the sidelines, without attempting to arbitrage the basis away.

Overall, the BOJ's QQE policy, amid constrained supply of dollars in the FX swaps, may expose Japanese investors to higher funding costs of the dollar, depleting the wealth of the nation. The BOJ should carefully examine this harmful side-effect of the QQE and consider engineering a proper exit from the QQE or its ultra-loose monetary policy.

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