Interest Rate Parity Theory, Risk Premium, and Break Point: Japanese Case from The 1990s

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Abstract

This article examines interest rate parity theory for exchange rate determination and its break point in the 1990s sample period in Japan. Interest rate parity theory, namely, covered and uncovered interest rate parity theory, has long been used to examine foreign exchange markets. This article examines whether or not this theory holds for the recent Japanese case and whether or not there is a break point for the recent Japanese case from the 1990s to now. Using empirical analyses, the article shows that uncovered interest rate parity theory does not hold, which means that there may be a risk premium in the foreign exchange market. Moreover, there is a break point in 2011Q3. A large earthquake occurred in Japan on March 11, 2011, which damaged the country and caused strong turmoil in the Japanese financial markets.

Keywords: Interest Rate Parity Theory, Japan, Risk Premium.

Introduction

Interest rate parity theory, namely, covered and uncovered interest rate parity theory, has long been used to examine foreign/international financial markets and have been cited repeatedly in many academic papers. Also, this theory has been employed in the business world. In the short-term, namely daily base transactions, this theory is used a great deal. This article examines whether or not this theory holds in the recent Japanese case(i.e., from the 1990s to present). Also, this article checks whether or not there is a break point in the recent period for Japan. There is no consensus about whether or not this theory holds. Depending on time, country, currencies, empirical methods, and so on, the empirical results are various. Fama (1984) indicated that this theory holds as the expected change in the exchange rate equals the spread in interest rates. On the other hand, Froot (1990) showed evidence of a forward premium puzzle. Cavaglia, et al. (1994) suggested that the puzzle in the foreign exchange markets is caused by a combination of no rational expectations and risk premium. Bansal and Dahlquist (1999) showed that the premium in the foreign exchange markets tends to exist in developed countries.

Roll and Yan (2000) showed that non stationary time series in the data are the reason for the puzzle. Kim (2001) showed that the existence of risk premium is determined by the frequency of consumers' expectations for exchange rates and the degree of their risk aversion. Chinn and Meredith (2004) showed that the puzzle in these markets is a short-term phenomenon rather than a long one. Moreover, Frankel and Froot (1990), Obstfeld and Rogoff (1996), and Sarno (2005) showed that the premium could be decreased by heterogeneous agents. Most studies have found that covered interest rate parity holds; on the other hand, they have showed that the uncovered interest parity does not hold in many studies. Of course, there are many exceptions; this problem requires much more analysis. Recently, models that use premium models have been appearing. Arminio (1986) provided a theoretical model for determination of the risk premium puzzle that depends upon the ratio of foreign assets and wealth dominated by foreign currencies, as well as on the variance-covariance matrix of prices and exchange rates. Goodhart, et al. (1992) found that forward premiums provide no information about changes in spot exchange rates. Beng and Siong (1993) suggested that forward discounts reflect expectations of future changes in exchange rates, and expectations of the financial market are not rational.

Basurto and Ghosh (2001) showed that there is little evidence that real interest rates cause a risk premium. Bhar, Chiarella, and Pham (2001) provided evidence that the forward risk premium is stationary and had significant time change during the 1990s. Lyons (2001) and Evans and Lyons (2002)presented information for the foreign exchange market and market structure relative to the transmission of signals on expected future fundamentals. Wu's (2007) empirical results rejected the restrictions on the foreign exchange rate and interest rate imposed by the term structure of interest rates. Olmo and Pilbeam (2008) used bootstrap simulation experiments that rejected the uncovered interest parity theory. Chakraborty (2009) showed that the forward exchange rate puzzle does not reflect the foreign exchange market inefficiency. Corte and Tsiakas (2009) found that risk-averse market participants prefer to pay a high performance fee to switch from a dynamic portfolio decision with the random walk model to the decision that conditions on the forward premium with stochastic volatility model. Pilbean and Olmo (2010) employed a Taylor rule model and indicated a negative bias in existing regressions of uncovered interest parity theory. Azouzi et al. (2011) found that forward premium is not important for long-term calculations that hold in the short-term.

Srikanth and Kishor (2012) indicated that most market participants agree that the forward premium influences exchange rates. Using data from six countries, Kim (2013) indicated that pricing revision errors of risk premium in the foreign exchange markets are significant. Recently, Alain and Carmelo (2015) found that pricing error that results from ignoring the term structure of interest rates is smaller than the error from omission of the foreign exchange risk premium. Breoll et al. (2015) showed that uncovered interest rate parity theory does not hold, especially when international firms were risk averse. The present study focuses on risk premium in the foreign exchange market for the Japanese case starting in the 1990s. After the bubble economy burst around 1991, Japan experienced serious deflation and recession.

In the middle of 1990s, rapid and large yen appreciation occurred and damaged that Japanese economy as a result of shrinking exports. The Bank of Japan (BOJ), the Japanese central bank, repeatedly lowered interest rates. In 1999, the BOJ introduced a new and unprecedented monetary policy: the zero interest rate policy. Since the 2000s, Japan has continuously used unconventional monetary policy, such as quantitative and qualitative monetary policy. During that period, the yen fluctuated largely despite the fact that interest rates were constantly quite low. The validity of the interest rate parity theory and the break point in recent years are examined empirically. Some facts should be considered relative to the break point: Drastic monetary policies, which are unprecedented all over the world, have been implemented. Also, in 2011, a tremendous earthquake hit Japan and damaged the Japanese economy. This article is structured as follows. In section 2, interest rate parity theory is examined theoretically. Section 3 reviews the recent Japanese experience. Section 4 uses empirical methods to examine the data and analyze the results. Finally, this study ends with a brief summary.

1. Covered Interest Parity and Uncovered Interest Rate Parity

Exchange rate theory has changed and developed continuously since the 1970s, when many developed countries adopted a floating exchange rate system from a fixed exchange rate system. One of the traditional and an important approach to short-term exchange rate determination is the uncovered interest rate parity theory. This theory has been employed not only in academic fields but also in business and real-world environments. In academia, this theory is best known and most commonly used as an exchange rate determination theory. This theory in general assumes that exchange rates instantaneously adjust to changes in relative interest rates between two currencies so as to eliminate arbitrage opportunities. The change in interest rates differences among international financial markets, in turn, tends to reflect changes in expected future economic fundamentals that are related to exchange rate determination. However, many studies have begun to indicate the existence of (positive/negative) premiums in the relationship among the variables. If uncovered interest parity holds, the difference in interest rates equals the forward premium rate:$i - i^* = \frac{s^e - s}{s}$ where i denotes domestic (Japanese) interest rate, i* denotes foreign (US) interest rate, s^e denotes expectation of exchange rate (yen/US dollar), and s denotes the nominal exchange rate. However, premium exists:$i - i^* \neq \frac{s^e - s}{s}$. This equation can be understood as follows. $i - i^* - \frac{s^e - s}{s} = (i - i^* - \frac{f - s}{s}) - \frac{s^e - f}{s}$. f means forward exchange rate. The second term on the left-side of the equation is the risk premium, which indicates risk-avert participants 'request for additional profits as they holds risky assets. Whether or not this risk premium exists is examined empirically in section 4.

2. The Japanese Experience

Before examining the equation, the recent economic situation of Japan should be reviewed. Japan suffered deflation and recession for several years after the bubble economy burst at the beginning of the 1990s despite aggressive monetary and fiscal policy. A fragile monetary system prevented Japan from recovering the economic downturn. Rapid and large appreciation of yen limited exported by Japanese industries, so the Japanese economy suffered serious consequences. In February 1999, the BOJ adopted the zero interest rate policy, which was unprecedented all over the world, to combat deflationary pressure and to boost the economy. Furthermore, the BOJ announced in April 1999 that it would continue the zero interest rate policy until deflationary concerns were dispelled. Later, in August 2000, the zero interest rate policy was rescinded, as the economic situation displayed signs of gradual recovery. However, as Japan had not recovered strongly, the BOJ employed drastic monetary policy after a long trial under the low interest rate policy.

However, the situation of the economy has not improved greatly. The BOJ introduced a new monetary policy, the quantitative easing policy, in 2001. This policy received much attention from all over the world as it was unprecedented. Under this unconventional policy, the BOJ made huge purchases of Japanese government bonds as the main instrument to reach its operating target of current account balances held by financial institutions at the BOJ. Also, the zero interest rate policy was again introduced. In March 2006, the BOJ exited quantitative easing amid signs that deflation was ending and the recession had disappeared. In July 2006, the zero interest rate policy, which had been implemented in March 2001, ended. Japan experienced some bright signs relative to the economy. After the occurrence of the subprime problems in 2007 and the Lehman shock in 2008, a huge amount of capital has flowed into the Japanese financial markets in spite of the fact that the Japanese economy has not been good. The yen appreciated strikingly against other currencies, which hit the Japanese economy with deteriorating exports. Stock prices were damaged and decreased sharply. Following this global financial crisis, the BOJ increased the pace of its Japanese government bond purchases and undertook unconventional measures to promote the economy and attain financial stability. In 2008, the BOJ judged that additional measures for money market operations were necessary so that the effects of extremely low interest rates policy would prevail in the financial markets.

In October 2010, the BOJ introduced comprehensive monetary easing policy to respond to the deflation in Japan. One key measure was an asset purchase program that involved government bonds as well as private assets. After that, the Japanese government changed and more aggressive fiscal policy was strongly demanded. The zero interest rate policy has been in effect from October 2010 and continues at present. Since the Tohoku Pacific Earthquake occurred on March 11, 2011, the Bank of Japan has been trying to gauge its effects on financial markets and financial institutions' business operations, as well as taking all possible measures to maintain financial intermediation functions and smooth fund settlements. In recognition of the current situation, the BOJ decided to take the following additional measures to enhance monetary easing:

(1) The Guideline for Money Market Operations for the Intermeeting Period: The BOJ provides ample funds sufficient to meet demand in financial markets and will do its utmost to ensure financial market stability. The BOJ encourage the uncollateralized overnight call rate to remain at around 0 to 0.1%.; and

(2) Asset Purchase Program: With a view to preventing deterioration in business sentiment and an increase in risk aversion in financial markets from adversely affecting economic activity, the BOJ decided to increase the amount of the Asset Purchase Program, mainly of the purchases of risk assets such as ETFs and J-REITs by about 5 trillion yen to about 40 trillion yen in total.

After that, Japan introduced an unprecedented aggressive monetary policy in April 2013. This new policy is called Abenomics (Abe is the prime minister's name). Japan's economy is now emerging from the current deceleration phase. The year-on-year rate of decline in the CPI (excluding fresh food) has continued to slow. The BOJ has maintained its baseline scenario that Japan's economy is expected to return to a moderate recovery path. The year-on-year rate of change in the CPI is expected to become slightly positive in the near future. However, damage from the 2011 earthquake has been geographically widespread, and thus, for the time being, production is likely to decline and there is also concern that the sentiment of firms and households might deteriorate. This study examines the case of the United States as yen-dollar exchange rate is used for estimation. The federal funds rate has been close to zero since December 2008, when the Federal Reserve Board's (FRB's) Federal Open Market Committee (FOMC) decided to reduce the target to between 0 and 0.25%.

With its policy rate near the zero bound, the FRB turned to large-scale asset purchases (so-called quantitative easing) as economic conditions warranted further action. The FRB's first quantitative easing program, which began in late 2008 and ended in the first quarter of 2010, consisted of purchases of agency debt, agency mortgage-backed securities, and longer-term treasury securities. Throughout the spring of 2010, however, financial market stress in the United States increased again, mostly in response to an intensification of the European sovereign debt crisis. During the summer of 2010, the pace of the US economic recovery slowed. In addition, inflation and expected inflation were both quite low. To avoid a similar experience in the United States was one of the primary motivations for a second round of quantitative easing. In August 2010, a second asset-purchase program was conducted. The FRB made the decision to purchase treasury securities at a pace of about $75 billion per month through the first half of 2011 for a total of $600 billion in a program commonly known as QE2. QE3 was announced in September 2012. The FRB decided to start a new $40 billion per month, open-ended bond purchasing program of mortgage-backed securities. Moreover, the FRB announced that it would likely maintain the federal funds rate near zero at least through 2015. This article has two purposes. One is to examine the validity of uncovered interest rate theory and the existence of risk premium. The other is, if the theory holds, to check the break point from the 1990s. Using empirical methods, the following sections analyze these two points.

3. *Empirical Analysis*

4-1 Empirical method

Based on the analysis in section 2, the estimated equation is as follows

$(s^e\text{-}s)/s = \alpha+\beta(i - i^*)$ (1)

The sample period is from 1990s to 2015Q2. The three-month money market (interbank) interest rate is used for estimation. The exchange rate is the average for each sample period. The data are quarterly. In addition to ordinary least squares (OLS), robust estimation is employed, which is unlike maximum likelihood estimation. OLS estimates for regression models are sensitive to outliers, which are observations that do not follow the pattern of the other observations. This is not a problem if the outlier is an extreme observation from the tail of a normal distribution; however, if the outliers are from non-normal measurement error or some other violation of standard OLS, the use of a no robust regression model compromises the validity of the regression results. All of the data are IFS (IMF). $S^e t$ = St+1 is hypothesized (t denotes time) for simplicity to avoid any biases that may cause.

4-2 Results

The results of the estimation are shown in Table 1.

Table 1: Uncovered Interest Rate Parity Theory

	OLS	Robust Estimate
c	-0.0645	-0.0361
	(0.0121)	(0.0217)
i – i*	-0.0182	-0.0123
	(0.0183)	(0.0095)
Adj.R2	0.0477	
Adj.Rw-squared		0.0825
F-statistic	5.7636	
	(0.0183)	
Rn-squared statistic		6.7238
		(0.0095)

Note. Parentheses indicate probability.

The results are almost clear and robust. Risk premiums appear in the estimated equations. As in most recent studies, risk premium in the foreign exchange market may play a role in exchange rate determination. The theory of uncovered interest rate parity does not hold; however, when the risk premium is included in the estimation, the estimation results are good. Uncovered interest rate transactions are strongly and statistically related to risk premium.

4-3 Structural Breaks

In addition, structural breaks during the sample period were checked. The Chow test is employed for this purpose. The idea of the breakpoint Chow test is to fit the equation separately for each subsample and to examine whether there are significant differences in the estimated equations for different data sets based on the F test.

The test is most commonly used in time series analysis to test for the presence of a structural break and helps to determine whether the independent variables have different impacts on various subgroups of the linear equation. A significant difference indicates a structural change in the relationship. This study uses this method and analyzes the results later. The results are shown in Table 2.

Table 2: ***Chow Test for Break Point***

1991Q1-2011Q2	
c	-0.0776
	(0.0064)
i – i*	-0.0207
	(0.0088)
2011Q3-2014Q4	
c	-0.1924
	(0.0026)
i–i*	-1.6673
	(0.0003)
Adj.R2	0.1902
F-statistic	7.2035
	(0.0002)

Note. Parentheses indicate probability.

The findings reveal one break point in the sample period in 2011Q3. It is interesting to note that some other candidates for a break point (e.g., the era of the zero interest rate policy, the era of quantitative easing [QE] policy in Japan, and the era of QE1~QE3 in the United States)were not selected for the break point. Instead of these candidates, 2011Q3 is chosen. The reason may be related to the 2011 earthquake. Aggressive monetary policy in response to the earthquake changed the financial market. From another view, market participants might respond as normal. Japanese financial markets calmed without troubles. The BOJ's policy was accepted and anticipated adequately without surprise or turmoil. On the other hand, the big earthquake might have caused different movements from the usual one in the markets. For example, the yen might have appreciated instead of depreciating after the earthquake and the damage to Japan.

4. Conclusions

This article examined the validity of interest rate parity theory and its break point since the 1990s in Japan. Interest rate parity theory, namely, covered and uncovered interest rate parity theory, has long been used to examine foreign exchange markets. This article examined whether or not this theory holds. Also, this article examined whether or not there is a break point. The results were robust. The theory did not hold, which means that there might be a risk premium puzzle in the foreign exchange market. Moreover, a break point in 2011Q3 was found empirically. A tremendous earthquake occurred in Japan on March 11, 2011,that damaged Japan and strongly influenced various movements in the Japanese financial markets.

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References

Alain, K.,& Carmelo, G. (2015). Foreign exchange rate risk and the term-structure of industry costs of equity. Journal of International Money and Finance, 51(1), 71–88.

Arminio, F. (1986). Price uncertainty and the exchange-rate risk premium. Journal of International Economics, 20(1–2), 179–185.

Azouzi, D., Kumar, R. V., & Aloui, C. (2011). Forward rate unbiasedness hypothesis in the Tunisian exchange rate market. International Journal of Academic Research in Business and Social Sciences, 1(2), 17–44.

Bansal, R.,& Dahlquist, M. (1999). The forward premium puzzle: Different tales from developed and emerging economies. Journal of International Economies, 31, 115–144.

Basurto, G.,& Ghosh, A. (2001). The interest rate-exchange rate Nexus in currency crises. IMF Staff Papers, suppl. IMF Annual Research Conference, 47, 99–120.

Beng, G. W.,& Siong, W. K. (1993). Exchange rate expectations and risk premium in the Singapore/US dollar exchange rate: Evidence from survey data. Applied Financial Economics, 3(4), 365–373.

Bhar, R., Chiarella, C., & Pham, T. (2001). Modeling the currency forward risk premium: A new perspective. Asia-Pacific Financial Markets, 8(4), 341–360.

Breoll, U., Welzel, P., & Wong, K. P. (2015). Exchange rate risk and the impact of regret on trade. Open Economics Review, 26(1), 109–119.

Cavaglia, M., Verschoor, W. F. C., & Wolff, C. C. P. (1994). On the biasedness forward foreign exchange rates: Irrationality or risk premia. Journal of Business, 67, 321–343.

Chakraborty, A. (2009). Learning, the forward premium, and market efficiency. Macroeconomic Dynamics,S1(suppl 13), 31–57.

Chinn, M. D., & Meredith, M. (2004). Monetary policy and long-horizon uncovered interest parity. IMF Staff Papers, 51, 409–430.

Corte, S. L., & Tsiakas, I. (2009). An economic evaluation of empirical exchange rate models. The Review of Financial Studies, 22(9), 3491–3530.

Evans, M. D. D., & Lyons, R. K. (2002). Informational integration and FX trading. Journal of International Money and Finance, 21(6), 807–831.

Fama, E. F. (1984). Forward and spot exchange rates. Journal of Monetary Economics, 14, 319–338.

Frankel, J. A., & Froot, K. A. (1990). Chartists, fundamentalists, and trading in the foreign exchange markets. American Economics Review, 80, 181–185.

Froot, K. A. (1990). Short rates and expected asset returns. NBER Working Paper, 3247.

Goodhart, C.A.E., McMahon, P. C., Patrick, C., & Yerima, L. (1992). Does the forward premium/discount help to predict the future change in the exchange rate? Scottish Journal of Political Economy, 39(2), 129–140.

Kim, H. (2001). Market instability and revision error in risk premium. International Advances in Economic Research, 17(2), 169–180.

Kim, H. (2013). Uncertainty and risk premium puzzle. Journal of Economics and Finance, 37(1), 62–79.

Lyons, R.K. (2001). The microstructure approach to exchange rates. Boston, MA: MIT Press.

Obstfeld, M., & Rogoff, K. (1996). The six major puzzles in international macroeconomics: Is there a common cause? NBER Macroeconomics Annual, 15.

Olmo, J., & Pilbeam, K. (2008). Uncovered interest parity and the efficiency of the foreign exchange market: A re-examination of the evidence. International Journal of Financial Economics, 16(2), 189–204.

Pilbean, K., & Olmo, J. (2010). The forward discount puzzle and market efficiency. Annuals of Finance, 7(1), 119–135.

Roll, R., & Yan, S. (2000). An explanation of the forward premium puzzle. European Financial Management, 6, 121–148.

Sarno, L. (2005). Viewpoint: Towards a solution to the puzzles in exchange rate economics: Where do we stand? Canadian Journal of Economics, 38, 673–708.

Srikanth, M., & Kishor, H. (2012). Exchange rate dynamics in Indian foreign exchange market: An empirical investigation on the movement of USD/INR. IUP Journal of Applied Finance, 18(4), 46–61.

Wu, N. S. (2007). Interest rate risk and the forward premium anomaly in foreign exchange markets. Journal of Money, Credit, and Banking, 39(2–3), 423–442.