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Asymmetric Movements of Foreign Exchange Rates in the Financial Crises of the 2000s

: Case of the Japanese Yen and the Korean Won

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1. Background of the paper

Two prominent features have been recognized about the changes of the foreign exchange rates at the financial crisis that was triggered by the Lehman shock of September 2008. One was the surprising hike of the US dollar, contrary to the expectations of many economists that the dollar would fall because of the capital flights from the US. Actually the dollar sharply rose against almost all currencies except the Japanese yen, despite the fact that the US was the epicenter of the financial crisis.

Secondly, the yen sharply appreciated against almost all currencies including the US dollar

[1] English translation of a Japanese report dated on June 3, 2013

and the appreciation of the yen continued until the end of 2012. On the opposite side of this, there was a sharp depreciation of the Korean won. This opposite movements of the exchange rate could have been one factor which caused differences of the economic recoveries of the two countries after the crisis up to 2012.

The trend of a stronger yen was eventually corrected by “Abenomics”, the economic package taken by the Abe Cabinet, that started after the general election in November 2012 and a policy shift to an “unprecedentedly bold quantitative monetary easing” taken by Mr. Kuroda, a new governor of the Bank of Japan who aims to break away from the long-lasting deflation. However, it is yet to be seen if the Japanese economy gets out of the deflation eventually.

The first phenomenon, that is, an unexpected appreciation of the dollar at the US financial crisis, can be accounted for by the following two reasons. First, while there was a withdrawal of foreign capital from the US for a short time (money flow selling the dollar), at the same time the repatriation of financial investment by the US investors from the overseas market (money flow buying the dollar) occurred at the almost same scale. And the former money flow was offset by the latter. Second, due to the sever credit crunch at the financial crisis, foreign investors including investment banks and hedge funds were forced to rewind their global portfolios that depended on funding in the US dollar, thus creating selling pressure for non-dollar currencies and demands for the dollar. (Masaharu Takenaka (2008, 2009), McCauley& McGuire (2009))

Then what factors caused the stronger yen and its mid-term continuation? Will the bold unconventional monetary policies by Gov. Kuroda achieve a sustainable effect on correcting higher yen? In the meantime the Korean won depreciated against both the dollar and the yen after the Lehman shock, and remained weak against the yen to 2012 while it regained the loss against the dollar rather quickly. In this paper, we will try to explain the asymmetric movements between the Japanese yen and the Korean won.

２．Factors for exchange rate fluctuations in short- and mid-term

Chart 1 shows that the dollar plunged against almost all currencies except the yen after the Lehman shock of September 2008, but its exchange rate was corrected substantially within a year. In contrast the yen rate sharply appreciated against the dollar and remained at a higher level until November 2012. What kind of factors have operated to bring such a contrast?

It is an established proposition that the changes of the exchange rates between two currencies in the long-run can be most effectively explained by the relative purchasing power parity (hereinafter referred to as PPP) that reflects the inflation differentials of the two currencies. PPP is calculated by the following formula. (An example for the dollar/the yen)

PPP = market exchange rate at a benchmark point × Price Index of Japan／Price Index of the US

In the short-term (less than one year) and medium-term (one to several years), the market exchange rates repeat their divergence and convergence to the PPP. The indexed based on the gaps between the market exchange and the PPP is called a “real exchange rate index” which is calculated by the following formula. (Based on 100)

Real exchange rate index = (nominal exchange rate／**PPP**) × 100

As long as the nominal exchange rates repeat their divergence and convergence to the PPP, the real exchange rate index also repeats its divergence and convergence around the longer term average rate (Chart 2). Therefore, it can be said that exchange fluctuations in the short- and medium-term can well be represented by the movements of the real exchange rate index.

As for the movements of the dollar/yen exchange rates in the latter half of the 2000s to present with the Lehman shock, it was said roughly based on experiences by the market participants that the following two factors exerted a strong influence on the short- and mid-term fluctuations of the exchange rates.

The first one is the interest rate differentials between the two currencies. Particularly since the latter half of the 1990s, interest rate of the yen went down to an historical low and it encouraged selling of the yen while buying currencies with higher interest rates. It has been often pointed out that winding and rewinding of this yen short carry trade position came to have a big impact on the movement of the yen exchange rate in the short- and medium-term span.

The second factor is the changes of investors’ risk tolerance that is reflected in the big movement of the various risk premiums in the market. These changes of investors’ risk tolerance are generally referred as “risk-on” and “risk-off”. What were seen in the risk-on phase when the risk tolerance of investors rose was the global rises of stock prices and depreciation of low-interest currencies mainly the Japanese yen and Swiss franc (they came to be called as safe haven currencies after the Lehman shock of 2008) and the appreciation of non-safe haven currencies. In contrast, in the phase of financial crisis (risk-off), unwinding of such investment positions drove the currencies to the opposite directions.

Polarization to "the risk-on" currencies and "the risk-off" ones

Such a tendency of asymmetric movements of exchange rates and international money flows has been described in the working paper of the BIS by McCauley (2012). (The author uses VIX Index which was based on the volatility of S&P 500 option transaction as a variable of risk premium.)

Asymmetric reactions of the exchange rates of individual currencies against risk premium also produce asymmetric movements of stock prices and exchange rates of the currencies. Chart 3 roughly shows the relationship between the changes of nominal effective exchange rates of major currencies and changes of the MSCI World Index[2] which represents the weighted average of the stock prices of mainly advanced countries.

It can be clearly noticed that there are two groups of currencies; what can be called "risk-on" currencies that are likely to be bought when investors' risk tolerance increases (e.g., the Korean won, the Australian dollar, and the Indonesian rupiah) and what can be called "risk-off" currencies (such as the Japanese yen, the US dollar, and the Swiss franc) that tend to be bought when the investors' risk aversion intensifies. Of course there are some currencies which cannot be classified clearly as either.

The risk-off currencies like the Japanese yen and the Swiss franc commonly have current balance surplus, net external assets for the whole country, and relatively low inflation (or deflation) and they are chosen as safe haven currencies at a time of market instability. Except to the yen and Swiss franc, the US dollar is also seen as a safe haven currency that is favored at a time of financial crisis. This is because the US, despite its current account deficits and net external debts, is playing a role of supplying the world with the dollar liquidity as a key international currency.

On the other hand, risk-on currencies were found in such countries as those which were expected to grow higher than the world average at a time of favorable global economy (e.g., such emerging currencies as the Korean won, the Indonesia rupiah and the Turkish lira), those resource-rich countries that were expected for a higher growth due to expanded exports of minerals, foods, and energy resources reflecting increased global demands for those (e.g., Norway and Australia).

This polarization of the exchange movements has become especially pronounced after the 1990s and in its background there was an intensified synchronization of investors' behaviors as a result of the globalization of investment activities (lowering of home bias, and expansion of

[2] As to the MSCI World Index, please refer to the following page.
http://www.msci.com/products/indices/tools/index.html#WORLD

global portfolios)[3].

A model of real exchange rate movements

Academically various models have been examined to explain the movements of real exchange rates. One of representative examples is an asset approach that explains the exchange rates by the factors of (1) differentials of real interest rates between the two currencies, and (2) risk premiums. Generally the ratios of current account deficits or net external debts to the GDP of a country were used as variables of risk premiums for the currency concerned. (Yoshikawa (1989))

This method, however, failed to well explain the movements of the dollar/yen real exchange rate index in the period of 1973-1987 after the currencies shifted to a floating rate regime. "No formula could effectively explain the movements throughout the period. There is a high possibility that the dominant factors may have changed from time to time." (Yoshikawa (1989)) Yet, regressions for shorter terms of several years have produced somewhat significant results, with the degree of impact of (1) and (2) noted above differing from period to period.

Fukao (1988) also made regression analyses on the real exchange rates for the dollar/yen and the dollar/D-mark for the period of 1973 to 1987, using real interest rates and accumulated current account balances for the two currencies as explanatory variables. In his case, in order to take into account temporal changes in the dominant factors of exchange rates, he used the Karman filter technique that allowed the change of parameters in the estimated period, instead of using the normal regression model which kept the coefficient values constant throughout the period. He observed the result of an increase of the impact of real interest rate factor and a decrease of accumulating current account balance factor.

Both Fukao (1988) and Yoshikawa (1989) pointed out the possibility of a change in the determining factors that affected the exchange rates depending on the periods, which may have posed a difficulty to make an empirical analysis based on a theoretical model on the movement of exchange rates.

As far as we know, there is no determining formula/model invented so far that could consistently explain the long-term movements of real exchange rate using macroeconomic variables. Instead, studies are increasing that try to explain the exchange rate movements paying more attention to the micro-structure of the market where macroeconomic information forms the exchange rates through the foreign exchange transaction flows in the market. (Iwatsubo &

[3] In this regards, Shaghil Ahmed & Andrei Zlate(2013) , who have analyzed the international money flows in the emerging countries before and after the crisis, also point out the interest differentials and risk aversion behavior of investors as major reasons for the money flows.

Marsh (2011))

We also think that it is difficult to explain consistently the exchange rate movements that repeat a divergence and a convergence around the PPP (i.e. movements of real exchange rate index) using specific macroeconomic variables, since from time to time different particular conditions exert their strong influence on the market. The problem is that these particular variables and their relationship change from time to time. However, as far as the medium term is concerned, we think that we can make a significant explanation with a linear regression, if we can choose appropriate macroeconomic variables at that time.

3. Regression analysis of the dollar-yen exchange rate and its implications

We have tried to make a regression analysis to see how far we can explain the movements of the real exchange rates of the dollar-yen using the above two factors that are considered strongly affecting the movements, for the period of January 2005 to March 2013. The variables are set as follows[4].

Explained variable: real dollar-yen exchange rate index (1973 as benchmark year with the yen deflated by corporate price index and the dollar by producers price index)[5]

Explanatory variables:

Variable X1 = differential of real interest rates

= Real dollar interest rate – Real yen interest rate

Dollar interest rate refers to the federal fund rate (O/N), and yen interest rate to call rate (O/N), both deflated by the same indices as used above.

Variable X2 = risk premiums

= Baa rated corporate bond yield – Aaa rated corporate bond yield, both published by the FED

The risk premiums used in this paper differ from those defined in Yoshikawa (1989) which

[4] The real dollar-yen exchange rate index is assumed to have a stationarity since it repeats divergence and convergence around the long-term averages. For the monthly data from January 1973 to March 2013, Augmented Dickey-Fuller test verifies that the possibility for non-stationarity with unit roots can be dismissed (less than10% base). However, it was not always possible to identify the stationarity for the shorter and medium terms that includes January 2005 to March 2013. Also for the real interest rate differentials (Variable X1) the same stationarity was identified for the period of July 1985 to March 2013, but it was not always possible to identify the stationarity for the latter period tested above. In the same way the stationarity was identified for the risk premium (Variable X2) for the whole period analyzed here.

[5] The reasons we used the corporate price index (Japan) and producers price index (the US) are that, needless to say, the PPP theory is based on the tradable goods and the two indices cover most of the tradable goods and empirically demonstrate a high degree of explanation over the long term movements of nominal exchange rates.

adopted a scale of current account deficit of a country, or its net external position (net external liabilities) as a variable. It assumes if the variable increases, the risk premium for the country (in this case the US) also rises. This assumption may well have been appropriate under the Breton Woods regime that ended at early 1970s.

Currently, however, at least in the short- and medium-terms, we cannot find a stable relationship between these indicators of external imbalance and the risk premiums observed in the market (such as those for government and corporate bonds of the country concerned). Therefore, we need to select a new risk premium as a variable that will affect the world money flows.

Since the 1990s when there was a dramatic expansion of international financial and investment flows backed by the lowering home bias of investors, plummeting asset prices and financial crises in a country or in a region have had an increasingly strong impact on the risk tolerance of the global investors.

In this regard, as the dramatic increase of risk premium that followed the Lehman shock has arisen in a worldwide scale, it is appropriate to think that the risk premium of the global market can be represented by the change of the risk premium in the US bond market where the money of worldwide investors flow in and out. For these reasons, we selected the yield spread between Aaa rated corporate bonds and Baa rated ones that are published by the FED as a risk premium factor.

The responses of individual currencies to this risk premium can be broadly classified as the following three.

The first type is the response of the US dollar as a key currency. In the period from September 2008 to the spring of 2009, the dollar dramatically appreciated against almost all currencies except the yen. To address the crisis, the FED, the European Central Bank (ECB) and the Bank of Japan cooperatively supplied the liquidity to the markets. The US authorities made every effort to restore the stability of the market. Then the risk premium came to be normalized in the latter half of 2009 with the dollar exchange rate also falling back.

The second type is the response seen in the Japanese yen, followed with a bit of lag by the non-key safe haven currencies like the Swiss franc. The exchange rates of these currencies dramatically appreciated in line with the sharp rise of the risk premiums. Especially the yen had stayed at the appreciated level until the 4th quarter of 2012 without almost any correction even after the normalization of the risk premium.

The third type is the response of non safe haven currencies against the dollar. After once plunged in line with the surge of the risk premiums, they regained the former levels in a short

term (generally within one year) in tandem with the normalization of the risk premiums.

Charts 4 and 5 graphically show the correlations of the dollar-yen real exchange rate index and the explanatory variables X1 and X2. The real dollar-yen exchange rate index shows a positive correlation with the real interest rate differentials (interest rate on the dollar – interest rate on the yen) for almost all the time period examined. In other words, narrowing of differentials or expansion of the negative ones tends to lead to the appreciation of the yen/ depreciation of the dollar. Negative correlation with the risk premium (i.e. higher risk premium leads to the depreciation of the dollar/appreciation of the yen) was seen on a high level in the period of June 2008 to August 2009 with the Lehman shock of September 2008 but the level of correction was lower in other periods.

The results of multiple regression and its implications

Chart 6 shows the results of the multiple regression. The coefficient of determination (corrected R2) was 0.63 and the coefficient of X1 is positive and that of X2 is negative expectedly and the regression results were statistically significant.

The magnitude of the coefficients of the variables reveals that the change of 1 point in the real interest rate differentials corresponds to the change of 1.93 points in the real exchange rate index while the 1 point change of risk premium brings the change of 4.46 points in the real exchange rate index. Chart 7 shows the estimated values calculated based on this regression and the actual real exchange rate index. It visually presents that the estimated values approximately follow the actual movements of the exchange rates.

Based on this regression result, Chart 8 shows the breakdown of effects of each factor, i.e., real interest rate differential factor, risk premium factor, and residuals. (March 2008 was selected as a benchmark point as it had almost the same level as the average value of the real exchange rate index for the period reviewed, and also the difference between the estimated value and the actual one was relatively small at this time.) It is clearly seen that the effect of the real interest rate differentials was reversed from lower yen/higher dollar to higher yen/lower dollar in the aftermath of the Lehman crisis, and that the risk premium factor worker strongly to appreciate the yen/depreciate the dollar during the period just after the Lehman shock to the first half of 2009.

Chart 9 shows the real interest rate differential factor broken down into nominal interest rate differential factor and the price index factor. After the real interest rate differential factor exerted to push the dollar higher and the yen lower until mid-2007, it reversed its impact to push the yen higher and the dollar lower mainly because of the declining nominal interest rate on the

dollar since the mid-2007. Then, since 2009 when the interest rates in both the US and Japan were lowered to near zero, the price index factor began to bear a strong influence on the depreciation of the dollar/appreciation of the yen as the falls in the Japanese corporate price index superseded those of the US producer price index. This trend continued until 2012.

Now we are ready to explain the movements of the dollar-yen exchange rates from 2005 to March 2013 with the Lehman shock of 2008. The exchange rate of the yen had been on the course of depreciation affected by winding of yen short carry-trade which was induced by the widening real interest rate differentials between the US and Japan until mid-2007.

However, the Lehman crisis of 2008 and a rapid easing of the US monetary policies, bringing the narrower and then negative real interest rate differentials between the dollar and the yen. This, combined with the jump of the risk premium, brought a rapid appreciation of the yen since. That is to say, due to both reasons of narrowing real interest rate differentials and lowering of risk tolerance of the investors, the market participants rushed to buy back the yen to unwind the yen short carry-trade position that was enormously accumulated up to 2007.

In the latter half of 2009, the risk premium came to be normalized as a result of the policy addresses to the crisis by the governments and the central banks. However, Japan faced with a stronger deflationary phase because of the recession, which brought a widening negative real interest rate differential while the nominal interest rates in both countries sticking to almost zero percent level. This continuation of the negative real interest differentials under the constraint of nominal zero interest rate is thought to be a major factor that the appreciation of the yen continued up to the 4th quarter of 2012.

Expected inflation rates incorporated in the exchange rates of ¥ 100-105/dollar

The rapid correction to a lower yen that was triggered by “Abenomics” and the bold quantitative monetary easing by the governor Kuroda of the Bank of Japan reflects the shift of the market participants’ position toward a yen-short/dollar-long expecting a scenario of a “change from deflation to inflation which leads to a cheaper yen”. This is suggested by the expansion of the gap between the actual and estimated exchange rates with the actual rates jumping up towards lower yen /higher dollar since January 2013. (Chart 7)

While the inflation rates used in the estimation were ex-post inflation rates, it is considered that the short term change in the exchange rates should reflect the expected real interest rate differentials based on the expected inflation rates. Therefore, the differentials between the expected inflation rate and the ex-post inflation rate are considered to account for the gap between the estimated exchange rates and the actual ones.

Based on the estimation formula derived from the regression, let us estimate what will be the

level of an expected inflation rate in Japan that is incorporated in the exchange rates of the yen around 100-105/dollar.

Assumptions of the estimation：

Period: 2 years after the reviewed period (March 2015)

Federal Fund rate(O/N) 0.5%

(the level currently suggested by the forward federal fund rate)

Call rate(O/N) 0.1%

Change of the producers price index in the US: 2% (yoy)

Calculated with the above assumptions, the nominal exchange rate of the yen at the range of 100-105/dollar is estimated to incorporate a yearly increase of 7~8% on the corporate price index. We saw such level of corporate price changes on the middle of 2008, just before the Lehman shock. At that time when international resource prices soared and the Japanese overall consumer price index temporarily rose at around 2% year on year base which again turned to negative in the recession triggered by the Lehman shock.

In this sense, it can be said that the dollar-yen exchange rate has been already shifted to the level incorporating about 2% annual change in the consumer price index. In other words, it can be assumed that the yen may turns to appreciate if the target of achieving 2% CPI growth in two years is seen difficult to accomplish.

Regression analysis based on the vector autoregressive model (VAR)

To supplement, we made a regression analysis based on the VAR with the same variables used above. At first in the Granger causality test it was verified that there was a stable Granger causality in the direction that the real interest rate differentials affect the real dollar-yen exchange rate index. (Probability was less than 10% that the null hypothesis that there is no existence of such relation is satisfied.) Yet, the effect of risk premiums on the real dollar-yen exchange rate index was somewhat unstable, largely depending on the number of lags used in the estimation.

Also a relationship was seen for risk premiums affecting the real interest rate differentials. Although it is not to be covered in this paper, there is a possibility that it reflects the fact that the monetary policies taken in the period were addressed strongly to the soaring risk premiums at the financial crises.

Chart 10 provides an impulse response of the VAR analysis. We selected here only two

relations noted above. In the Chart, changes in the real dollar-yen exchange rate index (REALEX in the chart) are shown for 12 months responding to each change of the real interest rate differentials (IGAP) and risk premium (RISKP) by 2 standard deviations. An expanding real interest rate differential led to the depreciation of the yen/appreciation of the dollar in around 6 months, while the rise in risk premium led to the appreciation of the yen/depreciation of the dollar in about 3 months.

４．Regression analysis of the dollar/won exchange rates and its implications

We also made a similar regression analysis on the movement factors of the US dollar-Korean won for the period of 2005 –March 2013. The result is asymmetrically different from the case of the dollar-yen analysis in the following two points.

Firstly, the dollar-won exchange rate showed an opposite response to the risk premium from that of the dollar-yen, where the rise in the risk premium led to the depreciation of the won/appreciation of the dollar. Secondly, as we have seen above in the dollar-yen case, the real interest rate differentials had a stronger impact through almost all the period observed, while a strong impact of the risk premiums was only seen in a relatively short period around the Lehman shock. In the case of the dollar-won, on the other hand, the real interest rate differentials had a very weak influence with no significant correlation throughout the period, while the risk premiums had a very strong impact.

Korean won：Results of regression analysis of short-and medium-term movements of a risk-on currency and their implications

The variables were set as the same as for the dollar-yen, namely with the real exchange rate of the dollar-won as an explained variable and the difference of the real short term interest rates between the US and Korea and the risk premiums as explanatory variables[6].

Explained variable : Real dollar-won exchange rate index (starting from 1973, and deflated by the producer price indices)

Explanatory variables :

Variable X1 = Differentials of real interest rates = Real dollar interest rates - real won

[6] The real exchange rate index of the dollar-won is also assumed to have a stationarity as it repeats a divergence and a convergence around the long-term average value. However, in the years before 1996 the dollar-won exchange rates did not necessarily satisfy the stationarity because the Korean won was either pegged to the dollar or on a strongly managed floating regime. For the period of January 1997 to March 2013 when the volatility of the won increased a lot, an Augmented Dickey-Fuller test verifies that the probability that all the monthly data for the above variables, i.e. real exchange rates of the dollar-won, real interest rate differentials, and risk premiums have a unit root (non-stationarity) can be dismissed(less than 5% base). However, in the short and medium term including the period of January 2005 to March 2013, the possibility of non-stationarity was not all dismissed for the real dollar-won exchange rates and the real interest rate differentials.

interest rate

Federal Fund rate (O/N) for dollar interest rate

Call rate (O/N) for the won interest rate

Both were deflated respectively by the same price index used in the explained variable.

Variable X2 = risk premiums = yield on Baa rated bonds - yield on Aaa rated bonds, both are published by the FED.

Before making a multiple regression analysis, we provide in Charts 11 and 12 the correlations between the dollar-won real exchange rate index and the two explanatory variables of real interest rate differentials and risk premiums. It is seen that the correlation of the exchange rate and the real interest rate gaps is weak while the risk premiums had a strong positive correlation with the exchange rate.

Regression results and their implications

Regression results are shown in Chart 13. Coefficient of determination (corrected R^2) is 0.62, and the coefficient of X2 (risk premiums) is positive as expected but that of X1(real interest rate differentials) is negative against our expectation. The real exchange rate index responds with a very high sensitivity of 18.3 points to the change of 1 point of X2. Although X1 has a positive correlation in the simple linear regression analysis, it shows a negative correlation under the multiple regression analysis probably because X2 has such a dominant influence.

Chart 14 shows a comparison of the actual movements of the real exchange rate index and the estimated ones based on the result of the regression. As in the case of the dollar-yen analysis, it is seen that the estimated exchange rates of the dollar-won also follow the actual movements.

Chart 15 shows the breakdown of effects of each factor, i.e., real interest rate differential factor, risk premium factor, and residuals. As is in the case of the dollar-yen analysis, it is based on the benchmark point of August 2008, when the real exchange rate index showed the nearest value to the average rate during the observed period.

The risk premium factor worked strongly to appreciate won/depreciate dollar until 2007, but it reversed its direction of influence in 2008 when the Lehman shock occurred, working to depress the won and push up the dollar until the first half of 2009. Since then, it again affected in the direction of appreciating won/depreciating dollar in tandem with the narrowing of the risk premium.

Behind these movements there is the fact that the external investment position of Korea has

been net liabilities and the won is a non-internationalized currency that depends on the net capital inflows from foreign countries (See Morikawa (2011)). It means that the won exchange rate depreciated due to the decreased inflow of foreign capital (withdrawal of money by foreign investors and financial institutions) when the global credit crunch and a rise of the risk premium (i.e. the lowering of the risk tolerance of investors) occurred at the financial crisis in Europe or in the US. Then the won exchange rate recovered its value against the dollar with the alleviation of global credit contraction and lowering of risk premium that followed since the latter half of 2009.

On the other hand, the real interest rate differential factor has a very weak and unstable influence on the won exchange rate as compared to the case of the dollar-yen. The reasons can be explained as follows. The won is not an international currency in the sense that it is not allowed to be held in the settlement accounts by nonresidents and therefore the won can be hardly used in a large scaled carry trade that requires a large quantity of off-balance transactions like foreign exchange futures. This may explain the low sensitivity of the won exchange rate to the interest rate differentials in the short-to medium-term, as compared to the case of the dollar-yen[7].

In other words, the dollar/yen exchange rates are strongly affected by the transaction flows including massive foreign exchange futures and other off balance transactions with high sensitivity to the interest rate differentials. On the other hand, the dollar-won exchange rates are more likely to be affected by the transactions with high sensitivity to the risk premium (such as actual money flows rather than off-balance transactions).

Regression analysis based on the vector autoregressive model

As in the case of the dollar-yen analysis, we made a regression analysis based on the VAR model and using the same variables. Regarding the Granger causality we found that, contrary to the dollar-yen case, there was a stable relationship of risk premium affecting the real dollar-won exchange rate index. On the other hand, the relationship of real interest rate differentials affecting the real dollar-won exchange rate index was found unstable depending on the number of lag used.

Chart 16 shows the impulse responses based on the VAR analysis. We have shown the changes in the real dollar-won exchange rate index for 12 months responding to each change of the real interest rate differentials (IGAP) and risk premium (RISKP) by 2 standard deviations.

7 It was reported, however, that until the first half of 2007 there was a certain expansion of a cash based carry trade in Korea where they borrowed the yen to invest it in the won assets after conversion.

The risk premiums has an effect to cause a statistically significant change in the real exchange rate index in about 5 months (lower chart), but the influence of the real interest rate differentials are not clearly detected and its relationship is not statistically significant (upper chart).

5．Money flows behind the asymmetric movements of the yen and won exchange rates

Let us try to examine whether the movements of the exchange rates of the yen and the won can be explained by the international money flows in the balance of payments statistics.

As to Korea, the dollar-won exchange rates and the external money flows reveal a certain level of correlation. The financial account in the balance of payments statistics comprehensively covers the financial transactions of a country. In the case of Korea, the component of "other investments" which include the short-term money transactions such as bank loans and deposits shows some relationship with the exchange rate of the won (Chart 17-1, 17-2).

Especially, in 2007-2010 when money outflows from Korea were most striking, there can be detected, as is shown in Chart 17-1, a certain relationship of money outflows affecting the won to depreciate and money inflows affecting the won to appreciate. On the other hand, we cannot see any significant relationship between the international money flows and the changes of the yen rates.

There may be two reasons behind this. The first relates to the components of the money flows. Needless to say, the exchange rates are subjected to the demand and supply for the currency not only in transactions that accompany actual money flows but also in off-balance transactions that include various derivatives transactions of swaps, foreign exchange futures, and options.

The Korean won has not been internationalized and nonresident financial institutions are not allowed to hold a settlement account in Korea, therefore they have to depend on the non-deliverable forwards (NDF) for overseas transactions of the won. For this reason, the scale of off balance transactions remains very small compared to that of the actual money transactions, which may explain the existence of a certain relationship between actual external money flows and the movements of the won exchange rate.

On the other hand, the yen is freely traded and settled in the world market as an international currency, and therefore the scale of the off-balance transactions has become very large compared to the one of actual money transactions. As a result, there can be no direct relationship seen between the actual external money flows and the movements of the yen exchange rate.

The second reason relates to the characteristics of the balance of payments statistics. The BOP statistics compile the net transactions of money flows on the basis of a certain time of

period, say, monthly or quarterly, although they make distinctions for domestic and foreign money with some breakdowns of the categories. On the other hand, the fluctuations of the exchange rates are greatly influenced by the current liquidity in the market. When the liquidity is low, a small flow of money can create a big fluctuation in the exchange rate, while the rate tends to be relatively stable even for a big money flow when the liquidity is abundant.

It should be noted, however, the strong relationship of the dollar-won exchange rate with the external money flow was largely associated with the category of the "other investment" which covers mostly the short-term money such as bank loans and deposits. When examined against the total flows of "portfolio investments (bonds and stocks)" and "other investments" combined, almost no relationship can be seen between the flows and the real dollar-won exchange rates. (Chart 18)

A possibility can be estimated here that the transactions centered in the categories of "other investments" are more likely to directly affect the exchange rates while those in the "portfolio investments" have been more neutralized e.g. by hedging on the future markets to affect the demand-supply situation of the foreign exchanges, but this remains to be a matter for further investigation.

In this connection, it may also call your attention to the fact that when there was an enormous shock in the financial market, like the Lehman crisis, there was so strong pressure for selling the won in the Korean financial market that the private banks could not come to the market to counter the heavy demands, leaving the central bank as an only counterpart for the transactions. This resulted in a large dwindling of the foreign exchange reserves of the central bank, as is shown on the right part of the chart 18.

6 . Conclusions

: **Higher sensitivity of the yen exchange rate to the real interest rate differentials and higher sensitivity of the won exchange rate to the risk premium**

In this paper, we tried to explain the factors and their characteristics for short- and medium-term movements of the dollar-yen exchange rates and the dollar-won exchange rates in the period of January 2005 to March 2013 which included the Lehman shock of September 2008.

The results of the regression analyses show that both of the real exchange rates could be explained by more than 60% by two factors of their real interest rate differentials against the US and the risk premiums in the US (Baa rated bond yields – Aaa rated bond yields).

Their sensitivities to the two factors noted above, however, are asymmetric in a double

meaning. Firstly, the sensitivities to the risk premium are diametrically opposed between the yen and the won. Secondly, the dollar-yen exchange rates showed a higher sensitivity to the real interest rate differentials throughout all the period reviewed, and its sensitivity to the risk premium was only noticeable for a short period of around the Lehman shock of September 2008. On the other hand, the dollar-won exchange rates showed very uncertain sensitivity to the real interest differentials but its sensitivity to the risk premium was very high.

Behind this asymmetry in the movement factors for the two currencies, there are two reasons to be thought. (1)Japan's international investment position is net external assets while that of Korea is net liabilities. (2)The yen is used for a massive carry trade by off-balance transactions like foreign exchange futures, thus having a feature of strong sensitivity to the interest differentials, while the won has a very limited volume of off-balance transactions as it is a non-international currency and shows rather high sensitivity to the risk premium. This is a result of the fact that the won exchange rate is strongly influenced by the actual external money flows.

The main reason for the continuation of an appreciated yen until the end of 2012 after the Lehman shock can be accounted for by the fact that the real interest rate differentials had changed to a negative range as the prices in the Japanese corporate price index fell more sharply than those in the US while the nominal short-term interest rates of both countries had stayed nearly zero per cent. This real interest differential continued to work to appreciate the yen/depreciate the dollar.

This trend of the higher yen came to an end and was rapidly reversed toward a depreciation of the yen because of the mounting expectation for a mild inflation from a persistent deflation which was fostered by "Abenomics" and the "unprecedentedly bold quantitative monetary easing" initiated by Gov. Kuroda of BOJ.

As far as we estimate based on the results of the regression analysis, nominal exchange rates at the range of ¥100-105 per US dollar incorporate an expectation of a rise for 7-8% in the corporate price index, which is nearly the same level in the middle of 2008, just before the start of the Lehman shock. At that time the consumer price index temporarily rose at about 2% annually.

In this sense, it is highly possible that the BOJ's targeted inflation rates 2% in the CPI excluding the effect of consumption tax hike, which is supposed to be achieved by the spring of 2015, have been already incorporated in the exchange rates at the range of 100-105 yen per US dollar. As long as the current expectation about US nominal interest rates and inflation rates, it is likely that the yen will again appreciate if the targeted inflation rate is thought to be difficult to be achieved.

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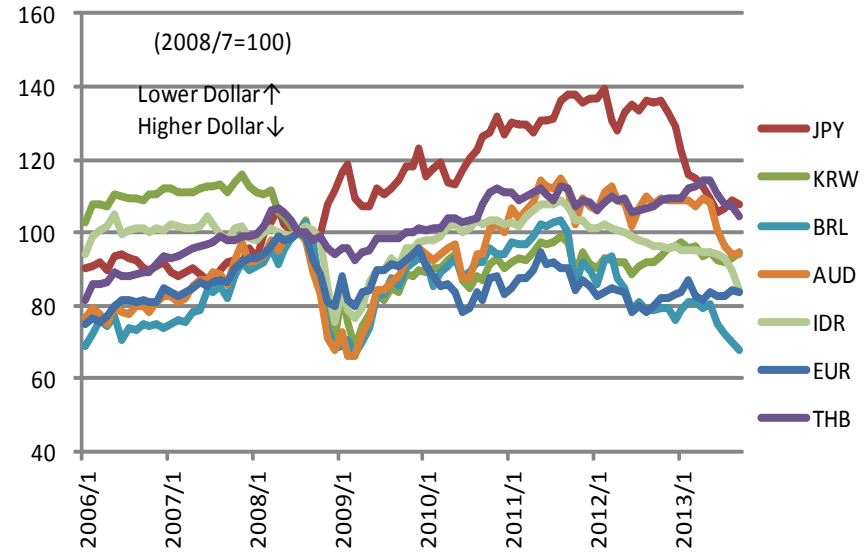
Chart 1

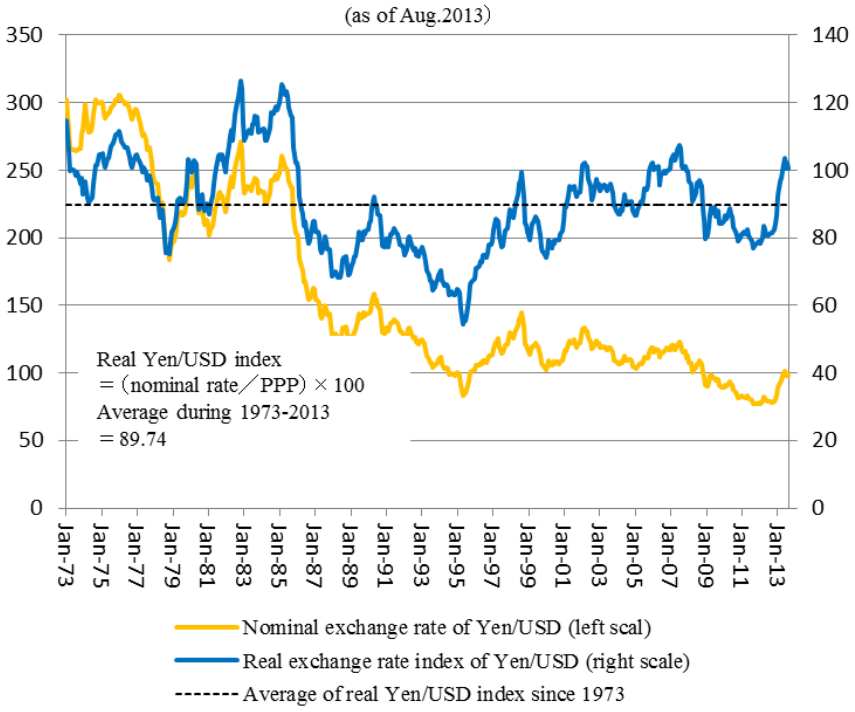
Nominal Exchange Rates of Major Currencies
against US Dollar
(Jan.2006 - Dec.2013)



(Source) Datastream

Chart 2

Nominal and Real Yen/USD Rate
(as of Aug.2013)

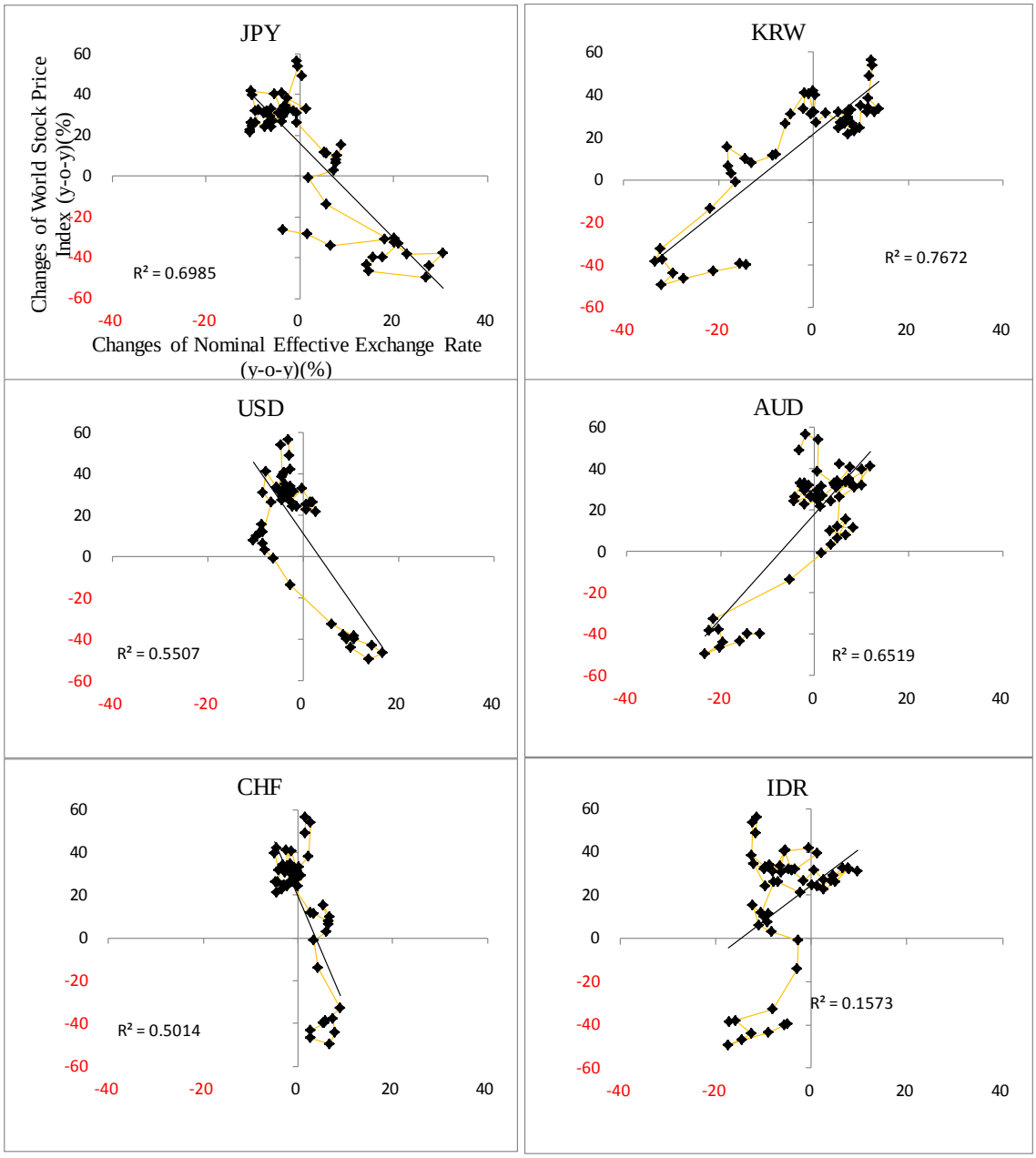


Data:BOJ, Dept. of Commerce, Dept. of Labor
PPP is calculated based on CGPI(JPN) and PPI (US)
Benchmark year :1973

Chart 3

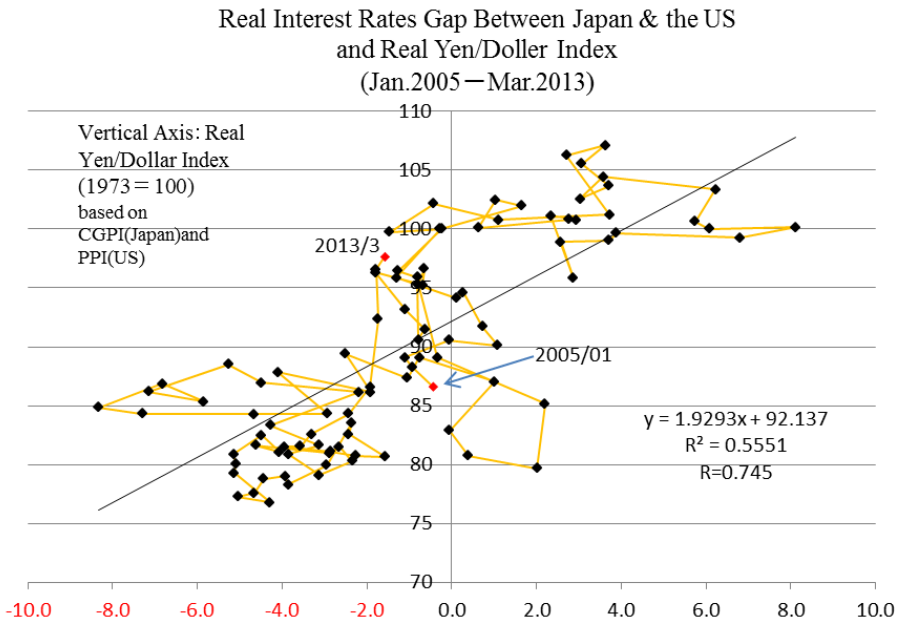
Risk-on currencies and risk-off currencies
(Jan.2005-Dec.2009)

＜Risk-off currencies＞ ＜Risk-on currencies＞



Data：BIS、Bloomberg

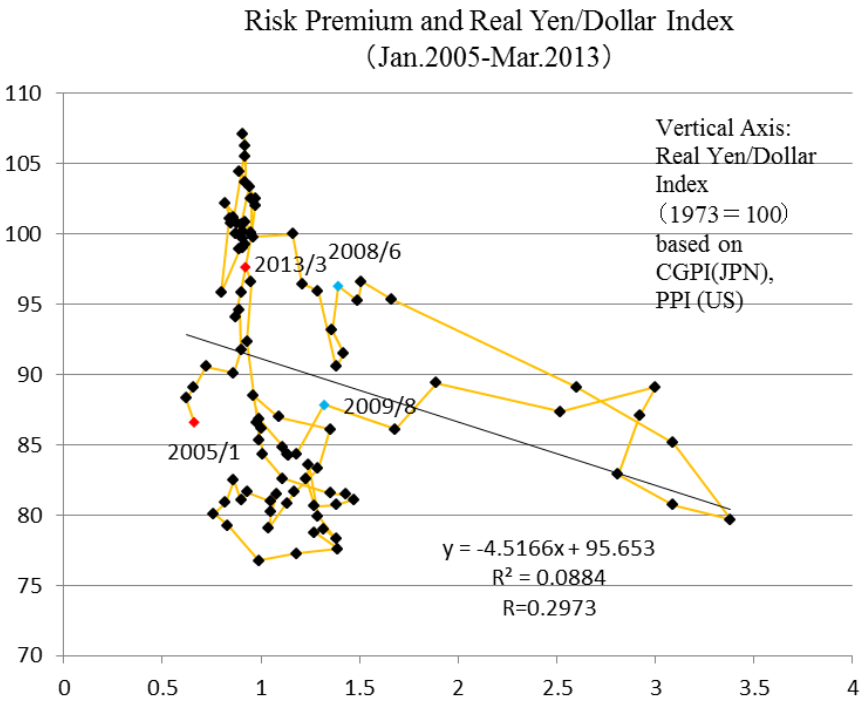
Chart 4



Horizontal Axis: Real Interest Gap between Japan & the US
=Real Federal Funds Rate(O/N)－Real Call Rate(O/N)
adjusted by CGPI (Japan) and PPI (US)

Data: BOJ, FRB, Labor Dept.

Chart 5



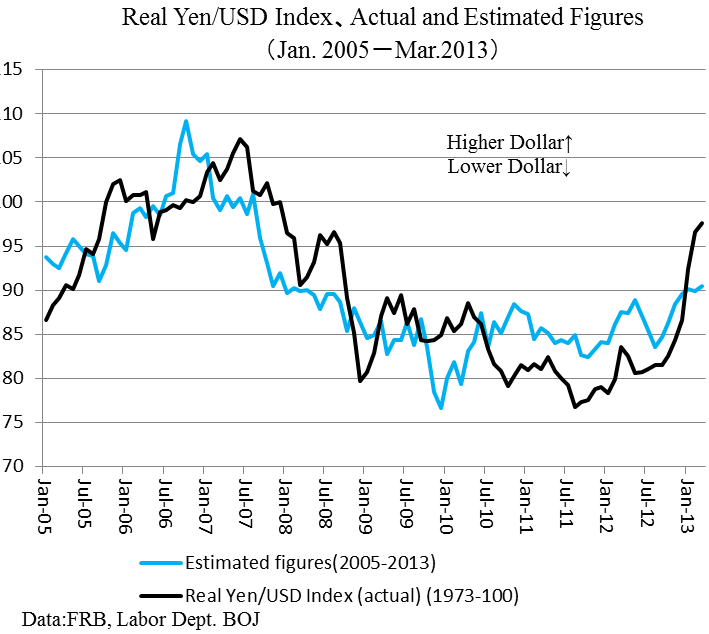
Horizontal Axis: Risk Premium
(Baa rated corporate bond yield－Aaa rated one)

Data: FRB、Labor Dept. BOJ

Chart 6

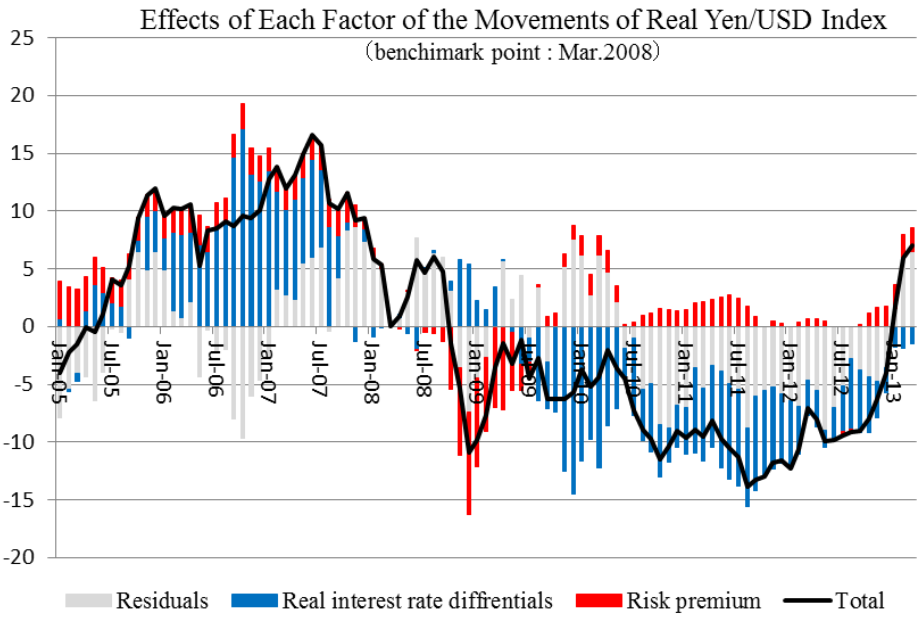
Multiple correlation R	0.800909		Coefficient	Standard Error	t	P − Value
R Square	0.641455	Intercept	97.5763	1.256842	77.63607	1.93E−88
Adjusted R Square	0.633985	X Value 1	1.925722	0.158246	12.16919	3.65E−21
Standard Error	5.195329	X Value 2	−4.4639	0.928563	−4.80732	5.63E−06
Observations	99					
Significant F	4.15E−22					

Chart 7



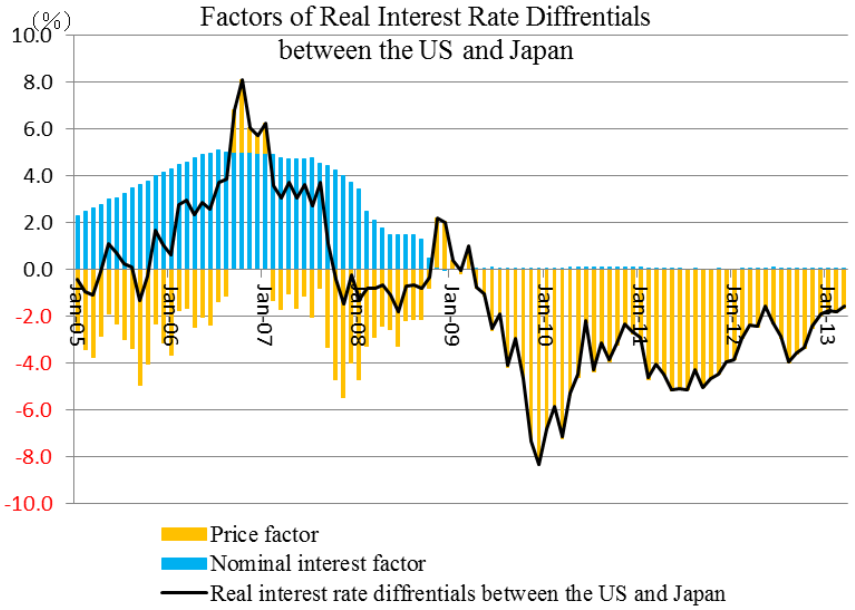
Data:FRB, Labor Dept. BOJ

Chart 8



Data: FRB、Labor Dept. BOJ

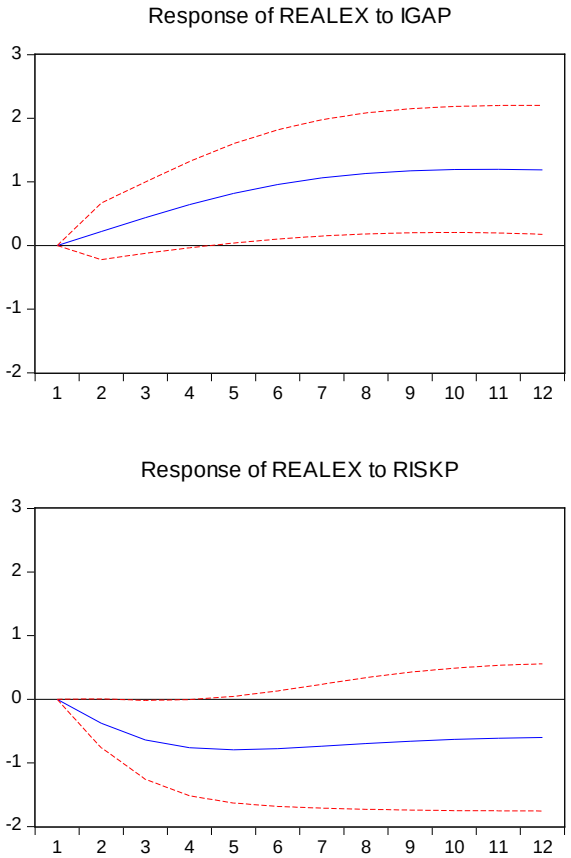
Chart 9



Data: FRB、Labor Dept、BOJ

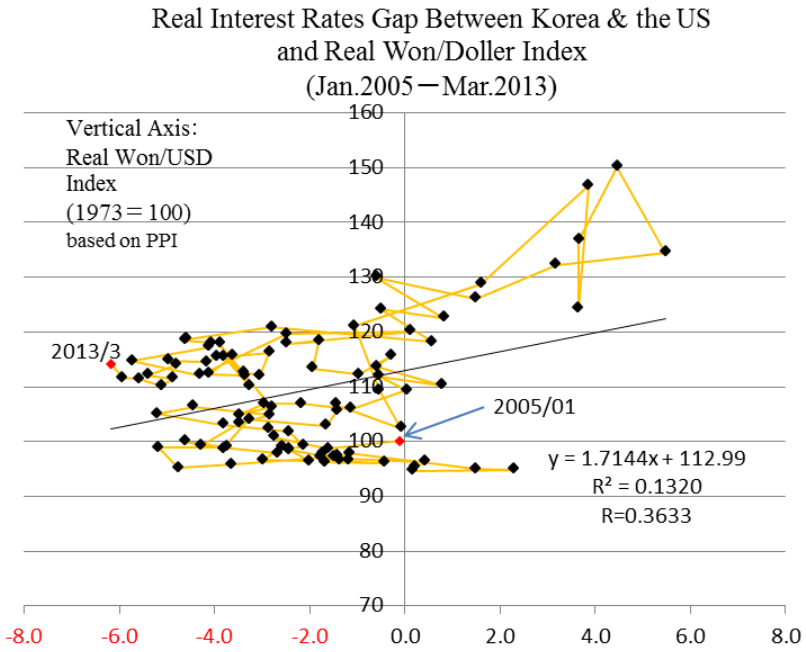
Chart 10

Response to Cholesky One S.D. Innovations ± 2 S.E.



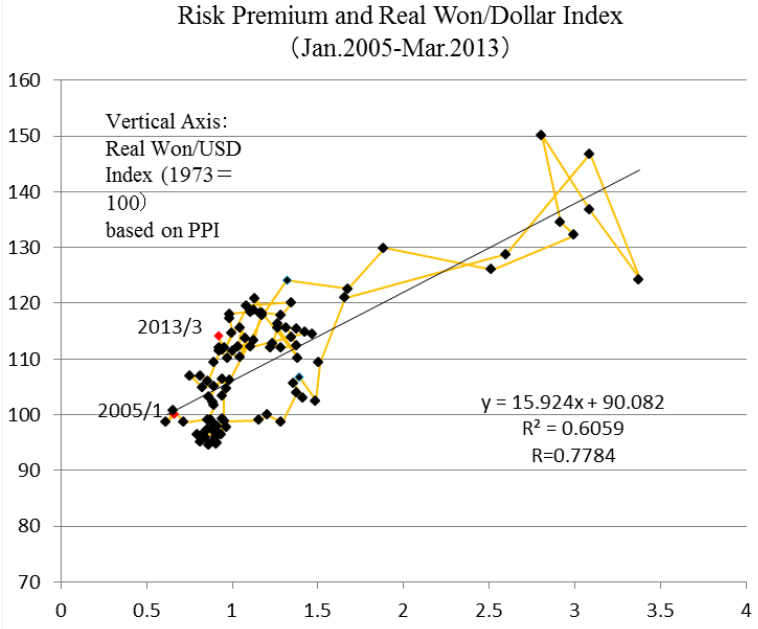
（REALEX：Real Yen/USD Exchange Rate、IGAP：Real Interest Rate Differentials、RSIKP：Risk Premiums）

Chart 11



Horizontal Axis: Real Interest Gap between Korea & the US
=Real Federal Funds Rate(O/N) − Real Call Rate(O/N)
adjusted by PPI
Data: BOK, FRB, Labor Dept.

Chart 12

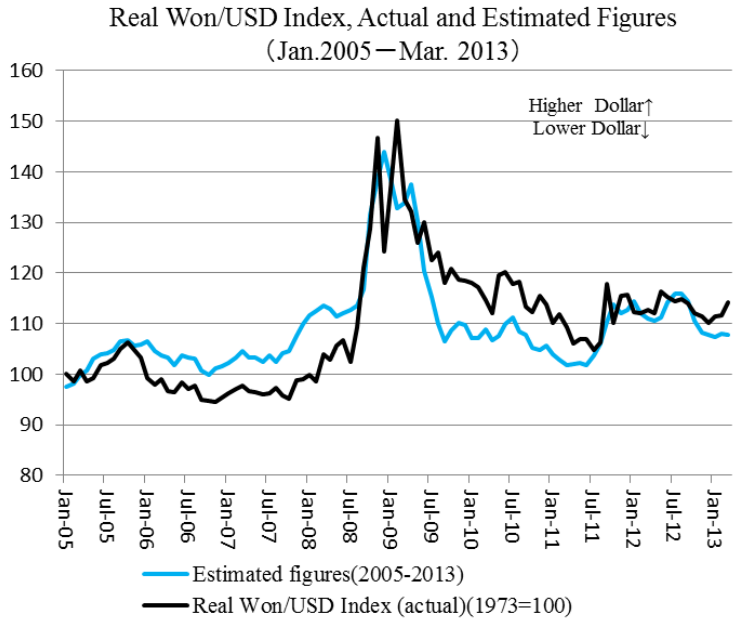


Horizontal Axis: Risk Premium
(Baa rated corporate bond yield − Aaa rated one)
Data: FRB、Labor Dept., Bank of Korea

Chart 13

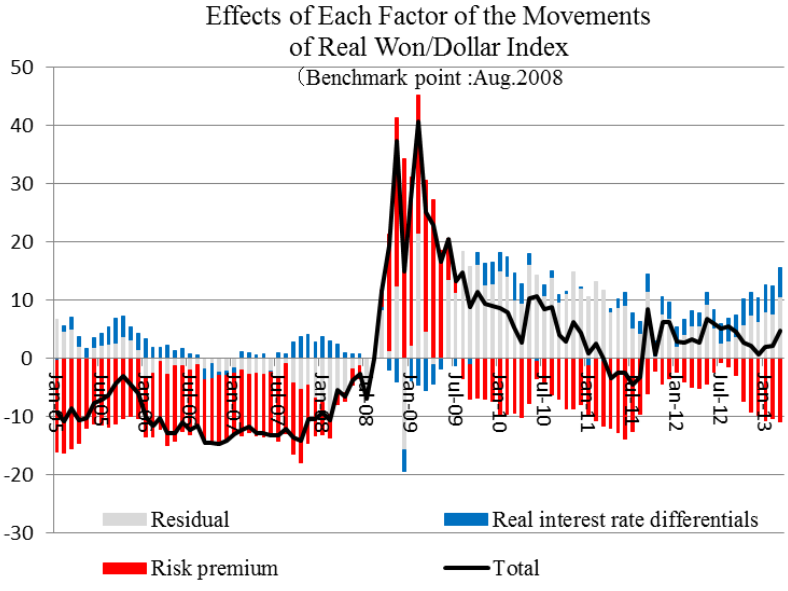
Multiple correlation R	0.792757		Coefficient	Standard Error	t	P − Value
R Square	0.628463	Intercept	85.29219	2.617777	32.58192	1.06E−53
Adjusted R Square	0.620723	X Value 1	−0.90232	0.373553	−2.4155	1.76E−02
Standard Error	7.120951	X Value 2	18.34408	1.619677	11.32576	2.19E−19
Observations	99					
Significant F	2.29E−21					

Chart 14



Data:FRB, Labor Dept. , Bank of Korea

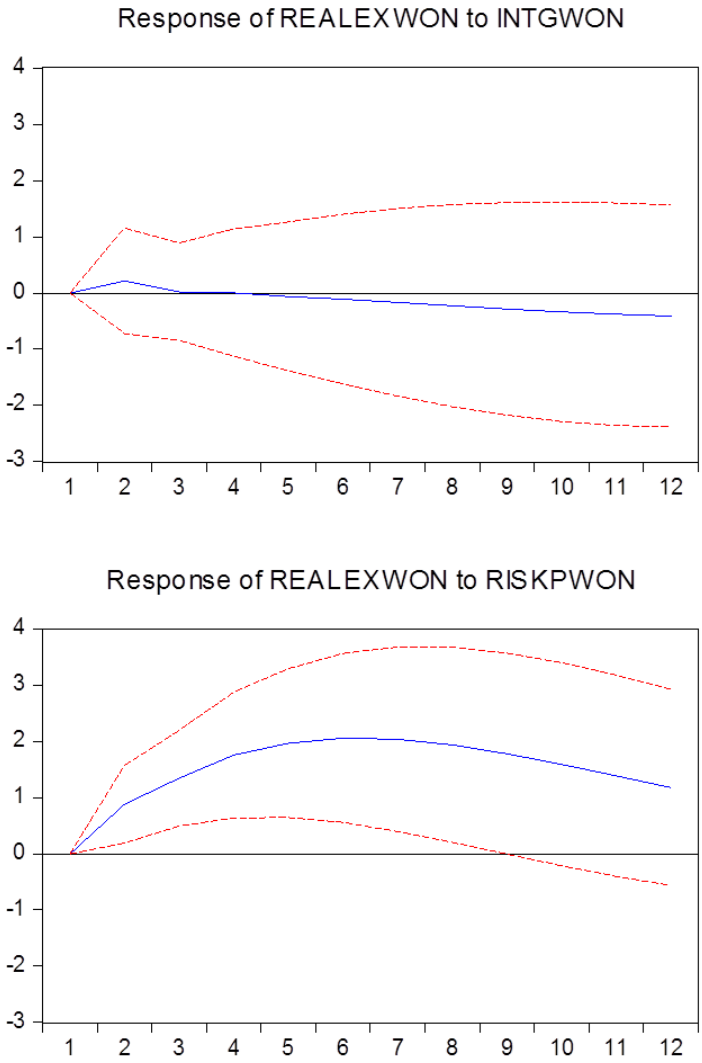
Chart 15



Data: FRB、Labor Dept.　Bank of Korea

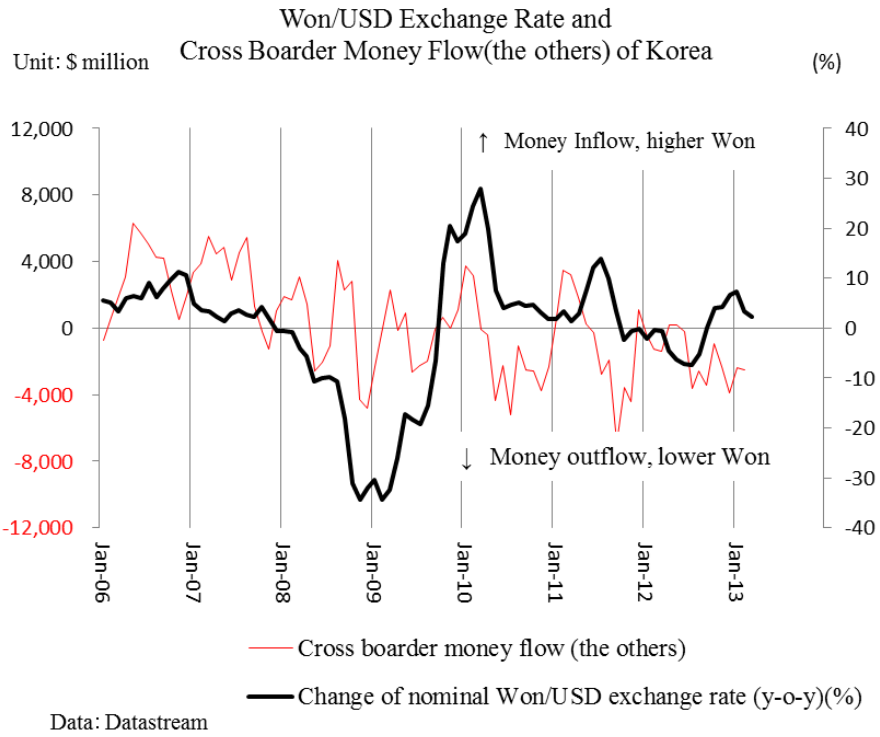
Chart 16

Response to Cholesky One S.D. Innovations ± 2 S.E.



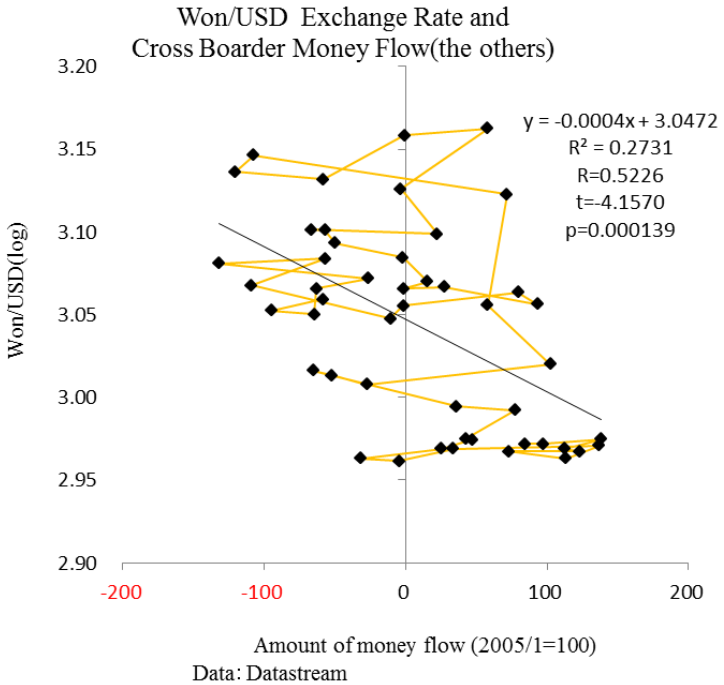
(REALEXWON : Real USD/KRW Exchange Rate、INTGWON : Real Interest Rate Differentials、RSIKPWON : Risk Premiums)

Chart 17-1



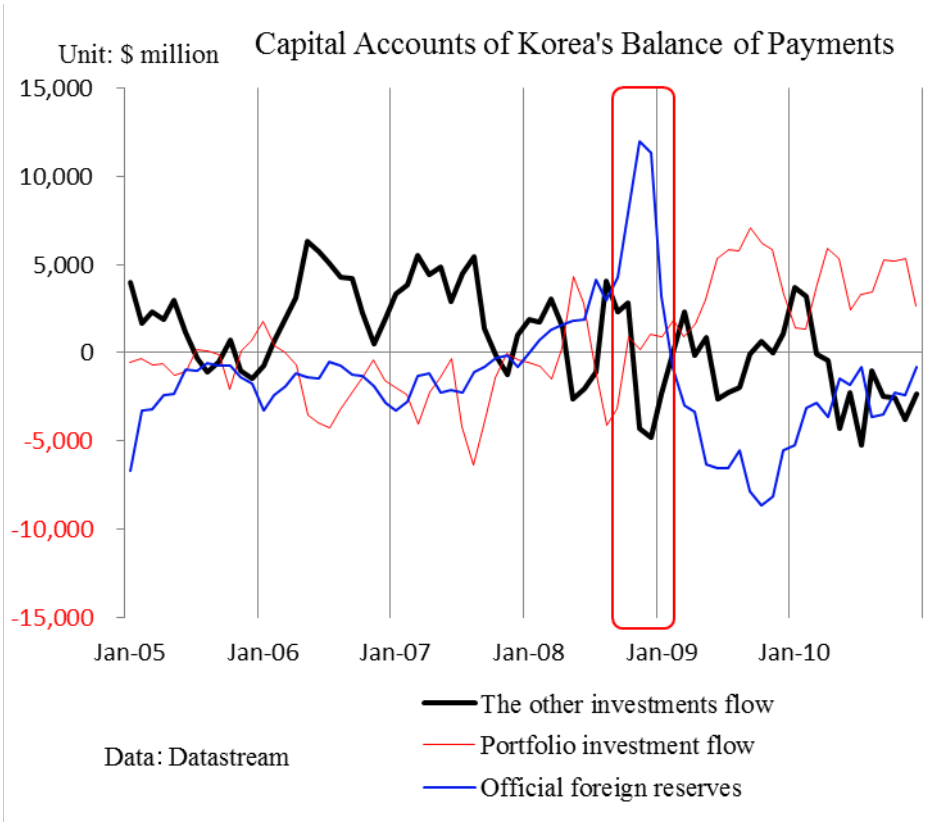
Data: Datastream

Chart 17-2



Data: Datastream

Chart 18



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