Effects of Exit Strategy of the Quantitative Easy Monetary Policy on East Asian Currencies[*]

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Abstract

The FRB decided to finish its quantitative easy monetary policy as the global financial crisis is subsiding in the United States. It is expected that it will raise the FF rate from almost zero percentage in the near future. Abundant money which flowed from the United States into emerging market countries is beginning to flow backward to it. As a result, the emerging market countries are beginning to face depreciation of their home currencies and drops in stock prices. Basing on the situation in global economy, we consider effects of changes in the monetary policy, especially effects of raising the in the interest rates in the United States on East Asian currencies in this paper. Specifically, we use data on interest rates as a monetary policy instrument to investigate how changes in the interest rates and interest differentials affect interest rates, exchange rates, and capital flows in the East Asian emerging market countries.

We obtained the following analytical results:

1. Changes in interest rates in the United States had the same direction of partial

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effect on interest rates in some of East Asia countries.

2. Widening interest differentials of the United States against East Asian countries had a tendency to depreciate exchange rates of East Asian currencies against the US dollar.

3. Increasing interest differentials of the United States against Japan appreciated East Asia currencies (except for the Japanese yen) against a weighted average of East Asian currencies or an Asian Monetary Unit (AMU) in terms of AMU Deviation Indicators.

4. Changes in interest differentials and expected return differentials of the United States against the relevant East Asian country had effects on capital flows in terms of portfolio and other investments of financial accounts for the East Asian countries.

Given the analytical results, it is concluded that East Asian countries would face capital outflows to depreciate their home currencies while they would have upward pressure against their own interest rates if the FRB adopted an exit strategy of the quantitative easy monetary policy to raise the interest rate in the near future.

1. Introduction

Six years have passed since the global financial crisis happened with the Lehman shock as a trigger. Each country in the world has been going toward economic recovery or slump in an asymmetric direction. Among them, the United States, that was an epicenter of the global financial crisis, has begun to overcome economic slump and begin to be back on track because the Federal Reserve Board (FRB) has been conducting a large scale of quantitative easing monetary policy. On the other hand, the euro zone crisis is calming down in Europe after some European countries faced the similar financial crisis related with the subprime mortgage problems as the United States and fiscal crisis subsequently. Establishing the European Stability Mechanism (ESM) which makes direct capital injection into financial institutions contribute to it. In Japan, the Bank of Japan is conducting a quantitative and qualitative easing monetary policy in order to escape from the long-term deflation or "lost decade" though Japan faced little influence by the global financial crisis.

The global financial crisis affected also emerging market countries' economy through the United States and European economies. Immediately after the Lehman shock, governments of major developed countries adopted large scale of measures to boost economy. Although they have begun to recover from the worldwide recession, it is still lacking in strength for them to recover aggregate demand and economic growth. In addition, central banks of developed countries have been conducting quantitative easing monetary policy. In this situation, financial globalization makes the abundant money move around the world. The abundant money was flowed from the developed countries into in particular, remarkably growing economy of emerging market countries as investments with high returns. However, the FRB decided to reduce its quantitative easing monetary policy as the global financial crisis is subsiding in. Moreover, it finished further increases in monetary base in October 2014. They have fear that the FRB's action might make the money flow backward from emerging market countries into the United States to depreciate their currencies and to decrease stock prices.

While the FRB is reducing the quantitative easing money in the context of economic recovery, the Bank of Japan is continuing the quantitative and qualitative easing monetary policy in order to accomplish 2% of inflation targeting. On one hand, the European Central Bank (ECB) has begun to adopt minus interest rate for deposit facility and excess reserves. Thus, differences in timing of conducting monetary policy among the developed countries could affect capital flows and exchange rates not only among the developed countries but also among the developing countries and the emerging market countries. Many of the emerging market countries have fear that an

exit strategy of quantitative easing monetary policy of the FRB would make money flow backward from the emerging market countries into the United States to have adverse effects on their economies.

Given the current situation of global economy, this paper has an objective to investigate how changes in monetary policy in the developed countries affect emerging market country economy in East Asia. Specifically, it makes empirical analysis of how changes in interest rates of the developed countries affect interest rates and exchange rates of East Asian emerging market countries. Moreover, it is to analyze empirically how changes in interest rates of the developed countries affect capital flows of East Asian emerging market countries.

2. FRB's exit strategy from quantitative easing monetary policy

A large shock was given to financial markets in the world when a fund affiliated to the BNP Paribas suspended payments of investment trust in August 2007. Afterward the Lehman Brothers went bankrupt with $600 million of total debts in September 2008. The series of shocks (BNP Paribas shock and Lehman shock) were originally caused by burst of housing bubble based on subprime mortgage, that is, housing loan for lower income group in the United States. The subprime mortgage problem, which appeared in summer of 2007, increased its seriousness by the Lehman shock in 2008. Moreover, the subprime mortgage problem has affected not only the United States but also European countries.

The FRB rapidly reduced the Federal Fund (FF) rate as its policy interest rate in order to tackle with the global financial crisis that was developed by the subprime mortgage problem in the United States. The FF rate, which was set to be 5.25% in July 2007, was reduced to 0.5% in September 2008 when the Lehman shock happened. The Federal Open Market Committee (FOMC) of the FRB decided to set the target of FF rate at 0% - 0.25% on 16 December, 2008. Afterwards it has been actually kept at an ultra- low rate around 0.1%.

In addition to the ultra-low interest rate policy, the FRB adopted the first round of quantitative easing monetary policy (Board of Governors of the Federal Reserve System (2014a, 2014b)). The FRB purchased $300 billion of long-term Treasury securities, $1.25 trillion of mortgage-backed securities (MBS), and $175 billion of other securities to increase its monetary base from $300 billion in September 2008 to $2.1 trillion in March 2010. At the same time, the FRB began to show a forward guidance which suggest to continue the quantitative easing monetary policy for the future.

Next, the FRB conducted the second round of quantitative easing monetary policy

(QE2) from November 2010 to June 2011. It purchased $600 billion of long-term Treasury securities with a pace of $75 billion per month. Thus, the monetary base reached at $2.64 trillion in June 2011. Moreover, the FRB has adopted the third round of quantitative easing monetary policy (QE3) since September 2012. It purchased $40 billion of MBS and $45 billion of long-term Treasury securities per month till December 2012 to increase the monetary base at a pace of $85 billion per month.

However, the FRB has slowed down the pace of purchasing MBS and long-term Treasury securities toward an exit strategy of quantitative easing monetary policy since January 2014. Figure 1 shows that amounts of MBS and long-term Treasury securities purchased by the FRB reached its peak early in 2013 and has had a tendency to decrease afterward. Specifically, the FRB reduced amounts of purchasing MBS from $40 billion per month to $35 billion per month and long-term Treasury securities from $45 billion per month to $40 billion per month in January 2014. It has been reducing the amounts of purchasing MBS and long-term Treasury securities every month. For the reason, a growth rate of the monetary base has been slowing down. Eventually, the FRB decided to purchase no MBS and long-term Treasury securities per month at the FOMC on October 29, 2014. At the point of time the FRB finished the quantitative easing monetary policy and accomplished the exit strategy of quantitative easing monetary policy.

The FOMC made a statement "the Committee continues to anticipate, based on its assessment of these factors, that it likely will be appropriate to maintain the current target range for the federal funds rate for a considerable time after the asset purchase program ends, especially if projected inflation continues to run below the Committee's 2 percent longer-run goal, and provided that longer-term inflation expectations remain well anchored" (Board of Governors of the Federal Reserve System (2014d)). Chair Yellen of FRB referred that "a considerable time" is about six months at the press conference after the FOMC on 19 March, 2014 (Board of Governors of the Federal Reserve System (2014c)). It suggests that the FRB will begin to raise the FF rate six month later after it finishes the quantitative easing monetary policy. It means a switch from the exit strategy of the quantitative easing monetary policy to a conventional monetary policy of raising the interest rates. For the reason, market participants expect that interest rates in United States will begin to increase in the mid of 2015.

On one hand, such FRB's exit strategy of the quantitative easing monetary policy as reducing the quantitative easing monetary policy and removing the zero interest rate policy is expected to flow the money from emerging market countries back to the United States. They are worried that the flow back of the money will bring about drop of stock

prices in emerging market countries and depreciation of the currencies[1].

3. Effects of the global financial crisis on East Asia

The global financial crisis had little direct effects on financial institutions in East Asian countries which include Japan because they held not so much subprime mortgages and subprime mortgage backed securities unlike financial institutions in the United States and Europe. However, the global financial crisis brought about severe worldwide economic recession, which drastically reduced exports from East Asia to the United States and Europe. Moreover, speculative money inflows into East Asia came to a sudden stop and moreover it flows backward from East Asia as the global financial crisis became more serious. Thus, East Asian currencies were indirectly affected by the global financial crisis.

More specifically, financial institutions of the United States and Europe made active currency carry-trade, especially yen carry-trade before the global financial crisis occurred. The super low interest rate monetary policy is pointed out as a background for the yen carry trades. Figure 2 shows that the Japanese yen denominated interest rates were kept at very low level compared with the dollar and euro denominated interest rates. Financial institutions exploited the interest differentials to raise money in terms of the Japanese yen with a lower interest rate and invested in financial assets in terms of currency with a higher interest rate. The carry trades affected capital flows within East Asian region. Moreover, they had some relationship with changes in capital flows or rebounds of capital flows.

Yen carry trades between lower interest rate of the Japanese yen and higher interest rates of the Korean won were very active from 2005 to summer in 2007 (Ogawa and Wang (2013)). Figures 3 show asset and liability balance (net position) of international banks for Japan and Korea[2]. The two figures show that Japan had outflows of capital before the global financial crisis occurred and that it had rapid inflows of capital as US and European financial institutions close the carry trades because they damaged their balance sheet during the global financial crisis. On one hand, Korea continued to have capital inflows before the global financial institutions. Afterward, it was hit by sudden capital outflows as the carry trades closed.

The capital flows from Japan to Korea depreciated the Japanese yen against the

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[1] For more detail, see IMF (2013a, 2013b) for a summary of unconventional monetary policies.
[2] Assets and liabilities balance (net position) is defined as a balance of outstanding assets and outstanding liabilities. Positive net position represents capital outflows while negative net position represents capital inflows.

Korean won before the global financial crisis. The global financial crisis changed capital flows from Korea to Japan because the US and European financial institutions closed the yen carry trades. Thus, the Korean won abruptly depreciated against the Japanese yen during the global financial crisis.

The asymmetric movements in intra-regional exchange rates among East Asian currencies have occurred since 2005 and have continued till the recent years. The asymmetric movements have brought about misalignments among the currencies for the long time. The currency misalignments might distort relative prices of products that are made in each of East Asian countries to make misallocation of resources in not only international trades but also foreign direct investments. It might have adverse effects on establishing production networks in East Asia.

Figures 4 show movements in nominal and real AMU Deviation Indicators for each of East Asian currencies[3]. Figure 4(1) shows that the Brunei dollar, the Singapore dollar, Malaysian ringgit, and Chinese yuan have fluctuated within plus/minus 10% of band in terms of nominal AMU Deviation Indicators during the sample period. On one hand, the Indonesian rupiah and the Vietnamese dong have been depreciating over time. Especially the Vietnamese dong has depreciated by about 50% point compared with a benchmark exchange rate in 2000/2001. The Korean won and the Thai baht as well as the Japanese yen were fluctuating before and after the global financial crisis. The Korean won was overvalued by more than 20% compared with the benchmark level before the global financial crisis. Also the Thai baht made abrupt appreciation before the global financial crisis. After the global financial crisis, the Korean won and the Thai baht abruptly depreciated. In contrast, the Japanese yen was undervalued by 10% compared with the benchmark level before the global financial crisis. The Japanese yen appreciated in contrast with the Korean won and the Thai baht during the global financial crisis. In total, East Asian currencies have a tendency to widen deviation

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[3] An AMU is an abbreviation for Asian Monetary Unit. It is a unit of common currency basket which is calculated based on exchange rates of ASEAN+3 currencies. The AMU is expressed in a weighted average of the US dollar (65%) and the euro (35%) because the United States and the euro zone are major trade partners for East Asia countries. The weights 65%:35% on the US dollar and the euro are based on shares of East Asia's trade with the United States and the euro zone. On one hand, an AMU Deviation Indicator is a measurement which shows how much each of East Asian currencies is deviated from its benchmark in terms of the AMU. A nominal AMU Deviation Indicator is calculated based on nominal exchange rates while a real AMU Deviation Indicator is calculated by taking into account inflation differentials. Their data are available from a website of Research Institute of Economy, Trade and Industry (http://www.rieti.go.jp/users/amu/index.html). See the website for details of AMU and AMU Deviation Indicators.

indicators among them. The largest deviation indicator differential was larger than 60% point between the most overvalued currency (the Japanese yen) and the most undervalued currency (the Vietnamese dong) in 2011.

On one hand, Figure 4(2) shows movements of real AMU Deviation Indicator for each of East Asian currencies in terms of real exchange rates. Currencies with relatively higher inflation rate have a tendency to appreciate while currencies with relatively lower inflation rate have a tendency to depreciate. For example, the Indonesian rupiah, the Vietnamese dong, and the Lao kip are appreciating in terms of real AMU Deviation Indicators while they are depreciating in terms of nominal AMU Deviation Indicators. In contrast, the Japanese yen has a tendency to depreciate in the real term after the global financial crisis while it has a tendency to appreciate in the nominal term. The reason is considered to be why the Japanese economy experienced deflation. The Korean won reflected appreciation of the nominal exchange rate to be overvalued in terms of real AMU Deviation Indicator after late 2004 to 2006. The Thai baht abruptly appreciated in the real term from 2007. The real AMU Deviation Indicators of East Asian currencies on the whole have a tendency to widen. Differential of real AMU Deviation Indicators between the Indonesian rupiah (the most overvalued currency) and the Japanese yen (the most undervalued currency) is shown to be larger than 120% points.

Thus, East Asian currencies showed asymmetric responses against the global financial crisis. One of major reasons is that carry trades brought about capital flows between one East Asian country with relatively lower interest rate such as Japan and others with relatively higher interest rates such as Korea and Thailand. The carry trade driven capital flows within the region affected fluctuations of intra-regional exchange rates among East Asian countries (Ogawa and Wang (2013)).

4. Effects of interest rates in the United States on interest rates, exchange rates, and capital flows in East Asia

A number of recent studies have concentrated on the effects of the United States unconventional monetary policy. For example, Eichengreen and Gupta (2014) analyze the effects of "tapering talk" on macroeconomic variables of emerging markets. Bowman, Londono and Sapriza (2014) explore how the U.S. unconventional monetary policy affected emerging market economy's asset price as well as capital flow. Lim, Mohapatra and Stocker (2014) focus mostly on the effect of unconventional monetary policies of high income economies on the financial inflows to developing economies, and simulate the effect of monetary policy normalization. Aizenman, Binici and Hutchison (2014)

shed light over the effects of "tapering news," which trigger a reduction of capital inflows and a depreciation of exchange rates on emerging markets. Here, we focus on the East Asian countries and consider how an exit strategy of quantitative easing monetary policy by the FRB will affect capital flows in East Asian countries. For the purpose, we empirically analyze how the interest rates in the United States as well as the euro zone affect interest rates, exchange rates, capital flows in East Asian countries. A Vector Autoregressive (VAR) Model is used to investigate causality relationships among the economic variables. We use data which include interest rates in East Asian countries, the United States, and the euro zone, exchange rates of East Asian currencies in terms of the US dollar and the euro, exchange rates of AMU (CMI) in terms of the US dollar and the euro[4], AMU Deviation Indicators of East Asian currencies, portfolio and other investments of financial accounts in the balance of payments statistics.

(1) Objectives of analysis

East Asian currencies were indirectly affected by the global financial crisis as explained above. After the global financial crisis, quantitative easing monetary policy of the Bank of Japan, the FRB, and the ECB have supplied plentiful of money into financial markets. The money flew into emerging market countries to boost the domestic economies. However, it is expected that the quantitative easing monetary policy is changing into an exit strategy in the United States in the background of end of the global financial crisis and economic recovery. It is expected that the change of monetary policy into an exit strategy increase interest rates in the United States. The money that flew into emerging market countries might flow backward by the change of monetary policy in the United States. It might have adverse effects on the emerging market countries.

We investigate effects of the change in monetary policy in the United States on East Asian countries. Specifically, we analyze how change in interest rates in the United States will affect interest rates, exchange rates, and capital flows in East Asian countries. Moreover, based on the estimation, we forecast effects of exit strategy of quantitative easing monetary policy on East Asian countries. We focus on interest rate as a policy instrument that is used to accomplish objectives of monetary policy.

At first, we analyze how changes in interest rates in the United States affect interest rates in East Asian countries. It is expected that changes in interest rates in

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[4] An AMU (CMI) is an Asian Monetary Unit with weights based on contribution share which each of East Asian countries is decided under Chiang Mai Initiative Multilateralization (CMIM).

the United States have a same direction of effect on interest rates in East Asian countries with neither capital controls nor foreign exchange control.

Next, we analyze how interest differentials between the United States and East Asian countries affect exchange rates of the relevant home currencies in terms of the US dollar. It is expected that the relevant currency depreciate against the US dollar as interest differentials (US dollar denominated interest rate minus the relevant home currency denominated interest rate) is increasing.

Moreover, we analyze how interest differentials between a weighted average of interest rates in the United States and the euro zone and East Asian countries affect exchange rate of the AMU in terms of a currency basket of the US dollar and the euro[5]. It is expected that the AMU depreciate against a currency basket of the US dollar and the euro as interest differentials (US dollar & euro interest rate minus the relevant home currency interest rate) is increasing.

We make the following supplementary analysis. The FRB's exit strategy of quantitative easing monetary policy would increase interest differential between the United States and Japan, given that the Bank of Japan keeps the quantitative easing monetary policy for the time being. We analyze how the interest differential between the United States and Japan affects East Asian currencies except for the Japanese yen.

Lastly, we analyze how interest differentials or expected return differentials by taking into account expected rate of change in exchange rate between the United States and the relevant East Asian countries affects capital flows or financial accounts of East Asian countries. It is expected that East Asian countries face capital out flows or minus financial account as interest differentials or expected return differentials (interest rate or expected return in the United States minus that in East Asian countries) increase.

(2) Data and analytical periods

We suppose that the United States and the euro zone might affect capital flows of East Asian countries. We target ten countries and region which include Japan, China, Korea, Hong Kong, Thailand, Singapore, Indonesia, Malaysia, the Philippines, and Vietnam. We treat a weighted average of ten countries and region as a whole of East Asia in order to investigate effects on East Asia as a whole.

We use the following data in conducting the empirical analysis. Daily data on inter-bank interest rate (3 months) are used as interest rates in East Asian countries,

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[5] Weights on the US dollar interest rate and the euro interest rate are set to be 65% and 35%, respectively. Weights on interest rates of East Asian countries are based on basket shares of AMU (CMI).

the United States, and the euro zone. Due to data constraints, data on uncollateralized overnight call rates are used as interest rates in Korea and China. Data on interest rate of Treasury Bills (364 days) are used as interest rates in the Philippines. Daily data on exchange rates of East Asian currencies in terms of the US dollar and the euro as well as the above-mentioned interest rates are obtained from Datastream. Data on exchange rates of both AMU (CMI) and AMU (CMI) Deviation Indicators of East Asian currencies are downloaded from a website of Research Institute of Economy, Trade and Industry (RIETI). Data on portfolio and other investments in financial account are obtained from IMF, Balance of Payments Statistics. Data on financial account of Japan and Korea are used from the Bank of Japan and the Bank of Korea, respectively.

Analytical periods are selected in order to cover all data on the East Asian countries. Analytical periods are from January 1, 2000 to December 31, 2013 for analyses that daily data on interest rates and exchange rates. On one hand, analytical periods are the 1st quarter of 2000 to the 2nd quarter of 2013 for Hong Kong, Singapore, Thailand, and the Philippines in using quarterly data on financial account. Due to data constraints, analytical periods are the 1st quarter of 2000 to the 4th quarter of 2012 for Indonesia, and the 1st quarter of 2000 to the 3rd quarter of 2012 for Malaysia and Vietnam. Analytical periods are January 2000 to the December 2013 for Japan and Korea. We cannot conduct any analysis of financial accounts in China because data on Chinese financial account is available only for a period from the 1st quarter of 2010 to the 4th quarter period of 2012. As an additional means of evaluation, we also analyzed how changes in interest rates in the United States affect interest rates in East Asian countries before the FRB decided to push its FF rate down to 0% - 0.25%. Analytical periods are selected just before announcement made by FRB about the constraints of zero lower bound interest rate on 16 December, 2008. Daily data are from January 1, 2000 to December 15, 2008, quarterly data from the 1st quarter of 2000 to the 4th quarter of 2008, and monthly data from January 2000 to the December 2008.

We take a first logarithm difference for exchange rates, rate of changes in financial accounts and first difference of interest rates and AMU (CMI) Deviation Indicators to make empirical analysis.

(3) Results of empirical analysis

Table 1 shows empirical results regarding relationships of interest rates among the United States, the euro zone, and East Asian countries. Economic variables in the first column in Table 1 shows economic variable to be used for each of analysis. The next column shows causality relationships among the economic variables that are in theory

expected to have. The analytical results are shown in each column of countries and region. The analytical results are summarized as follows.

We found many expected causality relationship from changes in interest rates in the United States and the euro zone to many East Asian countries except for Indonesia, Malaysia and China. Especially for Japan, Korea, and Singapore which have no capital control and foreign exchange control, we found that the interest rates have positive correlation with those in the United States and the euro zone. When the interest rates in the United States or the euro zone decrease (increase), the interest rates in many of the East Asia countries also decrease (increase). Moreover, we found that positive correlation between a weighted average of interest rates in the United States and the euro zone and a weighted average of interest rates in East Asian countries. When the a weighted average of interest rates in the United States and the euro zone decrease (increase), a weighted average of interest rates in the East Asia countries also decrease (increase). With respect to the results of sub-sample periods summarized in Table 2, no capital control and foreign exchange control countries have a significant result.

Tables 3 and 4 give empirical results regarding relationship between interest differentials of the United States and /or the euro zone minus East Asian countries and the relevant exchange rates of East Asian currencies in both full and sub-sample periods, while relevant interest differentials are shown in Figures 5 and 6. The interest differentials have a positive correlation with exchange rate of currencies of East Asian countries except for Indonesia, Vietnam and the Philippines. The exchange rates of East Asian currencies depreciate against the US dollar as the interest rates in East Asian countries decrease relatively compared with the United States. Differentials between a weighted average of interest rates in the United States and the euro zone and a weighted average of interest rates in East Asian countries has a negative relationship with an exchange rate of the AMU, that is a weighted average of East Asian currencies, in terms of a weighted average of the US dollar and the euro. When a weighted average of interest rates in the United States and the euro zone decreases relatively compared with a weighted average of interest rates in East Asian countries, it means that an exchange rate of the AMU appreciates against a weighted average of the US dollar and the euro. By focusing on the results of full sample periods as well as sub-sample periods, we cannot find statistically significant results.

Tables 5 and 6 show empirical results regarding how interest differentials between Japan and the United States, between Japan and the euro zone, and between the United States and the euro zone affect exchange rates of East Asian currencies. We found that interest differentials between Japan and the United States have the

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expected correlation with exchange rates of the relevant currency against the AMU and the nominal AMU Deviation Indicators for some of the East Asian currencies over both the full sample and sub-sample periods. We found that the interest differentials between the United States and the euro zone have the expected correlation with exchange rates of the relevant currency against the AMU and the nominal AMU Deviation Indicators for Japan and Korea only.

Tables 7 and 8 summarize empirical results regarding how capital flows in East Asian countries are caused by interest differentials or expected return differentials between the United States and East Asian countries over the full sample periods as well sub-sample periods. Interest differential is calculated as the US dollar denominated interest rate minus home currency denominated interest rate. Expected return differential is calculated in order to take into account expected rate of change in exchange rate. It is calculated as the US dollar denominated interest rate minus home currency denominated interest rate plus expected rate of change in exchange rate of the US dollar in terms of home currency. Regarding the expected rate of change in exchange rate, we assume a perfect forecast that market participants can perfectly expect an actual future exchange rate. Its empirical results show that we have expected relationship between interest differentials and financial accounts for several countries and region. We found also expected relationship between expected return differentials and financial accounts. However, these expected relationships are not statistically significant.

Also, Tables 1 to 8 show accumulated impulse response of each economic variable to one standard deviation of shock of interest rates or interest differential for ten days or two years after the shock[6]. We found that response of interest rates in East Asian countries are statistically significant ten days later when interest rates in the United States or the euro zone exogenously happen. On the other hand, responses of exchange rates and AMU Deviation Indicators of East Asian currencies are smaller compare with the interest rates or statistically insignificant when interest rates in the United States or the euro zone exogenously happen.

Moreover, we found that accumulated responses of financial accounts to the interest differentials and the expected return differentials are positive but statistically insignificant for some of the East Asian countries.

(4) Implication of the empirical results: effects of the exit strategy

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[6] Accumulated impulse response graphs are not reported because of space limitations but are available upon request.

The above empirical results have the following implication. It is expected that interest rates in the East Asian countries increase to follow increase in the interest rates in the United States if the FRB adopts an exit strategy of the quantitative easing monetary policy to raise the FF rate. For example, according to the estimated value of one standard deviation summarized in Tables 9 and 10, interest rate in Korea will increase by 0.741%points over the full sample periods and by 0.606%points over the sub-sample period after the FRB raises the FF rate by 2%points for ten days. It is expected that interest rate in Hong Kong, Singapore, and Thailand will increase by 4.074%points, 1.111%points, and 0.593%points over the full sample periods after the FRB raises its FF rate for ten days. With respect to sub-sample periods, interest rate in Hong Kong, Singapore, and Thailand will increase 4.061%points, 1.152%points, and 0.485%points, respectively.

On one hand, the Bank of Japan seems to keep its quantitative and qualitative easing monetary policy for the time being in order to accomplish 2% of inflation target, while at the same time central banks of East Asian countries except for Japan would follow the increase in interest rates in the United States. Given the different timing of exit strategy of quantitative easing monetary policy between the FRB and the Bank of Japan, the interest differential will widen. It would stimulate carry trades which borrow the Japanese yen fund with lower interest rate to invest in other East Asian countries with higher interest rates. As a result, the other East Asian currencies would appreciate against the Japanese yen. For example, according the estimation results in Tables 5 and 6, the Korean won would appreciate by 3.925%points, the Hong Kong dollar appreciate by1.185%points, the Singapore dollar appreciate by 0.889%points, the Thai baht appreciate by 2.444%points, the Indonesian rupiah appreciate by 4.815%pionts, and the Vietnamese dong appreciate by 1.407%points over the full sample periods after the FRB would increase its FF rate to 2%. By focusing on the sub-sample periods, the Korean won, the Hong Kong dollar, the Singapore dollar, the Thai baht, the Indonesian rupiah, and the Vietnamese dong would appreciate by 4.182%points, 0.788%points, 0.970%points, 2.788%points, 4.970%pionts, and 1.212%points in terms of the AMU Deviation Indicator within ten days, respectively.

Lastly, it is expected that the exit policy of the quantitative easing monetary policy by the FRB would increase interest rates in the United States relative to interest rates in East Asian countries. For the reasons, most of East Asian countries would face sudden stop of capital inflows and/or reversal of capital flows and moreover capital outflows. For example, it is expected that the change in interest differentials would make the Korean economy face capital outflows in portfolio and other investments by

58.023% and 15.658% after eight quarters[7]. Or it is expected that the change in expected return differentials would make the Korean economy face capital outflows in portfolio and other investments by 54.090% and 14.358%, respectively.

Thus, it is expected that the East Asian countries would be given an upward pressure on interest rates and, at the same time, capital outflow and depreciation of their home currencies when the FRB adopted the exit strategy of quantitative easing monetary policy to raise interest rates in the United States. These findings are consistent with the common saying that "when the United States sneezes, emerging countries catch a cold."

5. Conclusion

The global financial crisis gave severe damages to not only the US economy but also the European economy. The related worldwide recession had adverse effects on East Asian economy by reducing its export to the United States and Europe. At the same time, the global financial crisis made a large change in capital flows around the world to have indirect effects on fluctuations of East Asian currencies. The effect appeared to be increasing volatility of exchange rates of East Asian currencies and widening misalignments of intra-regional exchange rates among them.

This paper empirically analyzed the phenomenon in the past to investigate how the exit strategy of quantitative easing monetary policy by the FRB or FRB's raising interest rates affects interest rates, exchange rates, and capital flows of East Asian countries. The empirical results suggest that if the FRB adopts the exit strategy to raise interest rates, it would give an upward pressure to interest rates in East Asia. Moreover, East Asian countries would face sudden stop of capital inflows and capital outflows to depreciate East Asian currencies.

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[7] If the FRB increases the FF rate from 0% to 2%, Korea would experience an enormous capital outflows of which are accumulated over eight quarters. That is, the amount of capital outflows would be 58.023% and 15.658% in portfolio and other investments after increasing the FF rate for two years.

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Figure 1: Accumulation of MBS and Long-term Treasury Securities Purchased by the FRB
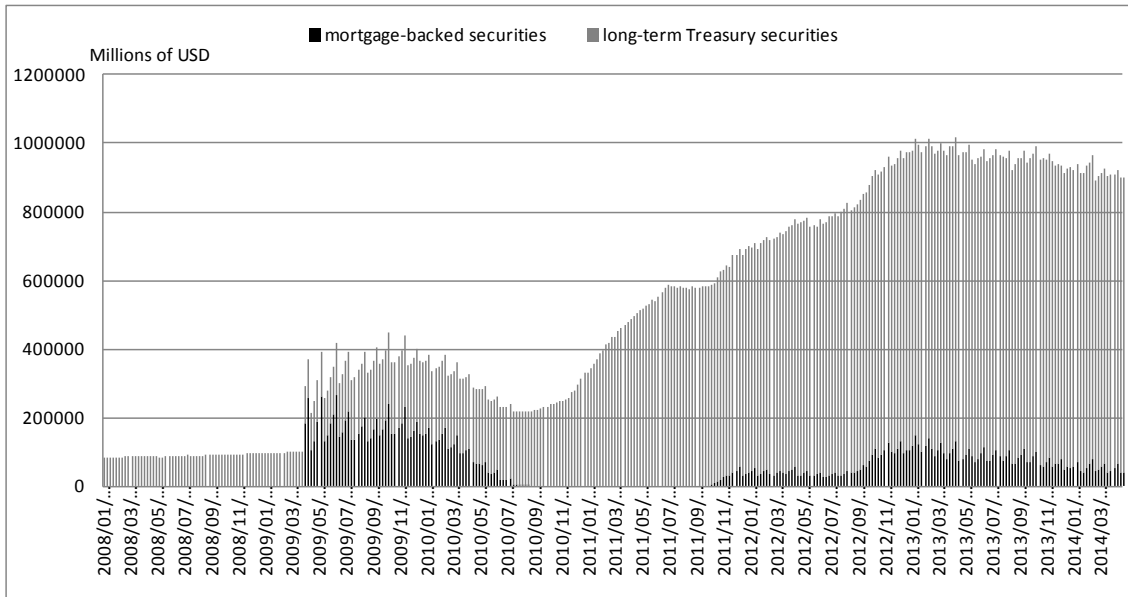
Data: FRB

Figure 2: Japanese Yen, US Dollar, and Euro Interest Rates
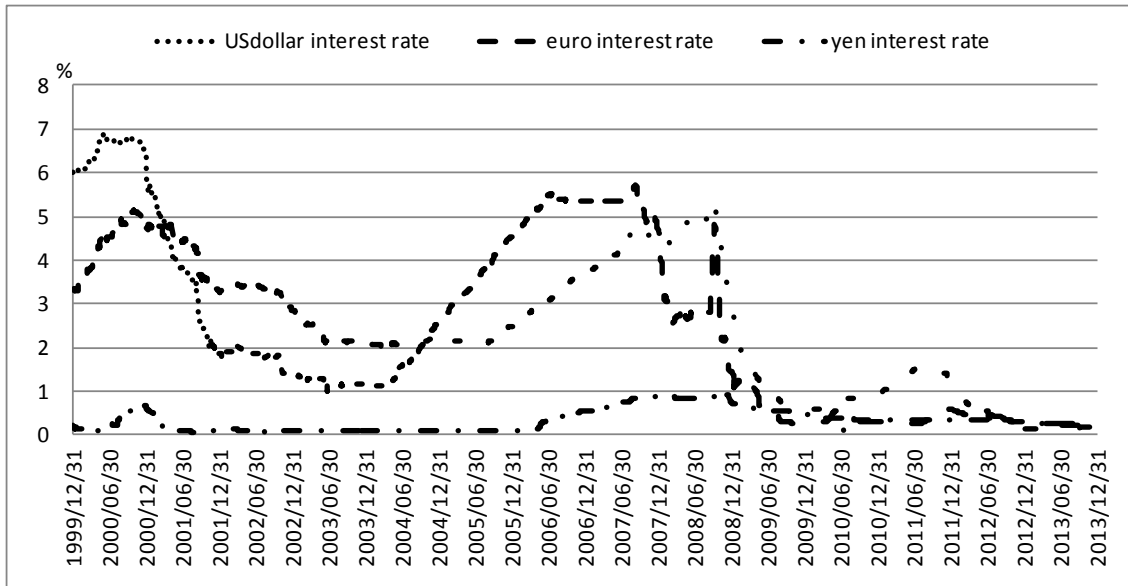
Data: Datastream

Figure 3(1): Asset and Liability Balance of Japan

Millions of USD
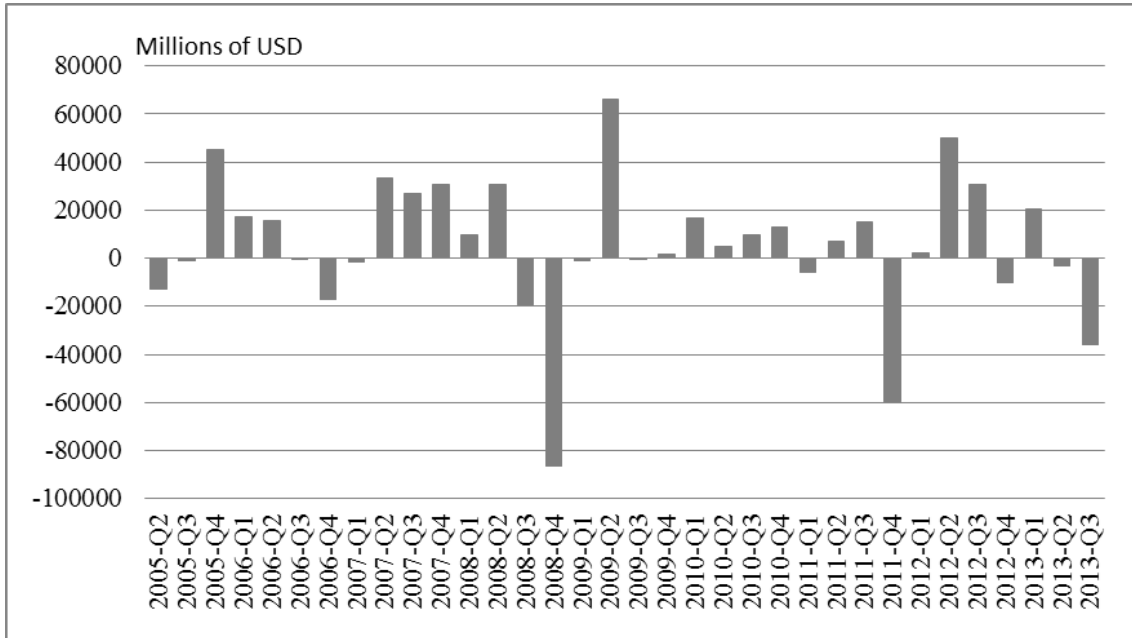
Data: BIS

Figure 3(2): Asset and Liability Balance of Korea

Millions of USD
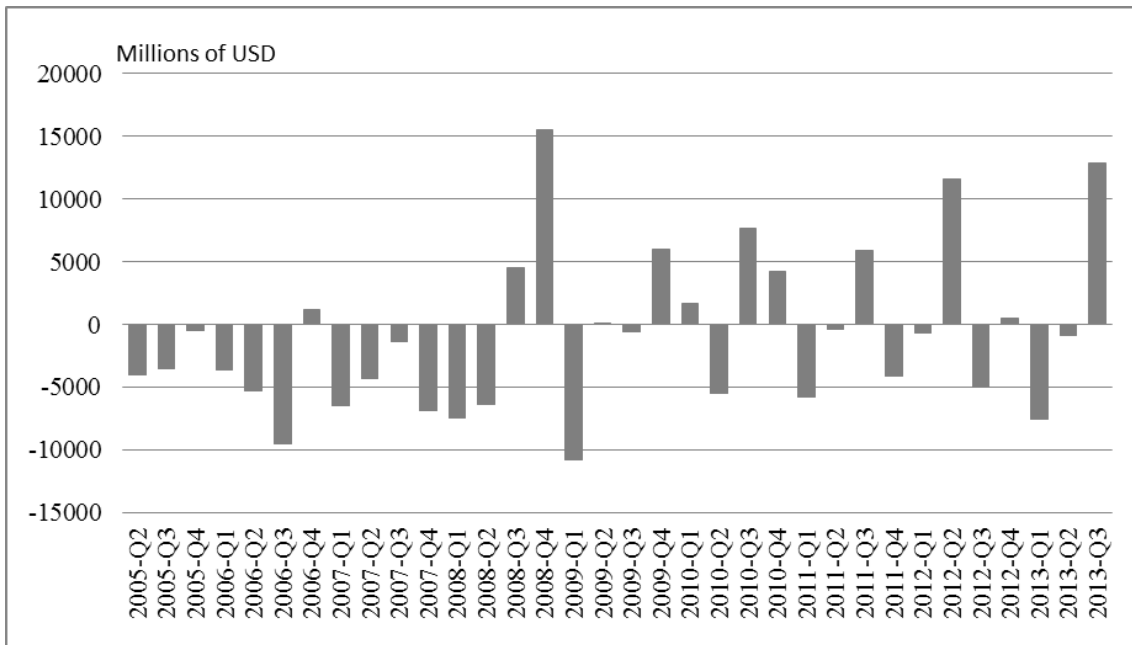
Data: BIS

Figure 4(1): Nominal AMU Deviation Indicators

Data: RIETI (http://www.rieti.go.jp/users/amu/index.html)
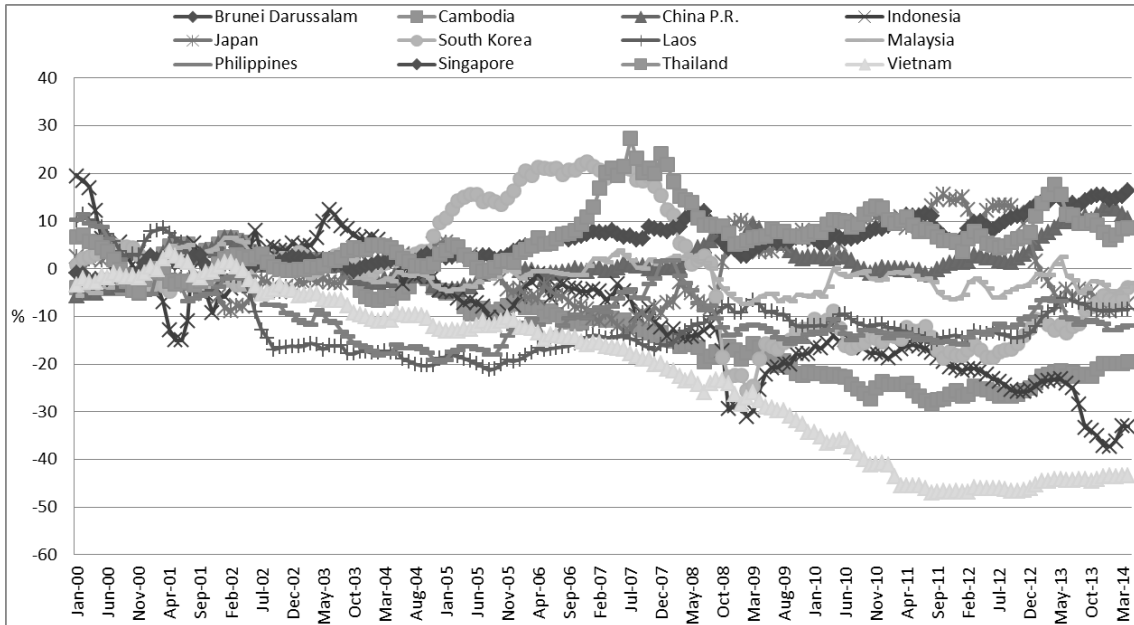
Figure 4(2): Real AMU Deviation Indicators

Data: RIETI (http://www.rieti.go.jp/users/amu/index.html)
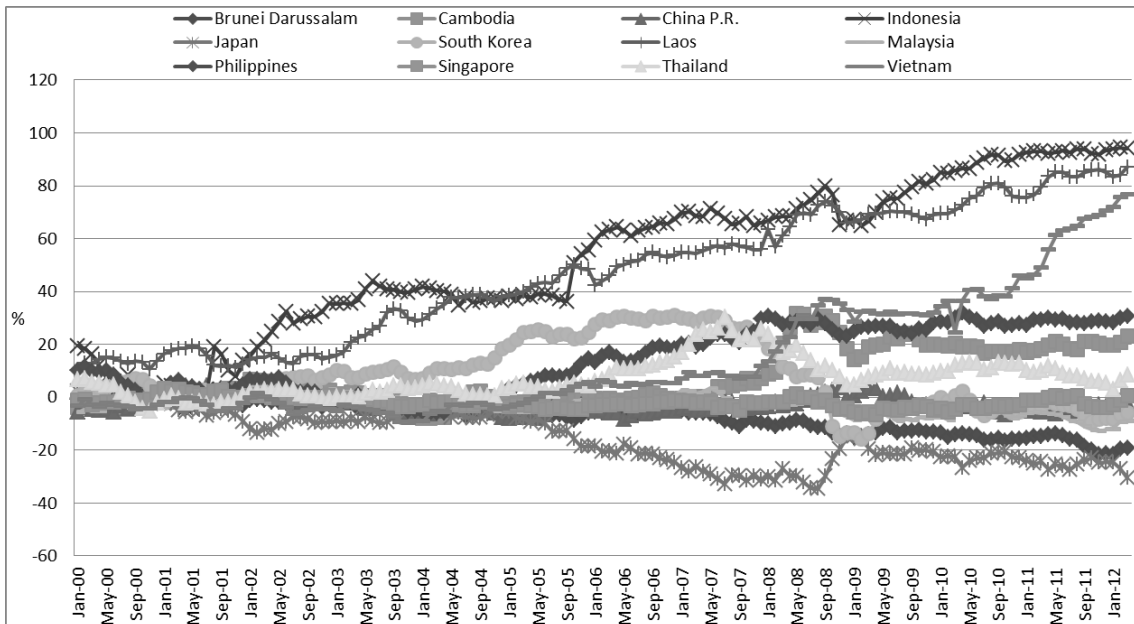
Figure 5: Interest Rate Differential between US and East Asian Country
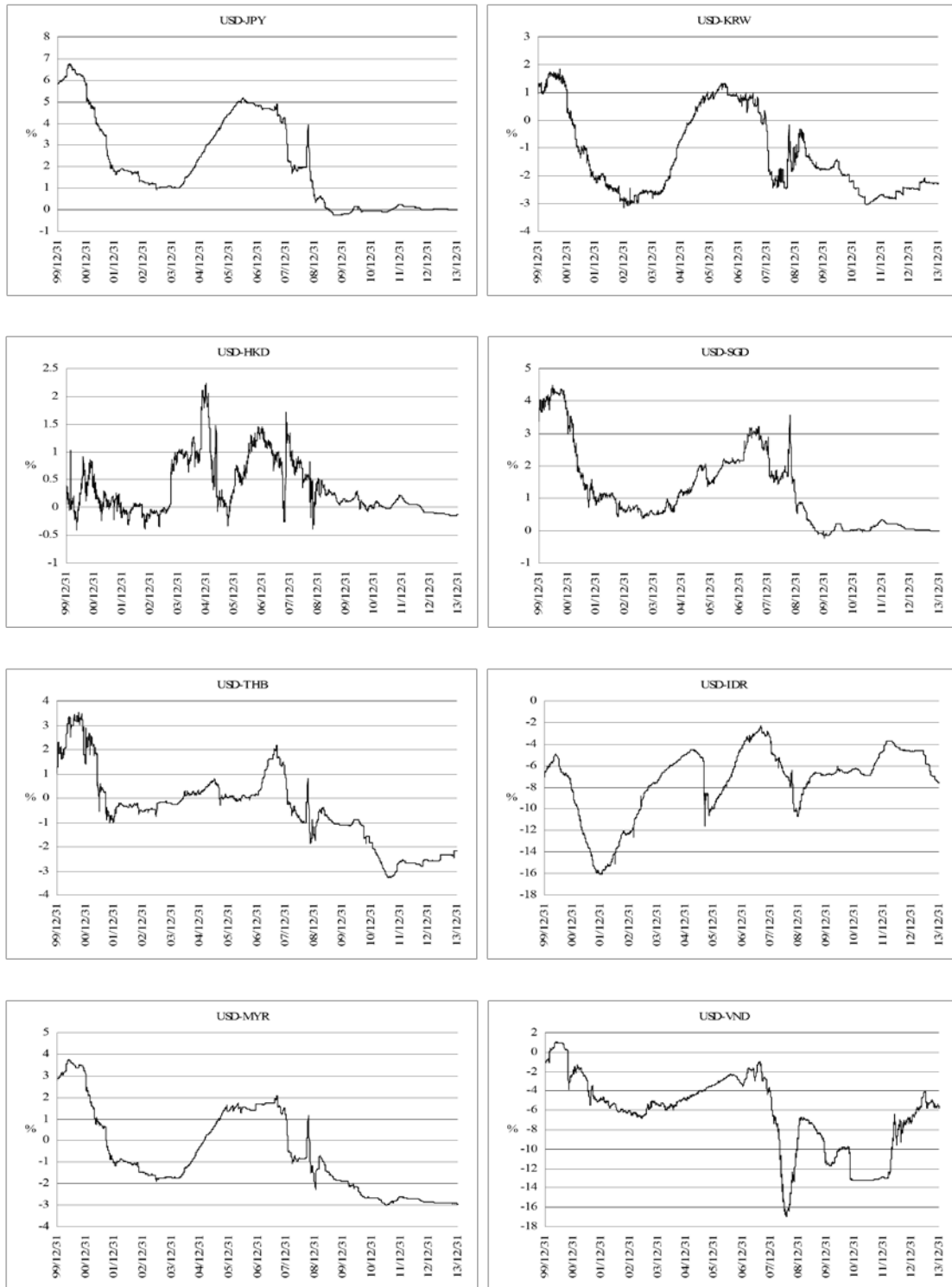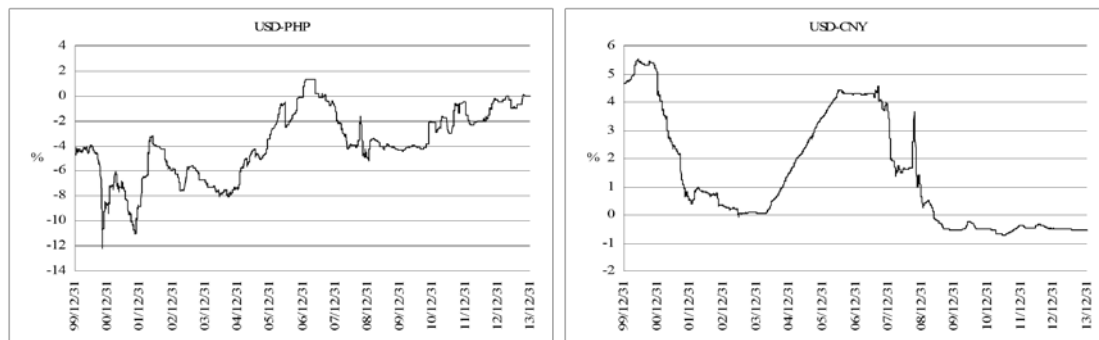
Note:

Inter-bank interest rate (3 months): Japan, Hong Kong, Singapore, Thailand, Indonesia, Malaysia, Vietnam, the United States, and the euro zone, uncollateralized overnight call rate: Korea and China, interest rate of Treasury Bills (364 days): the Philippines.

Data: Datastream

Figure 6: Interest Rate Differential between Euro Zone and East Asian Country
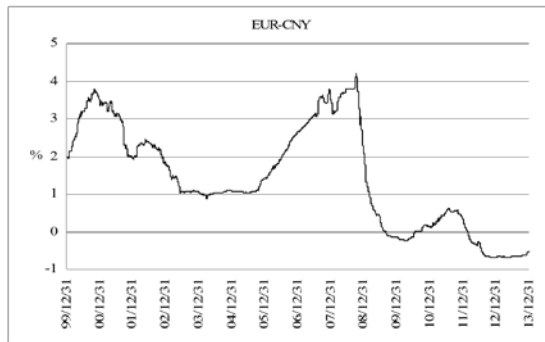
Note:

Inter-bank interest rate (3 months): Japan, Hong Kong, Singapore, Thailand, Indonesia, Malaysia, Vietnam, the United States, and the euro zone, uncollateralized overnight call rate: Korea and China, interest rate of Treasury Bills (364 days): the Philippines.

Data: Datastream

Table 1: Relationship between Interest Rates in the United States, the Euro Zone and East Asian Countries (full sample)

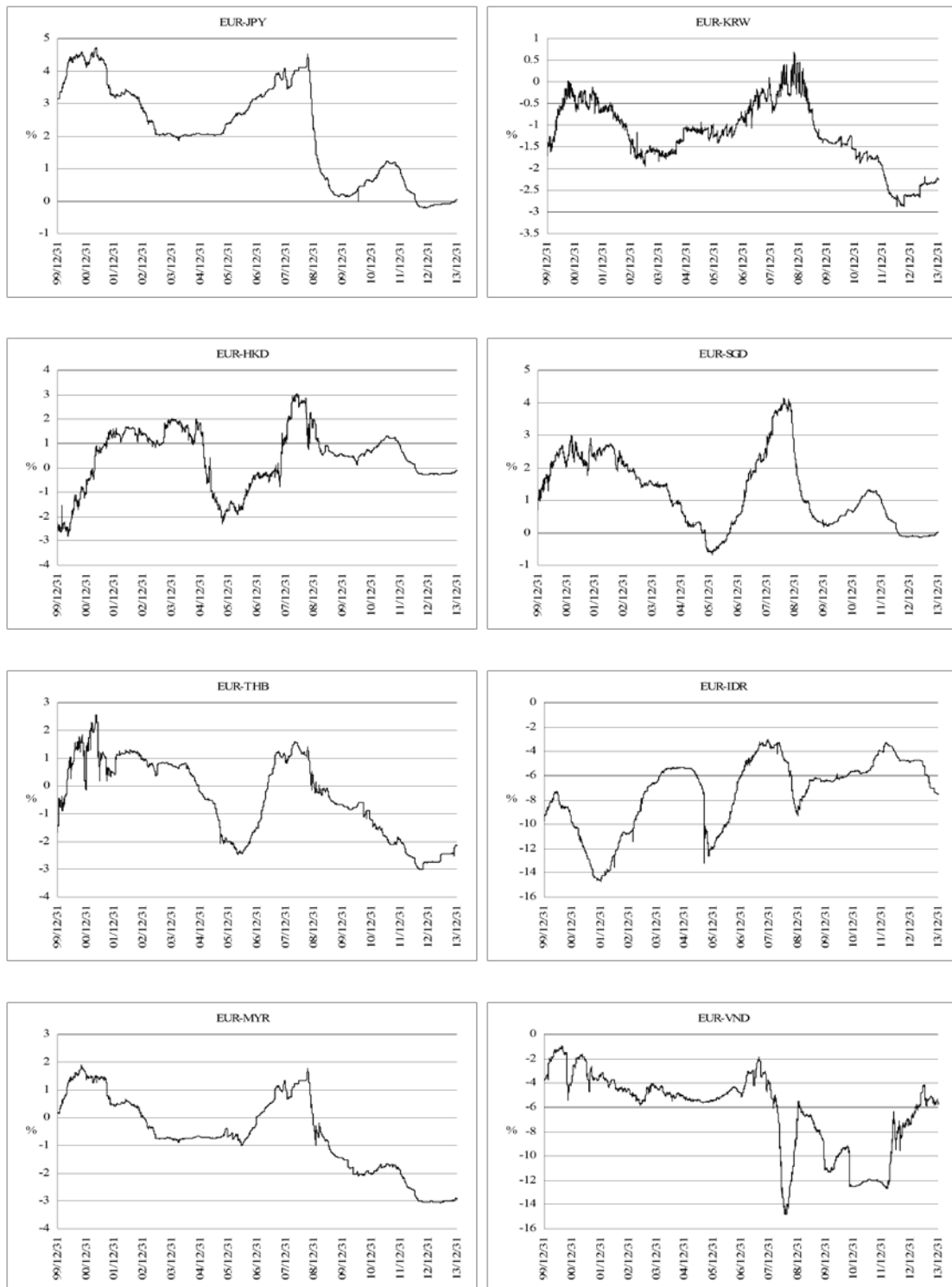|		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest rate in US B: interest rate in euro zone C: interest rate in East Asian country	A→C(+) accumulated response	○ 0.002***	○ 0.010***	○ 0.055***	○ 0.015***	○ 0.008***	x −	x −	○ 0.028***	△ 0.008	x −	N/A
		B→C(+) accumulated response	○ 0.002***	○ 0.014***	○ 0.032***	○ 0.010***	○ 0.011***	△ 0.004	○ 0.006***	○ 0.039***	○ 0.017***	○ 0.001***	
2	A: a weighted average of interest rate in US and euro zone B: a weighted average of interest rate of East Asian countries	A→B(+) accumulated response	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	○ 0.006***
3	A: a weighted average of interest rates in US and euro zone B : interest rate in East Asian country	A→B(+) accumulated response	○ 0.002***	○ 0.013***	○ 0.056***	○ 0.016***	○ 0.009***	x −	○ 0.002*	○ 0.034***	△ 0.011	x −	N/A

analytical period: January 1, 2000 to December 31, 2013, data: Datastream

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

△: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

–: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

***, **, and * represent a statistically at a significant level of 1%, 5%, and 10%, respectively.

Table 2: Relationship between Interest Rates in the United States, the Euro Zone and East Asian Countries (sub-sample)

		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest rate in US B: interest rate in euro zone C: interest rate in East Asian country	A→C(+) accumulated response	○ 0.002***	○ 0.010***	○ 0.067***	○ 0.019***	○ 0.008**	x —	Δ 0.001	○ 0.029***	Δ 0.008	x —	N/A
		B→C(+) accumulated response	○ 0.001**	○ 0.015***	○ 0.041***	○ 0.013***	○ 0.010***	x —	○ 0.003***	○ 0.041***	○ 0.019*	○ 0.001**	
2	A: a weighted average of interest rate in US and euro zone B: a weighted average of interest rate of East Asian countries	A→B(+) accumulated response	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	○ 0.007***
3	A: a weighted average of interest rates in US and euro zone B : interest rate in East Asian country	A→B(+) accumulated response	○ 0.002***	○ 0.013***	○ 0.069***	○ 0.019***	○ 0.010**	x —	○ 0.001*	○ 0.036***	Δ 0.011	x —	N/A

analytical period: January 1, 2000 to December 15, 2008, data: Datastream

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

Δ: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

—: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

***, **, and * represent a statistically at a significant level of 1%, 5%, and 10%, respectively.

Table 3: Relationship between Interest Differentials between the United States/the Euro Zone and East Asian Countries and Exchange Rates of East Asian Countries (full sample)

		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest differential between US and East Asian country B: N.C./US$	A→B(+) accumulated response	○ 0.001***	○ -0.001**	○ 0.000	○ 0.000	○ 0.000	x —	Δ 0.000	x —	x —	○ 0.000	N/A
2	A: interest differential between euro zone and East Asian country B: N.C./euro	A→B(+) accumulated response	x —	○ 0.000	Δ 0.000	Δ 0.000	Δ 0.000	x —	x —	x —	x —	x —	N/A
3	A: differential between a weighted average of interest rates of US and euro zone and a weighted average of interest rates in East Asian countries B: US$+euro/AMU	A→B(-) accumulated response	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Δ 0.000

#	A / B	Direction / response											
4	A: differential between a weighted average of interest rates of US and euro zone and a weighted average of interest rates in East Asian countries B: AMU DI	A→B(-) accumulated response	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Δ 0.000
5	A: differential between a weighted average of interest rates of US and euro zone and interest rates in East Asian countries B: N.C./AMU	A→B(+) accumulated response	○ 0.001***	○ -0.001***	○ 0.000	x —	Δ 0.000	x —	x —	Δ 0.000	x —	x —	
6	A: differential between a weighted average of interest rates of US and euro zone and interest rates in East Asian countries B: AMU DI	A→B(-) accumulated response	○ -0.056***	○ 0.063***	○ -0.030***	x —	Δ -0.008	x —	x —	x —	x —	x —	N/A

analytical period: January 1, 2000 to December 31, 2013, data: Datastream and RIETI

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

△: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

—: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

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Table 4: Relationship between Interest Differentials between the United States/the Euro Zone and East Asian Countries and Exchange Rates of East Asian Countries (sub-sample)

		expected relation	Japan	Korea	Hong Kong	Singa pore	Thaila nd	Indonesi a	Malays ia	Vietna m	Philipp ines	China	East Asia
1	A: interest differential between US and East Asian country B: N.C./US$	A→B(+) accumulated response	○ 0.001***	○ -0.001***	○ 0.000	○ 0.000	○ 0.000	x —	○ 0.000	x —	x —	○ 0.000	N/A
2	A: interest differential between euro zone and East Asian country B: N.C./euro	A→B(+) accumulated response	x —	x —	△ 0.000	△ 0.000	△ 0.000	x —	x —	x —	x —	x —	N/A
3	A: differential between a weighted average of interest rates of US and euro zone and a weighted average of interest rates in East Asian countries B: US$+euro/AMU	A→B(-) accumulated response	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	x —

#	A/B	Response											
4	A: differential between a weighted average of interest rates of US and euro zone and a weighted average of interest rates in East Asian countries B: AMU DI	A→B(-) accumulated response	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	○ 0.000
5	A: differential between a weighted average of interest rates of US and euro zone and interest rates in East Asian countries B: N.C./AMU	A→B(+) accumulated response	○ 0.001***	x —	○ 0.000	x —	Δ 0.000	x —	x —	x —	x —	x —	N/A
6	A: differential between a weighted average of interest rates of US and euro zone and interest rates in East Asian countries B: AMU DI	A→B(-) accumulated response	○ -0.065***	x —	○ -0.039***	x —	Δ -0.009	x —	x —	x —	x —	x —	N/A

analytical period: January 1, 2000 to December 15, 2008, data: Datastream and RIETI

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

∆: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

–: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

***, **, and * represent a statistically at a significant level of 1%, 5%, and 10%, respectively.

Table 5: Relationship between Interest Differentials and Exchange Rates (full sample)

		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest differential between US and Japan B : N.C./AMU	A→B(-) accumulated response	N/A	○ -0.001**	○ 0.000	Δ 0.000	Δ 0.000	○ -0.001***	Δ 0.000	○ 0.000	Δ 0.000	○ 0.000	N/A
2	A: interest differential between US and Japan B: AMU DI	A→B(+) accumulated response	N/A	○ 0.053**	○ 0.016	Δ 0.012	Δ 0.033*	○ 0.065**	Δ 0.001	○ 0.019*	Δ 0.014	○ 0.014	N/A
3	A: interest differential between euro zone and Japan B : N.C./AMU	A→B(-) accumulated response	N/A	x —	Δ 0.000	Δ 0.000	x —	○ -0.001*	Δ 0.000	Δ 0.000	Δ 0.000	Δ 0.000	N/A
4	A: interest differential between euro zone and Japan B: AMU DI	A→B(+) accumulated response	N/A	x —	Δ 0.013	Δ 0.014	x —	○ 0.046*	Δ 0.016	Δ 0.014	Δ -0.009	○ 0.021*	N/A
5	A: interest differential between US and euro zone B : N.C./AMU	A→B(+) accumulated response	Δ 0.000	○ -0.001***	x —	x —	x —	x —	Δ 0.000	x —	x —	x —	N/A

| 6 | A: interest differential between US and euro zone B: AMU DI | A→B(-) accumulated response | ○ -0.044** | ○ 0.058** | x — | x — | x — | x — | Δ -0.008 | x — | x — | x — | N/A |

analytical period: January 1, 2000 to December 31, 2013, data: Datastream and RIETI

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

Δ: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

–: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

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Table 6: Relationship between Interest Differentials and Exchange Rates (sub-sample)

		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest differential between US and Japan B : N.C./AMU	A→B(-) accumulated response	N/A	○ -0.001**	○ 0.000	○ 0.000	△ 0.000	○ -0.001**	△ 0.000	○ 0.000	△ 0.000	○ 0.000	N/A
2	A: interest differential between US and Japan B: AMU DI	A→B(+) accumulated response	N/A	○ 0.069**	○ 0.013	○ 0.016	○ 0.046*	○ 0.082**	△ 0.007	○ 0.020	△ 0.017	○ 0.008	N/A
3	A: interest differential between euro zone and Japan B : N.C./AMU	A→B(-) accumulated response	N/A	x —	△ 0.000	x —	x —	△ -0.001	△ 0.000	△ 0.000	x —	△ 0.000	N/A
4	A: interest differential between euro zone and Japan B: AMU DI	A→B(+) accumulated response	N/A	x —	△ 0.016	x —	x —	△ 0.055	△ 0.019	△ 0.021	x —	△ 0.023	N/A
5	A: interest differential between US and euro zone B : N.C./AMU	A→B(+) accumulated response	○ 0.001**	○ -0.001***	x —	x —	x —	x —	x —	x —	x —	x —	N/A

| 6 | A: interest differential between US and euro zone B: AMU DI | A→B(-) accumulated response | ○ -0.052** | ○ 0.075*** | x — | x — | x — | x — | x — | x — | x — | x — | N/A |

analytical period: January 1, 2000 to December 15, 2008, data: Datastream and RIETI

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

△: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

–: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

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Table 7: Relationship between Interest Differentials/Expected Return Differentials and Capital Flows (full sample)

		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest differential B: portfolio investment	A→B(+) accumulated response	x –	Δ 7.630	Δ 1.229	Δ -3.197	Δ 0.529	Δ 1.564	Δ 4.153	N/A	Δ -2.197	N/A	N/A
2	A: interest differential B: other investment	A→B(+) accumulated response	x –	Δ 2.059	Δ 0.077	Δ 0.068	x –	Δ -0.295	x –	Δ 0.891	Δ 1.021	N/A	N/A
3	A: expected return differential B: portfolio investment	A→B(+) accumulated response	x –	Δ 7.248	Δ 1.230	Δ -3.179	Δ 0.516	Δ 1.411	Δ 4.121	N/A	Δ -2.244	N/A	N/A
4	A: expected return differential B: other investment	A→B(+) accumulated response	x –	Δ 1.924	Δ 0.076	Δ -0.009	x –	Δ -0.331	x –	Δ 0.899	Δ 1.035	N/A	N/A

analytical period: January 2000 to the December 2013 for Japan and Korea, Q1:2000 to Q2:2013 for Hong Kong, Singapore, Thailand, and the Philippines, Q1:2000 to Q4: 2012 for Indonesia, Q1:2000 to Q3: 2012 for Malaysia and Vietnam, data: Datastream, Balance of Payments Statistics (IMF), Bank of Japan, and Bank of Korea

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

Δ: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

–: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

***, **, and * represent a statistically at a significant level of 1%, 5%, and 10%, respectively.

Table 8: Relationship between Interest Differentials/Expected Return Differentials and Capital Flows (sub-sample)

		expected relation	Japan	Korea	Hong Kong	Singapore	Thailand	Indonesia	Malaysia	Vietnam	Philippines	China	East Asia
1	A: interest differential B: portfolio investment	A→B(+) accumulated response	x —	Δ 6.554	Δ 2.752	x —	Δ 0.825	Δ 5.243	Δ 1.459	N/A	Δ -3.751	N/A	N/A
2	A: interest differential B: other investment	A→B(+) accumulated response	x —	Δ 1.594	Δ -2.337	Δ -0.153	Δ 1.106	Δ 0.571	x —	Δ 9.968	Δ 2.600	N/A	N/A
3	A: expected return differential B: portfolio investment	A→B(+) accumulated response	x —	Δ 6.078	Δ 2.757	x —	Δ 0.718	Δ 5.299	Δ 1.297	N/A	Δ -3.805	N/A	N/A
4	A: expected return differential B: other investment	A→B(+) accumulated response	x —	Δ 1.665	Δ -2.332	Δ -0.122	Δ 1.082	Δ 0.610	x —	Δ 9.877	Δ 2.634	N/A	N/A

analytical period: January 2000 to the December 2008 for Japan and Korea, Q1:2000 to Q4:2008 for Hong Kong, Singapore, Thailand, Indonesia, Malaysia, Vietnam and the Philippines, data: Datastream, Balance of Payments Statistics (IMF), Bank of Japan, and Bank of Korea

○: statistically significant and expected sign (95% confidence interval; including time lag in response)

∆: statistically insignificant but expected sign (95% confidence interval)

x: not expected sign

–: accumulated impulse response is insignificant (95% confidence interval)

N/A: no data or not analyzed due to a few number of data

***, **, and * represent a statistically at a significant level of 1%, 5%, and 10%, respectively.

Table 9: One Standard Deviation of Estimated Values (%point) (full sample)

US interest rate (daily)	Interest differential between US and Japan (daily)	Interest differential between US and Korea (daily)	Interest differential between US and Hong Kong (daily)	Interest differential between US and Singapore (daily)	Interest differential between US and Thailand (daily)	Interest differential between US and Indonesia (daily)	Interest differential between US and Malaysia (daily)	Interest differential between US and Vietnam (daily)	Interest differential between US and Philippines (daily)
0.027	0.027	0.059	0.054	0.041	0.071	0.095	0.035	0.111	0.150
Interest differential between US and China (daily)	Interest differential between US and Japan (monthly)	Interest differential between US and Korea (monthly)	Interest differential between US and Hong Kong (quarterly)	Interest differential between US and Singapore (quarterly)	Interest differential between US and Thailand (quarterly)	Interest differential between US and Indonesia (quarterly)	Interest differential between US and Malaysia (quarterly)	Interest differential between US and Vietnam (quarterly)	Interest differential between US and Philippines (quarterly)
0.029	0.261	0.263	0.430	0.450	0.611	1.346	0.639	1.860	1.417
Expected return differential between US and Japan (monthly)	Expected return differential between US and Korea (monthly)	Expected return differential between US and Hong Kong (quarterly)	Expected return differential between US and Singapore (quarterly)	Expected return differential between US and Thailand (quarterly)	Expected return differential between US and Indonesia (quarterly)	Expected return differential between US and Malaysia (quarterly)	Expected return differential between US and Vietnam (quarterly)	Expected return differential between US and Philippines (quarterly)	
0.257	0.268	0.431	0.442	0.603	1.359	0.626	1.862	1.425	

Data: Datastream, Bank of Japan, and Bank of Korea

Table 10: One Standard Deviation of Estimated Values (%point) (sub-sample)

US interest rate (daily)	Interest differential between US and Japan (daily)	Interest differential between US and Korea (daily)	Interest differential between US and Hong Kong (daily)	Interest differential between US and Singapore (daily)	Interest differential between US and Thailand (daily)	Interest differential between US and Indonesia (daily)	Interest differential between US and Malaysia (daily)	Interest differential between US and Vietnam (daily)	Interest differential between US and Philippines (daily)
0.033	0.033	0.066	0.067	0.051	0.085	0.113	0.037	0.103	0.171
Interest differential between US and China (daily)	Interest differential between US and Japan (monthly)	Interest differential between US and Korea (monthly)	Interest differential between US and Hong Kong (quarterly)	Interest differential between US and Singapore (quarterly)	Interest differential between US and Thailand (quarterly)	Interest differential between US and Indonesia (quarterly)	Interest differential between US and Malaysia (quarterly)	Interest differential between US and Vietnam (quarterly)	Interest differential between US and Philippines (quarterly)
0.035	0.316	0.303	0.530	0.453	0.652	1.386	0.613	1.778	1.553
Expected return differential between US and Japan (monthly)	Expected return differential between US and Korea (monthly)	Expected return differential between US and Hong Kong (quarterly)	Expected return differential between US and Singapore (quarterly)	Expected return differential between US and Thailand (quarterly)	Expected return differential between US and Indonesia (quarterly)	Expected return differential between US and Malaysia (quarterly)	Expected return differential between US and Vietnam (quarterly)	Expected return differential between US and Philippines (quarterly)	
0.311	0.310	0.531	0.450	0.645	1.407	0.606	1.789	1.565	

Data: Datastream, Bank of Japan, and Bank of Korea