Widening Deviation among East Asian Currencies

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Abstract

This paper investigates recent diverging trends among East Asian currencies as well as recent movements of the weighted average value of East Asian currencies (Asian Monetary Unit: AMU) and deviations (AMU Deviation Indicators) of the East Asian currencies from the average values. Our empirical analysis shows that linkages with the US dollar have been weakening since 2001 or 2002 for some of the East Asian countries. On the other hand, the monetary authority of China continues stabilizing the exchange rate of the Chinese yuan against the US dollar even though it announced its adoption of a currency basket system. It is found that the weighted average of East Asian currencies has been appreciating against the US dollar in recent years while depreciating against the currency basket of the US dollar and the euro. Also, deviations among the East Asian currencies have been widening in recent years, reflecting the fact that these countries' monetary authorities are adopting a variety of exchange rate systems. In other words, a coordination failure in adopting exchange rate systems among these monetary authorities increases volatility and misalignment of intra-regional exchange rates in East Asia.

JEL: F31, F33

Introduction

The monetary authorities of East Asian countries have learnt a lesson that it is inadequate for a country with close economic relationships, not only with the United States but also other countries, to adopt either an official or *de facto* dollar-peg system following the experience of the Asian currency crisis in 1997. Countries changed to more flexible exchange rate systems, including free-floating and managed floating systems. Moreover, the Chinese government announced on July 21, 2005 that it would change from the dollar-peg system to a managed floating exchange rate system that references a currency basket. East Asia seems to also be trending toward more flexible exchange rate systems. These trends would contribute to solving a coordination failure in choosing exchange rate systems in East Asian countries, as shown in Ogawa and Ito (2002) if these countries are actually adopting a similar type of exchange rate system.

This paper's objective is to investigate actual exchange rate systems and exchange rate policy conducted by the monetary authorities of East Asian countries. For this purpose, the methodology of Frankel and Wei (1994) is used to estimate linkages of each East Asian currency with three major currencies: the US dollar, the euro, and the Japanese yen. Also, this paper investigates recent movements of the average value of East Asian currencies and deviations among these currencies in order to uncover if the intra-regional exchange rates are stabilizing under the current exchange rate system trends in East Asia. If the monetary authorities of East Asian countries continue adopting a variety of exchange rate systems, they may face coordination failure in exchange rate systems, as pointed out in Ogawa and Ito (2002). This situation will likely increase volatility and misalignment of the intra-regional exchange rates in East Asia.

In the next section, we use the methodology of Frankel and Wei (1994) to investigate actual exchange rate systems and policies conducted by the monetary authorities of East Asian countries. We obtain current trends, which show that some countries are shifting to more flexible exchange rate system with reference to a currency basket while China continues to value the Chinese yuan in terms of the US dollar. In the third section, we use the AMU and AMU Deviation Indicators in order to investigate movements of the average value of East Asian currencies and deviations among them in recent years. The average value is found to be appreciating against the US dollar while depreciating against the currency basket of the US dollar and the euro. Also, a weighted average of the AMU Deviation Indicator is calculated in order to statistically investigate recent deviation developments among East Asian currencies. Deviations are found to have been widening in recent years. The third section of the paper points out coordination failure in exchange rate systems in East Asia and suggests that East Asian monetary authorities should seek coordination in exchange rate policies. Specifically, all the ASEAN+3 member countries' monetary authorities should agree on an arrangement to create a common unit of account that consists of a basket of regional currencies for coordinated exchange rate policy. In the conclusion, we point out that the widening deviations

among the East Asian currencies reflect that East Asian monetary authorities are adopting a variety of exchange rate systems. Moreover, the coordination failure increases volatility and misalignment of intra-regional exchange rates in East Asia.

1. Linkages of East Asian currencies with three main currencies

At first, we look at the International Monetary Fund (IMF) classification for exchange rate systems in East Asian countries, because movements in rates depend on the type of exchange rate system adopted by monetary authorities. According to the IMF's classification, Japan, South Korea, and the Philippines use a floating exchange rate system. Indonesia, Singapore, Thailand, Cambodia, Myanmar, Laos, and Vietnam use a managed floating exchange rate system. China and Malaysia adopted a fixed exchange rate system under which the monetary authorities peg the home currencies to the US dollar. The Chinese government announced on July 21, 2005 that its exchange rate system would change to a managed floating exchange rate system with reference to a currency basket. Immediately after the announcement, the monetary authority of Malaysia followed the Chinese government. Hong Kong and Brunei use a currency board system. Hong Kong pegs its home currency to the US dollar while Brunei pegs to the Singapore dollar. The monetary authority of Brunei has to conduct the same exchange rate policy with the Monetary Authority of Singapore under the currency board. Thus, we can classify East Asian countries' exchange rate systems into three groups; floating, managed floating, and fixed (dollar-pegging). The adopted exchange rate system may determine degree of linkage of each of the currencies with the US dollar.

Next, an empirical analysis is conducted to investigate what linkage trends each East Asian currency actually has with three major currencies: the US dollar, the euro, and the Japanese yen. For this purpose, the empirical analytical method of Frankel and Wei (1994) is used to analyze these linkages for each year during an entire sample period from 1999 to 2006.[1] The ASEAN10 countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam), China, and South Korea are covered, although the sample periods for Cambodia, Laos, and Myanmar cover only from 2003 to 2006 due to data constraints.

Frankel and Wei (1994) assume the Swiss franc as a numeraire in the denomination of exchange rates. Daily data of exchange rates are used to conduct regression of log differences of a local currency (in terms of the Swiss franc) on log differences of the three major currencies (in terms of the Swiss franc) for each year of the sample period from 1999 to 2006. The regression for each year shows trend linkages of each East Asian currency with the three major currencies during the period.[2]

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[1] Kawai and Akiyama (1998, 2000) conducted a method to investigate exchange rate policies of East Asian countries.
[2] McKinnon (2001) and Ogawa (2002, 2004) conducted a similar method to investigate the dynamics of the coefficients. Ogawa and Sakane (2006) used the Kalman filter method to investigate

The regression equation is as follows:

$$\Delta \log e^{home/SFR} = a_0 + a_1 \Delta \log e^{USD/SFR} + a_2 \Delta \log e^{JPY/SFR} + a_3 \Delta \log e^{euro/SFR} + \varepsilon_t \qquad (1)$$

where $e^{home/SFR}$: exchange rate of a home currency in terms of the Swiss franc, $e^{USD/SFR}$: exchange rate of the US dollar in terms of the Swiss franc, $e^{JPY/SFR}$: exchange rate of the Japanese yen in terms of the Swiss franc, $e^{euro/SFR}$: exchange rate of the euro in terms of the Swiss franc.

Table 1 shows results of the regression for each of the East Asian currencies.

(1) Brunei dollar

The monetary authority of Brunei has a currency board backed by the Singapore dollar. Accordingly, the Brunei dollar should have the same movements as the Singapore dollar. Linkages of the Brunei dollar with the three major currencies show almost the same trend as with the Singapore dollar. Linkage with the US dollar peaked in 2000 during the analyzed periods (0.8335). The linkage has been decreasing since 2001 and reached its lowest level (0.5742) in 2005. On one hand, the linkage of the Brunei dollar with the euro was not statistically significant from 2000 to 2002. After 2003, this linkage increased to a significantly higher level (0.2768). The linkages with the yen increased from 1999 to 2006, reaching its highest level (0.2418) in 2005.

(2) Cambodian riel

The Cambodian riel was fixed to the US dollar for nearly the entire analyzed period from 2003 to 2006 while data constraints due to the blank years from 1999 to 2002 prevented us from conducting empirical analysis. Linkage with the US dollar remained at levels between 0.9191 and 0.9864. Coefficients on the euro and the yen were statistically significant in a couple of years.

(3) Chinese yuan

On July 21, 2005, the Chinese government announced it would change the Chinese exchange rate system from a dollar-peg system to a managed floating system with reference to a currency basket. Linkage of the Chinese yuan with the US dollar was completely perfect before the announcement, as shown by the coefficients on the US dollar of 1.000 from 1999 to 2004. The linkage with the US dollar decreased to a level of 0.9399 in 2005 which includes a period after the reform announcement. It is statistically significant that the monetary authority of China abandoned the dollar-peg system because the standard deviation of the estimate (0.9399) was 0.0169 in 2005. However, the coefficient was much higher than China's trade shares (about 15%) with the US in

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these dynamics for the Chinese yuan.

recent years. [3] Moreover, the linkage with the US dollar increased again to a level of 0.9797. The linkage of the Chinese yuan with the euro was statistically insignificant despite the Chinese government's announcement of the exchange rate system reform.

(4) Indonesian rupiah

Linkage of the Indonesian rupiah with the US dollar was over unity in 2000 and 2001. Linkage with the US dollar has decreased since 2002, and was around 0.7 in 2006. Coefficients on the euro and the Japanese yen were statistically significant in some years (1999, 2000, and 2006 for the euro and 1999, 2003, and 2004 for the yen). Linkage with the yen was statistically significant only in 2005. However, the adjusted R2s or coefficients of determination were very low over the sample period. This implies that the Indonesian rupiah was influenced by factors other than the three major currencies.

(5) Korean won

The IMF classifies that the monetary authority of South Korea uses an independent floating exchange rate system. Linkage of the Korean won with the US dollar has a decreasing trend over the sample period, with a high of 0.9845 in 2000. Linkage decreased since 2001 and reached a level of 0.5778 in 2005. Linkage with the yen was statistically significant over the sample period, with a high of 0.2127 in 2005. Although linkage with the euro was not always statistically significant over the sample period, the coefficients were not so low.

(6) Lao kip

The Lao kip was fixed to the US dollar for nearly the entire analyzed period from 2003 to 2006. Linkage with the US dollar stayed at between 0.9900 and 0.8424 and dropped to 0.8424 in 2006. The coefficients on the euro and the yen were not found to be statistically significant during the sample period.

(7) Malaysian ringgit

On July 21, 2005, the monetary authority of Malaysia immediately followed the Chinese government's announcement and announced it would change from a dollar-peg exchange rate system to a managed floating system with reference to a currency basket. Linkage of the Malaysian ringgit with the US dollar was completely perfect before the announcement as shown by coefficients on the US dollar of 1.000 from 1999 to 2004. Linkage with the US dollar decreased to 0.9399 in 2005, which includes a period after the announcement. Linkage was 0.8335 with the US dollar and 0.1105 with the yen in 2006. The monetary authority of Malaysia has in fact changed its exchange rate

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[3] See Ogawa and Sakane (2006) for details of the Chinese exchange rate system reform.

system to a currency basket system.

(8) Myanmar kyat

The Myanmar kyat was fixed to the US dollar for nearly the entire analyzed period from 2003 to 2006. Linkages with the US dollar stayed at levels between 0.9922 and 0.8732. The linkage with the US dollar dropped to 0.8732 in 2006 while the linkage with the yen was statistically significant in 2006 though it was no more than 0.0723. It is not found the coefficients on the euro were statistically significant during the sample period.

(9) Philippine peso

The Philippine peso had strong linkage with the US dollar during the sample period. The coefficient on the US dollar was 1.0592 and the highest in 2000 during the sample period. It has been decreasing since 2001 and reached at a level of 0.8622 in 2006. However, the level was still higher than other East Asian countries. The Philippine peso has some linkages with the yen in some years (in 1999, 2001, 2004, and 2005) while it has no linkages with the euro during the sample period.

(10) Singapore dollar

It is known that the Monetary Authority of Singapore uses a currency basket system where it target the Singapore dollar to a currency basket which includes its major trading partners' currencies. The currency basket system reflects in an analytical result that coefficients on the three major currencies were statistically significant almost over the sample period. The linkages of the Singapore dollar with the US dollar were relatively high in 1999 and 2000. The linkage with the US dollar decreased from 0.8230 in 2000 to 0.5586 in 2005. On one hand, the linkages with the euro and the yen increased and reached levels of 0.2459 in 2006 for the euro and 0.3312 in 2005 for the yen, respectively.

(11) Thai baht

The Thai baht has linkages with not only the US dollar but also the euro and the Japanese yen. The coefficient on the US dollar was 0.8615 in 2001 and then decreased to a level of 0.6621 in 2005 and 0.6857 in 2006. On one hand, coefficients on the yen were always statistically significant while coefficients on the euro were statistically significant in some years which include 1999, 2004, and 2006. The coefficients on the yen increased from 0.1138 in 1999 to 0.2731 in 2005 while the coefficient on the euro reached a level of 0.4301 in 2006.

(12) Vietnamese dong

The monetary authority of Vietnam has been focusing only the exchange rate of the Vietnamese dong in terms of the US dollar during the sample period. The coefficients on the US dollar are between 0.9934 and 1.0044 during the sample period while the coefficients on the euro and the yen were not statistically significant. Moreover, the coefficients of determination were almost unity, which implies that fluctuations of the Vietnamese dong can be explained only by those of the US dollar.

The empirical results show that the linkage with the US dollar has been weakening since 2001 or 2002 for the Brunei dollar, Indonesian rupiah, Korean won, Philippine peso, Singapore dollar, and Thai baht. In addition, the Malaysian ringgit has weakened since 2005 when its and China's monetary authorities announced their exchange rate system reforms. On the other hand, the Chinese yuan has of yet changed little in terms of its linkage with the US dollar. This shows that the monetary authority of China continues to stabilize the exchange rate of the Chinese yuan against the US dollar.

All three coefficients on the US dollar, the euro, and the yen were statistically significant for the Brunei dollar, Singapore dollar, and Thai baht in 2006. As mentioned, the Brunei dollar follows the Singapore dollar. The monetary authorities of both Singapore and Thailand appear to have adopted a currency basket which includes the US dollar, the euro, and the yen. Coefficients on the yen, as well as on the US dollar, are statistically significant for the Cambodian riel, Korean won, Malaysian ringgit, and Myanmar kyat in recent years while linkage of the Korean won increased over the sample period.

2. Widening deviation among East Asian currencies

Next we show deviation measurements of each East Asian currency from an average of the currencies to investigate widening deviation among them. Ogawa and Shimizu (2005) created an Asian Monetary Unit (AMU) as a regional unit for East Asia that is a weighted average of its currencies: those of the ASEAN10+3 (ASEAN10 with China, Japan, and South Korea) economies. The weight of each currency in the basket is based both on countries' respective shares of GDP measured at purchasing power parity (PPP), and their trade volumes (the sum of exports and imports) in the total of sampled countries. These two measurements are calculated as the average of the most recent three years (2002-2004) for which data is available. Also, an AMU Deviation Indicator is measured for each East Asian currency's deviation from the AMU.[4] The AMU Deviation Indicators are set at zero during their benchmark period of two years in 2000 and 2001 when trade imbalances of East Asian countries were at their smallest in the period of 1999-2007.

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[4] Both the AMU and AMU Deviation Indicators are available at a website of the Research Institute of Economy, Trade and Industry (http://www.rieti.go.jp/users/amu/en/index.html)

Figure 1 shows a recent trend in the AMU nominal exchange rate in terms of a US dollar and euro currency basket as well as in terms of the US dollar and the euro separately. The currency basket is composed 65% of the US dollar 35% of the euro based on trade shares of the East Asian countries with the US and the euro area in 2002-2004 in order to reflect the value of the AMU in terms of major trading partners' currencies. Figure 1 shows that the AMU has been gradually depreciating against the currency basket of the US dollar and the euro, about 5% in May 2007 compared with the benchmark years of 2000 and 2001. When viewing the currencies separately, the AMU has been gradually appreciating against the US dollar while gradually depreciating against the euro.

Figure 2 shows movements in deviations of East Asian currencies against the AMU in terms of nominal exchange rates from the benchmark years of 2000 and 2001. The Nominal AMU Deviation Indicators of East Asian currencies were limited within plus/minus 10% during the period from 2001 to the end of 2004, except for the Philippine peso. The Korean won has been appreciating against the AMU or a weighted average of East Asian currencies since the end of 2004. The won is overvalued by more than 20% compared with the benchmark years. The Thai baht has been appreciating very quickly since the end of 2005. It is overvalued by more than 20% compared with the benchmark years. On the other hand, the Philippine peso was undervalued by more than 10% from 2003 to 2006. The Lao kip was devalued by 25% in April 2004 though it has been relatively stable since the devaluation. The Vietnamese dong has been gradually depreciating and is undervalued by 15% compared with the benchmark years.

Figure 3 shows movements in deviations of East Asian currencies against the AMU in terms of real exchange rates from the benchmark years. The Real AMU Deviation Indicators of East Asian currencies were limited within plus 20% and minus 10% during a period from 2000 to 2001. The Indonesia rupiah and the Lao kip have appreciated against the AMU in terms of real exchange rates because of higher inflation since 2003. The Korean won has been appreciating against the AMU also in terms of real exchange rates due to the appreciation of the nominal exchange rate since the end of 2004. The Thai baht has quickly appreciated in terms of real exchange rates because of the quick appreciation of the nominal exchange rate since the end of 2006. The four currencies have recently been overvalued by more than 20% compared with the benchmark years. On the other hand, the Japanese yen has been depreciating because of a combination of yen depreciation in terms of nominal exchange rate and the deflation in prices, and has recently been undervalued by 25% compared with the benchmark years.

Figures 4 and 5 show movements in the weighted averages of the above Nominal and Real AMU Deviation Indicators for all of the East Asian currencies. The two weighted averages of the AMU Deviation Indicators are calculated according to the following equation:

$$weighted\ ave.\ AMU\ DI = \sqrt{\sum{(w_i AMU\ DI_i)}^2} \qquad (2)$$

where $AMU\ DI_i$: AMU Deviation Indicator for currency i, w_i: weight on currency i. The weights are based on the arithmetic of the GDP measured at PPP and trade shares according to the calculation of the AMU.

Figure 4 shows that the weighted average of the Nominal AMU Deviation Indicator rapidly decreased after it recorded a level of 3.5% in January 2002. It stayed at a lower level, between 0.5% and 2.0%, from May 2002 to December 2004. However, it has been increasing since January 2005 and it recorded its highest level of 4.3% in June 2007. This means that deviations of East Asian currencies from the AMU in terms of nominal exchange rates have been, on average, increasing in the last two and a half years.

Figure 5 shows that the weighted average of the Real AMU Deviation Indicator briefly decreased after it recorded at a level of 4.0% in February 2002. It stayed between 2.5% and 3.2% from 2002 to 2004. However, it has been increasing since the end of 2004 and recorded its highest level of 8.0% in May 2007. This means that deviations of East Asian currencies from the AMU in terms of real exchange rates have been, on average, increasing in the last two and a half years.

Contributions of each country's AMU Deviation Indicator to the weighted averaged AMU Deviation Indicator are reported in Figures 6 to 9. The contributions are calculated daily for the Nominal and monthly for the Real AMU Deviation Indicators. From the contributions, the average is calculated yearly. We also calculate averages for the two periods divided by the Chinese reform on July 21, 2005. Table 2 reports the top three contributors each year and each period. Generally speaking, movements in yen and Chinese yuan have contributed to movements in the weighted average of the AMU Deviation Indicators. In the latter part of the sample period, the yen increased its contribution to the weighted average of AMU Deviation though the Chinese yuan decreased its contribution. This means that the upward trend of the weighted average of AMU Deviation Indicators is mainly caused by increasing deviation of the yen from the AMU. Table 2 shows that the Thai baht, Singapore dollar, and Korean won also made important contributions to the weighted average of AMU Deviation in the latter part of the sample. The Chinese yuan decreased its contribution after the reform of exchange rate regime because it nearly maintained its degree of deviation from the AMU though the other countries increased their deviation in the second part of the sample period, as shown in Figure 2 and 3. Accordingly, the Chinese exchange rate system reform is not likely to be a direct factor of decreasing contribution of the Chinese yuan to the weighted average of the AMU Deviation Indicators.

In summary, the AMU or a weighted average of East Asian currencies has been appreciating against the US dollar in recent years while depreciating against the currency basket of the US dollar

and the euro. Deviations among the East Asian currencies have been widening, as shown by their AMU Deviation Indicators and the weighted average of AMU Deviation Indicators in terms of both nominal and real exchange rates.

3. Need for Regional Monetary Coordination

Ogawa and Ito (2002) pointed out possible coordination failure in choosing an exchange rate system and exchange rate policy in a game theory framework as long as one country's choosing the dollar-peg system has an adverse effect on others' choosing their own exchange rate systems through relative price effects. Ogawa (2007) conducted an empirical analysis on whether the dollar-pegging currencies adversely affected other East Asian countries' choices of exchange rate systems and exchange rate policies. They did not choose a desirable exchange rate system but rather the *de facto* dollar-peg system because the dollar-pegging countries continued to adopt official or *de facto* dollar-peg systems. In other words, this has been coordination failure. Accordingly, it is clear that regional coordination is needed for a desirable exchange rate regime instead of a formal or *de facto* dollar-peg system.

The officially and *de facto* dollar-pegging countries should adopt more flexible systems such as an intermediate exchange rate system that consists of both a currency basket and an exchange rate band. More flexible does not mean free-floating but intermediate exchange rate systems located between free-floating and dollar-peg. Although the monetary authority of China announced that it would shift to a managed floating exchange rate system with reference to a currency basket in July 2005, our analysis suggests that China has retained a *de facto* dollar-peg system. An intermediate exchange rate system seems to be desirable for East Asian countries, particularly China, due to the following two reasons.

First, under a currency basket system, monetary authorities do not target the US dollar but a combination of the dollar, yen, and euro, with a view toward international trade and foreign direct investment. East Asian countries have strong economic relationships in terms of international trade, foreign direct investment, and international finance with East Asia, Europe, and the US. Second, under an exchange rate band system, the monetary authorities set a range in which a currency is allowed to float freely. An exchange rate band gives a certain degree of latitude in monetary policy to the monetary authorities.

It is desirable for East Asian countries to stabilize exchange rates among intra-regional currencies as well as outside currencies such as the US dollar and the euro. For this purpose, the monetary authorities of East Asian countries should coordinate their exchange rate policies against outside currencies. They should also care about the yen because Japan plays a larger role in intra-regional economic relations.

The monetary authorities of ASEAN+3 member countries have through the Chiang Mai

Initiative been strengthening regional monetary cooperation since the Asian Currency Crisis in 1997. Under the Initiative, a network of bilateral and multilateral swap arrangements was established for managing currency crises in ASEAN+3 countries. Via the Initiative, monetary authorities are supposed to conduct a surveillance process for preventing future currency crises. However, these authorities have no standing institution for carrying out this process. Instead, they regularly meet as the Economic Review and Policy Dialogue (ERPD) in the ASEAN+3 Finance Deputy Ministers Meeting for surveillance of their macroeconomic performance and they focus only on domestic macroeconomic variables including GDP, inflation, and soundness of the financial sector.

The monetary authorities of East Asian countries should prevent biased changes in relative prices caused by US dollar depreciation under the different exchange rate systems. To do so, they have been trying to coordinate their exchange rate systems and exchange rate policies. Kawai, Ogawa, and Ito (2004) suggested that first the monetary authorities of ASEAN+3 should discuss the exchange rate issue as a part of their surveillance process, in addition to discussion on domestic macroeconomic policies and the soundness of financial sector. The exchange rates of these currencies against those of neighboring countries are indeed linked by terms of trade and competitive prices. Each country in East Asia has strong economic relationships with the others as well as with the US and Europe.

Exchange rates among the intra-regional currencies affect economic activities in each East Asian country via intra-regional trade, investments, and finance. The monetary authorities should not only consider movements of the exchange rates but also their deviations from regional averages and, in turn, their exchange rate policies.

The surveillance process in itself might not be sufficiently solid to preserve regional policy coordination in the long run because the monetary authorities from each country are not committed to policy coordination, they only may make limited contributions. A mechanism is needed that will compel the monetary authorities to be committed to the long-term regional policy coordination.

With this coordination it is necessary that all East Asian monetary authorities agree on an arrangement to create a common unit of account that consists of a basket of regional currencies. They might then commit to following the regional common unit of account in carrying out their exchange rate policy. An East Asian regional monetary unit could then be referred to in coordinating exchange rate policies. For this purpose, a common currency basket that includes regional currencies of the ASEAN+3 countries has been created. The ASEAN+3 Financial Ministers Meeting has launched to make a research group study a Regional Monetary Unit for coordinated exchange rate policy.

4. Conclusion

This paper investigated recent trends in exchange rate systems in East Asia. The IMF

classification tells us that the monetary authorities of East Asian countries are adopting various exchange rate systems: free–floating, soft-peg, or currency board. The two corner solutions for exchange rate systems and intermediate exchange rate systems are found in East Asia. Exchange rate systems in East Asia are trending toward greater flexibility following the Asian Currency Crisis, typified by the Chinese government's decision to change from a dollar-peg system to a managed floating exchange rate system with reference to a currency basket. Malaysia immediately followed suit after China's announcement it would change.

Empirical results show that linkages with the US dollar have been weakening since 2001 for some East Asian countries. The monetary authorities of both Singapore and Thailand appear to have adopted a currency basket which includes the US dollar, the euro, and the yen. The monetary authorities of Cambodia, South Korea, Malaysia, and Myanmar are targeting their exchange rates in terms of not only the US dollar but also the yen. On the other hand, the Chinese yuan has yet to significantly change in terms of its linkage with the US dollar. The monetary authority of China continues to stabilize the exchange rate of the Chinese yuan against the US dollar despite its announcements of adopting a currency basket system.

Our analysis shows that the weighted average has been appreciating against the US dollar in recent years while it has been depreciating against the currency basket of the US dollar and the euro. Also deviations among the East Asian currencies have been widening as shown by the AMU Deviation Indicators and the weighted average of the AMU Deviation Indicators. The widening deviations reflect that the monetary authorities of East Asian countries are adopting a variety of exchange rate systems. In other words, coordination failure in exchange rate systems among these authorities increases volatility and misalignment of intra-regional exchange rates in East Asia.

References

Frankel, Jeffrey and Shang Jin Wei (1994) "Yen bloc or dollar bloc? Exchange rate policies of the East Asian economies," in T. Ito and A. O. Krueger, eds., *Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows*, Chicago, University of Chicago Press, 295-355.

Kawai, Masahiro and Shigeru Akiyama (1998) "The role of nominal anchors currencies in exchange arrangements," *Journal of the Japanese and International Economies*, 12, 334-387.

Kawai, Masahiro and Shigeru Akiyama (2000) "Implications of the currency crisis for exchange rate arrangements in emerging East Asia," World Bank, May.

Kawai, Masahiro, Eiji Ogawa, and Takatoshi Ito (2004) "Developing New Regional Financial Architecture: A Proposal," mimeo.

McKinnon, Ronald I., (2001) "After the crisis, the East Asian dollar standard resurrected: An interpretation of high-frequency exchange rate pegging." in Joseph Stiglitz and Shahid Yusuf eds.

Rethinking the East Asian Miracle, World Bank

Ogawa, Eiji (2002) "Should East Asian countries return to a dollar peg again?" in Peter Drysdale and Kenichi Ishigaki eds. *East Asian Trade and Financial Integration: New Issues*, Asia Pacific Press, 159-184.

Ogawa, Eiji (2004) "Regional monetary cooperation in East Asia against asymmetric responses to the US dollar depreciation," *Journal of Korean Economy*, Vol. 5, No. 2, 43-72.

Ogawa, Eiji (2007) "Economic interdependence and international coordination in East Asia," :in Takatoshi Ito, ed., *A Basket Currency for Asia*, Routledge, Pub., 99-123.

Ogawa, Eiji and Takatoshi Ito, (2002) "On the desirability of a regional basket currency arrangement," *Journal of the Japanese and International Economies*, Vol. 16, No. 3, 317-334.

Ogawa, Eiji and Michiru Sakane (2006) "The Chinese yuan after the Chinese exchange rate system reform," *China & World Economy*, Vol. 14, No. 6, 39-57.

Ogawa, Eiji and Junko Shimizu (2005) "AMU deviation indicator for coordinated   exchange rate policies in East Asia," RIETI Discussion Paper, no. 05-E-017.

Ogawa, E. and Taiyo Yoshimi (2007) "Exchange Rate Regimes in East Asia – Recent Trends," a paper prepared for the International Conference on "Ten Years After the Crisis: Evolving East Asian Financial System and Challenges Ahead" held by the Ministry of Finance, Asian Development Bank, and Asian Development Bank Institute on 12 June, 2007.

Table 1: Linkages of East Asian currencies to three main currencies

Brunei dollar	US dollar		euro		Japanese yen		Adj. R2
1999	0.8175	***	0.4343	***	0.0961	***	0.821
	(0.0339)		(0.1068)		(0.0198)		
2000	0.8335	***	0.0456		0.1151	***	0.909
	(0.0282)		(0.0541)		(0.0207)		
2001	0.7973	***	0.0644		0.1804	***	0.877
	(0.0306)		(0.0582)		(0.0259)		
2002	0.6629	***	−0.0006		0.2008	***	0.841
	(0.0265)		(0.0768)		(0.0231)		
2003	0.6834	***	0.1589	**	0.1558	***	0.844
	(0.0321)		(0.0684)		(0.0302)		
2004	0.6082	***	0.2695	***	0.1912	***	0.889
	(0.0249)		(0.0677)		(0.0226)		
2005	0.5742	***	0.1543	*	0.2418	***	0.840
	(0.0271)		(0.0853)		(0.0288)		
2006	0.5986	***	0.2768	***	0.1898	***	0.811
	(0.0312)		(0.0883)		(0.0307)		
2007	0.6879	***	0.5605	***	−0.0224		0.777
	(0.0377)		(0.0659)		(0.0236)		
Cambodia riel	US dollar		euro		Japanese yen		Adj. R2
1999							
2000							
2001							
2002							
2003	0.9534	***	−0.3878		0.0257		0.736
	(0.1091)		(0.3024)		(0.1048)		
2004	0.9864	***	0.1569	*	−0.0261		0.876
	(0.0333)		(0.0905)		(0.0302)		
2005	0.9214	***	0.1191		−0.0194		0.607
	(0.0632)		(0.1989)		(0.0672)		
2006	0.9191	***	−0.1765		0.1248	***	0.685
	(0.0554)		(0.1564)		(0.0547)		
2007	0.9382	***	0.1134	*	−0.0031		0.814
	(0.0373)		(0.0652)		(0.0233)		
Chinese yuan	US dollar		euro		Japanese yen		Adj. R2
1999	1.0002	***	0.0006		−0.0002		1.000
	(0.0004)		(0.0012)		(0.0002)		
2000	1.0001	***	0.0000		−0.0002		1.000
	(0.0006)		(0.0011)		(0.0004)		
2001	1.0002	***	−0.0007		0.0000		1.000
	(0.0005)		(0.0009)		(0.0004)		
2002	1.0004	***	−0.0005		−0.0004	*	1.000
	(0.0002)		(0.0007)		(0.0002)		
2003	1.0000	***	0.0002		0.0002		1.000
	(0.0002)		(0.0005)		(0.0002)		
2004	1.0003	***	−0.0004		−0.0001		1.000
	(0.0002)		(0.0006)		(0.0002)		
2005	1.0001	***	−0.0035		−0.0026		0.999
	(0.0024)		(0.0073)		(0.0026)		
2006	0.9797	***	0.0231		−0.0002		0.984
	(0.0107)		(0.0303)		(0.0105)		
2007	0.9361	***	0.0304		−0.0047		0.938
	(0.0195)		(0.0341)		(0.0122)		

Indonesia yupiah	US dollar	euro	Japanese yen	Adj. R2
1999	0.6829 ***	1.8011 **	0.2781 *	0.143
	(0.2283)	(0.7182)	(0.1332)	
2000	1.1070 ***	0.4676 *	0.1481	0.436
	(0.1343)	(0.2578)	(0.0985)	
2001	1.2880 ***	−0.3345	−0.0310	0.286
	(0.1649)	(0.3136)	(0.1395)	
2002	0.7556 ***	0.1575	0.0264	0.308
	(0.0898)	(0.2603)	(0.0784)	
2003	0.8526 ***	0.1052	0.1078 *	0.669
	(0.0603)	(0.1283)	(0.0567)	
2004	0.7479 ***	0.1292	0.1965 ***	0.622
	(0.0630)	(0.1713)	(0.0572)	
2005	0.7353 ***	−0.0348	0.1579	0.316
	(0.1007)	(0.3166)	(0.1070)	
2006	0.7060 ***	0.5174 **	−0.0682	0.331
	(0.0921)	(0.2607)	(0.0906)	
2007	0.7844 ***	0.5461 ***	−0.0524	0.526
	(0.0725)	(0.1268)	(0.0454)	
South Korean won	US dollar	euro	Japanese yen	Adj. R2
1999	0.9199 ***	0.1876	0.0645 **	0.672
	(0.0528)	(0.1660)	(0.0308)	
2000	0.9845 ***	−0.0923	0.1456 ***	0.675
	(0.0737)	(0.1415)	(0.0541)	
2001	0.8703 ***	0.0362	0.3039 ***	0.726
	(0.0595)	(0.1132)	(0.0503)	
2002	0.6853 ***	−0.3222	0.2373 ***	0.428
	(0.0711)	(0.2061)	(0.0621)	
2003	0.7408 ***	0.2136	0.2001 ***	0.551
	(0.0757)	(0.1611)	(0.0712)	
2004	0.7516 ***	0.2433 *	0.1915 ***	0.767
	(0.0456)	(0.1240)	(0.0414)	
2005	0.5778 ***	0.1611	0.2127 ***	0.574
	(0.0524)	(0.1649)	(0.0557)	
2006	0.7845 ***	0.1477	0.1062 *	0.594
	(0.0608)	(0.1719)	(0.0597)	
2007	0.8057 ***	0.4886 ***	0.0132	0.700
	(0.0512)	(0.0895)	(0.0320)	
Laos kip	US dollar	euro	Japanese yen	Adj. R2
1999				
2000				
2001				
2002				
2003	0.9717 ***	−0.3510	0.0035	0.774
	(0.0993)	(0.2752)	(0.0954)	
2004	0.9900 ***	0.0391	−0.0241	0.965
	(0.0166)	(0.0450)	(0.0150)	
2005	0.9381 ***	0.0618	−0.0015	0.767
	(0.0238)	(0.0651)	(0.0221)	
2006	0.8424 ***	0.2448	0.0592	0.631
	(0.0594)	(0.1680)	(0.0584)	
2007	0.9598 ***	0.0912 *	0.0021	0.865
	(0.0314)	(0.0548)	(0.0196)	

Malaysian ringgit	US dollar		euro		Japanese yen		Adj. R2
1999	1.0078	***	0.0346	***	−0.0042	*	0.997
	(0.0040)		(0.0127)		(0.0024)		
2000	1.0005	***	−0.0003		−0.0004		1.000
	(0.0004)		(0.0007)		(0.0003)		
2001	1.0001	***	−0.0001		−0.0002		1.000
	(0.0017)		(0.0033)		(0.0015)		
2002	1.0003	***	0.0028		0.0002		0.999
	(0.0023)		(0.0066)		(0.0020)		
2003	1.0004	***	−0.0083		0.0024		0.997
	(0.0047)		(0.0100)		(0.0044)		
2004	1.0045	***	0.0001		−0.0035		0.999
	(0.0026)		(0.0070)		(0.0023)		
2005	0.9890	***	0.0149		−0.0107		0.940
	(0.0212)		(0.0667)		(0.0225)		
2006	0.8335	***	0.1383		0.1105	*	0.627
	(0.0599)		(0.1695)		(0.0589)		
2007	0.7204	***	0.6601	***	0.0397		0.725
	(0.0479)		(0.0837)		(0.0300)		
Myanmar kyat	US dollar		euro		Japanese yen		Adj. R2
1999							
2000							
2001							
2002							
2003	0.9695	***	−0.3268		0.0029		0.794
	(0.0940)		(0.2605)		(0.0903)		
2004	0.9922	***	0.0449		−0.0136		0.975
	(0.0142)		(0.0386)		(0.0129)		
2005	0.9485	***	0.0863		−0.0185		0.926
	(0.0228)		(0.0716)		(0.0242)		
2006	0.8732	***	0.0692		0.0723	**	0.842
	(0.0340)		(0.0962)		(0.0334)		
2007	0.9636	***	0.0958	*	−0.0022		0.884
	(0.0288)		(0.0504)		(0.0180)		
Philippine peso	US dollar		euro		Japanese yen		Adj. R2
1999	0.8660	***	0.2347		0.0928	***	0.646
	(0.0548)		(0.1724)		(0.0320)		
2000	1.0592	***	−0.2352		−0.0640		0.544
	(0.0850)		(0.1632)		(0.0624)		
2001	0.9673	***	0.0033		0.1864	*	0.431
	(0.1094)		(0.2081)		(0.0926)		
2002	0.8208	***	−0.0542		0.0671		0.620
	(0.0510)		(0.1479)		(0.0445)		
2003	0.9465	***	0.0232		0.0617		0.731
	(0.0546)		(0.1162)		(0.0513)		
2004	0.9107	***	0.0001		0.0660	***	0.932
	(0.0229)		(0.0622)		(0.0208)		
2005	0.8646	***	0.0088		0.1100	***	0.833
	(0.0351)		(0.1104)		(0.0373)		
2006	0.8622	***	−0.0620		0.0399		0.581
	(0.0626)		(0.1771)		(0.0615)		
2007	0.8216	***	0.4339	***	−0.0149		0.419
	(0.0901)		(0.1575)		(0.0564)		

Singapore dollar	US dollar		euro		Japanese yen		Adj. R2
1999	0.8045	***	0.3951	***	0.1226	***	0.789
	(0.0380)		(0.1194)		(0.0221)		
2000	0.8230	***	0.0753		0.1392	***	0.910
	(0.0285)		(0.0548)		(0.0209)		
2001	0.7645	***	0.0348		0.2188	***	0.880
	(0.0301)		(0.0572)		(0.0254)		
2002	0.6783	***	−0.0155		0.2933	***	0.875
	(0.0255)		(0.0739)		(0.0223)		
2003	0.6455	***	0.2198	***	0.2388	***	0.882
	(0.0288)		(0.0613)		(0.0271)		
2004	0.5782	***	0.1606	***	0.2730	***	0.910
	(0.0228)		(0.0620)		(0.0207)		
2005	0.5586	***	0.1405	*	0.3312	***	0.870
	(0.0254)		(0.0800)		(0.0270)		
2006	0.5948	***	0.2459	***	0.3105	***	0.875
	(0.0268)		(0.0758)		(0.0263)		
2007	0.7693	***	0.3596	***	−0.0729	***	0.781
	(0.0367)		(0.0641)		(0.0230)		
Thai baht	US dollar		euro		Japanese yen		Adj. R2
1999	0.7517	***	0.6589	***	0.1138	***	0.478
	(0.0746)		(0.2348)		(0.0435)		
2000	0.8489	***	0.1678		0.1782	***	0.691
	(0.0651)		(0.1249)		(0.0477)		
2001	0.8615	***	−0.0031		0.1868	***	0.865
	(0.0343)		(0.0652)		(0.0290)		
2002	0.6685	***	−0.0052		0.1499	***	0.540
	(0.0538)		(0.1559)		(0.0470)		
2003	0.7217	***	0.1223		0.2164	***	0.814
	(0.0393)		(0.0837)		(0.0370)		
2004	0.7271	***	0.1921	***	0.1924	***	0.896
	(0.0271)		(0.0738)		(0.0247)		
2005	0.6621	***	0.1050		0.2731	***	0.824
	(0.0327)		(0.1028)		(0.0347)		
2006	0.6857	***	0.4301	***	0.1387	**	0.607
	(0.0577)		(0.1632)		(0.0567)		
2007	0.9687	***	−0.1413		−0.0902		0.161
	(0.1602)		(0.2802)		(0.1003)		
Vietnamese dong	US dollar		euro		Japanese yen		Adj. R2
1999	0.9984	***	−0.0051		−0.0003		0.999
	(0.0021)		(0.0066)		(0.0012)		
2000	0.9961	***	0.0067		0.0011		0.998
	(0.0040)		(0.0076)		(0.0029)		
2001	0.9991	***	0.0048		−0.0003		0.998
	(0.0035)		(0.0066)		(0.0029)		
2002	1.0044	***	−0.0079		−0.0017		0.999
	(0.0029)		(0.0085)		(0.0026)		
2003	0.9988	***	0.0063		0.0053		0.996
	(0.0057)		(0.0122)		(0.0054)		
2004	0.9970	***	−0.0200		0.0035		0.996
	(0.0056)		(0.0151)		(0.0051)		
2005	0.9934	***	−0.0166		0.0058		0.996
	(0.0055)		(0.0172)		(0.0058)		
2006	0.9969	***	0.0129		−0.0043		0.995
	(0.0060)		(0.0169)		(0.0059)		
2007	0.9958	***	−0.0067		0.0011		0.988
	(0.0089)		(0.0155)		(0.0055)		

*: significant level of 10%, **: significant level of 5%, ***: significant level of 1%
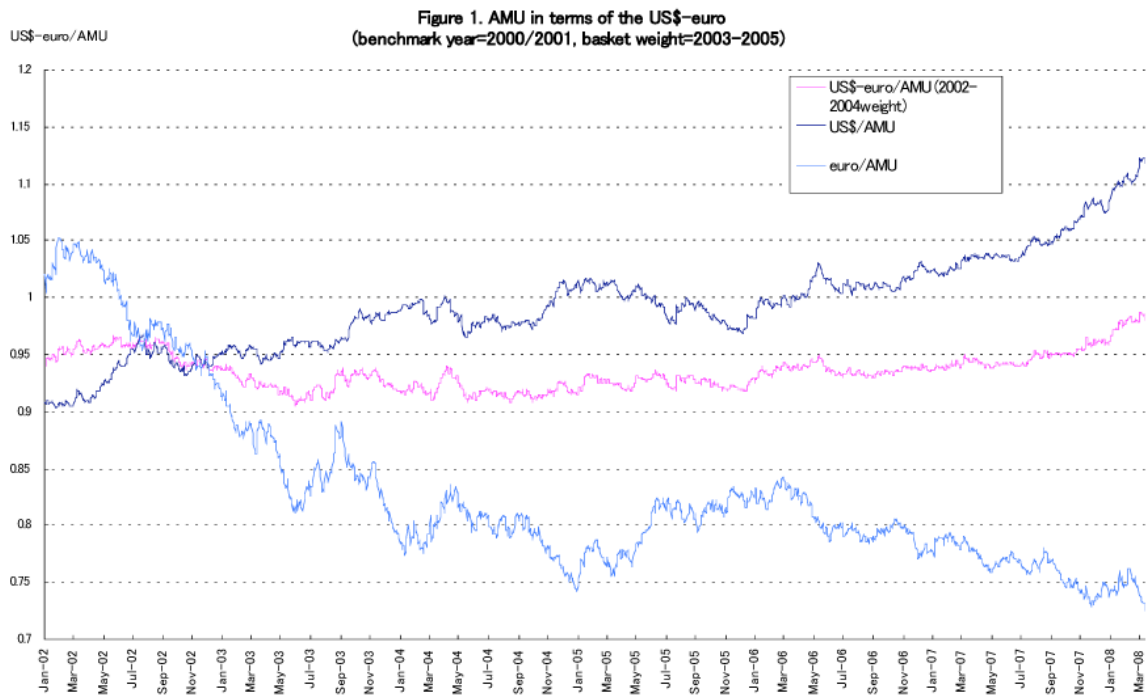
Standard deviations are reported between parentheses.

Table 2: Contribution of AMU Deviation Indicators (top 3 countries)

Nominal AMU DI			Real AMU DI		
2000	Japan	69.8%	2000	China,P.R.	96.1%
	China,P.R.	43.7%		Indonesia	3.8%
	Singapore	1.4%		Japan	0.6%
2001	China,P.R.	211.1%	2001	Japan	59.8%
	South Korea	31.3%		China,P.R.	52.1%
	Malaysia	6.0%		South Korea	2.3%
2002	Japan	67.0%	2002	Japan	95.7%
	China,P.R.	23.4%		China,P.R.	3.6%
	Indonesia	12.2%		Malaysia	1.4%
2003	China,P.R.	51.3%	2003	Indonesia	50.6%
	South Korea	29.3%		China,P.R.	50.0%
	Indonesia	9.2%		Malaysia	0.6%
2004	Japan	47.2%	2004	Japan	124.8%
	China,P.R.	42.5%		South Korea	14.3%
	South Korea	8.1%		Thailand	1.6%
2005	China,P.R.	32.5%	2005	Indonesia	53.4%
	South Korea	30.4%		South Korea	34.6%
	Japan	29.1%		Japan	31.1%
2006	Japan	123.1%	2006	Japan	383.4%
	Thailand	5.3%		Thailand	4.3%
	Singapore	2.1%		Philippines	1.8%
2007	Japan	80.5%	2007	Japan	95.2%
	Thailand	23.3%		Thailand	3.6%
	Singapore	3.6%		South Korea	2.1%
from 2000/1/4	China,P.R.	73.3%	from 2000/2	Japan	47.7%
to 2005/7/20	Japan	16.4%	to 2005/6	China,P.R.	35.9%
	South Korea	11.4%		Indonesia	8.5%
from 2005/7/21	Japan	88.5%	from 2005/7	Japan	221.3%
to 2007/12/31	Thailand	11.8%	to 2007/12	Indonesia	6.0%
	Singapore	2.3%		Vietnam	0.2%

Source: Authors' calculations

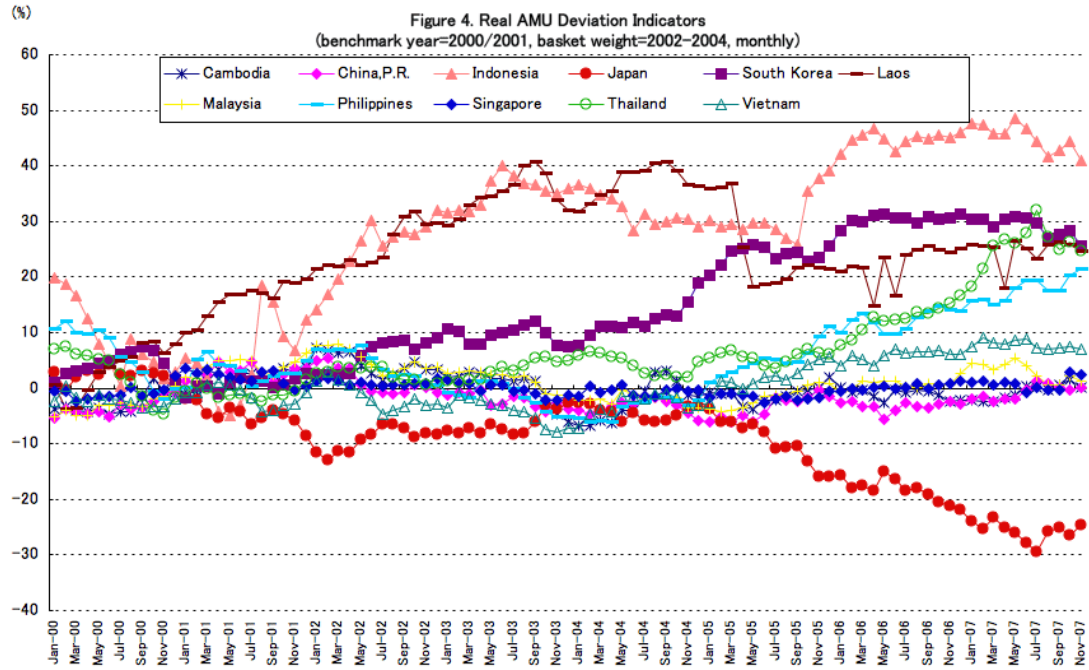Figure 1: Movement of East Asian currency

Figure 1. AMU in terms of the US$-euro
(benchmark year=2000/2001, basket weight=2003-2005)

Source: http://www.rieti.go.jp/users/amu/en/index.html

Figure 2: Nominal AMU Deviation Indicators (daily)

Source: http://www.rieti.go.jp/users/amu/en/index.html
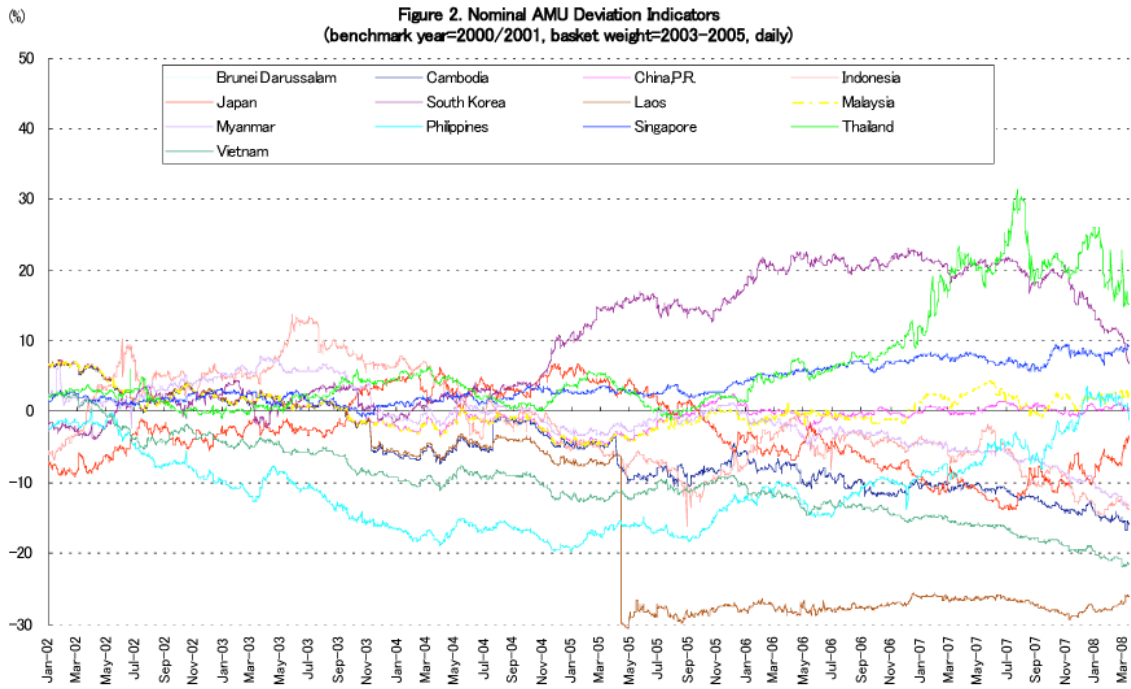
Figure 3: Real AMU Deviation Indicators (monthly)

Source: http://www.rieti.go.jp/users/amu/en/index.html

Figure 4: Weighted Average of Nominal AMU Deviation Indicators

Weighted Average of Nominal AMU Deviation Indicators (Daily)
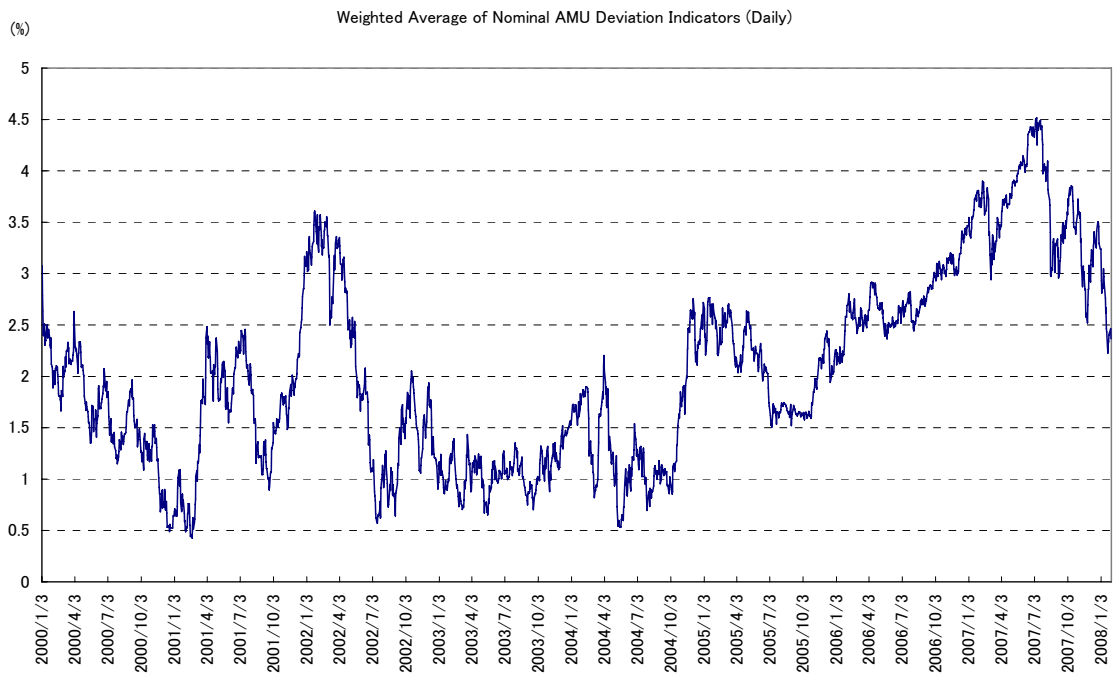
Source: Authors' calculations

Figure 5: Weighted Average of Real AMU Deviation Indicators

Weighted Average of Real AMU Deviation Indicators
(benchmark year=2000/2001, basket weight=2002-2004, monthly)

Source: Authors' calculations

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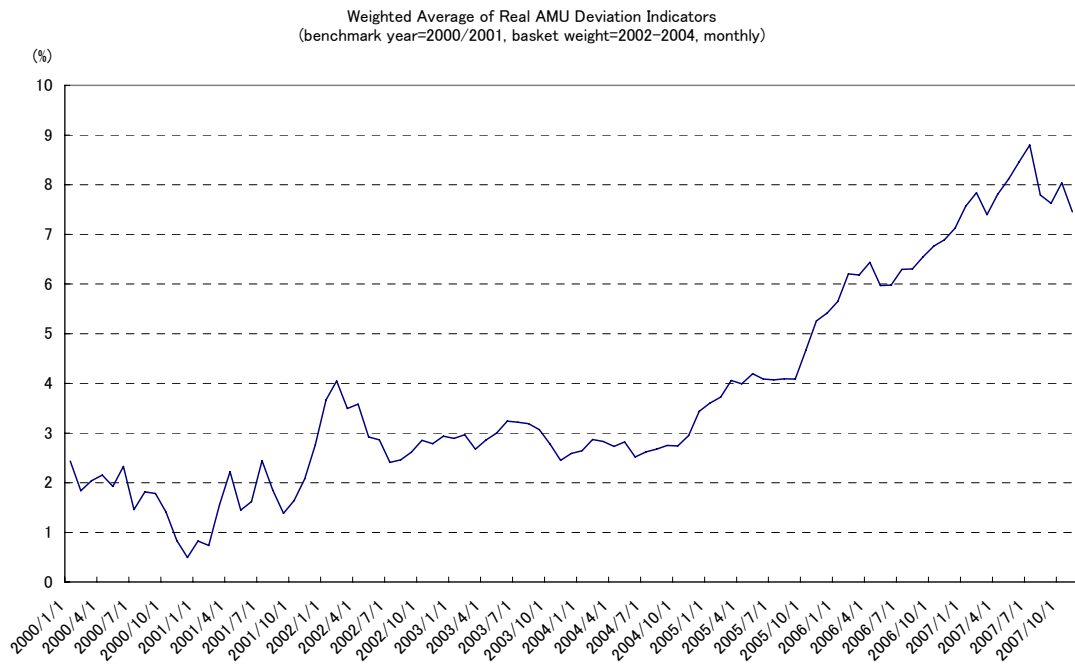
Figure 6: Contribution of Nominal AMU Deviation Indicators
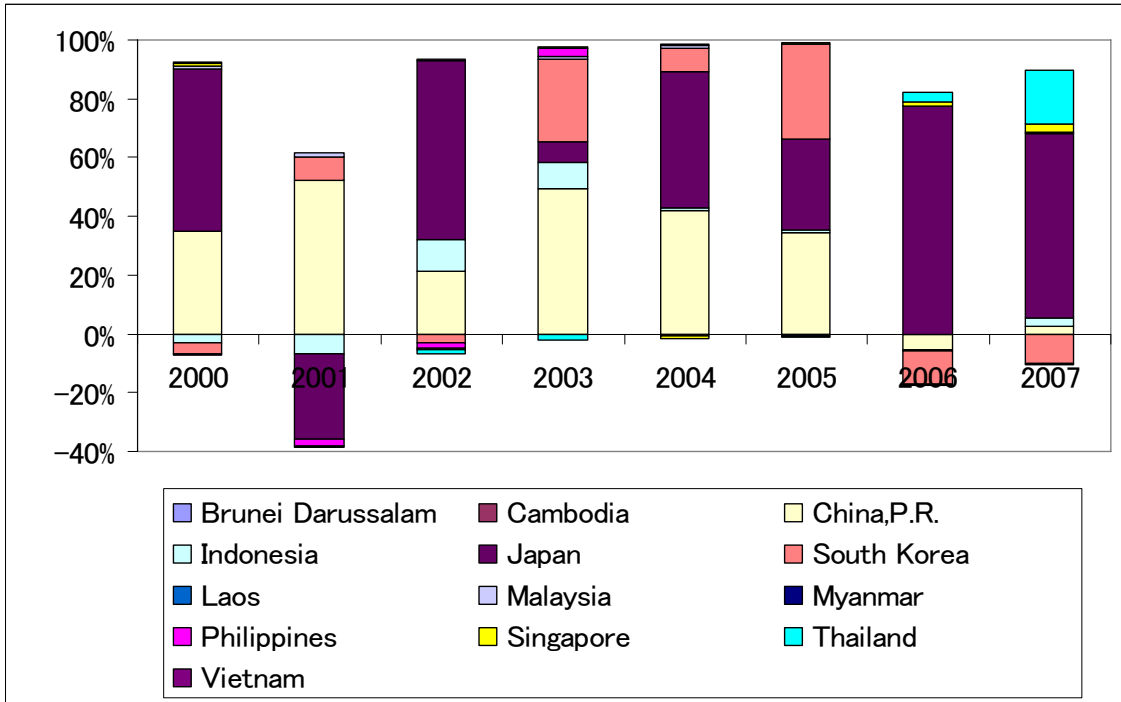
Source: Authors' calculations

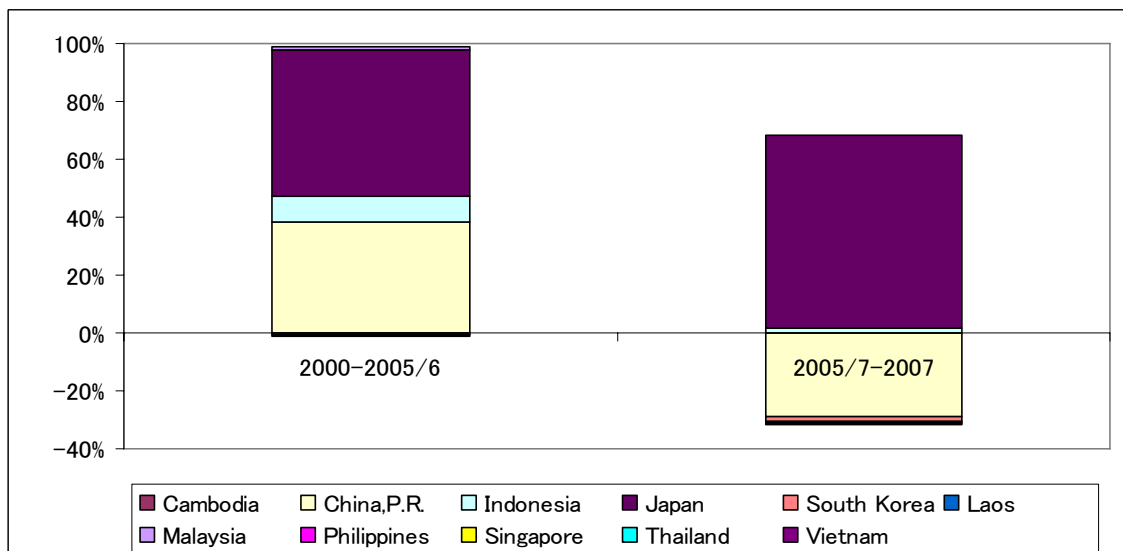Figure 7: Contribution of Nominal AMU Deviation Indicators and Chinese exchange rate system reform
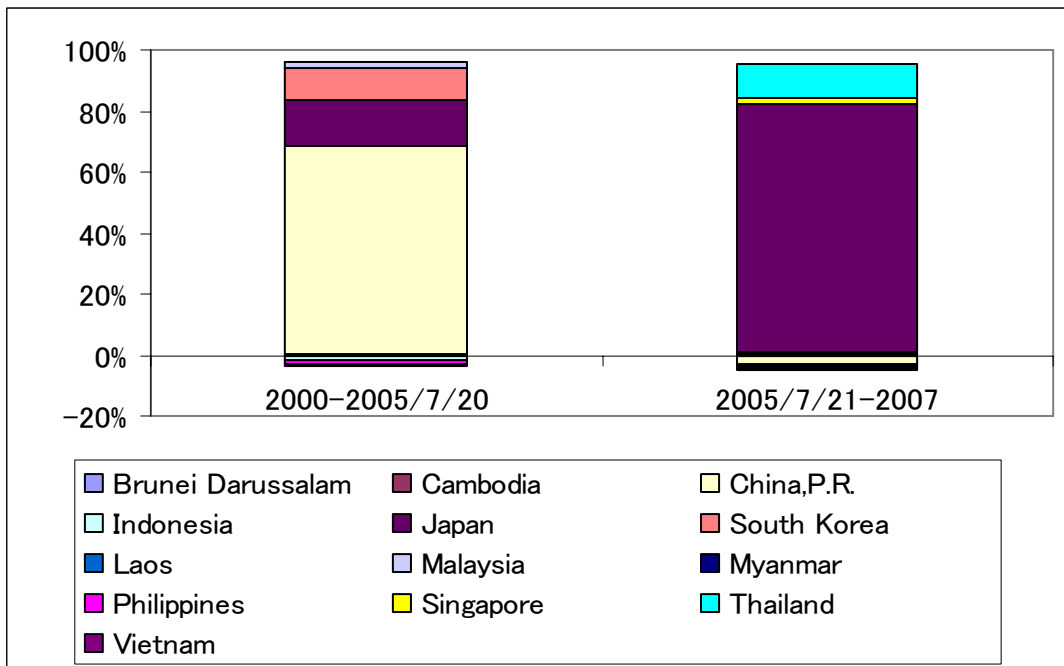
Figure 8: Contribution of Real AMU Deviation Indicators
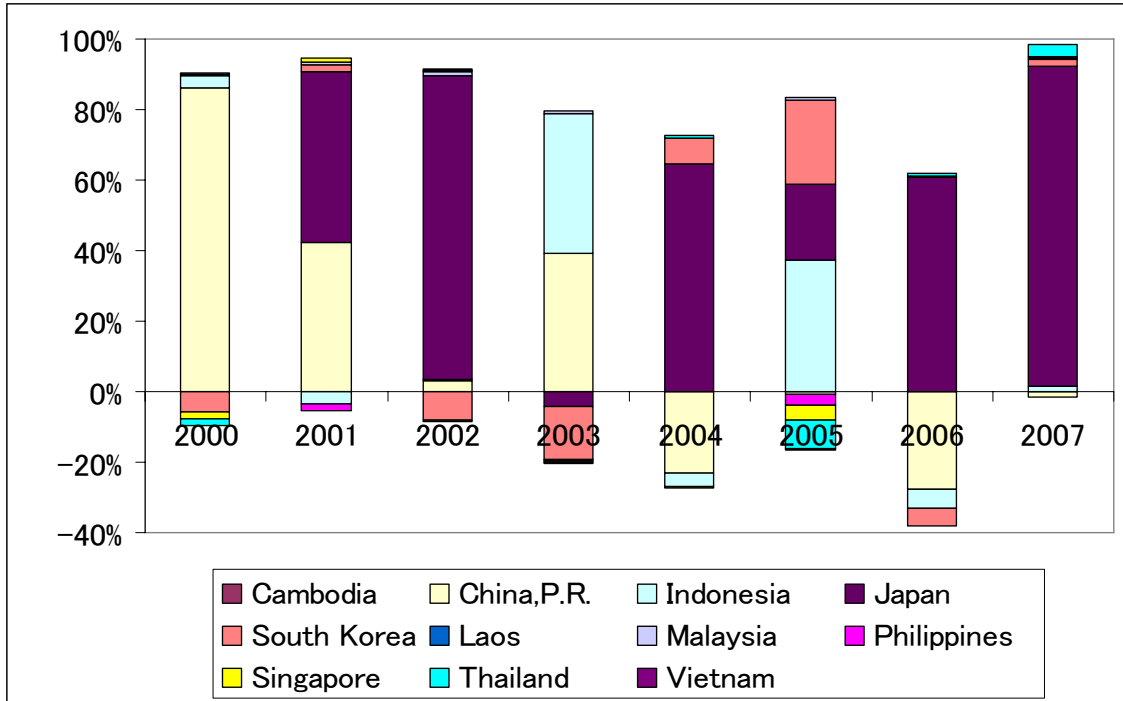
Figure 9: Contribution of Real AMU Deviation Indicators and Chinese exchange rate system reform