Japan's Monetary and Financial Cooperation in East Asia— From the Viewpoint of the Spillover Effects of Currency Misalignment

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Abstract

The purpose of this paper is to examine what forms of monetary and financial cooperation will be desirable in East Asia with a focus on the spillover effects of currency misalignment on the Japanese economy in particular, thereby obtaining implications for monetary and financial cooperation in which Japan should engage in the region in the future. First, we took an overview of the movements of East Asian countries' currencies using the Asian Monetary Unit (AMU) and the AMU Deviation Indicator, which have been attracting attention in recent years as tools to measure currency misalignment. Then, we conducted empirical analysis of exchange rate systems adopted in effect by East Asian countries by measuring the currency basket weight and discussed the relationship between the systems and the global financial crisis. By conducting analysis with regard to both the pre-Lehman Shock period and the post-Lehman Shock period, we showed that because of the global financial crisis, the currency peg to the US dollar strengthened in some countries and weakened in others. Next, we conducted a structural VAR (vector autoregressive) analysis as to how currency misalignment among East Asian countries could affect Japanese macroeconomic variables using the real AMU Deviation Indicator and examined what kind of exchange rate system and exchange rate policy will be desirable in order to achieve macroeconomic stability.

Key words: currency misalignment, AMU Deviation Indicator, East Asian currencies, monetary and financial cooperation, global financial crisis

JEL classification: F31, F33, F42

I. Introduction

In this paper, we examine what forms of monetary and financial cooperation will be desirable in East Asia with a focus on the spillover effects of currency misalignment on the Japanese economy in particular, and discuss monetary and financial cooperation in which Japan should engage in the region in the future.

First, in order to explain the current situation of monetary and financial cooperation in East Asia, we describe the Asian Monetary Unit (AMU) and the AMU Deviation Indicator, which have been attracting attention in recent years as tools to measure currency misalignment in addition to the Chiang Mai Initiative (CMI), and review how East Asian countries' currencies deviate from the benchmark level. Then, by estimating the weights of the yen, the US dollar, and the euro in the currency basket through the method used by Frankel and Wei (1994), we analyze the exchange rate systems adopted in effect by East Asian countries, with a focus on how East Asian countries' currencies deviated from the AMU before and after the global financial crisis, and how the weights of the currencies in the basket changed during these periods.

Next, we conduct a structural VAR (vector autoregressive) analysis to investigate how currency misalignment among East Asian countries could affect Japanese macroeconomic variables. This paper is the first attempt to apply these indicators to the monitoring of the spillover effects of currency misalignment on Japan's real economy.

In conclusion, we discuss the role that Japan should play in the future based on the results of the two empirical analyses mentioned above.

II. Current Situation of Monetary and Financial Cooperation in East Asia

In this section, after explaining the current situation of monetary and financial cooperation in East Asia based on the Chiang Mai Initiative, we describe the Asian Monetary Unit (AMU) and the AMU Deviation Indicator and provide an empirical analysis of the exchange rate systems adopted in effect by East Asian countries.

II-1. Chiang Mai Initiative (CMI), Asian Monetary Unit (AMU), and AMU Deviation Indicators

The Chiang Mai Initiative (CMI),[1] launched in 2000 among ASEAN countries, Japan, China, and Korea, is the first framework for financial cooperation in the region. In light of the lessons learned from experiencing the currency crisis in Asia, which broke out in Thailand in 1997 and then spread across other countries in the region, this initiative was launched with the objective of enabling the countries in the region to provide one another with short-term liquidity facilities under bilateral currency swap arrangements (BCSAs) as a means for currency crisis management. Initially, the CMI existed as a network of BCSAs and played a role in addressing short-term liquidity difficulties by way of foreign reserves. Another characteristic of the CMI is that it is recognized as a quantitative supplement for financial aid provided by the International Monetary Fund (IMF).

[1] The details of the Chiang Mai Initiative are available on the Ministry of Finance website (http://www.mof.go.jp/international_policy/financial_cooperation_in_asia/cmi/index.html), from which we obtained useful information to write this section. Ogawa (2006) also provides a detailed explanation of this framework.

In March 2010, the CMI Multilateralization (CMIM) Agreement took effect, and a common decision-making mechanism was established in the region so that the monetary authorities would be able to provide one another with liquidity facilities more promptly under a single multilateral arrangement. It was also decided that ASEAN + 3 countries (ASEAN countries, plus Japan, China, and Korea; 13 countries in total) would form a single multilateral currency swap arrangement. Under the CMIM, East Asian countries agreed to create an independent regional surveillance unit, named ASEAN + 3 Macroeconomic Research Office (AMRO), with the aim of preventing an outbreak of a financial crisis in the region. Furthermore, the CMIM participants recognize the necessity to ensure coordinated management of exchange rate systems and implementation of exchange rate policies based on the surveillance of macroeconomic situations in East Asian countries.

The Asian Monetary Unit (AMU) is a regional currency unit which is the weighted average of currencies of East Asian countries. It is expected to be used for policy coordination and surveillance of exchange rates in the region.[2] It is composed of the currencies of 13 countries in Asia, namely, the 10 ASEAN members (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam), plus Japan, China, and Korea. The weight assigned to each country's currency is calculated using the arithmetic average of the country's regional weight of GDP measured at purchasing power parity (PPP), and its regional weight of trade volumes (the sum of exports and imports). Table 1 shows the AMU weights of East Asian countries' currencies as of October 2012.

Table 1 AMU weights of East Asian countries' currencies

	Trade volume* %	GDP measured at PPP** %	Arithmetic average shares % (a)	Benchmark exchange rate*** (b)	AMU weights (a)/(b)
Brunei	0.35	0.11	0.23	0.589114	0.0039
Cambodia	0.20	0.16	0.18	0.000270	6.5556
China	27.18	51.87	39.52	0.125109	3.1592
Indonesia	5.79	5.29	5.54	0.000113	490.0725
Japan	21.39	24.61	23.00	0.009065	25.3757
South Korea	13.25	7.65	10.45	0.000859	121.6898
Laos	0.16	0.08	0.12	0.000117	10.0825
Malaysia	7.66	2.16	4.91	0.272534	0.1802
Myanmar	0.45	0.23	0.34	0.159215	0.0212
Philippines	2.24	1.95	2.10	0.021903	0.9570
Singapore	11.74	1.46	6.60	0.589160	0.1120
Thailand	6.54	3.03	4.78	0.024543	1.9481
Vietnam	3.07	1.40	2.23	0.000072	310.3313

* : The trade volume is calculated as the average of total export and import volumes in 2008, 2009 and 2010 taken from DOTS (IMF).
**: GDP measured at PPP is the average of GDP measured at PPP in 2008, 2009 and 2010 taken from the World Development Report, World Bank. For Myanmar's share of GDP measured at PPP, we use the data of 2006 because of the data constraint.
*** : The Benchmark exchange rate ($-euro/Currency) is the average of the daily exchange rate in terms of US$-euro in 2000 and 2001.
**** : AMU shares and weights were revised in Oct. 2012. This is the 8th version.

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

[2] For details, see the Research Institute of Economy, Trade and Industry (RIETI) website (http://www.rieti.go.jp/users/amu/index.html). Ito, Ogawa, and Shimizu (2010) also provide a detailed explanation.

Figure 3 shows the exchange rates of the AMU in terms of the US dollar and the euro, as well as in terms of the US dollar-euro currency basket, separately. The US dollar accounts for 65% of the currency basket and the euro accounts for 35%. This figure shows that the value of the AMU has been on a rising trend in terms of the US dollar and in terms of the US dollar-euro currency basket, especially since around September 2008, when Lehman Brothers collapsed.

Figure 1 Nominal AMU Deviation Indicators

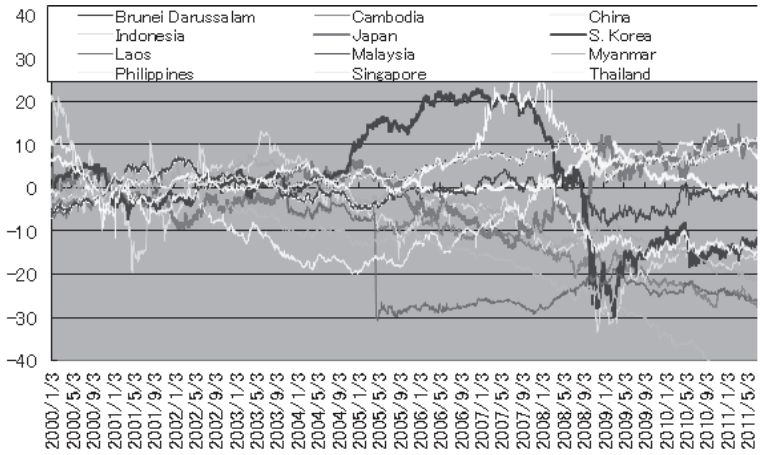


Figure 2 Real AMU Deviation Indicators

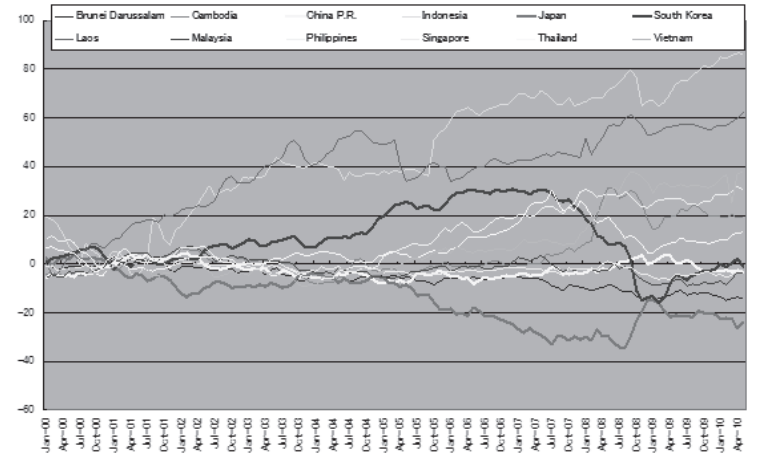
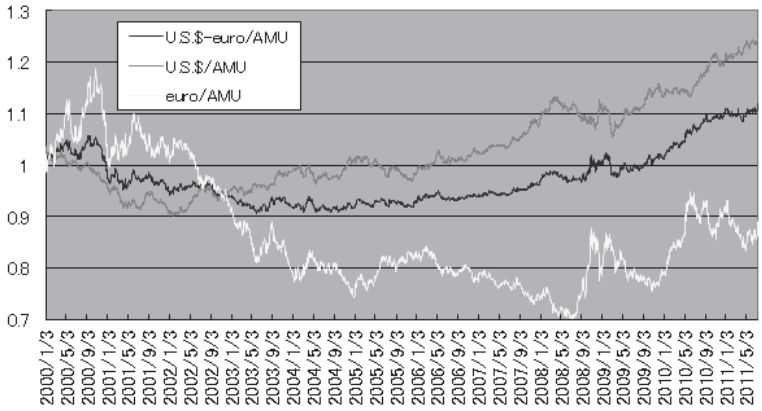


Figure 3 Values of AMU



Let us review how East Asian countries' currencies reacted to the situation before and after the global financial crisis, by means of the nominal AMU Deviation Indicators shown in Figure 1. The AMU Deviation Indicator is the degree of deviation of each currency's real exchange rate in terms of the AMU from the level during the benchmark period, which is set as 2000 and 2001 in this paper. Figure 1 demonstrates asymmetric movements of the currencies in the ASEAN 10 + 3 region. Characteristic currency movements seen during the period from 2007 to 2008, when the subprime mortgage problem occurred and led to the Lehman Shock, are the appreciation of the Japanese yen and the depreciation of the Korean won. These may be largely due to US and European financial institutions' discontinuing of their yen carry trades in the wake of the financial crisis. The same movement as the Korean won can be seen with regard to the Thai baht, although it was not as large. On the other hand, the Chinese yuan slightly appreciated after the financial crisis. Thus, the reactions of the currencies of ASEAN 10 + 3 countries to the financial crisis are asymmetric. In addition to the nominal deviation indicators, the real AMU Deviation Indicators have been calculated and published on a monthly basis, using the weighted average of consumer price indexes of the AMU countries, as shown in Figure 2. As the real AMU Deviation Indicators are real values measured by controlling changes in the inflation rates, they may be suitable to the objective of monitoring the effects of currency misalignment on the Japanese real economy.

In order to explore a policy for minimizing the effects of currency volatility in East Asia on the macroeconomic situation, it is necessary to conduct analysis using the AMU Deviation Indicators. Kamin and Rogers (2000), and Kim and Ying (2007) investigated the effects of currency misalignment on the real GDP. These earlier studies attempted to test the hypothesis of "contractionary devaluation" in developing countries. Kamin and Rogers (2000) conducted analysis using the real exchange rate and real GDP of Mexico, in an attempt to find out whether Mexico's devaluation of the peso in 1994 was effective in terms of economic recovery. Through the analysis using a VAR model, they demonstrated that the substantial devaluation of the peso had a negative effect on Mexico's real GDP. Kim and Ying (2007) attempted to test the same hypothesis using data of East Asian countries. Based on the analysis

using the data up until 1997, they reached the conclusion that currency devaluation does not always lead to economic downturn, calling into question the generality of the result obtained by Kamin and Rogers (2000). A large difference between these earlier studies and our analysis in this paper is that we use the real AMU Deviation Indicators, not the real exchange rates of the target countries. In addition to real exchange rates, real effective exchange rates might be another alternative indicator. However, unlike the real AMU Deviation Indicators, neither real exchange rates nor real effective exchange rates represent the directly measured degree of deviation of East Asian countries' currencies from the benchmark exchange rate which is assumed for stabilizing the trade balance.[3]

II-2. Linkage between East Asian countries' currencies and the US dollar

With a view to measuring the degree of linkage between East Asian countries' currencies and the US dollar, we conducted analysis applying the empirical analysis method used by Frankel and Wei (1994) to the currencies of East Asian countries. In this analysis, we targeted China, Korea, Thailand, Singapore, the Philippines, Indonesia, Malaysia, and Hong Kong, and used monthly data of these economies downloaded from the IMF*, International Financial Statistics*, for the period from January 1999 to January 2013. In order to investigate the impact of the global financial crisis, we divided this analysis period into two, i.e., the pre-Lehman Shock period (from January 1999 to August 2008) and the post-Lehman Shock period (from September 2008 to January 2013). The regression equation we applied in this analysis is as follows.

$$\Delta \log e^{home/SFR} = a_0 + a_1 \Delta \log e^{USD/SFR}$$

$$+ a_2 \Delta \log e^{JPY/SFR} + a_3 \Delta \log e^{EURO/SFR} + \varepsilon_t$$

where $e^{home/SFR}$ denotes the exchange rate of the target country's currency in terms of the Swiss franc, $e^{USD/SFR}$ denotes the exchange rate of the US dollar in terms of the Swiss franc, $e^{JPY/SFR}$ denotes the exchange rate of the Japanese yen in terms of the Swiss franc, and $e^{EURO/SFR}$ denotes the exchange rate of the euro in terms of the Swiss franc.

The estimate results are shown in Table 2. As can be seen from the movements of the nominal AMU Deviation Indicators shown in Figure 1, the Korean won experienced the largest fluctuations among East Asian countries' currencies after the financial crisis. According to the estimated results of the weights of the currencies for the Korean won, the weight of the US dollar dropped from about 64% before the Lehman Shock to 48% after. With regard to the Singapore dollar, which is recognized as being linked to the currency basket, the weight of the US dollar declined but not as greatly as seen for the Korean won. The weight of the US dollar also dropped from about 91% to about 70% for the Malaysian

[3] Ogawa and Shimizu (2006) provide a detailed explanation of the relationship between effective exchange rates and the AMU and AMU Deviation Indicators.

ringgit, which also experienced depreciation. The same declining trend was seen for the Philippine peso and the Indonesian rupiah. The weight of the US dollar for the Hong Kong dollar reached a high level, exceeding 98%, which is because Hong Kong adopts the currency board system and pegs the Hong Kong dollar to the US dollar.

The Thai baht also experienced larger fluctuations like the Korean won during the financial crisis. However, unlike the Korean won, the weight of the US dollar for the Thai baht rose from about 57% before the Lehman Shock to about 77% after, showing a stronger link to the US dollar than before.

With regard to the Chinese yuan, although China announced that it would adopt a managed floating exchange rate system with reference to a currency basket, the estimated weight of the US dollar for the Chinese yuan exceeded 96%, showing that this currency has continued to be pegged to the US dollar since before the Lehman Shock.

Table 2 Estimated weights of the basket currencies for East Asian countries' currencies, before and after the Lehman Shock

	Estimation period	Constant	USD	JPY	EUR	adjusted R-square	D.W.valule
THB	Pre-Lehman Shock	-0.0000 (0.0012)	0.5712 (0.0638)	0.1688 (0.0666)	0.4985 (0.1681)	0.6325	1.1352
	Post-Lehman Shock	-0.0021 (0.0013)	0.7736 (0.0728)	-0.0417 (0.0563)	0.1029 (0.0721)	0.8462	1.5353
SPD	Pre-Lehman Shock	-0.0009 (0.0007)	0.5944 (0.0368)	0.1807 (0.0384)	0.4421 (0.097)	0.847	1.7781
	Post-Lehman Shock	-0.0022 (0.0011)	0.5792 (0.0623)	0.0184 (0.0482)	0.1940 (0.0617)	0.8465	1.5893
KRW	Pre-Lehman Shock	-0.0009 (0.0015)	0.6464 (0.0790)	0.4050 (0.0825)	0.4327 (0.2081)	0.6541	1.4763
	Post-Lehman Shock	-0.0019 (0.0036)	0.4817 (0.1884)	-0.3367 (0.1457)	0.6719 (0.1867)	0.3598	1.6075
PHP	Pre-Lehman Shock	0.0015 (0.0015)	0.8819 (0.0767)	0.0729 (0.0801)	0.5022 (0.2021)	0.6862	1.1266
	Post-Lehman Shock	-0.0025 (0.0018)	0.7805 (0.0956)	-0.0977 (0.0739)	0.2555 (0.0947)	0.7688	1.9435
IDR	Pre-Lehman Shock	0.0011 (0.0035)	0.6120 (0.1811)	0.1299 (0.1892)	1.4901 (0.4772)	0.2506	1.5714
	Post-Lehman Shock	0.0003 (0.0038)	0.4701 (0.1981)	-0.1430 (0.1532)	0.4344 (0.1963)	0.2553	1.7267
MYR	Pre-Lehman Shock	-0.0009 (0.0005)	0.9116 (0.0297)	0.0104 (0.0310)	0.0761 (0.0783)	0.9294	1.2520
	Post-Lehman Shock	-0.0015 (0.0016)	0.7077 (0.0875)	-0.0901 (0.0676)	0.1141 (0.0867)	0.7405	1.5041
HKD	Pre-Lehman Shock	0.0000 (0.0001)	0.9855 (0.0052)	0.0047 (0.0054)	-0.0013 (0.0137)	0.9979	1.5823
	Post-Lehman Shock	-0.0001 (0.0001)	0.9882 (0.0083)	0.0128 (0.0064)	0.0093 (0.0082)	0.9986	1.4640
CNY	Pre-Lehman Shock	-0.0015 (0.0003)	0.9715 (0.0162)	-0.0028 (0.0169)	-0.0236 (0.0427)	0.9798	0.6103
	Post-Lehman Shock	-0.0015 (0.0003)	0.9628 (0.0199)	0.0099 (0.0153)	0.0124 (0.0197)	0.9917	1.1367

(Divided into the pre-Lehman Shock period (from January 1999 to August 2008) and the post-Lehman Shock period (from September 2008 to January 2013); monthly data; figures in parentheses are standard errors)

III. Estimation of Structural VAR Model, Using Real AMU Deviation Indicators of ASEAN 10 + 3

In this section, we describe the estimation of a structural vector regressive (VAR) model conducted in order to analyze the effects of currency misalignment on Japanese macroeconomic variables. First, we conducted a structural VAR analysis using seven variables, namely, (i) Japan's real GDP (*y*), (ii) Japan's current account balance as a percentage of GDP (*ca*), (iii) the real exchange rate of the AMU in terms of the US dollar-euro currency basket (*RAMU*), (iv) the real AMU Deviation Indicators of the respective countries' currencies (*RAMUDI*), (v) the real AMU Deviation Indicator of the Japanese yen (*RAMUDIYEN*), (vi) Japan's inflation rate (π), and (vii) United States' real GDP (y^*).

III-1. Estimation Method

In order to analyze the effects of the real AMU Deviation Indicators of East Asian countries' currencies on Japanese macroeconomic variables, we used the structural VAR model expressed by the following equation. We took the logs of the variables except for the real AMU Deviation Indicators, inflation rate, and current account balance, and we took differences of the first degree for some variables, which are marked with Δ.

$$\begin{bmatrix} \Delta y_t^* \\ \Delta RAMU_t \\ \Delta RAMUDI_t \\ \Delta RAMUDIYEN_t \\ \pi_t \\ \Delta y_t \\ \Delta ca_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \\ \mu_7 \end{bmatrix} + A(L) \begin{bmatrix} \Delta y_{t-1}^* \\ \Delta RAMU_{t-1} \\ \Delta RAMUDI_{t-1} \\ \Delta RAMUDIYEN_{t-1} \\ \pi_{t-1} \\ \Delta y_{t-1} \\ \Delta ca_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \end{bmatrix} \quad (1)$$

where the first term of the right-hand side denotes a constant term, *A(L)* denotes a lag coefficient, and the last term of the right-hand side denotes a standard error. The lag number we used for the analysis was four. Equation (1) conducts estimation separately for the real AMU Deviation Indicator (*RAMUDI*) of each target country. Then, in order to distinguish the economic impact of currency misalignment as represented by the real AMU Deviation Indicators (misalignment impact) by applying the method used by Sims (1980), we imposed the following restrictions.

$$\varepsilon_t = Bu_t,$$

where *B*: Lower triangular matrix, $\varepsilon_t \equiv [\varepsilon_{1t}\ \varepsilon_{2t}\ \varepsilon_{3t}\ \varepsilon_{4t}\ \varepsilon_{5t}\ \varepsilon_{6t}\ \varepsilon_{7t}]'$: error term of a reduced-form model, and $u_t \equiv [u_{1t}\ u_{2t}\ u_{3t}\ u_{4t}\ u_{5t}\ u_{6t}\ u_{7t}]'$: error term of a structural model. The variance-covariance matrix of u_t is assumed as 7 × 7 identity matrix.

Then, we distinguished the economic impact of currency misalignment by conducting Cholesky decomposition of matrix *BB'*. In this process, where the order of variables is important, we set a hypothetical order as shown in Equation (1), with reference to Kamin and Rogers (2000) and other earlier studies. In this hypothesis, we assumed that Japan's real GDP

would not affect any of the other variables, except for Japan's current account balance (as a percentage of GDP), in the short-run, and that Japan's current account balance would not affect any of the other variables in the short-run.. We also assumed that the United States' GDP would serve as an exogenous variable which would not be affected by any of the other variables. We also used the real exchange rate of the AMU in terms of the US dollar-euro currency basket (*RAMU*) as a variable, with a view to analyzing whether currency misalignment, represented by the real AMU Deviation Indicators of East Asian countries' currencies, could still affect Japanese macroeconomic variables even when we preclude the fact that the AMU fluctuated in conjunction with the US dollar and euro, which are the major currencies in the region.

III-2. Data used for estimation

For estimation, we used quarterly data taken during the period from the first quarter of 2000 to the first quarter of 2012. As the data of the United States' real GDP, we used the seasonally adjusted data (benchmark year=2005) downloaded from the database provided by the Federal Reserve Bank of St. Louis, named the Federal Reserve Economic Data (FRED). As the data of the real exchange rate of the AMU in terms of the US dollar-euro currency basket (*RAMU*), we used the data of the nominal exchange rate of the AMU in terms of the US dollar-euro currency basket downloaded from the Research Institute of Economy, Trade and Industry (RIETI) website, AMU page (http://www.rieti.go.jp/users/amu/), by turning it into real-term data using the weighted arithmetic averages of the consumer price index of the United States (downloaded from the FRED database) and of the consumer price indexes of 10 ASEAN countries plus Japan, China, and Korea (ASEAN 10 + 3) on the basis of the trade balance and GDP. The US dollar accounts for 65% of the currency basket and the euro accounts for 35%. As for the real AMU Deviation Indicators, we used the data downloaded from the AMU page of the RIETI website. As for Japan's real GDP, we used the seasonally adjusted data downloaded from the IMF, *International Financial Statistics*. Regarding Japan's current account balance and trade balance (balance of goods and services), as percentages of GDP, we used the data downloaded from the Balance of Payments page of the Ministry of Finance website, after dividing it by Japan's nominal GDP (published by the Cabinet Office; benchmark year = 2005).

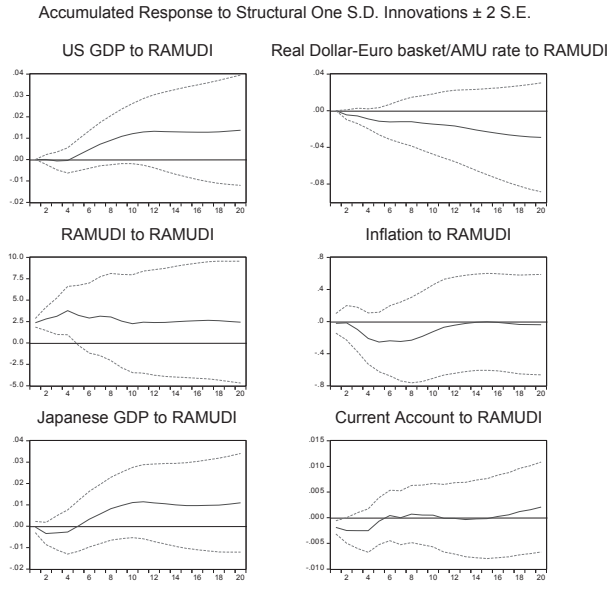
III-3. Analysis results

Figures 4 to 12 show the accumulated impulse response functions of the respective variables in relation to the economic impact of currency misalignment as represented by the real AMU Deviation Indicators of the target countries' currencies.

Figure 4 shows the impulse response functions in relation to the economic impact of currency misalignment as represented by the real AMU Deviation Indicator of the Japanese

yen, using only the real AMU Deviation Indicator of the Japanese yen in Equation (1).[4] From this figure, we can see that the impact of the rise in the real AMU Deviation Indicator of the Japanese yen, that is, the impact of the real overvaluation of the Japanese yen in terms of the AMU, measured with the effect of the inflation being excluded, caused a slight decline in Japan's real GDP in the short term but then caused a rise in the GDP. This result suggests that when, conversely, the Japanese yen depreciates and it is undervalued, Japan's real GDP would rise only in the short-run and it would decline thereafter. This finding calls into question the effectiveness of an exchange rate policy of leading the Japanese yen to depreciate. Furthermore, the accumulated impulse response function of Japan's inflation rate, or in other words, the impulse response of prices in Japan, in relation to the impact of the real overvaluation of the Japanese yen, declined in the short-run but became statistically insignificant thereafter, from around the fourth quarter. Similarly, the impulse response of Japan's current account balance in relation to the impact of the real overvaluation of the Japanese yen declined in the short-run but then became statistically insignificant, from around the fourth quarter. These results suggest that when the Japanese government adopts a policy of leading the Japanese yen to depreciate, prices in Japan would rise and Japan's current account balance would increase in the short term, but such policy would not have a significant influence on domestic prices or current account balance in the long-run.

Figure 4 Accumulated impulse response functions in relation to the economic impact of currency misalignment as represented by the real AMU Deviation Indicator of the Japanese yen



[4] In this case, the third variable is excluded from Equation (1).

Figure 5 shows the impulse response functions in relation to the economic impact of currency misalignment as represented by the real AMU Deviation Indicator of the Korean won. The impact of the real overvaluation of the Korean won in terms of the AMU caused a slight decline in Japan's real GDP at the time when the impact took place, but then it caused a significant rise in Japan's real GDP. The positive correlation between Japan's real GDP and the impact as represented by the real AMU Deviation Indicator of the Korean won implies a *beggar-thy-neighbor* relationship in the sense that the undervaluation of the Korean won that took place due to the withdrawal of capital from Korea in the wake of the global financial crisis resulted in the decline of Japan's GDP. The figure also shows that Japan's current account balance improved in response to the impact of the real overvaluation of the Korean won. These results suggest that the undervaluation of the Korean won had an adverse effect on Japan's current account balance, which is consistent with the effect of the abovementioned *beggar-thy-neighbor* relationship between Korea and Japan. Similar results can be found in the impulse response functions of Japanese macroeconomic variables in relation to the real AMU Deviation Indicator of the Thai baht, as shown in Figure 7. The impact of the real overvaluation of the Thai baht in terms of the AMU caused a rise in the Japan's real GDP as well as a rise in its current account balance. This result suggests the effect of a *beggar-thy-neighbor* relationship between Thailand and Japan through misalignment of the Thai baht, as was found between Korea and Japan, in the sense that the undervaluation of the Thai baht that took place in the wake of the global financial crisis resulted in the decline in Japan's real GDP and current account balance.

Figure 5 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Korean won

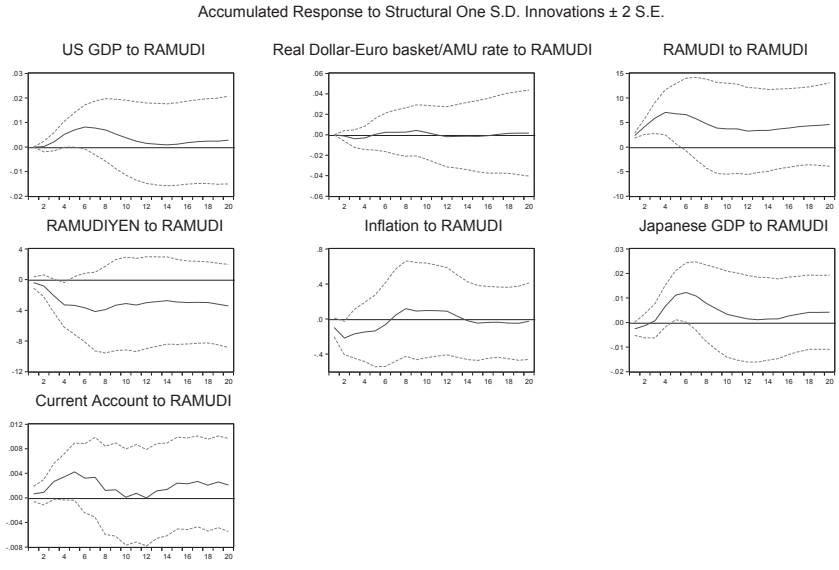


Figure 6 shows the impulse response functions in relation to the real AMU Deviation

Indicator of the Chinese yuan. In response to the real overvaluation of the Chinese yuan in terms of the AMU, Japan's real GDP did not change significantly in the short-run but it then declined over the medium term. Japan's current account balance rose in the short term but it did not change significantly in the long-run. The accumulated impulse response function of Japan's inflation rate, that is, the impulse response of prices in Japan was not significant, which suggests that the Chinese yuan would not greatly affect prices in Japan, irrespective of whether it is overvalued or undervalued.

Figure 6 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Chinese yuan

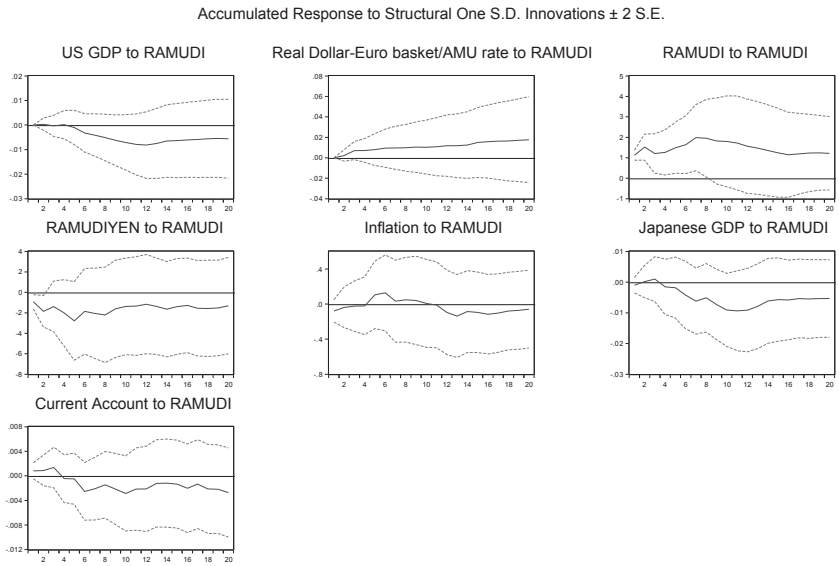
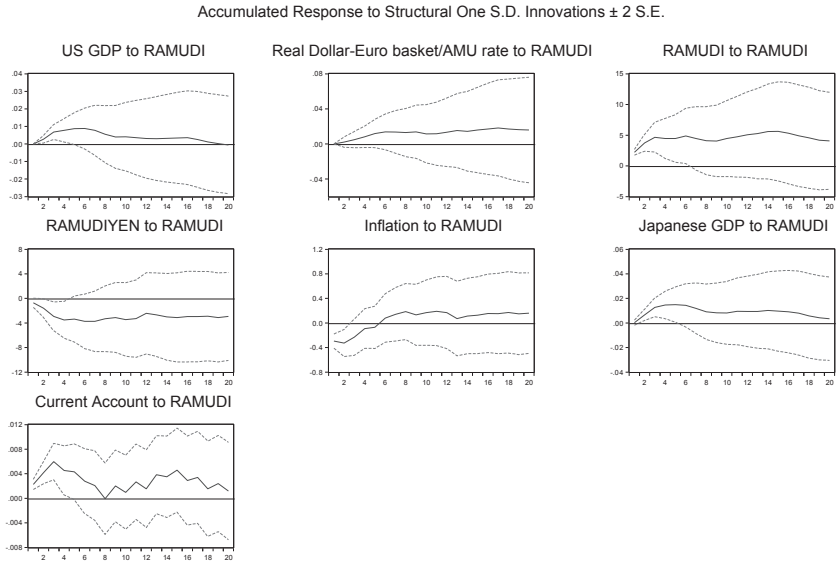


Figure 7 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Thai baht



Figures 8 to 11 show the impulse response functions in relation to the real AMU Deviation Indicators of the currencies of Malaysia, the Philippines, Singapore, and Indonesia. Reactions of Japanese macroeconomic variables were small or insignificant. In other words, the currencies of these four countries would not greatly affect Japanese macroeconomic variables, irrespective of whether these currencies are overvalued or undervalued in real terms against the AMU. This suggests that it is necessary to conduct surveillance focusing on the movements of the deviation indicators of the currencies of the aforementioned four countries, namely, Japan, Korea, Thailand, and China.

Figure 8 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Malaysian ringgit

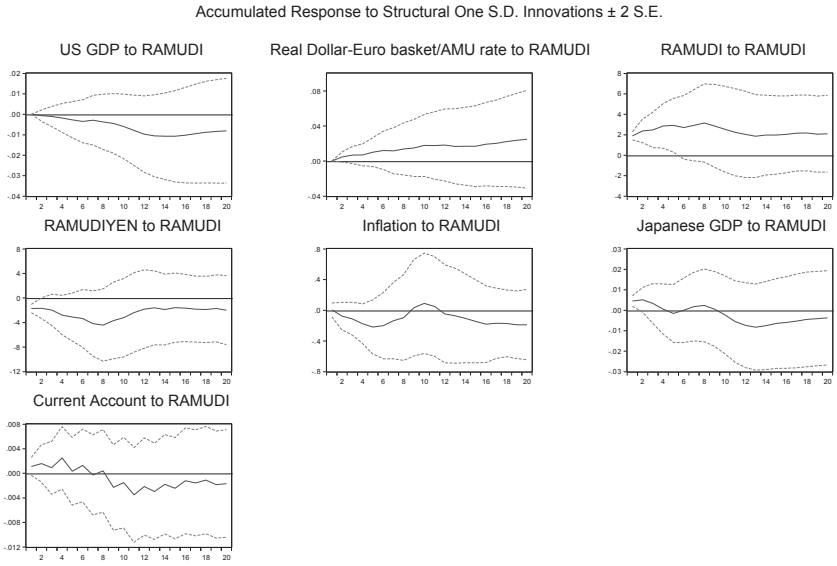


Figure 9 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Philippine peso

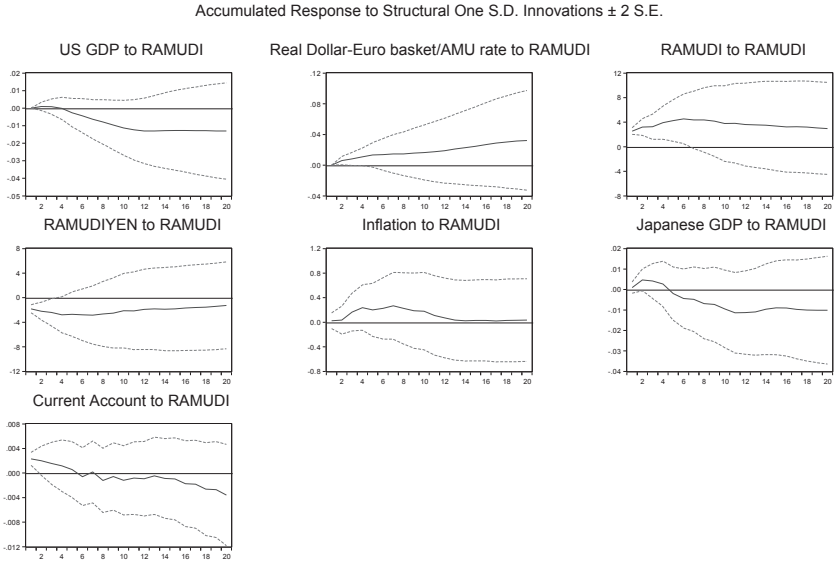


Figure 10 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Singapore dollar

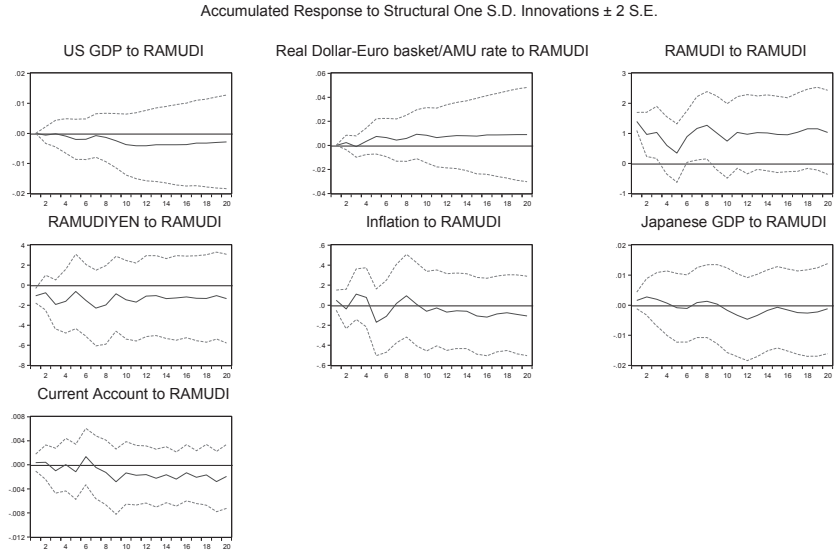


Figure 11 Accumulated impulse response functions in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicator of the Indonesian rupiah

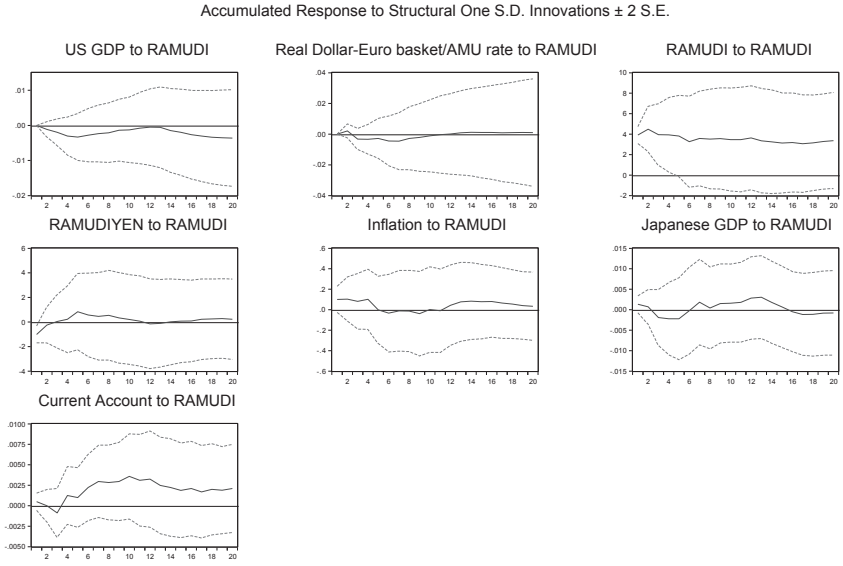
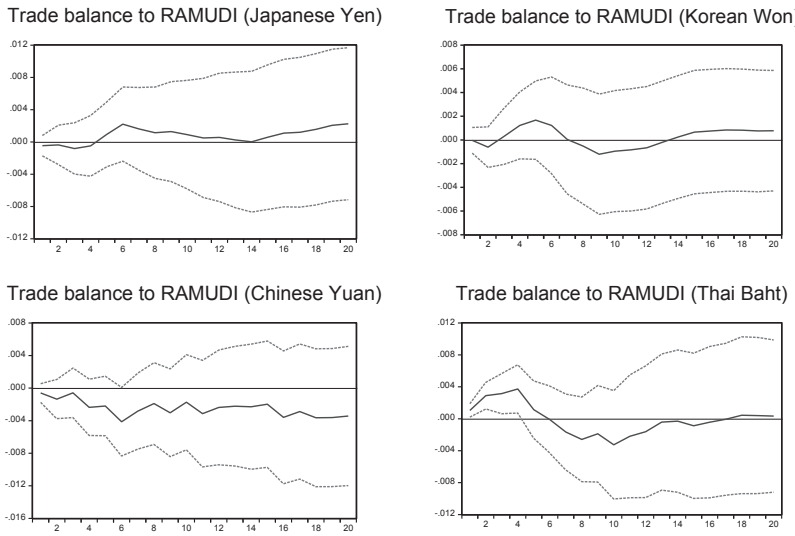


Figure 12 shows the results of the impulse response functions using Japan's trade balance (*tb*), instead of its current account balance. Hereinafter, we only present the results of the four estimation equations using the deviation indicators of the currencies of Japan, China, Korea, and Thailand—which we have picked out as countries of particular note based on the analysis

of the current account balance described above. On a qualitative basis, the impulse responses measured using the trade balance are the same as those measured using the current account balance. More specifically, the economic impact of currency misalignment as represented by the real AMU Deviation Indicator of the Japanese yen did not significantly affect Japan's trade balance. This means that the policy of leading the Japanese yen to depreciate so that it would be undervalued is no longer effective as a means to improve the trade balance. The same tendency can be found with the results regarding the real AMU Deviation Indicators of the Chinese yuan and the Korean won. Misalignment of the Chinese yuan did not greatly affect Japan's trade balance. On the other hand, the positive impact as represented by the real AMU Deviation Indicator of the Thai baht caused a rise in Japan's trade balance in the short term (about one year). This suggests the possibility that when the real AMU Deviation Indicator of the Thai baht declines, that is, when the Thai baht depreciates against the other East Asian currencies, Japan's trade balance would deteriorate in the short term.

Figure 12 Accumulated impulse response functions of Japan's trade balance in relation to the impact of currency misalignment as represented by the real AMU Deviation Indicators of the Japanese yen, the Korean won, the Chinese yuan, and the Thai baht



Tables 3 to 5 show the results of variance decomposition of the prediction error, which are results of the estimation equations using only the current account balance. Based on the results of the impulse response functions mentioned above, we excluded Malaysia, the Philippines, Singapore, Indonesia, and China because they only have a small influence, and we only presented the results of the estimation equations using the real AMU Deviation Indicators of the remaining three countries, namely, Japan, Korea, and Thailand. The estimation periods are the first, second, fourth, eighth, and twentieth quarters. In each table, the first column shows variables in VAR that contribute to the variance of the prediction error

of the respective variables (real GDP, inflation rate, and current account balance).

Table 3 shows that in the case of the real AMU Deviation Indicator of the Japanese yen, the variable that had the highest degree of contribution to the variance of Japan's real GDP had been the real GDP itself in all analytical periods, contributing to 40% to 70% of the variance, when roughly estimated. The point deserving the most attention is that the real AMU Deviation Indicator of the Japanese yen scarcely contributed to the variance of Japan's real GDP in the first quarter, but its degree of contribution increased with each passing quarter and exceeded 10% in eight quarters (two years), reaching the same level as the degree of contribution of the real exchange rate of the AMU in terms of the US dollar-euro currency basket. The degree to which the real AMU Deviation Indicator can explain the variance of the inflation rate was low, staying between 0% and 9%. Meanwhile, the real AMU Deviation Indicator contributed to about 16% of the variance of the current account balance in the first and second quarters, marking the third highest degree of contribution following the current account balance itself and the real GDP.

Table 3 Variance decomposition of Japanese macroeconomic variables (by the estimation equation using the real AMU Deviation Indicator of the Japanese yen)

Quarter	(1)	(2)	(4)	(8)	(20)
Variance decomposition of the real GDP					
y^*	7.86	30.49	24.09	19.23	18.31
RAMU	21.30	14.50	13.55	13.10	13.24
RAMUDIYEN	0.11	5.95	4.67	12.67	13.06
π	0.05	0.62	9.90	8.55	9.00
y	70.69	47.78	40.42	38.28	38.01
ca	0.00	0.66	7.38	8.17	8.37
Variance decomposition of the inflation rate					
y^*	1.63	16.69	13.67	13.27	14.05
RAMU	2.92	4.42	8.98	7.99	9.58
RAMUDIYEN	0.29	0.25	6.95	6.23	8.15
π	95.16	77.89	61.68	55.31	51.54
y	0.00	0.75	3.45	12.31	11.72
ca	0.00	0.00	5.27	4.89	4.94
Variance decomposition of the current account balance					
y^*	5.60	5.59	13.36	19.53	26.67
RAMU	4.05	3.88	2.88	21.26	19.20
RAMUDIYEN	15.91	16.70	9.66	9.97	7.11
π	8.06	9.52	15.82	11.61	13.77
y	20.12	19.66	15.85	16.12	16.00
ca	46.26	44.64	42.43	21.51	17.25

Table 4 shows the results of the estimation equation using the real AMU Deviation Indicator of the Korean won. The real AMU Deviation Indicator of the Korean won can explain about 6% of the variance of Japan's real GDP even in the short term (in the first and second quarters). After four quarters (one year) passed, the degree of contribution of the real AMU Deviation Indicator of the Korean won exceeded that of the real exchange rate of the AMU in terms of the US dollar-euro currency basket, reaching the level of over 20%. The degree to which the real AMU Deviation Indicator of the Korean won can explain the variance of Japan's inflation rate was low (about 7% to 11% in all quarters), but the degree of

contribution of the real AMU Deviation Indicator to the variance of the inflation rate was the second highest in the first quarter, following the inflation rate itself. The degree of contribution of the real AMU Deviation Indicator to Japan's current account balance was low in the short term, but after four quarters passed, it exceeded the degree of contribution of the real exchange rate of the AMU in terms of the US dollar-euro currency basket and then its influence gradually diminished.

Table 4 Variance decomposition of Japanese macroeconomic variables (by the estimation equation using the real AMU Deviation Indicator of the Korean won)

Quarter	(1)	(2)	(4)	(8)	(20)
Variance decomposition of the real GDP					
y^*	4.15	16.11	12.76	12.73	12.96
RAMU	23.97	19.64	14.20	17.15	16.56
RAMUDI	5.65	5.72	20.27	20.73	21.83
RAMUDIYEN	0.07	2.76	5.54	10.50	9.91
π	1.49	1.26	3.98	3.72	4.78
y	64.68	54.48	36.25	29.77	28.27
ca	0.00	0.03	7.00	5.40	5.68
Variance decomposition of the inflation rate					
y^*	1.71	30.29	25.42	22.21	21.34
RAMU	2.58	5.02	14.09	12.85	14.79
RAMUDI	6.65	9.56	8.31	11.22	11.04
RAMUDIYEN	0.01	4.29	7.78	6.47	7.20
π	89.05	50.01	40.41	35.24	32.08
y	0.00	0.69	2.10	10.21	11.21
ca	0.00	0.13	1.88	1.81	2.35
Variance decomposition of the current account balance					
y^*	0.01	1.04	13.13	15.62	22.07
RAMU	10.29	10.12	7.24	29.58	24.64
RAMUDI	2.19	2.44	10.68	9.12	8.64
RAMUDIYEN	18.66	18.27	10.95	9.08	8.52
π	0.67	0.78	4.42	5.72	9.71
y	16.94	16.25	14.32	14.70	14.86
ca	51.23	51.09	39.27	16.18	11.58

Table 5 shows the results of the estimation equation using the real AMU Deviation Indicator of the Thai baht. The degree of contribution of the real AMU Deviation Indicator of the Thai baht to the variance of Japan's real GDP was low in the short term, but, as in the case of the Korean won, after two quarters passed, it considerably exceeded the degree of contribution of the real exchange rate of the AMU in terms of the US dollar-euro currency basket, reaching the level over 20%. As for the variance of Japan's inflation rate and current account balance, the degree of contribution of the real AMU Deviation Indicator was the highest. These results suggest that the estimation using the real AMU Deviation Indicators demonstrates that currency misalignment could affect Japanese macroeconomic variables, that is, the real GDP, inflation rate, and current account balance, which is consistent with the finding based on the results of the impulse response functions.

Table 5 Variance decomposition of Japanese macroeconomic variables (by the estimation equation using the real AMU Deviation Indicator of the Thai baht)

Quarter	(1)	(2)	(4)	(8)	(20)
Variance decomposition of the real GDP					
y^*	4.83	34.84	24.50	22.94	22.33
RAMU	28.69	10.64	7.41	7.80	11.51
RAMUDI	0.09	22.33	29.68	26.05	23.47
RAMUDIYEN	0.04	0.64	16.43	20.19	17.39
π	1.62	6.95	5.03	6.82	8.76
y	64.74	24.50	16.73	14.69	14.85
ca	0.00	0.09	0.22	1.51	1.68
Variance decomposition of the inflation rate					
y^*	0.84	10.24	9.48	18.37	16.82
RAMU	0.24	2.55	4.16	3.45	6.24
RAMUDI	45.87	39.62	43.68	35.81	31.95
RAMUDIYEN	10.17	9.02	8.58	8.60	11.29
π	42.88	38.47	32.38	25.06	24.17
y	0.00	0.10	0.09	5.87	5.77
ca	0.00	0.00	1.64	2.83	3.76
Variance decomposition of the current account balance					
y^*	0.67	5.91	8.81	22.26	28.46
RAMU	0.24	0.16	1.12	20.98	18.15
RAMUDI	50.32	56.99	45.13	23.89	24.73
RAMUDIYEN	3.54	2.57	7.03	11.70	7.20
π	5.12	5.82	3.73	2.10	4.90
y	1.99	1.32	15.38	10.33	11.24
ca	38.13	27.23	18.80	8.74	5.33

IV. Conclusion

In this paper, we discussed the importance of monetary and financial cooperation in East Asia to the Japanese economy, based on the results of the two empirical analyses. First, we conducted an analysis of exchange rate systems operated in effect by East Asian countries, with regard to the pre-Lehman Shock period and the post-Lehman Shock period. In this analysis, we found that the currency peg to the dollar strengthened in some countries after the Lehman Shock, while it weakened in other countries. We also found that although China announced that it would adopt a more flexible exchange rate system as part of its currency reforms, the Chinese yuan continued to be pegged to the dollar before and after the Lehman Shock. The exchange rate systems actually adopted by East Asian countries are asymmetric, posing the risk of misalignment of exchange rates, without any desirable policy coordination having been made thus far.

The global financial crisis affected the currencies of East Asian countries in an asymmetric fashion. In particular, the Korean won and the Thai baht made larger fluctuation and abrupt depreciation during the global financial crisis. In this respect, we conducted an analysis of the spillover effects of misalignment of currencies of East Asian countries on Japanese macroeconomic variables, using the real AMU Deviation Indicators of these currencies. Through this analysis, we found that when the Korean won and the Thai baht, which made larger fluctuation in the wake of the global financial crisis, were undervalued in real terms

against the AMU, this brought about a *beggar-thy-neighbor* relationship in which the undervaluation of these currencies caused a decline in Japan's trade balance, current account balance, and real GDP. In order to mitigate such negative effects of currency misalignment on the business cycle and thereby stabilize macroeconomic variables in the region, it is desirable that exchange rates be coordinated using the AMU as a reference. At the same time, it is necessary to enhance surveillance on the macroeconomic situations including exchange rates in and outside East Asia, led by the ASEAN + 3 Macroeconomic Research Office (AMRO) under the multilateralized version of the Chiang Mai Initiative (CMI Multilateralization (CMIM)).

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