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The AMU Deviation Indicators Based on the Purchasing Power Parity and Adjusted by the Balassa-Samuelson Effect*

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Abstract

This paper investigates how the AMU Deviation Indicators for surveillance measurements among East Asian currencies are improved by changing their benchmark rates from the constant rates in 2000-2001 to time-varying rates based on their Purchasing Power Parities (PPPs). The Consumer Price Indexes (CPIs) are used to calculate their PPPs as a time-varying benchmark for the AMU Deviation Indicators. Because the CPIs include prices of non-tradable goods, the PPPs based on the CPIs have a problem related with the Balassa-Samuelson effect. For the reason, the PPPs adjusted by the Balassa-Samuelson effect should be used to calculate the AMU Deviation Indicators when the CPIs are used as price data. This paper compares the two types of the PPP-based AMU Deviation Indicators and the PPP-based AMU Deviation Indicators adjusted by the Balassa-Samuelson effect. We conclude that both the PPP-based AMU Deviation Indicators and the PPP-based AMU Deviation Indicators adjusted by the Balassa-Samuelson effect are also useful in making surveillance over overvaluation or undervaluation of the intra-regional exchange rates of East Asian currencies.

Key words: Asian Monetary Unit, AMU Deviation Indicators, Purchasing Power Parity, Balassa-Samuelson Effect, Regional Monetary Cooperation

JEL classification codes: F31, F33, F36

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1. Introduction

In the aftermath of the East Asian currency and financial crisis in 1997, the need for surveillance over intra-regional exchange rates among East Asian currencies for crisis prevention has been propounded by some policymakers and scholars. Among the propositions, in order to strengthen the regional monetary cooperation in East Asia, the Chiang Mai Initiative (CMI) was established by the members of ASEAN, Japan, China and Korea (ASEAN+3). Under the CMI, the monetary authorities have developed a cooperative relationship in the field of bilateral and multilateral currency swap arrangements. At the same time, in order to make surveillance over macroeconomic performance of each member country of ASEAN+3, the Economic Review and Policy Dialogue (ERPD) was executed at the Finance Deputy Ministers Meeting of ASEAN+3. However, the CMI is an agreement that was arranged for the purpose of managing a crisis. Therefore, it may be useful once a currency crisis happens. On one hand, the ERPD is a surveillance system only focusing on the performance of each country's macroeconomic variables such as GDP and inflation rate. To prevent a currency crisis in the future and enhance surveillance within ASEAN+3, it is necessary to incorporate intra-regional exchange rates into the surveillance process, and the monetary authorities are expected to establish a surveillance system to monitor fluctuations and misalignments of each currency of ASEAN+3.

In the context of the increasing needs for coordination of exchange rate policies among East Asian countries, Ogawa and Shimizu (2005, 2006a) have proposed a new surveillance measurement called the Asian Monetary Unit (AMU). The AMU is calculated by the same method used to calculate the European Currency Unit (ECU). AMU Deviation Indicators of component currencies of the AMU are useful for monitoring deviations of East Asian currencies from the benchmark rate. The AMU Deviation Indicators include two types, namely, the Nominal AMU Deviation Indicator and the Real AMU Deviation Indicator, depending on their purposes.

On the basis of previous studies about the AMU and the AMU Deviation Indicators, we point out that the benchmark rate should be not constant but varying over time especially for currencies of East Asian countries with higher productivity growth. We improve the AMU Deviation Indicators by changing the benchmark rate from a constant rate into a time-varying rate based on the Purchasing Power Parity (PPP). The Consumer Price Indexes (CPIs) are used to calculate their PPP as a time-varying benchmark for AMU Deviation Indicators because of data constraints for some countries. Because the CPIs include prices of non-tradable goods, the PPP based on the CPIs have a problem such as the Balassa-Samuelson effect. For the reason, the PPP

adjusted by the Balassa-Samuelson effect should be used to calculate the AMU Deviation Indicators when the CPIs are used as price data.

Thus, we also calculate the Balassa-Samuelson effect on each currency in order to eliminate the Balassa-Samuelson effect from the benchmark rate based on the PPP. We compare the two types of the AMU Deviation Indicators based on the PPP and the PPP adjusted by the Balassa-Samuelson effect. Our comparisons between both of them have a result that the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect can be used as subsidiary indexes to complement the original AMU Deviation Indicators.

This paper has the following contents. In section 2, we will begin by reviewing the advanced research about the AMU and the AMU Deviation Indicators. In section 3, we estimate the AMU Deviation Indicator by using the benchmark rate which is calculated by the PPP. In section 4, a simple model which is used to explain the Balassa-Samuelson effect will be clarified. The Balassa-Samuelson effect of each country of the ASEAN6+3 will be calculated according to the model. We use the results to indicate impacts of each variable on the calculation of the Balassa-Samuelson effect. The PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect will be worked out at last. In section 5, we conclude that it is a useful way to use the revised AMU Deviation Indicators as well as the original AMU Deviation Indicators to strengthen the regional monetary cooperation within ASEAN+3.

2. Asian Monetary Unit and AMU Deviation Indicators

In terms of a common currency basket in East Asia, which is expected to enforce surveillance over intra-regional exchange rates, it is believed that the monitoring effort within the framework of ASEAN+3 is the most efficient. Ogawa and Shimizu (2005) advocated a new type of currency basket called the Asian Monetary Unit that is a weighted average of the currencies of ASEAN+3. The AMU is calculated by the same method used to calculate the European Currency Unit (ECU) under the European Monetary System (EMS) prior to the introduction of the euro in 1999. Weights on each currency in the currency basket is based on the share of GDP measured in terms of PPP and trade volumes (the sum of exports and imports), which respectively is the proportion of one country to the others. Since both the United States and the EU are important trading partners of ASEAN+3, the official exchange rate of the AMU is set up in terms of a weighted average of the U.S. dollar and the euro. On the basis of the East Asian countries' trade volumes with the United States and the euro-zone, the weights of the U.S. dollar and the euro are set 65% and 35%, respectively.

It is necessary to determine a benchmark in order to calculate the AMU Deviation Indicators from the benchmark period level. Depending on the comparisons of the total trade balance of the member countries, the total trade balance of the member countries with Japan, and the total trade balance of the member countries with the rest of world, which a period relatively close to zero is selected as the benchmark period. Also, the benchmark exchange rate is selected with reference to the most balanced period of trading. On the basis of trade accounts of ASEAN+3 from the beginning of the 1990s until recently, the trade accounts of the 13 countries were closest to balance in 2001. Assuming a one-year time lag before changes in exchange rates affect trade volumes, 2000 and 2001 are chosen as the benchmark period. The exchange rate of the AMU is calculated by the following equation:[1]

$$\begin{aligned}\frac{USD\,\&\,EUR}{AMU} = {} & 0.0040\times\frac{USD\,\&\,EUR}{BND} + 6.2017\times\frac{USD\,\&\,EUR}{KHR} + 3.0765\times\frac{USD\,\&\,EUR}{CNY} \\ & + 472.2701\times\frac{USD\,\&\,EUR}{IDR} + 26.5817\times\frac{USD\,\&\,EUR}{JPY} \\ & + 124.1471\times\frac{USD\,\&\,EUR}{KRW} + 9.4017\times\frac{USD\,\&\,EUR}{LAK} \\ & + 0.1729\times\frac{USD\,\&\,EUR}{MYR} + 0.0208\times\frac{USD\,\&\,EUR}{MMK} \\ & + 0.9247\times\frac{USD\,\&\,EUR}{PHP} + 0.1165\times\frac{USD\,\&\,EUR}{SGD} \\ & + 1.9639\times\frac{USD\,\&\,EUR}{THB} + 298.7892\times\frac{USD\,\&\,EUR}{VND}\end{aligned}$$

where USD denotes the U.S. dollar, EUR denotes the euro, BND denotes the Brunei dollar, KHR denotes the Cambodian riel, CNY denotes the Chinese yuan, IDR denotes the Indonesian rupiah, JPY denotes the Japanese yen, KRW denotes the Korean won, LAK denotes the Laos kip, MYR denotes the Malaysian ringgit, MMK denotes the Myanmar kyat, PHP denotes the Philippine peso, SGD denotes the Singapore dollar, THB denotes the Thai baht, VND denotes the Vietnamese dong.

A Nominal AMU Deviation Indicator is useful in order to monitor the deviations of how far one currency's exchange rate in terms of the AMU per national currency is away from the benchmark rate in real time. The Nominal AMU Deviation Indicator is calculated by the following equation:[2]

[1] The share and the weight on each country in the AMU were revised in October 2011.
[2] N.C. stands for National Currency.

The Nominal AMU Deviation Indicator (%)

$$= \frac{\left(\frac{AMU}{N.C.}\right)^{Actual} - \left(\frac{AMU}{N.C.}\right)^{Benchmark}}{\left(\frac{AMU}{N.C.}\right)^{Benchmark}} \times 100$$

The Nominal AMU Deviation Indicator is expected to act as an index for each country to monitor the volatility of foreign exchange rates on a daily basis. If the Nominal AMU Deviation Indicator is positive, the value of the currency is overvalued. On one hand, if the Nominal AMU Deviation Indicator is negative, the value of the currency is undervalued.

In contrast, a Real AMU Deviation Indicator is more appropriate for conducting surveillance of the effects of foreign exchange rates on the real economy which includes international trade and trade balances. The Real AMU Deviation Indicator is calculated by taking into account inflation rate differentials. It can be worked out according to the following equation:

The Real AMU Deviation Indicator (%)

$$= \textit{the Rate of Change in Nominal AMU Deviation Indicator of Country } i - \left(\dot{P}_{AMU} - \dot{P}_i\right)$$

where $\dot{P}_{AMU}$ is the inflation rate in ASEAN+3 and $\dot{P}_i$ is the inflation rate of country i.

In summary, the Nominal AMU Deviation Indicator is more useful in monitoring the intra-regional exchange rates in terms of frequency and time lag. In contrast, the Real AMU Deviation Indicator is more effective in investigating the effects of exchange rates on real economic variables such as trade volumes or real GDP.

3. PPP-based AMU Deviation Indicator

Both the Nominal and Real AMU Deviation Indicators are expected to be used as complementary measures for the surveillance over intra-regional exchange rates among East Asian currencies. However, there is a question whether it is appropriate to use a constant benchmark rate over time to show overvaluation or undervaluation of East Asian currencies with higher productivity growth. Because the benchmark rate of the AMU Deviation Indicators is the average rate of 2000 and 2001, the Nominal and Real AMU Deviation Indicators reflect spreads between an actual exchange rate and the benchmark rate. Along with the remarkable economic growth with higher productivity improvements in East Asia and the structural changes in foreign exchange policies in China and Malaysia, there is a possibility that the current AMU Deviation Indicators

might not be sufficient to observe foreign exchange rate conditions of each country appropriately. Therefore, it is necessary to take into account equilibrium exchange rates or the PPP to observe the changes in exchange rates within ASEAN+3 adequately.

Furthermore, it is also important to strengthen the functions of the AMU Deviation Indicators because the AMU Deviation Indicators play an important role in regional currency cooperation among ASEAN+3. On the basis of previous studies about the AMU Deviation Indicators, a new approach to the AMU Deviation Indicators is introduced by taking into account a time-varying benchmark rate based on the PPP. The year of 2001 is selected as the benchmark year because the trade accounts of ASEAN+3 in 2001 are the most balanced as Ogawa and Shimizu (2005) pointed out. According to the relative PPP, the PPP of country i in time t can be calculated as the following equation:

$$S_t^{PPP,i} = S_{2001}^{i} \times \frac{P_t^{AMU} / P_{2001}^{AMU}}{P_t^{i} / P_{2001}^{i}} \quad (3\text{-}1)$$

where S_{2001}^{i} is the exchange rate of country i in 2001, P_t^{AMU} is the CPI of the AMU area in time t, P_{2001}^{AMU} is the CPI of the AMU area in 2001, P_t^{i} is the CPI of country i in time t, and P_{2001}^{i} is the CPI of country i in 2001.

According to the idea of the AMU Deviation Indicators, the PPP of currency i in terms of the AMU per national currency will be used in place of the benchmark rate in the case of calculation of the PPP-based AMU Deviation Indicator:

$$PPP-based\ \ AMU\ \ Deviation\ \ Indicator\ (\%) = \frac{\left(\frac{AMU}{N.C.}\right)^{Actual} - \left(\frac{AMU}{N.C.}\right)^{PPP}}{\left(\frac{AMU}{N.C.}\right)^{PPP}} \times 100 \quad (3\text{-}2)$$

If the PPP-based AMU Deviation Indicator is positive, it means that the actual exchange rate in terms of the AMU per national currency is overvalued than the PPP. On one hand, if the PPP-based AMU Deviation Indicator is negative, it means the actual exchange rate in terms of the AMU per national currency is undervalued than the PPP.

The sample for our empirical analysis is from the period of January 2000 to recently. We employ data from database of the Research Institute of Economy, Trade and Industry (RIETI), and International Financial Statistics (IFS) to calculate the PPP-

based AMU Deviation Indicators.[3] The calculation results of the PPP-based AMU Deviation Indicators are shown in figure 3-2. It is clear that the higher inflation rates are, the PPP-based AMU Deviation Indicators are the more overvalued, and vice versa. Inflation rates in each of country of ASEAN+3 and the AMU area are shown in figure 3-1. It shows that the PPP-based AMU Deviation Indicator in such high inflationary country as Indonesia and Laos is always overvalued. On one hand, the PPP-based AMU Deviation Indicator in such a deflationary country as Japan has a tendency to be undervalued. Furthermore, fluctuations of the PPP-based AMU Deviation Indicators have widened since 2005. Specifically after the bankruptcy of Lehman Brothers, many of the ASEAN+3 currencies plunged into the situation of undervaluation. When we compare the PPP-based AMU Deviation Indicators with the Nominal AMU Deviation Indicators in figure 3-3, it is obvious that the diverging spreads between both of them tend to be broadening in high inflationary countries. On the other hand, the Real AMU Deviation Indicators and the PPP-based AMU Deviation Indicators have a similar trend of fluctuations for the lower inflationary countries which include China, Japan, Korea, and Singapore.

4. PPP-based AMU Deviation Indicator Adjusted by the Balassa-Samuelson Effect

4-1. The Balassa-Samuelson Effects on ASEAN6+3

Due to data constraints that only the CPI is available across the countries, the CPI is used in the calculation of the AMU Deviation Indicator. There are some possibilities that the PPP of each currency diverges from an exchange rate that the law of one price holds especially for tradable goods because the CPI includes not only prices of tradable goods but also those of non-tradable goods. The PPP-based AMU Deviation Indicator is modified after we clarify a problem of the divergences between the PPP calculated by data on the CPI and the exchange rate based on the law of one price for tradable goods.

In general, a growth rate of productivity in the tradable good sectors is higher than that of the non-tradable good sectors. In the situation, inflation rates in prices of the tradable goods tend to be lower than those of the non-tradable goods. Therefore, the PPP-based on the CPI differs from the exchange rate based on the law of one price for the tradable goods. The difference between them is known as the Balassa-Samuelson effect.

[3] For the calculation of the PPP, the benchmark rate of each currency in terms of the AMU per national currency is from the AMU database in RIETI (Research Institute of Economy, Trade and Industry); the CPI is from International Financial Statistics (IMF).

A simple model is used to explain the Balassa-Samuelson effect according to Ogawa and Sakane (2006). Under an assumption of two countries (home and foreign countries) both of them have a tradable good sector (T) and a non-tradable good sector (N). The home country is assumed to be a small open economy, which means that the domestic economy gives no effects on the foreign economy. Labor is freely mobile between the tradable good sector and the non-tradable good sector while it is completely immobile across the border between both of the two countries. Under the assumption of full mobility of labor, a nominal wage rate (W) is equal between the tradable good sector and the non-tradable good sector in the home country. Similarly, a nominal wage rate (W^*) is equal between the tradable good sector and the non-tradable good sector in the foreign country.

For simplicity, a price of the tradable good (P_T) is assumed by a quotient of the nominal wage rate (W) in terms of labor productivity of the tradable good sector (α_T) while a price of the non-tradable good (P_N) is assumed by a quotient of the nominal wage rates (W) in terms of labor productivity of the non-tradable good sector (α_N). As well, prices of the tradable good and the non-tradable good in the foreign economy are assumed by the same way as the domestic economy.

Based on the above assumptions, the prices of the tradable good (P_T) and the non-tradable good (P_N) in the domestic economy are represented as following:

$$P_T = \frac{W}{\alpha_T} \quad (4\text{-}1)$$

$$P_N = \frac{W}{\alpha_N} \quad (4\text{-}2)$$

The prices of the tradable good (P_T^*) and the non-tradable good (P_N^*) in the foreign economy are represented as following:

$$P_T^* = \frac{W^*}{\alpha_T^*} \quad (4\text{-}3)$$

$$P_N^* = \frac{W^*}{\alpha_N^*} \quad (4\text{-}4)$$

Furthermore, a general price level is defined by a weighted average of the prices of the tradable good and the non-tradable good. General price levels of the domestic and the foreign economy (P and P^*) can be expressed as following:

$$P = P_T^{w_T} \cdot P_N^{w_N} \quad (4\text{-}5)$$

$$P^* = P_T^{*w_T^*} \cdot P_N^{*w_N^*} \quad (4\text{-}6)$$

where w_T is a weight on the tradable good in the general price level of the domestic economy, w_N is a weight on the non-tradable good in the general price level of the domestic economy, w_T^* is a weight on the tradable good in the general price level of the foreign economy, and w_N^* is a weight on the non-tradable good in the general price level of the foreign economy.

Under the law of one price on the tradable good, prices of the tradable good are equalized between the domestic and foreign economies. Given an exchange rate which is expressed in terms of home currency units per foreign currency as S^{LOP}, the law of one price is expressed as following:

$$P_T = S^{LOP} P_T^* \quad (4\text{-}7)$$

where S^{LOP} is an exchange rate on the law of one price.

On one hand, the PPP is expressed by a ratio of the domestic general price level in terms of the foreign general price level as following:

$$S^{PPP} = \frac{P}{P^*} \quad (4\text{-}8)$$

By substituting equations (4-5) and (4-6) into equation (4-8), the PPP is rewritten in terms of the prices of tradable and non-tradable goods as following:

$$S^{PPP} = \frac{P}{P^*} = \frac{P_T^{w_T} \cdot P_N^{w_N}}{P_T^{*w_T^*} \cdot P_N^{*w_N^*}} \quad (4\text{-}9)$$

Moreover, by substituting equations (4-1) to (4-4) and (4-7) into equation (4-9) and taking logarithm of the derived equation, equation (4-9) is rewritten as following:

$$\log S^{PPP} = \log S^{LOP} + w_N \cdot (\log \alpha_T - \log \alpha_N) - w_N^* \cdot (\log \alpha_T^* - \log \alpha_N^*) \quad (4\text{-}10)$$

By making differentiation of equation (4.10), the PPP is expressed in terms of the rate of change as following:

$$\dot{S}^{PPP} = \dot{S}^{LOP} + w_N (\dot{\alpha}_T - \dot{\alpha}_N) - w_N^* (\dot{\alpha}_T^* - \dot{\alpha}_N^*) \quad (4\text{-}11)$$

According to equation (4-11), $\dot{S}^{PPP}$ is larger than $\dot{S}^{LOP}$ if $w_N (\dot{\alpha}_T - \dot{\alpha}_N) - w_N^* (\dot{\alpha}_T^* - \dot{\alpha}_N^*) > 0$. That is, the PPP is changing to be undervalued compared with the exchange rate based on the law of one price. On one hand, $\dot{S}^{PPP}$ is

smaller than $\dot{S}^{LOP}$ if $w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*) < 0$. In this case, the PPP is changing to be overvalued compared with the exchange rate based on the law of one price. Specifically, in the case where a country has a higher growth rate of productivity in the tradable good sectors, the PPP has a tendency to be undervalued compared with the exchange rate based on the law of one price.

4-2. Data

The above simple model is used to conduct a simulation of the PPP based AMU Deviation Indicators and those adjusted by the Balassa-Samuelson effect. We have to limit six countries of ASEAN (Singapore, Indonesia, Thailand, Malaysia, the Philippines, and Vietnam), Japan, China, and Korea to conduct the simulation because of data constraints. [4]

In order to calculate the productivity in both a tradable good sector and a non-tradable good sector for each country of ASEAN6+3, industrial origins of each country are defined as below. For all the members of ASEAN6+3, the tradable good sectors include agriculture, livestock, forestry, fishery, mining, quarrying and manufacturing. On the other hand, the non-tradable good sectors include construction, utilities, wholesale, retail trade, hotels, restaurants, transport, storage, communications, financial services, business services, real estate services, community services, social services, personal services and other service industries.[5]

We define the productivities both the tradable good sectors and the non-tradable good sectors as a quotient of real GDP in terms of employment. The data of real GDP and employment of each sector are from the department of statistics, and statistical yearbook of each country. For Japan, the data of real GDP is from *Japan Statistical Yearbook* and Cabinet Office, Government of Japan, and employment is from OECD Structural Analysis Statistics and Ministry of Internal Affairs and Communications. For China, the data both real GDP and employment are from *China Statistical Yearbook* and National Bureau of Statistics of China. For Korea, the data of real GDP is from *Korea Statistical Yearbook* and Statistics Korea, and employment is from OECD Structural Analysis Statistics and Ministry of Employment and Labor. For Singapore, the data of

[4] The total weights of the other four countries (Brunei, Cambodia, Laos and Myanmar) in the AMU area are smaller than 1%. Therefore, there is no problems by neglecting the four countries when we limit the ASEAN6+3 to calculate economic variables in the AMU area.

[5] Based on the classification by General Statistics Office of Vietnam, the data of construction is issued with manufacturing, so the constructing industry in Vietnam is classified into the tradable good sectors.

real GDP is from *Yearbook of Statistics Singapore* and Department of Statistics Singapore, and employment is from Ministry of Manpower. For Indonesia, the data both real GDP and Employment are from *Statistical Yearbook of Indonesia* and Statistics Indonesia. For Thailand, the data of real GDP is from *Thailand Statistical Yearbook* and National Statistical Office, and employment is from Office the National Economic and Social Development Board. For Malaysia, the data both real GDP and employment are from *Yearbook of Statistics Malaysia* and Department of Statistics Malaysia. For Vietnam, the data both real GDP and employment are from *Statistical Yearbook of Vietnam* and General Statistics Office of Vietnam. For the Philippines, the data of real GDP is from *Philippine Statistical Yearbook* and National Statistical Coordination Board, and employment is from Bureau of Labor and Employment Statistics. The sample for our empirical analysis is from 2000 to 2010.[6]

4-3. Empirical Results of the Balassa-Samuelson Effect

In general, if a country has a higher growth rate of productivity in the tradable good sectors, its currency's PPP calculated by the CPIs tends to be undervalued compared with the exchange rate based on the law of one price of tradable goods. As shown in equation (4-11), the weight on the non-tradable good sector as well as growth rates of productivities is also a key factor on determining the Balassa-Samuelson effect. The simulation results show that there is a tendency that growth rates of productivity in the tradable good sectors are increasing during the analytical period excluding 2009 for most countries of ASEAN6+3. It might be said that the PPPs are undervalued with respect to the growth rate of productivity in the tradable good sectors for most countries of ASEAN6+3.

The Balassa-Samuelson effect on each currency is affected not only by differentials in the growth rates of productivities but also by the changing weight on the non-tradable good sectors. It means that changes in the industrial structure are an important factor in considering the Balassa-Samuelson effect within the area of ASEAN6+3. Thus, the Balassa-Samuelson effect is much affected by the variables of the relevant country in the case of a country that has a larger weight in the non-tradable good sectors than the AMU area like Singapore. On one hand, it seems that the rates of change of the Balassa-Samuelson effects tend to be negative and the currency tends to be overvalued in the case of a country that the growth rate of productivity is higher than the AMU area while the weight on the non-tradable good sectors is smaller than the

[6] Because there are time lags in data publication, we have to limit our empirical period to 2010.

AMU area like China and Vietnam. The detail of the simulation results are as following.

(1) Japan

In Japan, the growth rates of productivity both the tradable good sectors and the non-tradable good sectors have fallen into a sluggish pace especially from the end of 2008 to 2010. The growth rate of productivity in the tradable good sectors is relatively higher than that of the non-tradable good sectors. For the reason, it might be considered that the PPP of the Japanese yen is undervalued. On one hand, the growth rate of productivity in the tradable good sectors is higher than that in the non-tradable good sectors in the AMU area. Accordingly, a differential in the growth rates of productivity is positive in the AMU area. When we compare the differentials in growth rates of productivity between Japan and the AMU area, we can find that the growth rates of productivity in Japan are smaller than those in the AMU area in many years. When we focus on weights in Japan and the AMU area, it can be said that the rate of change of the Balassa-Samuelson effect of the Japanese yen is not only influenced by the domestic factors of Japan but also factors of the AMU area. Accordingly, the rate of change of the PPP of Japanese yen was undervalued before 2004, and then it has turned to be overvalued.

(2) China

In China, the growth rates of productivity in both the tradable good sectors and the non-tradable good sectors had increased steadily since around 2000. They dropped substantially after the bankruptcy of Lehman Brothers. Moreover, because the growth rate of productivity in the tradable good sectors is higher than that in the non-tradable good sectors, it might be said that the PPP of Chinese yuan is undervalued when we focus only on the domestic economy. On one hand, the weight on the non-tradable good sectors in China has grown since 2000, but it has not been over 40% in 2010. It means that the main industries are still the tradable good sectors in China. When we compare differentials in the growth rates of productivity between China and the AMU area, the differentials in growth rate in China is higher than those in the AMU area. Because of the lower weight in the non-tradable good sectors, the rate of change of the Balassa-Samuelson effect of the Chinese yuan is seriously affected by the factors of the AMU area. Therefore, it is clear that the rate of change of the Balassa-Samuelson effect of the Chinese yuan is negative. It means the rate of change of the PPP of Chinese yuan is overvalued.

(3) Korea

In Korea, the growth rates of productivity both the tradable good sectors and the non-tradable good sectors have kept increasing in the last ten years, excluding 2008 and 2009. Based on the growth rate of productivity in the tradable good sectors is higher than the non-tradable good sectors, it might be said that the PPP of Korean won is undervalued from the aspects of domestic economy. However, the weight on the non-tradable good sectors has decreased since 2000 though it is still higher than the AMU area. By comparing differentials in the growth rates of productivity between Korea and the AMU area, there is a tendency that differentials in the growth rate of productivity in Korea are higher than those in the AMU area. Because of the greater weight on the non-tradable good sectors and the higher differentials in growth rate of productivity in Korea, the rate of change of the Balassa-Samuelson effect of the Korean won is consistently positive. It means that the rate of change of the PPP of Korean won is undervalued.

(4) Singapore

As a member of the newly industrializing economies, Singapore had a positive growth rate of productivity in the tradable good sectors before 2008. Furthermore, since Singapore is one of the world's major financial centers, the growth rate of productivity in the non-tradable good sectors is also kept at a steady level. Because the differentials in growth rates of productivity between the tradable good sectors and the non-tradable good sectors tend to be positive, it seems that the PPP of Singapore dollar is undervalued from the viewpoint of domestic factor. The weight on the non-tradable good sectors in Singapore is larger than that in the AMU area. When we compare the differentials in growth rates of productivity between Singapore and the AMU area, the differential in Singapore is also larger than that the AMU area during most of analytical period. Because of the larger weight on the non-tradable good sectors and the larger differentials in growth rates of productivity in Singapore, the rate of change of the Balassa-Samuelson effect of the Singapore dollar tends to be positive. It means that the rate of change of the PPP of Singapore dollar is undervalued within the framework of AMU.

(5) Indonesia

Indonesia has no tendency to show both the growth rates of productivity of the tradable good sectors and the non-tradable good sectors. However, the differential in growth rates of productivity in Indonesia tends to be near zero or negative. It means that the PPP of Indonesian rupiah might be overvalued. Although the weight on non-tradable

good sectors was smaller than 50% at the beginning of 2000, it has reached a level at 55% in 2010. Based on the changes of weight in the non-tradable good sectors, it can be said that the main industries of Indonesia have shifted from the tradable good sectors to the non-tradable good sectors. On one hand, when we compare the differential in growth rates of productivity between Indonesia and the AMU area, the differential in growth rate of productivity in Indonesia is smaller than the AMU area during most of analytical period. For the reasons, the rate of change of the Balassa-Samuelson effect of the Indonesian rupiah has a tendency to be negative. It means that the rate of change of the PPP of Indonesian rupiah is overvalued.

(6) Thailand

In Thailand, both the growth rates of productivity of the tradable good sectors and the non-tradable good sectors have kept increasing during most of analytical period. The differential in growth rates of productivity also tends to be positive. Thus, the domestic factor might cause undervaluation of the PPP of Thai baht. The weight on the non-tradable good sectors in Thailand is around 50% and smaller than that in the AMU area. When we compare the differential in growth rate of productivity in Thailand with that in the AMU area, the differentials have varied from year to year. Because the weight on the non-tradable good sectors in the AMU area is around 60%, the rate of change of the Balassa-Samuelson effect of the Thai baht might be substantially affected by the factors in the AMU area. The analytical results show that the rate of change of the Balassa-Samuelson effect of the Thai baht tends to be negative. It means that the rate of change of the PPP of Thai baht is overvalued.

(7) Malaysia

In Malaysia, both the growth rates of productivity of the tradable good sectors and the non-tradable good sectors tend to be increasing during the whole analytical period excluding 2009. The growth rate of productivity in tradable good sectors was higher than that in the non-tradable good sectors before 2005 while it has been lower after 2006. It is considered that the PPP of Malaysian ringgit was undervalued before 2005 and has been overvalued since 2006. However, the weight on the non-tradable good sectors in Malaysia has grown since 2001, and surpassed the AMU area in 2007. On one hand, the differential in the growth rates of productivity in Malaysia was higher than that in the AMU area before 2004 while it has been lower from 2005 to recently. Therefore, the rate of change of the Balassa-Samuelson effect on the Malaysian ringgit was positive before 2004 and has been negative since 2005. It means that the rate of

change of the PPP of Malaysian ringgit has turned to be overvalued since 2005.

(8) Vietnam

Although the growth rates of productivity in the tradable good sectors and the non-tradable good sectors are increasing steadily in Vietnam, the pace is slower than other ASEAN members. Based on a higher growth rate of productivity in the tradable good sectors, it might be said that the PPP of Vietnamese dong is undervalued from the aspect of domestic factors. On one hand, the weight on the non-tradable good sectors in Vietnam is around 40%, and smaller than the AMU area. When we compare the differentials in growth rates of productivity between Vietnam and the AMU area, the differential in the growth rates of productivity in Vietnam has been increasing relatively while the growth rate of productivity in the non-tradable good sectors in Vietnam is near to zero or negative. Therefore, the rate of change of the Balassa-Samuelson effect of the Vietnamese dong tends to be positive. It means that the rate of change of the PPP of Vietnamese dong is undervalued in most years of the analytical period.

(9) The Philippines

In the Philippines, both the growth rates of productivity in the tradable good sectors and the non-tradable good sectors are increasing during most of analytical period. However, the growth rate of the tradable good sectors is not as high as that of the non-tradable good sectors. Therefore, it might be regarded that the PPP of Philippine peso is overvalued because of the domestic factors. On one hand, the weight on the non-tradable good sectors has grown since 2000. The weights have been close to each other between the Philippines and the AMU area in recent years. As mentioned above, the growth rate of productivity in the tradable good sectors of the Philippines was lower than the non-tradable good sectors before 2005. Accordingly, the differential in the growth rates of productivity was negative. The differential in the growth rates of productivity has turned into being positive because of an uptrend of productivity in the tradable good sectors since 2006. Furthermore, because the differential in the growth rate of productivity in the Philippines is smaller than the AMU area, the rate of change of the Balassa-Samuelson effect on the Philippine peso tends to be negative. It means that the rate of change of the PPP of Philippine peso is overvalued in many of observing years.

4-4. PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect

As previously mentioned, the benchmark rate of the PPP-based AMU Deviation

Indicator is calculated by the exchange rate in 2001 and the CPIs. However, we should take into account the Balassa-Samuelson effect in using CPIs to calculate PPPs. The PPP as a benchmark rate itself may be overvalued or undervalued due to the Balassa-Samuelson effect. It is necessary to eliminate the Balassa-Samuelson effect from the benchmark in order to secure the accuracy of the benchmark rate in the calculation of the AMU Deviation Indicators. It means that the exchange rate on the law of one price should be used as a benchmark rate.

On the basis of the definition about the AMU Deviation Indicators, the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect ($DI^{PPP\ Adjusted\ by\ BS}$) can be expressed as below:

$$DI^{PPP\ \ Adjusted\ \ by\ \ BS} = \frac{S^{Actual} - S^{LOP}}{S^{LOP}} \quad (4\text{-}12)$$

where S^{Actual} is the actual exchange rate in terms of the AMU per national currency, and S^{LOP} is the benchmark exchange rate on the law of one price.

Equation (4-12) can be expressed in terms of logarithm:

$$DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \log S^{Actual} - \log S^{LOP} \quad (4\text{-}13)$$

According to equation (4-10),[7] the exchange rate on the law of one price can also be expressed by $\log S^{LOP} = \log S^{PPP} - w_N \cdot (\log \alpha_T - \log \alpha_N) + w_N^* \cdot (\log \alpha_T^* - \log \alpha_N^*)$, so equation (4-13) can be rewritten as below:

$$DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \log S^{Actual} - \log S^{PPP} + w_N \cdot (\log \alpha_T - \log \alpha_N) - w_N^* \cdot (\log \alpha_T^* - \log \alpha_N^*) \quad (4\text{-}14)$$

Based on equation (4-14), the rate of change of the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect can be expressed in terms of logarithmic differentiation as following:

$$\triangle DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \dot{S}^{Actual} - \dot{S}^{PPP} + w_N (\dot{\alpha}_T - \dot{\alpha}_N) - w_N^* (\dot{\alpha}_T^* - \dot{\alpha}_N^*) \quad (4\text{-}15)$$

Because the PPP-based AMU Deviation Indicator is defined by equation (3-2),[8] the PPP-based AMU Deviation Indicator can also be expressed in terms of logarithm

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[7] $\log S^{PPP} = \log S^{LOP} + w_N \cdot (\log \alpha_T - \log \alpha_N) - w_N^* \cdot (\log \alpha_T^* - \log \alpha_N^*)$

[8] $PPP-based\ \ AMU\ \ D.I.\ (\%) = \dfrac{\left(\dfrac{AMU}{N.C.}\right)^{Actual} - \left(\dfrac{AMU}{N.C.}\right)^{PPP}}{\left(\dfrac{AMU}{N.C.}\right)^{PPP}} \times 100$

($DI^{PPP} \approx \log S^{Actual} - \log S^{PPP}$). By making differentiation of the PPP-based AMU Deviation Indicator, the rate of change of the PPP-based AMU Deviation Indicator can be expressed by a differential between the rate of change of an actual exchange rate and the exchange rate based on the PPP ($\triangle DI^{PPP} \approx \dot{S}^{Actual} - \dot{S}^{PPP}$).

So equation (4-15) can be rewritten as below:

$$\triangle DI^{PPP\ Adjusted\ by\ BS} \approx \triangle DI^{PPP} + w_N\left(\dot{\alpha}_T - \dot{\alpha}_N\right) - w_N^*\left(\dot{\alpha}_T^* - \dot{\alpha}_N^*\right) \quad (4\text{-}16)$$

Hence, equation (4-16) shows that the rate of change of the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect is expressed by the rate of change of the PPP-based AMU Deviation Indicator and the rate of change of the Balassa-Samuelson effect.

The above model is used to estimate the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect. The fluctuations of the PPP-based AMU Deviation Indicators adjusted by the Balassa-Samuelson effect are similar to the fluctuations of the PPP-based AMU Deviation Indicators as shown in figure 4-2. Currencies of Inflationary countries tend to be overvalued while a currency of deflationary country tends to be undervalued.[9] Comparison of the analytical results among the countries makes it clear that there is a disparity between the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect.

However, figure 4-3 shows that the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect has a tendency to be undervalued for the Japanese yen, the Chinese yuan, and the Malaysian ringgit while it has a tendency to be overvalued for the Korean won, the Indonesian rupiah, the Thai baht, the Vietnamese dong and the Philippine peso. Regarding the fluctuation of the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect, it can be said that the asymmetric diversity on the foreign exchange rate within the AMU area is still an important issue on the process of regional monetary cooperation in East Asia.

5. Conclusion

This paper investigated how the AMU Deviation Indicator should be revised by using the PPP adjusted by the Balassa-Samuelson effect instead of an average of exchange rates in 2000 and 2001 as the benchmark rate. It pointed out that the benchmark rate should be changing over time if fundamentals of exchange rates such as

[9] The Balassa-Samuelson effect on each currency is transformed from yearly to monthly by linear interpolation.

the PPP are changing over time and that there is a possibility that the benchmark itself is overvalued or undervalued because the PPPs are calculated based on the CPIs which include prices of non-tradable goods. By taking into account the Balassa-Samuelson effect of each currency, we calculated the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect.

When we compared the four types of the AMU Deviation Indicators which include the original Nominal and Real AMU Deviation Indicators, the PPP-based AMU Deviation Indicators, and the PPP-based AMU Deviation Indicators adjusted by the Balassa-Samuelson effect, it is clear that the trend of fluctuation is similar with one another although the PPP-based AMU Deviation Indicators and the PPP-based AMU Deviation Indicators adjusted by Balassa-Samuelson effect have different movements with the original Nominal AMU Deviation Indicators.

Each type of the AMU Deviation Indicator has its own merit. The Nominal AMU Deviation Indicator can be calculated at real time. For the reason, it can be used as a real-time indicator to monitor daily exchange rate movements. Because the Real AMU Deviation Indicator can only be calculated by monthly and there are time lags on the data, it is useful in estimating impacts of exchange rates on the macroeconomic variables of concern. On the other hand, the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect also have a disadvantage on time lags in collecting the data of price, real GDP and employment. However, they are useful in evaluating whether the exchange rates are in an appropriate level compared with such fundamentals as PPPs and growth rates of productivities.

Both the PPP-based AMU Deviation Indicators and the PPP-based AMU Deviation Indicators adjusted by the Balassa-Samuelson effect are expected to act as sub-indexes to judge of overvaluation or undervaluation for each of East Asian currencies. In the case of Japan, the Japanese yen is undervalued by approximately 35% in terms of the Real AMU Deviation Indicator since 2008. In contrast, it is undervalued by approximately 25% in terms of both the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect. The Chinese yuan tends to be overvalued in terms of the Real AMU Deviation Indicator after the bankruptcy of Lehman Brothers. However, it is undervalued in terms of both the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect.

Over ten years have passed since the regional monetary cooperation started in East Asia and some positive results on the cooperation have been reached as the CMI

Multilateralization (CMIM) and the ASEAN+3 Macroeconomic Research Office (AMRO). Moreover, the AMU and the AMU Deviation Indicators would be a symbol of these achievements if the monetary authorities of East Asian countries as well as the AMRO strengthened surveillance over intra-regional exchange rates. The PPP-based AMU Deviation Indicators and the PPP-based AMU Deviation Indicators adjusted by the Balassa-Samuelson effect are also expected to act as a supplementary to complement the role of the original AMU Deviation Indicators. The surveillance over the intra-regional exchange rates should be an important factor in the regional monetary cooperation in East Asia after we have experienced currency turmoil in the global financial crisis and the European fiscal crisis as well as the Asian currency crisis.

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Asian currencies," *RIETI Discussion Paper Series*, 09-E-018.

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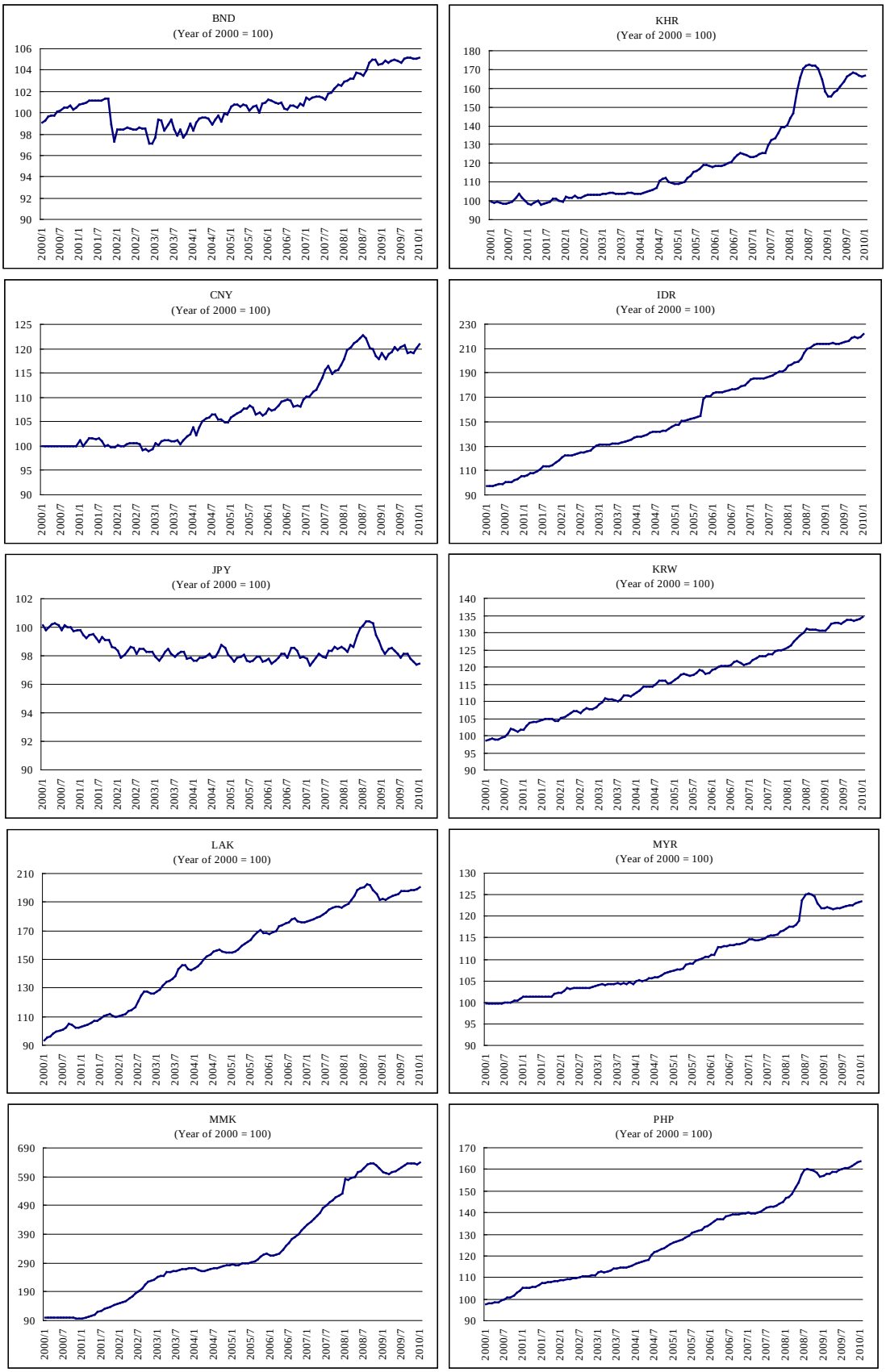
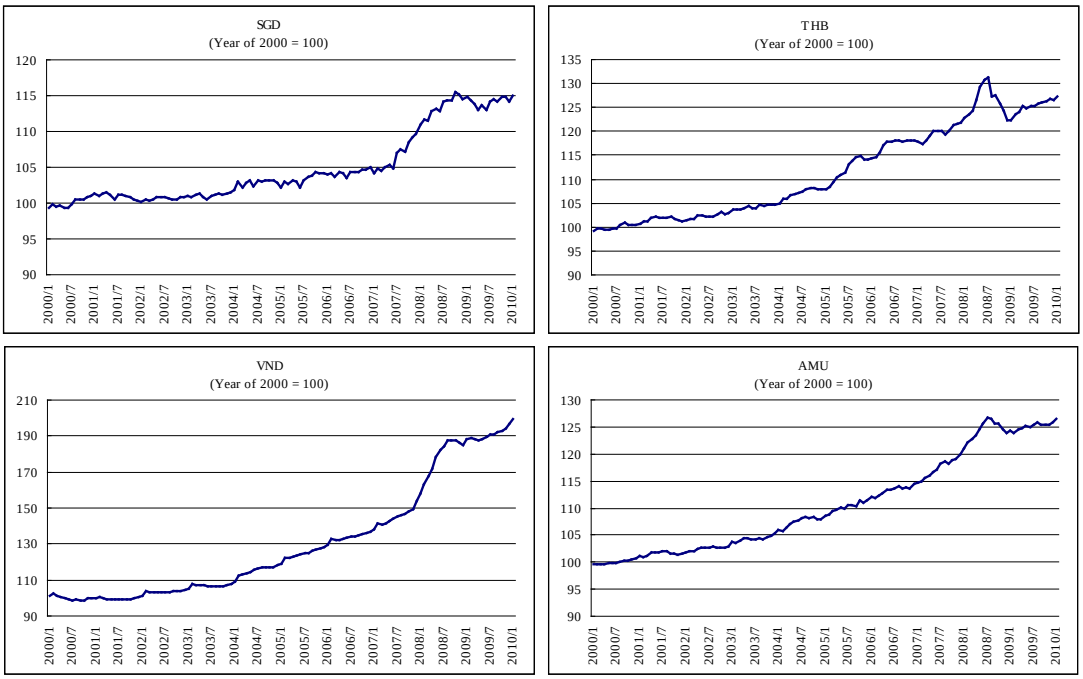
FIGURE 3-1. THE INFLATION RATES OF ASEAN+3 AND THE AMU AREA

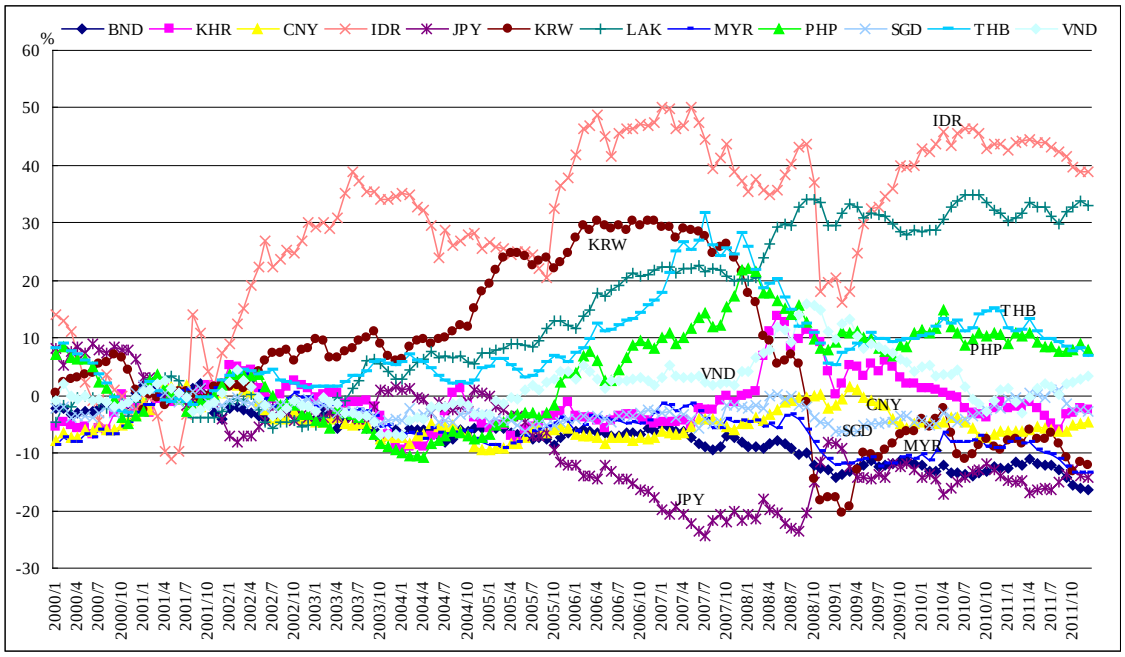




Source: International Financial Statistics (IMF).

Complete results are available from the authors.

FIGURE 3-2. THE PPP -BASED AMU DEVIATION INDICATORS

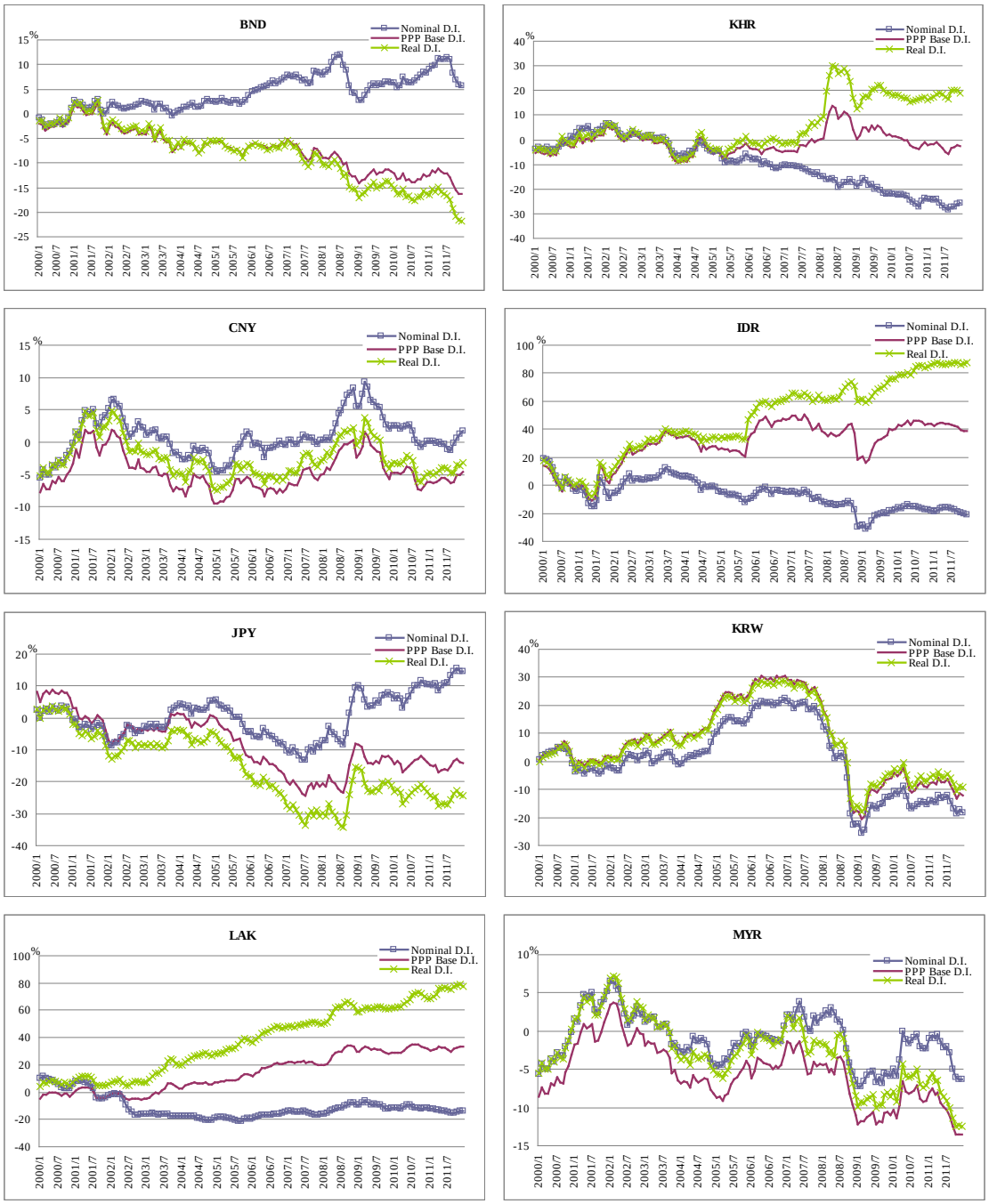


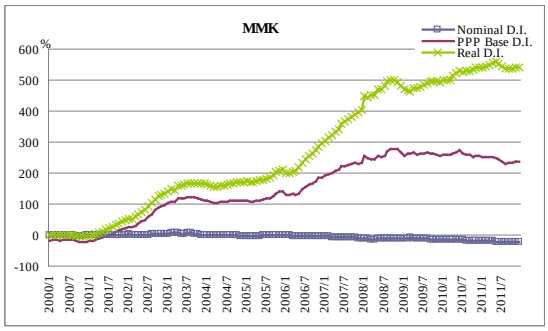
Note: The PPP-based AMU Deviation Indicator of Myanmar is drastically higher than the other countries; therefore, it is excluded from the figure of 3-2.

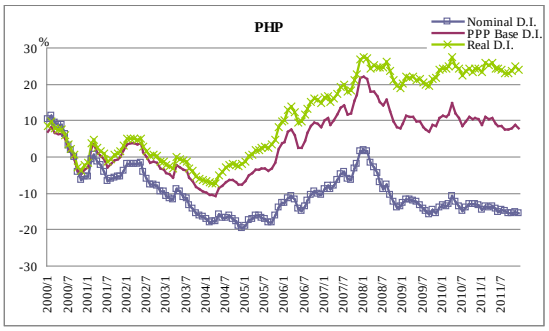
Source: RIETI (Research Institute of Economy, Trade and Industry) online database. International Financial Statistics (IMF).

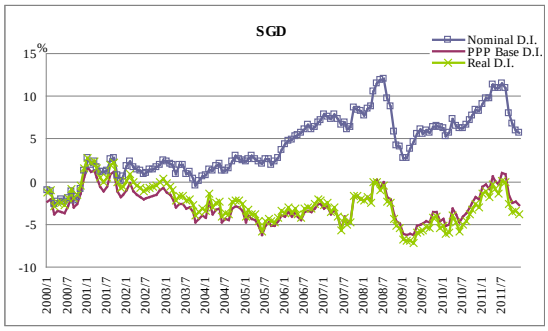
Complete results are available from the authors.

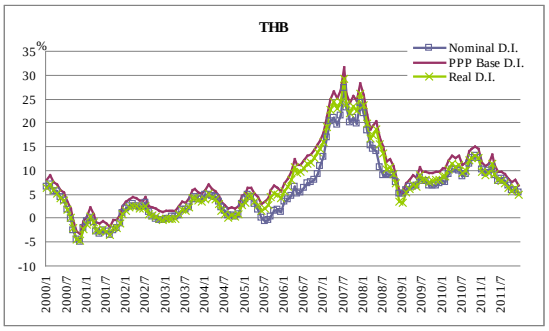
FIGURE 3-3. THE NOMINAL AMU DEVIATION INDICATOR, THE REAL AMU DEVIATION INDICATOR AND THE PPP-BASED AMU DEVIATION INDICATOR

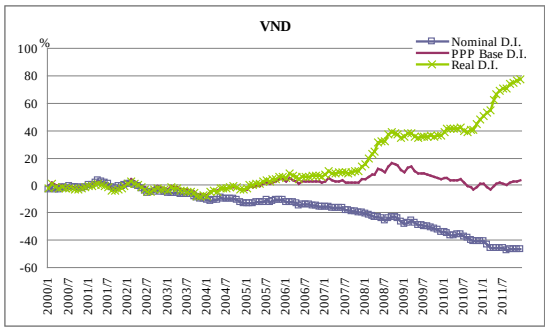












Source: RIETI (Research Institute of Economy, Trade and Industry) online database.
International Financial Statistics (IMF).

Complete results are available from the authors.

TABLE 4-1-1. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Japan)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	62.96	60.06	12.48	7.12	9.68	4.59	5.36	5.09	0.32
2001	63.96	60.44	-10.88	-10.32	-4.08	-3.20	-0.56	-0.88	0.17
2002	64.61	60.68	0.05	-2.38	6.39	3.86	2.43	2.54	0.03
2003	64.01	60.14	14.33	8.53	10.95	6.46	5.81	4.49	1.02
2004	63.36	59.52	13.27	7.26	12.64	4.51	6.00	8.13	-1.03
2005	63.10	59.02	2.26	-0.67	9.54	6.16	2.93	3.38	-0.15
2006	62.58	58.05	-3.51	-5.60	9.84	7.53	2.09	2.31	-0.03
2007	61.92	57.05	2.18	-0.56	12.34	11.21	2.74	1.13	1.05
2008	61.93	56.82	14.10	12.13	11.42	9.24	1.97	2.17	-0.01
2009	65.41	59.10	-3.85	5.83	1.26	1.86	-9.68	-0.60	-5.98
2010	62.82	57.12	22.63	7.14	18.81	9.56	15.48	9.25	4.44

Source: Japan Statistical Yearbook.

OECD Structural Analysis Statistics.

Cabinet Office, Government of Japan.

Ministry of Internal Affairs and Communications.

Complete results are available from the authors.

TABLE 4-1-2. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (China)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	35.03	60.06	8.15	6.27	9.68	4.59	1.88	5.09	-2.40
2001	35.61	60.44	6.87	8.24	-4.08	-3.20	-1.37	-0.88	0.05
2002	36.06	60.68	7.80	6.33	6.39	3.86	1.46	2.54	-1.01
2003	35.97	60.14	11.19	6.48	10.95	6.46	4.72	4.49	-1.00
2004	35.87	59.52	13.53	4.80	12.64	4.51	8.73	8.13	-1.71
2005	36.39	59.02	14.44	10.44	9.54	6.16	4.00	3.38	-0.54
2006	37.10	58.05	17.75	14.54	9.84	7.53	3.21	2.31	-0.15
2007	37.81	57.05	20.99	20.33	12.34	11.21	0.66	1.13	-0.39
2008	38.08	56.82	21.76	17.99	11.42	9.24	3.77	2.17	0.20
2009	38.68	59.10	12.49	9.19	1.26	1.86	3.30	-0.60	1.63
2010	38.55	57.12	14.18	9.06	18.81	9.56	5.12	9.25	-3.31

Source: China Statistical Yearbook.

National Bureau of Statistics of China.

Complete results are available from the authors.

TABLE 4-1-3. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Korea)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	65.31	60.06	16.92	5.71	9.68	4.59	11.20	5.09	4.26
2001	65.97	60.44	-8.83	-11.68	-4.08	-3.20	2.85	-0.88	2.41
2002	66.25	60.68	11.03	6.10	6.39	3.86	4.93	2.54	1.73
2003	65.85	60.14	11.55	6.40	10.95	6.46	5.15	4.49	0.69
2004	64.23	59.52	16.81	2.80	12.64	4.51	14.01	8.13	4.16
2005	63.67	59.02	18.94	12.99	9.54	6.16	5.95	3.38	1.79
2006	62.92	58.05	16.89	9.15	9.84	7.53	7.75	2.31	3.54
2007	62.48	57.05	11.34	5.35	12.34	11.21	5.99	1.13	3.10
2008	62.26	56.82	-9.95	-13.48	11.42	9.24	3.53	2.17	0.97
2009	62.93	59.10	-13.08	-14.05	1.26	1.86	0.97	-0.60	0.96
2010	60.80	57.12	22.05	12.12	18.81	9.56	9.93	9.25	0.75

Source: Korea Statistical Yearbook.

OECD Structural Analysis Statistics.

Statistics Korea.

Complete results are available from the authors.

TABLE 4-1-4. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Singapore)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	73.74	60.06	25.42	4.81	9.68	4.59	20.61	5.09	12.14
2001	76.36	60.44	-21.51	-9.02	-4.08	-3.20	-12.49	-0.88	-9.01
2002	75.38	60.68	11.32	2.76	6.39	3.86	8.56	2.54	4.92
2003	75.55	60.14	4.24	4.61	10.95	6.46	-0.37	4.49	-2.98
2004	74.47	59.52	19.11	8.34	12.64	4.51	10.76	8.13	3.18
2005	74.07	59.02	18.94	6.25	9.54	6.16	12.69	3.38	7.40
2006	73.35	58.05	7.62	4.25	9.84	7.53	3.37	2.31	1.13
2007	74.01	57.05	10.78	15.21	12.34	11.21	-4.42	1.13	-3.92
2008	75.72	56.82	-0.30	9.21	11.42	9.24	-9.51	2.17	-8.43
2009	76.54	59.10	-0.91	-4.97	1.26	1.86	4.06	-0.60	3.46
2010	73.58	57.12	39.06	13.01	18.81	9.56	26.05	9.25	13.88

Source: Yearbook of Statistics Singapore.

Department of Statistics Singapore.

Ministry of Manpower.

Complete results are available from the authors.

TABLE 4-1-5. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Indonesia)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	47.22	60.06	-7.41	0.80	9.68	4.59	-8.21	5.09	-6.94
2001	47.79	60.44	-15.24	-16.64	-4.08	-3.20	1.40	-0.88	1.20
2002	48.15	60.68	12.08	14.99	6.39	3.86	-2.90	2.54	-2.94
2003	48.82	60.14	11.66	17.98	10.95	6.46	-6.32	4.49	-5.79
2004	49.75	59.52	1.58	-7.34	12.64	4.51	8.92	8.13	-0.40
2005	50.69	59.02	-7.86	0.01	9.54	6.16	-7.86	3.38	-5.98
2006	51.57	58.05	8.98	14.62	9.84	7.53	-5.64	2.31	-4.25
2007	52.77	57.05	2.59	5.48	12.34	11.21	-2.89	1.13	-2.17
2008	53.96	56.82	-2.60	-6.70	11.42	9.24	4.10	2.17	0.98
2009	54.68	59.10	-4.78	-5.07	1.26	1.86	0.29	-0.60	0.51
2010	55.64	57.12	17.78	17.34	18.81	9.56	0.44	9.25	-5.04

Source: Statistical Yearbook of Indonesia.

Statistics Indonesia.

Complete results are available from the authors.

TABLE 4-1-6. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Thailand)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	52.24	60.06	-1.77	-4.15	9.68	4.59	2.39	5.09	-1.81
2001	52.43	60.44	-8.65	-13.13	-4.08	-3.20	4.48	-0.88	2.88
2002	52.20	60.68	6.31	5.32	6.39	3.86	0.99	2.54	-1.02
2003	50.43	60.14	14.69	2.25	10.95	6.46	12.45	4.49	3.58
2004	50.64	59.52	9.56	3.60	12.64	4.51	5.96	8.13	-1.82
2005	50.99	59.02	3.30	2.52	9.54	6.16	0.78	3.38	-1.60
2006	50.70	58.05	9.80	11.26	9.84	7.53	-1.45	2.31	-2.08
2007	50.62	57.05	14.19	13.15	12.34	11.21	1.04	1.13	-0.11
2008	49.96	56.82	6.63	1.59	11.42	9.24	5.04	2.17	1.28
2009	51.16	59.10	-7.08	-7.61	1.26	1.86	0.53	-0.60	0.63
2010	49.84	57.12	20.80	10.92	18.81	9.56	9.88	9.25	-0.36

Source: Thailand Statistical Yearbook.

National Statistical Office.

Office the National Economic and Social Development Board.

Complete results are available from the authors.

TABLE 4-1-7. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Malaysia)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	54.30	60.06	10.03	-0.03	9.68	4.59	10.07	5.09	2.41
2001	56.04	60.44	0.38	0.11	-4.08	-3.20	0.26	-0.88	0.68
2002	56.42	60.68	6.88	0.50	6.39	3.86	6.38	2.54	2.06
2003	55.50	60.14	6.60	-0.63	10.95	6.46	7.23	4.49	1.31
2004	55.12	59.52	9.20	3.26	12.64	4.51	5.94	8.13	-1.56
2005	55.84	59.02	4.39	5.79	9.54	6.16	-1.40	3.38	-2.78
2006	56.31	58.05	4.55	8.95	9.84	7.53	-4.40	2.31	-3.82
2007	58.08	57.05	10.74	12.71	12.34	11.21	-1.97	1.13	-1.79
2008	59.56	56.82	6.76	7.86	11.42	9.24	-1.10	2.17	-1.89
2009	62.06	59.10	-8.00	-7.79	1.26	1.86	-0.21	-0.60	0.23
2010	61.85	57.12	15.80	14.66	18.81	9.56	1.14	9.25	-4.58

Source: Yearbook of Statistics Malaysia.

Department of Statistics Malaysia.

Complete results are available from the authors.

TABLE 4-1-8. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (Vietnam)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	41.30	60.06	5.11	-6.36	9.68	4.59	11.47	5.09	1.68
2001	41.00	60.44	-3.51	-4.64	-4.08	-3.20	1.13	-0.88	1.00
2002	40.79	60.68	5.60	1.44	6.39	3.86	4.16	2.54	0.16
2003	40.45	60.14	5.85	-2.03	10.95	6.46	7.88	4.49	0.49
2004	40.25	59.52	4.91	0.53	12.64	4.51	4.38	8.13	-3.08
2005	40.27	59.02	5.94	1.34	9.54	6.16	4.60	3.38	-0.14
2006	40.29	58.05	5.57	1.51	9.84	7.53	4.06	2.31	0.30
2007	40.44	57.05	5.78	2.28	12.34	11.21	3.50	1.13	0.77
2008	40.84	56.82	2.34	1.43	11.42	9.24	0.90	2.17	-0.86
2009	41.35	59.10	-1.72	-1.15	1.26	1.86	-0.57	-0.60	0.12
2010	41.63	57.12	-3.57	-8.43	18.81	9.56	4.86	9.25	-3.26

Source: Statistical Yearbook of Vietnam.

General Statistics Office of Vietnam.

Complete results are available from the authors.

TABLE 4-1-9. THE RATE OF CHANGE OF EACH VARIABLE

The Rate of Change of Each Variable (the Philippines)									
Year	Weight (%)		Growth Rate of Productivity (%)				Growth Rate Gap of Productivity (%)		Rate of Change of Balassa-Samuelson Effect (%)
	w_N	w_N^*	$\dot{\alpha}_T$	$\dot{\alpha}_N$	$\dot{\alpha}_T^*$	$\dot{\alpha}_N^*$	$(\dot{\alpha}_T - \dot{\alpha}_N)$	$(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$	$w_N(\dot{\alpha}_T - \dot{\alpha}_N) - w_N^*(\dot{\alpha}_T^* - \dot{\alpha}_N^*)$
2000	51.58	60.06	-5.46	-8.90	9.68	4.59	3.44	5.09	-1.28
2001	52.15	60.44	-19.45	-19.72	-4.08	-3.20	0.28	-0.88	0.68
2002	52.44	60.68	1.66	2.06	6.39	3.86	-0.40	2.54	-1.75
2003	52.70	60.14	-5.01	-3.87	10.95	6.46	-1.14	4.49	-3.30
2004	53.47	59.52	2.53	4.83	12.64	4.51	-2.30	8.13	-6.07
2005	53.99	59.02	2.43	3.37	9.54	6.16	-0.94	3.38	-2.51
2006	54.39	58.05	11.96	11.84	9.84	7.53	0.12	2.31	-1.27
2007	54.88	57.05	16.36	16.33	12.34	11.21	0.03	1.13	-0.62
2008	54.79	56.82	8.55	4.02	11.42	9.24	4.53	2.17	1.25
2009	56.01	59.10	-7.44	-10.50	1.26	1.86	3.06	-0.60	2.07
2010	55.76	57.12	12.31	10.10	18.81	9.56	2.21	9.25	-4.05

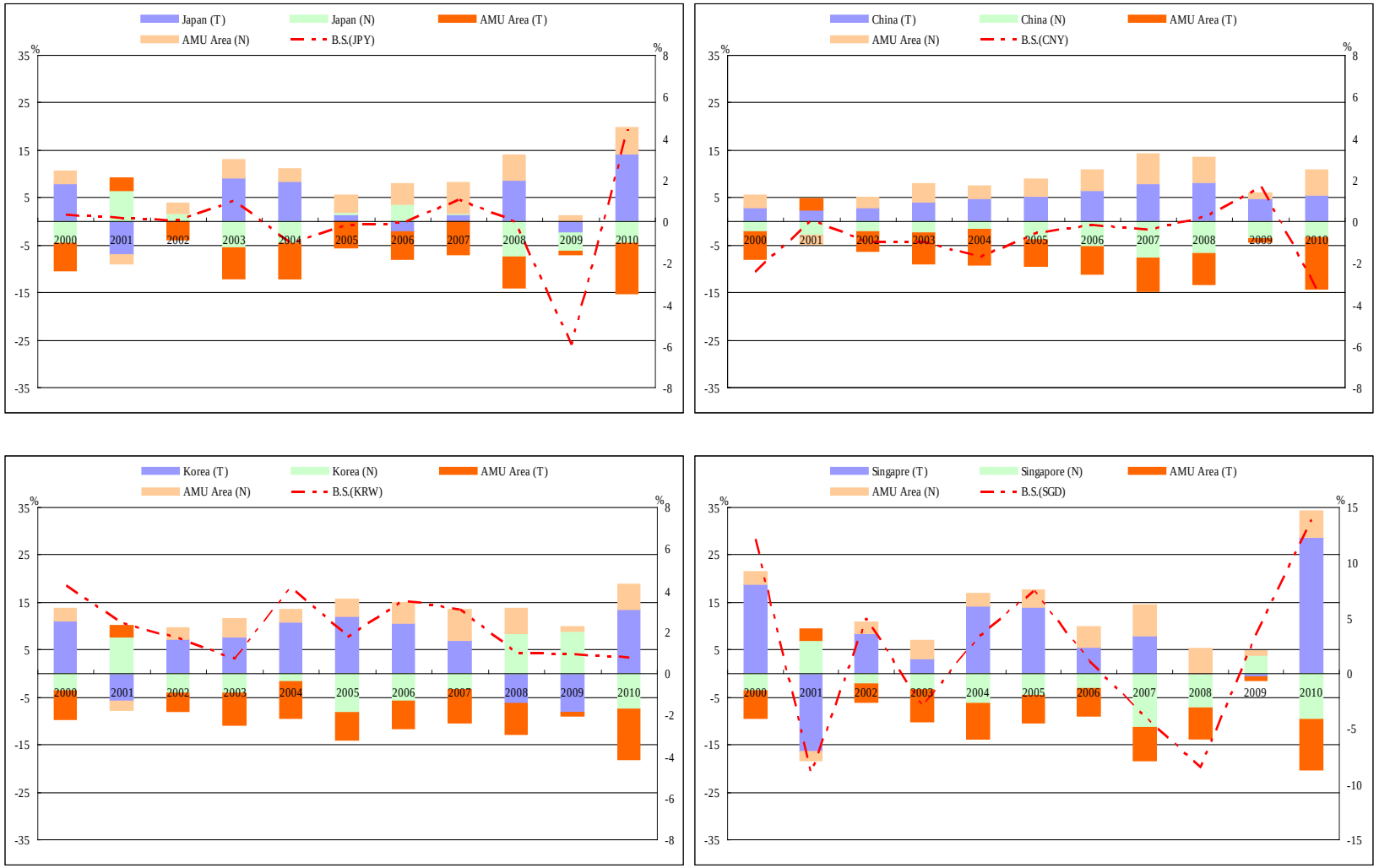
Source: Philippine Statistical Yearbook.

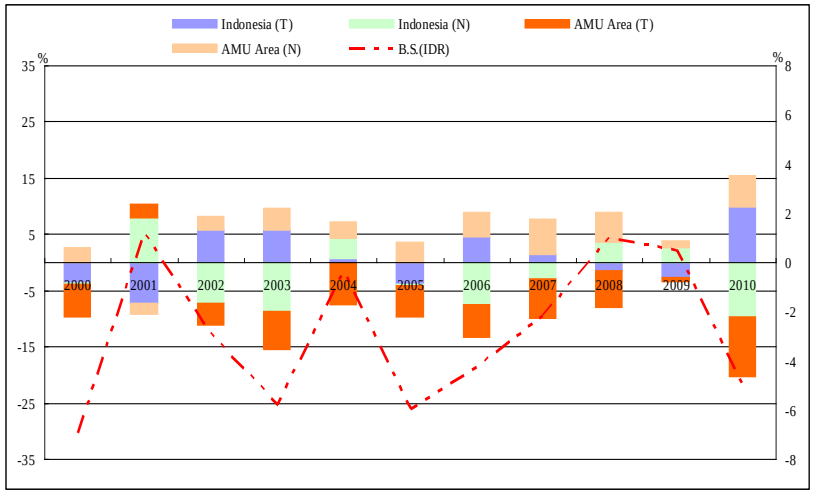
National Statistical Coordination Board.

Bureau of Labor and Employment Statistics.

Complete results are available from the authors.

FIGURE 4-1. THE COTRIBUTION OF EACH VARIABLE

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Indonesia (N)
AMU Area (T)
AMU Area (N)
B.S.(IDR)
%
%
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25
15
5
-5
-15
-25
-35
8
6
4
2
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-2
-4
-6
-8
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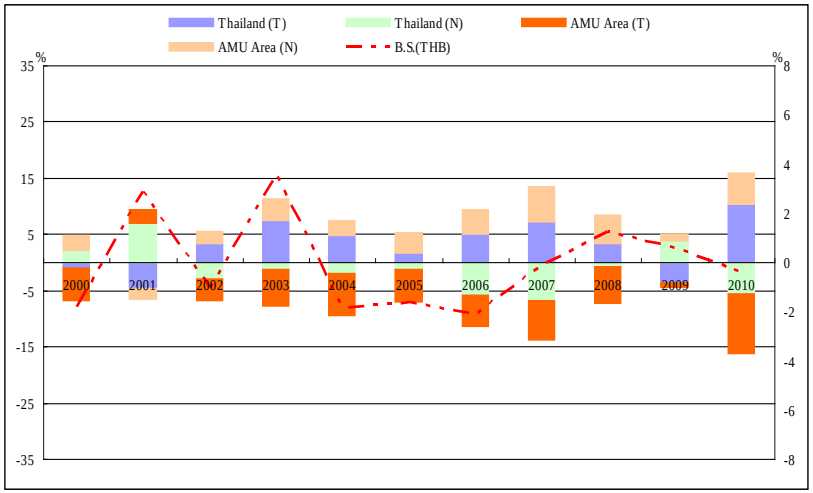
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010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Thailand (N)
AMU Area (T)
AMU Area (N)
B.S.(THB)
%
%
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15
5
-5
-15
-25
-35
8
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4
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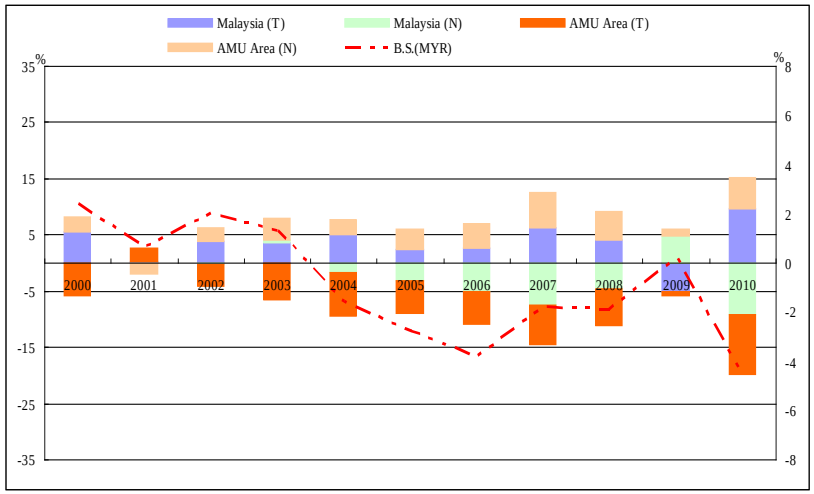
Malaysia (T)
Malaysia (N)
AMU Area (T)
AMU Area (N)
B.S.(MYR)
%
%
35
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-5
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-35
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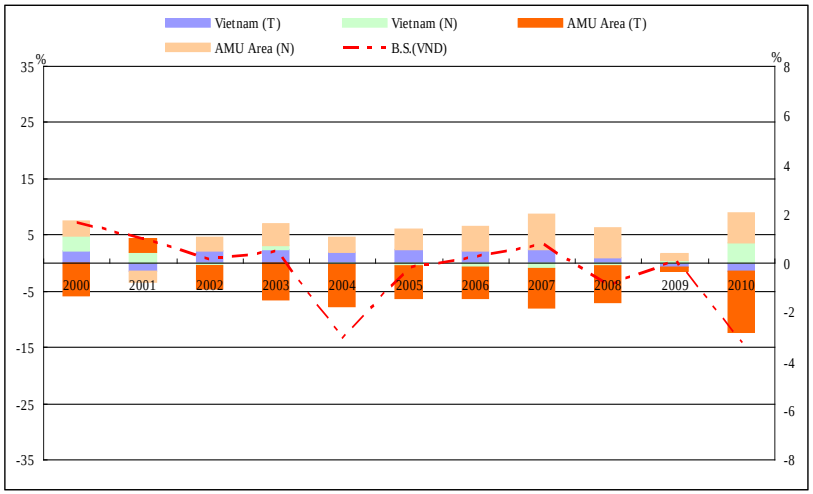
Vietnam (T)
Vietnam (N)
AMU Area (T)
AMU Area (N)
B.S.(VND)
%
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-5
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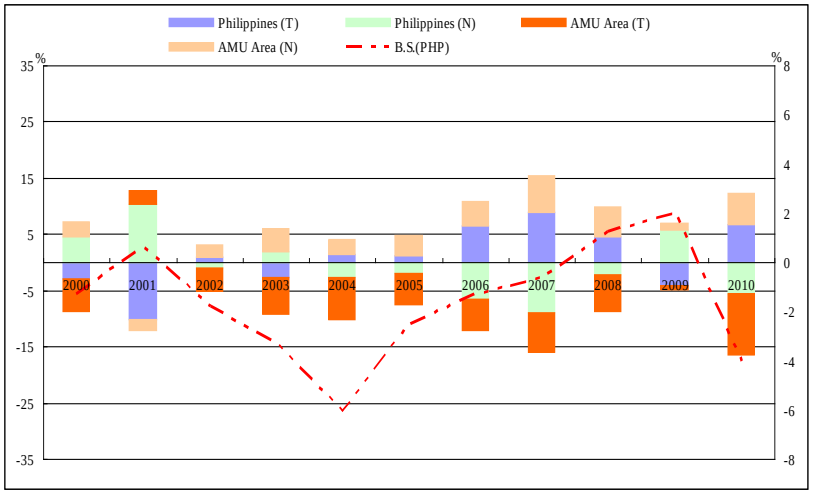
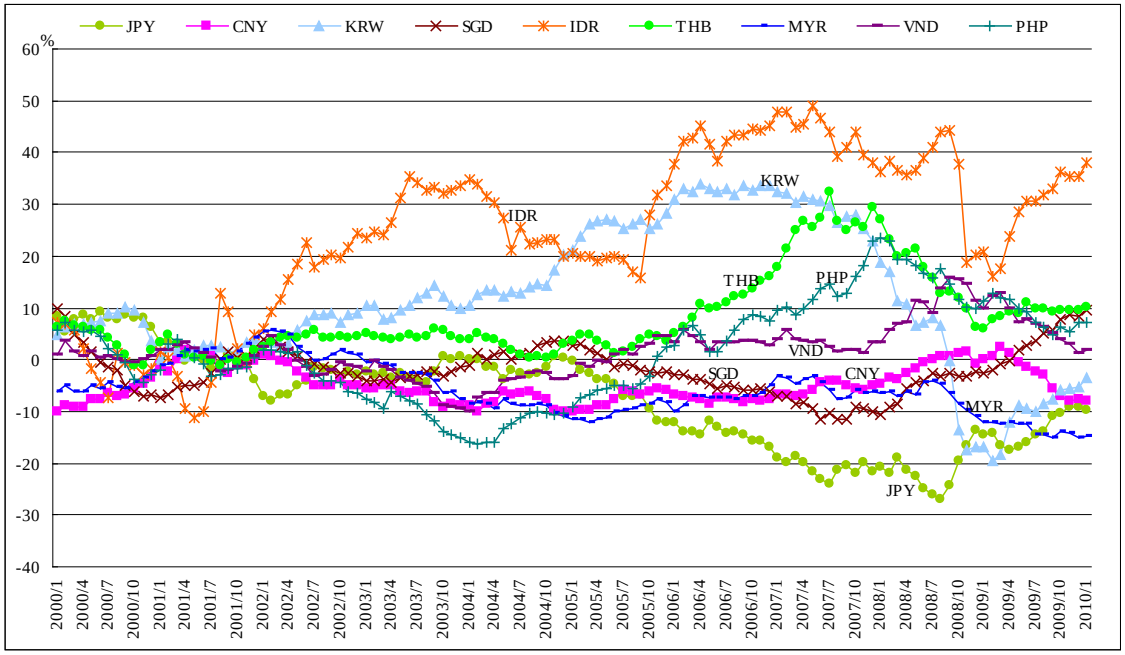


Note: Left scale is the rate of change of each variable; Right scale is the rate of change of the Balassa-Samuelson effect.

Source: The same as table 4-1-1 to 4-1-9.

Complete results are available from the authors.

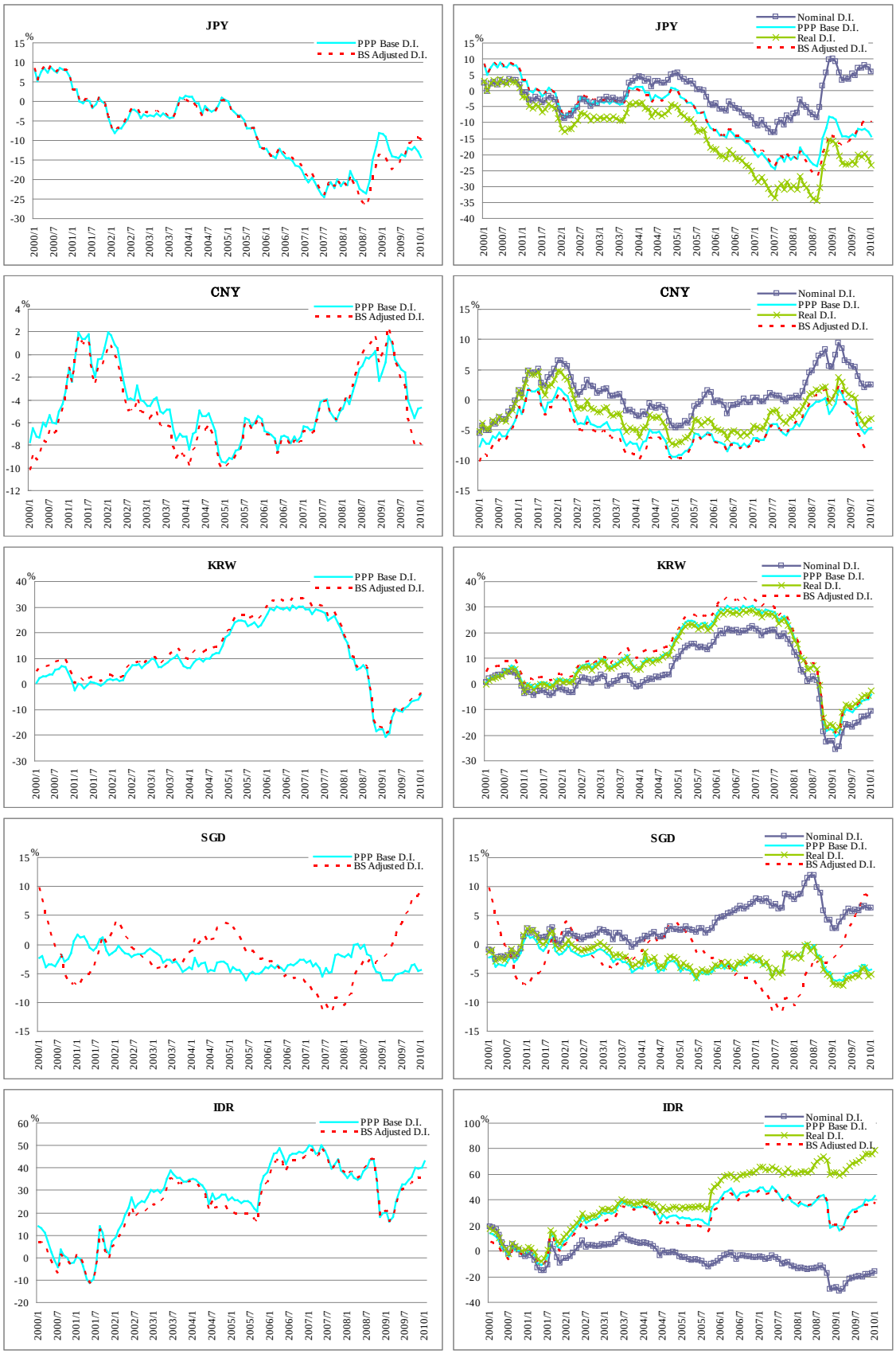
FIGURE 4-2. THE PPP-BASED AMU DEVIATION INDICATORS ADJUSTED BY THE BALASSA-SAMUELSON EFFECT

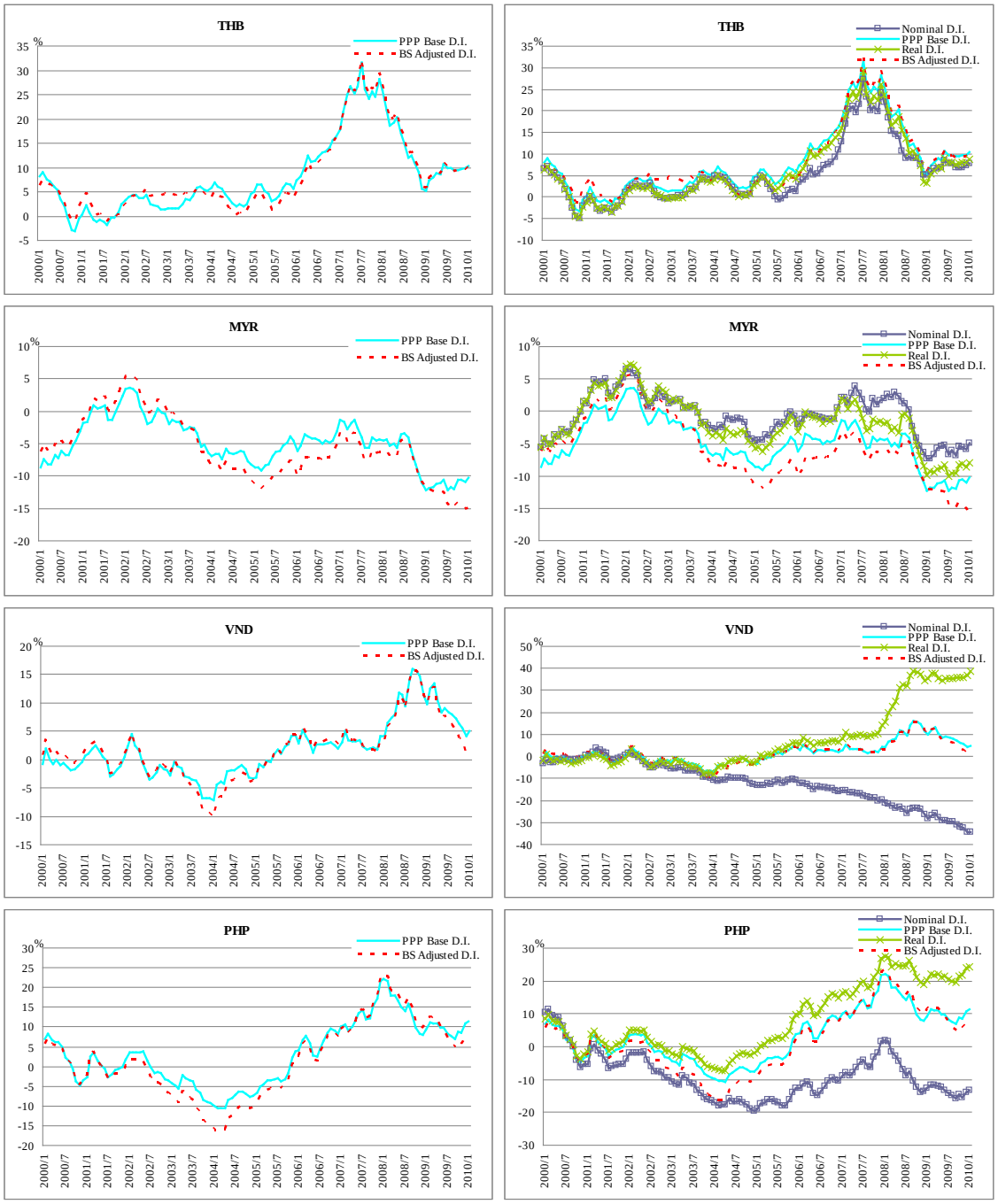


Source: RIETI (Research Institute of Economy, Trade and Industry) online database.
International Financial Statistics (IMF).
Table 4-1-1 to 4-1-9.

Complete results are available from the authors.

FIGURE 4-3. THE AMU DEVIATION INDICATORS OF ASEAN 6 + 3





Note: Left side is the graph on the comparisons of the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect; Right side is the graph on the comparisons of the Nominal AMU Deviation Indicator, the Real AMU Deviation Indicator, the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect.

Source: RIETI (Research Institute of Economy, Trade and Industry) online database. International Financial Statistics (IMF).

Table 4-1-1 to 4-1-9.

Complete results are available from the authors.