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OGAWA Eiji
RIETI

Zhiqian WANG
Hitotsubashi University

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
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The AMU Deviation Indicators Based on the Purchasing Power Parity and Adjusted by the Balassa-Samuelson Effect*

OGAWA Eiji[a] （Hitotsubashi University/RIETI）

Zhiqian WANG[b] （Hitotsubashi University）

Abstract

This paper investigates how the Asian Monetary Unit (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 this reason, the PPPs adjusted by the Balassa-Samuelson effect should be used to calculate when the CPIs are used as price data. This paper compares the PPP-based AMU Deviation Indicator with the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect. We conclude that both indicators are also useful in making surveillance of overvaluation or undervaluation of the intra-regional exchange rates of East Asian currencies.

Keywords: 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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[a] Eiji Ogawa, Professor, Graduate School of Commerce and Management, Hitotsubashi University and Faculty Fellow of Research Institute of Economy, Trade and Industry. Email: eiji.ogawa@r.hit-u.ac.jp

[b] Zhiqian Wang, Graduate Student, Graduate School of Commerce and Management, Hitotsubashi University.

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, the Chiang Mai Initiative (CMI) was established by the members of ASEAN, Japan, China and Korea (ASEAN+3) in 2000 in order to start the regional monetary cooperation in East Asia. Under the CMI, the monetary authorities have developed and strengthened it in the field of bilateral and multilateral currency swap arrangements. At the same time, the Economic Review and Policy Dialogue (ERPD) was executed at the Finance Deputy Ministers Meeting of ASEAN+3 in order to make surveillance over macroeconomic performance of each member country of ASEAN+3.

The currency swap arrangements are an agreement that was arranged for the purpose of managing a crisis. Therefore, it should 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 as well as soundness of financial sectors. It is necessary to incorporate intra-regional exchange rates into the surveillance process to prevent a currency crisis in the future and enhance surveillance within ASEAN+3. The monetary authorities are expected to establish a surveillance system to monitor fluctuations and misalignments of each currency of ASEAN+3 not only against the U.S. dollar but also among them.

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). The AMU Deviation Indicators of component currencies of the AMU are also calculated and they 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 Deviation Indicators, the benchmark rate of the AMU Deviation Indicators is fixed on 2000 and 2001. For more than ten years the benchmark rate has not been modified, there is a possibility that the benchmark rate itself might be overvalued or undervalued. 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. For keeping the benchmark rate at an appropriate level, we suggest that the benchmark rate should be measured by any

equilibrium exchange rate. There are several models to measure an equilibrium exchange rate, which include not only the Purchasing Power Parity (PPP) (Cassel 1916) but also Fundamental Equilibrium Exchange Rate model (Williamson 1983, 1994), Behavioral Equilibrium Exchange Rate model (Hinkle and Montiel 1999), and Yoshikawa's Equilibrium Exchange Rate model (Yoshikawa 1990). Here we improve the AMU Deviation Indicators by changing the benchmark rate from a constant rate into a time-varying rate based on the PPP which is the most general and easiest way to measure an equilibrium exchange rate due to data constraints for developing countries.

The Comsumer Price Indexes (CPIs) are used to calculate their PPPs as a time-varying benchmark for the AMU Deviation Indicators because of data constraints of price index statistics for some countries. Because the CPIs include prices of non-tradable goods, the PPPs based on the CPIs have a problem such as 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.

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 a measurement to complement the original AMU Deviation Indicators.

This paper has the following sections. In section 2, we 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, we explain a simple model which is used to explain the Balassa-Samuelson effect. The Balassa-Samuelson effect of each country of the ASEAN6+3 is calculated according to the simple 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 is 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 make surveillance over intra-regional exchange rates of East Asian currencies and 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. The weight on each currency in the currency basket is based on the share of GDP measured in terms of the 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 by 65% and 35%, respectively. 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.

The AMU Deviation Indicators are indexes that are used to monitor the divergences between an actual exchange rate and the benchmark rate. It is necessary to

[1] The share and the weight on each country in the AMU were revised in October 2011.

determine a benchmark in order to calculate the AMU Deviation Indicators. Depending on 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 rate affect trade volumes, 2000 and 2001 are chosen as the benchmark period.

A Nominal AMU Deviation Indicator is useful in monitoring 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]

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 rate 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 over the effects of foreign exchange rate on real economy which includes international trade and trade balance. 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 of 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

[2] N.C. stands for National Currency.

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 rate 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 an average of exchange rates in 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 rate or the PPP to observe the changes in exchange rate within ASEAN+3 adequately.

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 equilibrium exchange rate. As to the measurement on equilibrium exchange rate, there are a lot of different models have been advocated. For example, the Fundamental Equilibrium Exchange Rate model (FEER) introduced by Williamson (1983, 1994) is a method to measure equilibrium exchange rate from the aspect of macroeconomic balance approach. By focusing on the real economic variables, the Behavioral Equilibrium Exchange Rate model (BEER) introduced by Hinkle and Montiel (1999) is more popular. The BEER defines the exchange rate which is cointegrated by the corresponding fundamentals in the long run as equilibrium exchange rate. Yoshikawa (1990) has measured equilibrium exchange rate by emphasizing the role of supply factors. The most general way to measure an equilibrium exchange rate is the Purchasing Power Parity introduced by Cassel (1916). The PPP is known as an exchange rate of tradable good which is equal to the relative ratio of price level under the law of one price. However, it is difficult to measure an equilibrium exchange rate by a specified model because the key factors which are used to determine an equilibrium exchange rate are complicated. Therefore, we choose the PPP as the benchmark rate in

the calculation of the AMU Deviation Indicators because the PPP is the most general way in the calculation of an equilibrium exchange rate and the bias of macroeconomic variables is limited.

In order to calculate 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 by 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 that the actual exchange rate in terms of the AMU per national currency is undervalued than the PPP.

The sample periods for our empirical analysis are from January 2000 to recently. We employ data from AMU database of the Research Institute of Economy, Trade and Industry (RIETI) and *International Financial Statistics* of the International Monetary Fund (IMF) to calculate the PPP-based AMU Deviation Indicator.[3] The calculation results of the PPP-based AMU Deviation Indicator are shown in figure 3-1. It is clear that the higher inflation rate is, the PPP-based AMU Deviation Indicator is the more

[3] For the calculation of the PPP, the benchmark rate of each currency in terms of the AMU per national currency is from AMU database of RIETI; the CPI is from *International Financial Statistics* of IMF.

overvalued, and vice versa. Price levels of each country of ASEAN+3 and the AMU area are shown in figure 3-2. It shows that the PPP-based AMU Deviation Indicator in such high inflationary countries as Indonesia and Laos is always overvalued. On one hand, the PPP-based AMU Deviation Indicator in such deflationary country as Japan has a tendency to be undervalued. Furthermore, the fluctuations of the PPP-based AMU Deviation Indicator 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 Indicator with the Nominal AMU Deviation Indicator in figure 3-3, it is obvious that the diverging spreads between both of them tend to be broadening in high inflationary countries. On one hand, the Real AMU Deviation Indicator and the PPP-based AMU Deviation Indicator 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 PPP-based 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 in the non-tradable good sectors. In the situation, inflation rates in prices of tradable goods tend to be lower than those of non-tradable goods. Therefore, the PPP based on the CPI differs from the exchange rate based on the law of one price for tradable goods. The difference between them is known as the Balassa-Samuelson effect.

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

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

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

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

Prices of tradable good (P_T^*) and 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 prices of tradable good and non-tradable good. General price levels of the domestic and 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 tradable good in general price level of the domestic economy, w_N is a weight on non-tradable good in general price level of the domestic economy, w_T^* is a weight on tradable good in general price level of the foreign economy, and w_N^* is a weight on non-tradable good in general price level of the foreign economy.

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

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

where S^{LOP} is an exchange rate based 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 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:

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

The Balassa-Samuelson effect can be expressed by the last two terms of equation (4-10), that is $w_N \cdot (\log \alpha_T - \log \alpha_N) - w_N^* \cdot (\log \alpha_T^* - \log \alpha_N^*)$.

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.

We define productivity of the tradable good sectors as a quotient of real GDP (Y_T) in terms of employment (L_T), while productivity of the non-tradable good sectors as a quotient of real GDP (Y_N) in terms of employment (L_N) in order to calculate the Balassa-Samuelson effect. As well, productivities both the tradable good sectors and the non-tradable good sectors in the foreign economy are defined by the same way as the domestic economy.

Based on the above definition, productivity of the tradable good sectors (α_T) and productivity of the non-tradable good sectors (α_N) in the domestic economy are represented as following:

$$\alpha_T = \frac{\sum Y_T}{\sum L_T} \quad (4\text{-}12)$$

$$\alpha_N = \frac{\sum Y_N}{\sum L_N} \quad (4\text{-}13)$$

On one hand, productivity of the tradable good sectors (α_T^*) and productivity of the non-tradable good sectors (α_N^*) in the foreign economy are represented as following:

$$\alpha_T^* = \frac{\sum Y_T^*}{\sum L_T^*} \quad (4\text{-}14)$$

$$\alpha_N^* = \frac{\sum Y_N^*}{\sum L_N^*} \quad (4\text{-}15)$$

We also define the rate of change as the percent change from the previous year.

4-2. Data

The above simple model is used to conduct a simulation of the PPP based AMU Deviation Indicator 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]

[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.

In order to calculate productivity in both the tradable good sectors and the non-tradable good sectors 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 one 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]

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 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 periods for our empirical analysis are 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

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

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

good sectors, its currency's PPP calculated by the CPI tends to be undervalued compared with the exchange rate based on the law of one price for tradable goods. As shown in equation (4-11), the weight on the non-tradable good sectors as well as the growth rate of productivity 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 periods 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 the differentials in growth rate of productivity but also by the changing weight on the non-tradable good sectors. It means that changes in the industrial structure are important factors in considering the Balassa-Samuelson effect within the area of ASEAN6+3. Thus, the Balassa-Samuelson effect is much affected by the variables of relevant country in the case of a country that has a larger weight on the non-tradable good sectors than the AMU area like Singapore. On one hand, it seems that the rate of change of the Balassa-Samuelson effect tends 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 AMU area like China and Vietnam. Details of the simulation results are as following.

(1) Japan

In Japan, the growth rates of productivity in 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 in 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, the differentials in growth rate of productivity are positive in the AMU area. When we compare the differentials in growth rate of productivity between Japan and the AMU area, we can find that the differentials in growth rate of productivity in Japan are smaller than those in the AMU area in many years. When we focus on the weights on the non-tradable good sectors both 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 the factors of the AMU area. Accordingly, the rate of change of the PPP of the 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 the 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 the differentials in growth rate of productivity between China and the AMU area, the differentials in growth rate of productivity in China are higher than those in the AMU area. Because of the lower weight on 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 that the rate of change of the PPP of the Chinese yuan is overvalued.

(3) Korea

In Korea, the growth rates of productivity in both the tradable good sectors and the non-tradable good sectors have kept increasing in the last ten years, excluding 2008 and 2009. 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 the Korean won is undervalued from the aspect of domestic economy. However, the weight on the non-tradable good sectors has decreased since 2000 though it is still higher than that in the AMU area. By comparing the differentials in growth rate of productivity between Korea and the AMU area, there is a tendency that the differentials in 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 the 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 rate of productivity between the tradable good sectors and the non-tradable good sectors tend to be positive, it seems that the PPP of the Singapore dollar is undervalued from the viewpoint of domestic factors. 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 rate of productivity between Singapore and the AMU area, the differentials in growth rate of productivity in Singapore are also larger than those in the AMU area during most of the analytical periods. Because of the greater weight on the non-tradable good sectors and the larger differentials in growth rate 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 the Singapore dollar is undervalued within the framework of AMU.

(5) Indonesia

Indonesia has no tendency to show the growth rates of productivity in both the tradable good sectors and the non-tradable good sectors. However, the differentials in growth rate of productivity in Indonesia tend to be near zero or negative. It means that the PPP of the Indonesian rupiah might be overvalued. Although the weight on the 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 on 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 differentials in growth rate of productivity between Indonesia and the AMU area, the differentials in growth rate of productivity in Indonesia is smaller than those in the AMU area during most of the analytical periods. 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 the Indonesian rupiah is overvalued.

(6) Thailand

In Thailand, the growth rates of productivity in both the tradable good sectors and the non-tradable good sectors have kept increasing during most of the analytical periods. The differentials in growth rate of productivity also tend to be positive. Thus, the domestic factors might cause an undervaluation of the PPP of the 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 differentials in growth rate of productivity in Thailand with those 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 of 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 the Thai baht is overvalued.

(7) Malaysia

In Malaysia, the growth rates of productivity in both the tradable good sectors and the non-tradable good sectors tend to be increasing during the whole analytical periods excluding 2009. The growth rate of productivity in the 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 the 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 weight on the non-tradable good sectors of the AMU area in 2007. On one hand, the differentials in growth rate of productivity in Malaysia were higher than those in the AMU area before 2004 while they have been lower from 2005 to recently. Therefore, the rate of change of the Balassa-Samuelson effect of the Malaysian ringgit was positive before 2004 and has been negative since 2005. It means that the rate of change of the PPP of the Malaysian ringgit has turned to be overvalued since 2005.

(8) Vietnam

Although the growth rates of productivity in both 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 the higher growth rate of productivity in the tradable good sectors, it might be said that the PPP of the 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 that in the AMU area. When we compare the differentials in growth rate of productivity between Vietnam and the AMU area, the differentials in growth rate of productivity in Vietnam have 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 the Vietnamese dong is undervalued in most of the analytical

periods.

(9) The Philippines

In the Philippines, the growth rates of productivity in both the tradable good sectors and the non-tradable good sectors are increasing during most of the analytical periods. However, the growth rate of productivity in the tradable good sectors is not as high as that in the non-tradable good sectors. Therefore, it might be regarded that the PPP of the 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 weight has 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 in the Philippines was lower than that in the non-tradable good sectors before 2005. Accordingly, the differentials in growth rate of productivity were negative. The differentials in growth rate of productivity have turned into being positive because of an uptrend of productivity in the tradable good sectors since 2006. Furthermore, because the differentials in growth rate of productivity in the Philippines are smaller than those in the AMU area, the rate of change of the Balassa-Samuelson effect of the Philippine peso tends to be negative. It means that the rate of change of the PPP of the Philippine peso is overvalued in many of the 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 CPI. However, we should take into account the Balassa-Samuelson effect in using the CPI to calculate the PPP. 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 accuracy of the benchmark rate in 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:

$$DI^{PPP\ \ Adjusted\ \ by\ \ BS} = \frac{S^{Actual} - S^{LOP}}{S^{LOP}} \quad (4\text{-}16)$$

where S^{Actual} is an 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 (4-16) can be expressed in terms of logarithm:

$$DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \log S^{Actual} - \log S^{LOP} \quad (4\text{-}17)$$

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 (4-17) can be rewritten as below:

$$DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \log S^{Actual} - \log S^{PPP} + w_N \cdot (\log \alpha_T - \log \alpha_N) - w_N^* \cdot (\log \alpha_T^* - \log \alpha_N^*) \quad (4\text{-}18)$$

Based on equation (4-18), 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:

$$\triangle DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \dot{S}^{Actual} - \dot{S}^{PPP} + w_N (\dot{\alpha}_T - \dot{\alpha}_N) - w_N^* (\dot{\alpha}_T^* - \dot{\alpha}_N^*) \quad (4\text{-}19)$$

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 ($DI^{PPP} \approx \log S^{Actual} - \log S^{PPP}$). 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 the differentials in the rate of change between an actual exchange rate and the exchange rate based on the PPP ($\triangle DI^{PPP} \approx \dot{S}^{Actual} - \dot{S}^{PPP}$).

So equation (4-19) can be rewritten as below:

$$\triangle DI^{PPP\ \ Adjusted\ \ by\ \ BS} \approx \triangle DI^{PPP} + w_N (\dot{\alpha}_T - \dot{\alpha}_N) - w_N^* (\dot{\alpha}_T^* - \dot{\alpha}_N^*) \quad (4\text{-}20)$$

Hence, equation (4-20) 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 Indicator adjusted by the Balassa-Samuelson effect are similar to the

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

fluctuations of the PPP-based AMU Deviation Indicator as shown in figure 4-2. The currency of inflationary country tends to be overvalued while the 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 fluctuations of the PPP-based AMU Deviation Indicator adjusted by the Balassa-Samuelson effect, it can be said that the asymmetric diversity on 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. We consider that the benchmark rate should be changing over time if fundamentals of exchange rate such as the PPP are changing over time. Because the PPP is calculated based on the CPI which includes prices of non-tradable goods, we point out that the benchmark rate itself might be overvalued or undervalued for the Balassa-Samuelson effect. We took into account the Balassa-Samuelson effect of each currency to calculate 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 Indicator, and the PPP-based AMU Deviation Indicator 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 Indicator and the PPP-based AMU Deviation Indicator adjusted by Balassa-Samuelson effect have different movements with the original Nominal AMU Deviation Indicator.

Each type of the AMU Deviation Indicators has its own merit. The Nominal AMU Deviation Indicator can be calculated at real time. For the reason, it can be used as a

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

real-time indicator to monitor daily exchange rate movements. Although 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 rate on the macroeconomic variables of concern. On one 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 CPI, real GDP and employment. However, they are useful in evaluating whether the exchange rate is in an appropriate level compared with such fundamentals as the PPP and the growth rate of productivity.

Both the PPP-based AMU Deviation Indicator and the PPP-based AMU Deviation Indicator 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 was undervalued by approximately 35% in terms of the Real AMU Deviation Indicator in 2008. In contrast, it was 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 Indicator and the PPP-based AMU Deviation Indicator 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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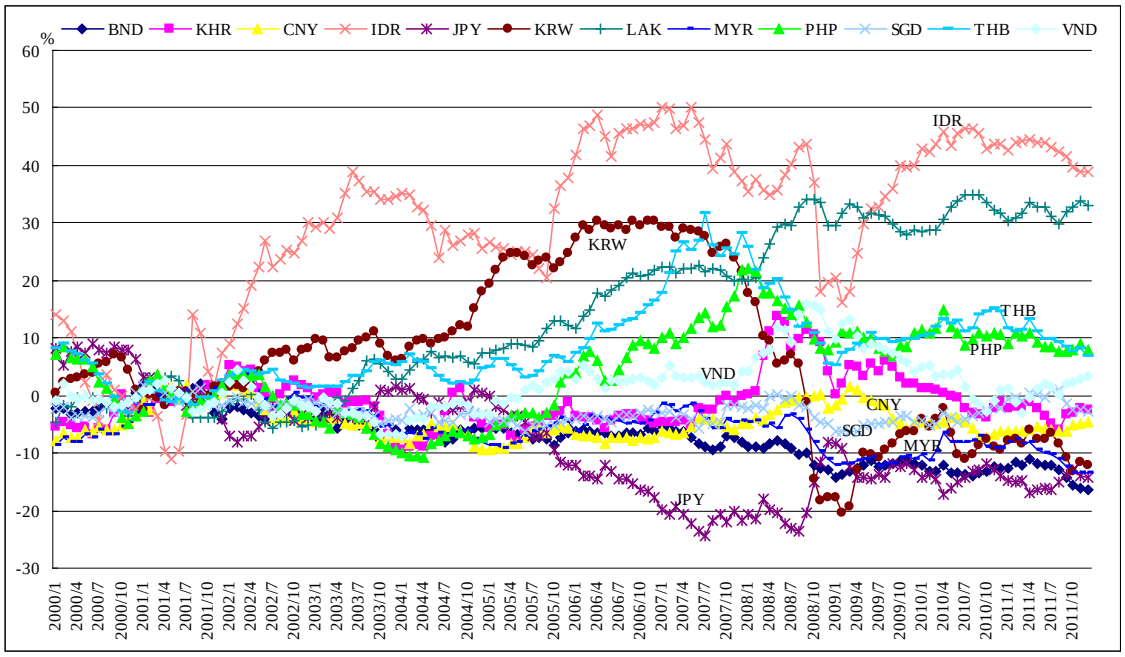
FIGURE 3-1. THE PPP -BASED AMU DEVIATION INDICATORS OF ASEAN+3



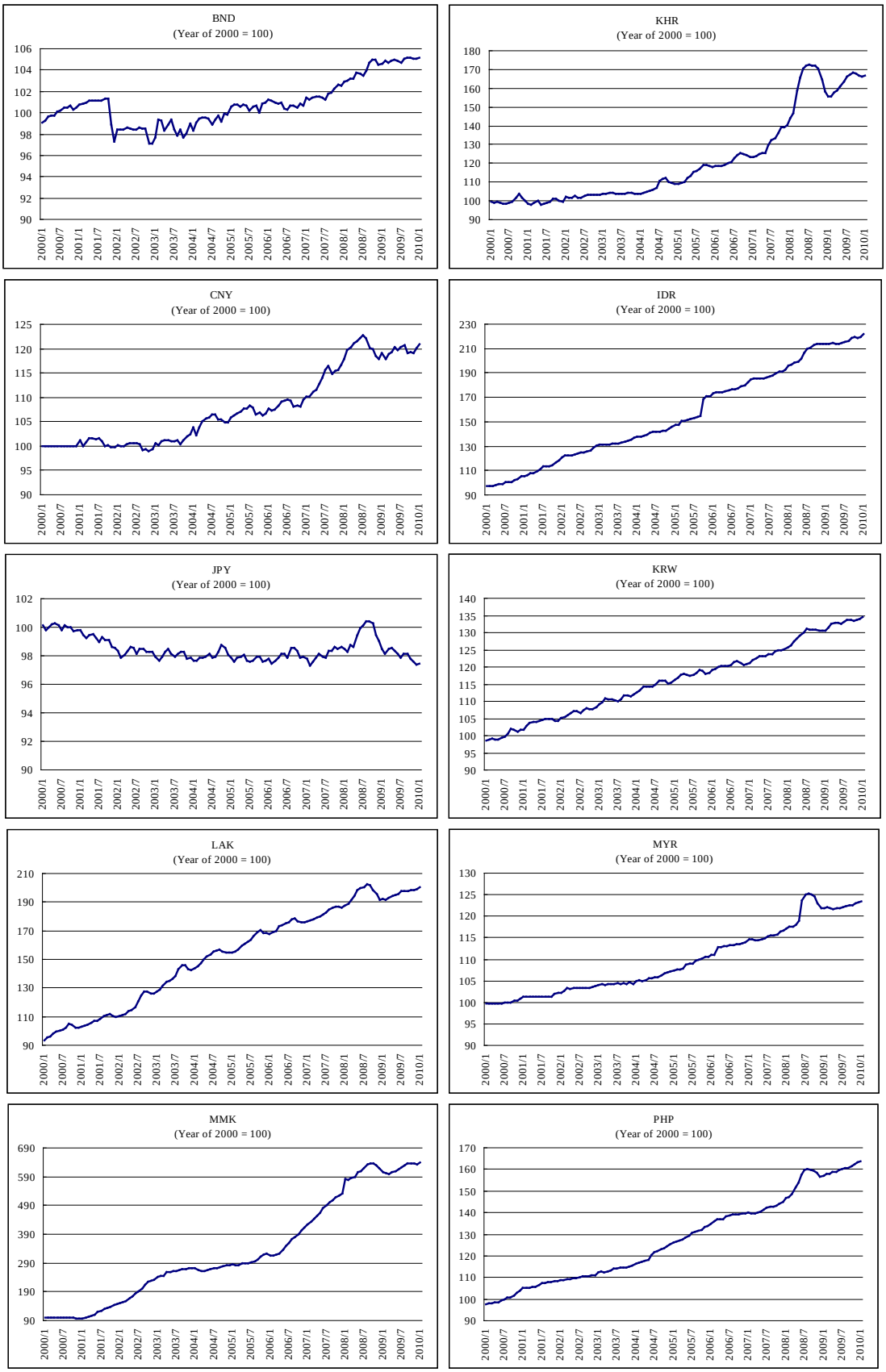
Note: The PPP-based AMU Deviation Indicator of Myanmar is drastically higher than the other countries; therefore, it is excluded from the figure of 3-1.

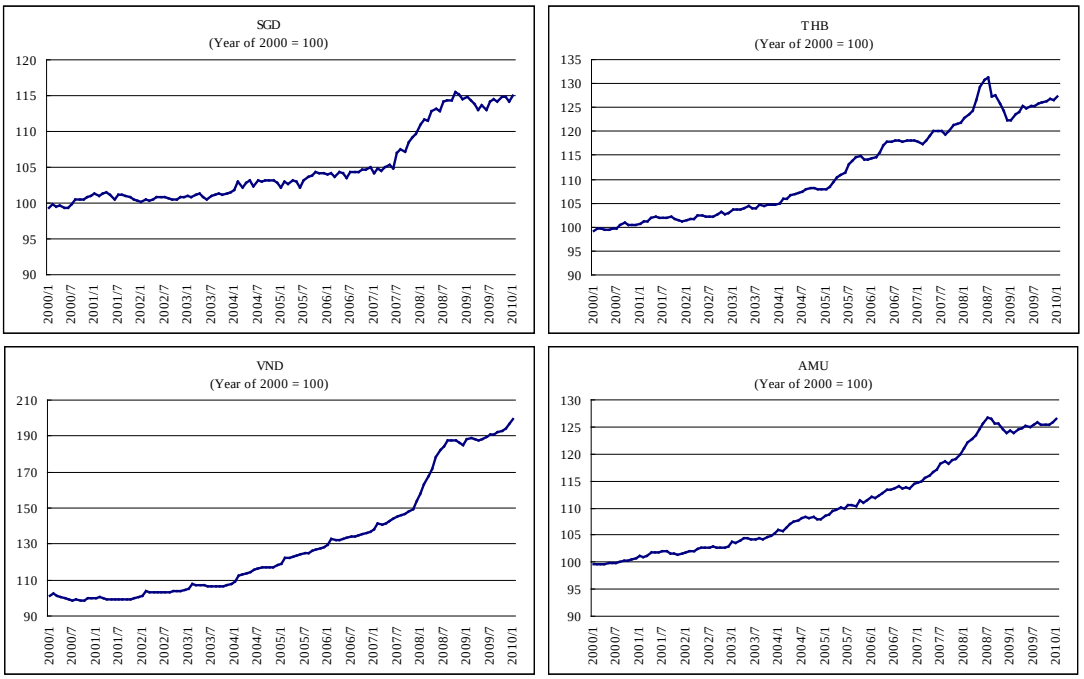
Source: RIETI online database.

International Financial Statistics (IMF).

Authors' calculation.

FIGURE 3-2. PRICE LEVELS OF ASEAN+3 AND THE AMU AREA

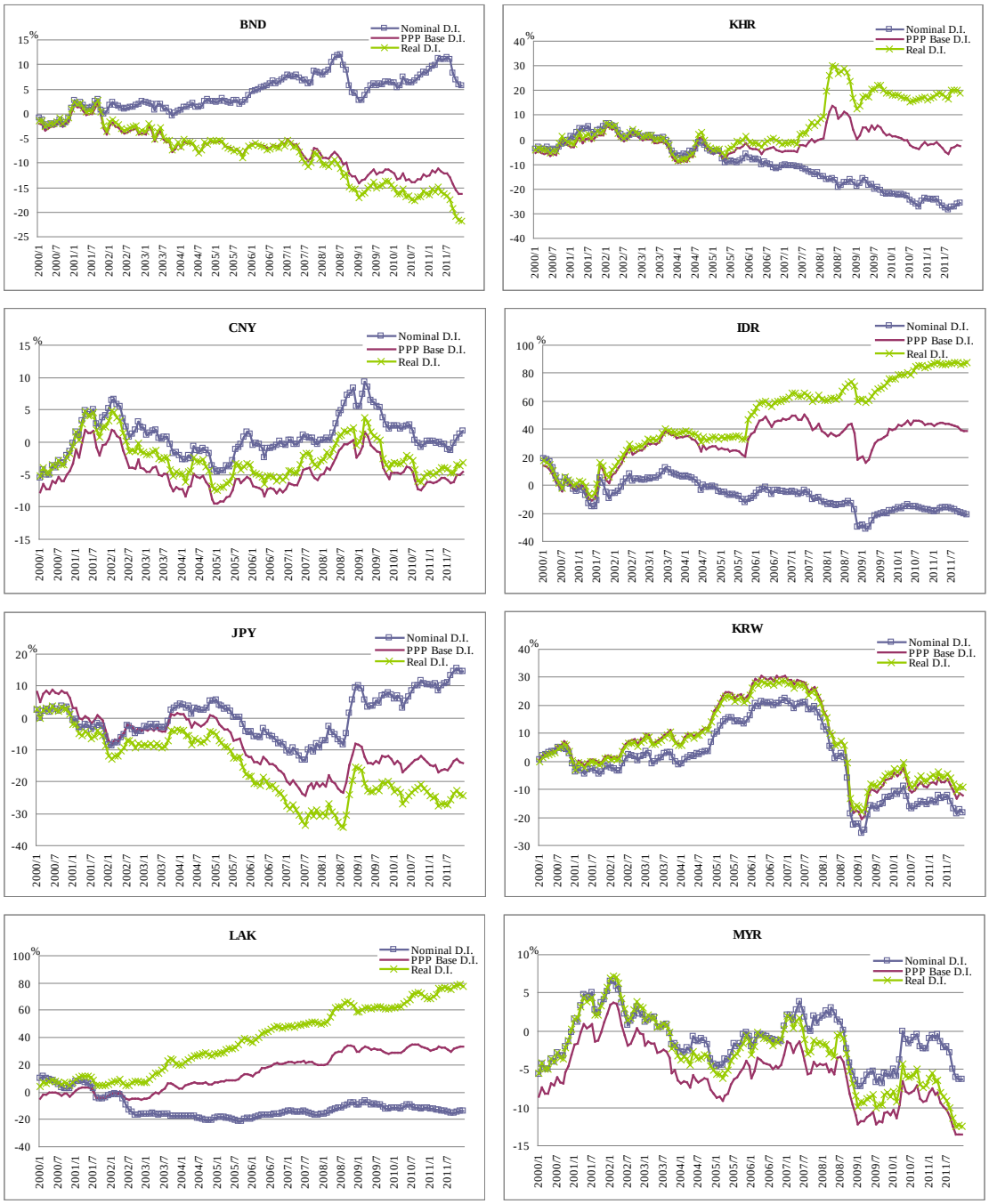


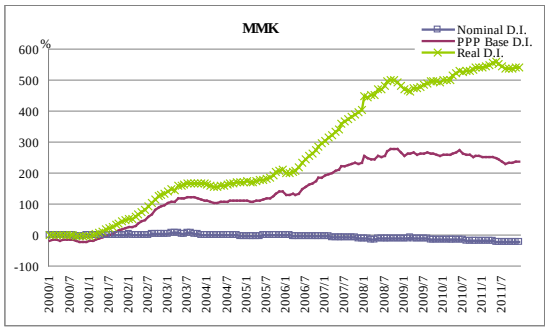


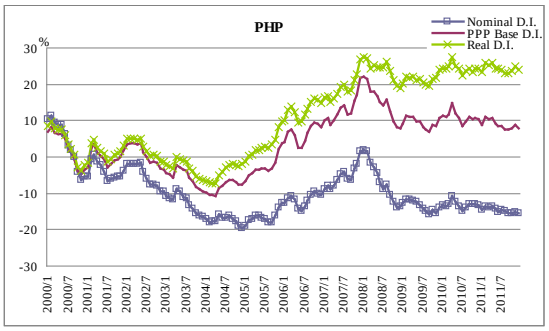
Source: *International Financial Statistics* (IMF).

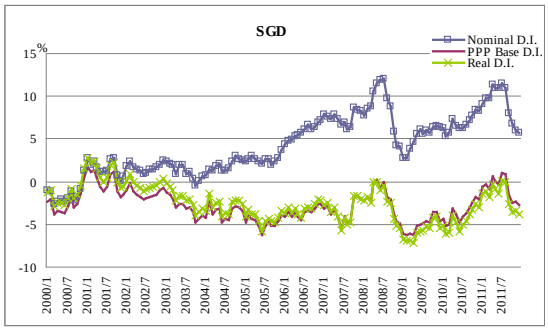
Authors' calculation.

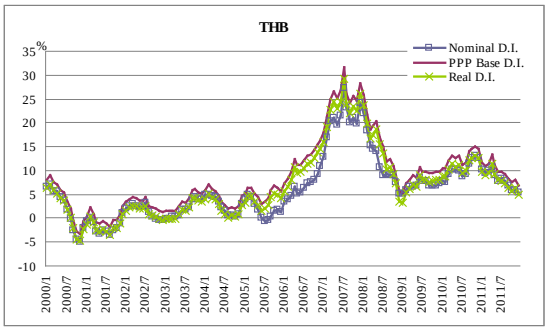
FIGURE 3-3. THE NOMINAL AMU DEVIATION INDICATOR, THE REAL AMU DEVIATION INDICATOR AND THE PPP-BASED AMU DEVIATION INDICATOR

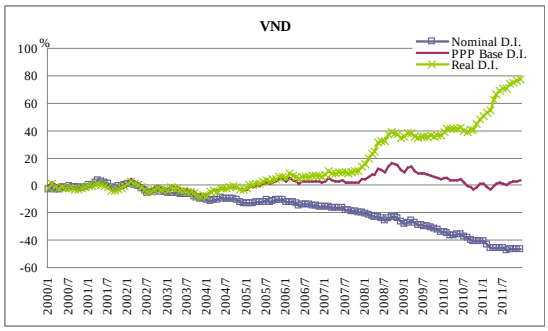












Source: RIETI online database.

International Financial Statistics (IMF).

Authors' calculation.

TABLE 4-1. DATA SOURCE OF REAL GDP AND EMPLOYMENT

	Real GDP	Employment
Japan	Japan Statistical Yearbook Cabinet Office, Government of Japan	OECD Structural Analysis Statistics Ministry of Internal Affairs and Communications
China	China Statistical Yearbook National Bureau of Statistics of China	China Statistical Yearbook National Bureau of Statistics of China
Korea	Korea Statistical Yearbook Statistics Korea	OECD Structural Analysis Statistics Ministry of Employment and Labor
Singapore	Yearbook of Statistics Singapore Department of Statistics Singapore	Ministry of Manpower
Indonesia	Statistical Yearbook of Indonesia Statistics Indonesia	Statistical Yearbook of Indonesia Statistics Indonesia
Thailand	Thailand Statistical Yearbook National Statistical Office	Office the National Economic and Social Development Board
Malaysia	Yearbook of Statistics Malaysia Department of Statistics Malaysia	Yearbook of Statistics Malaysia Department of Statistics Malaysia
Vietnam	Statistical Yearbook of Vietnam General Statistics Office of Vietnam	Statistical Yearbook of Vietnam General Statistics Office of Vietnam
The Philippines	Philippine Statistical Yearbook National Statistical Coordination Board	Bureau of Labor and Employment Statistics

TABLE 4-2-1. 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.

Authors' calculation.

TABLE 4-2-2. 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.

Authors' calculation.

TABLE 4-2-3. 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.

Ministry of Employment and Labor.

Authors' calculation.

TABLE 4-2-4. 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.

Authors' calculation.

TABLE 4-2-5. 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.

Authors' calculation.

TABLE 4-2-6. 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.

Authors' calculation.

TABLE 4-2-7. 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.

Authors' calculation.

TABLE 4-2-8. 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.

Authors' calculation.

TABLE 4-2-9. 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

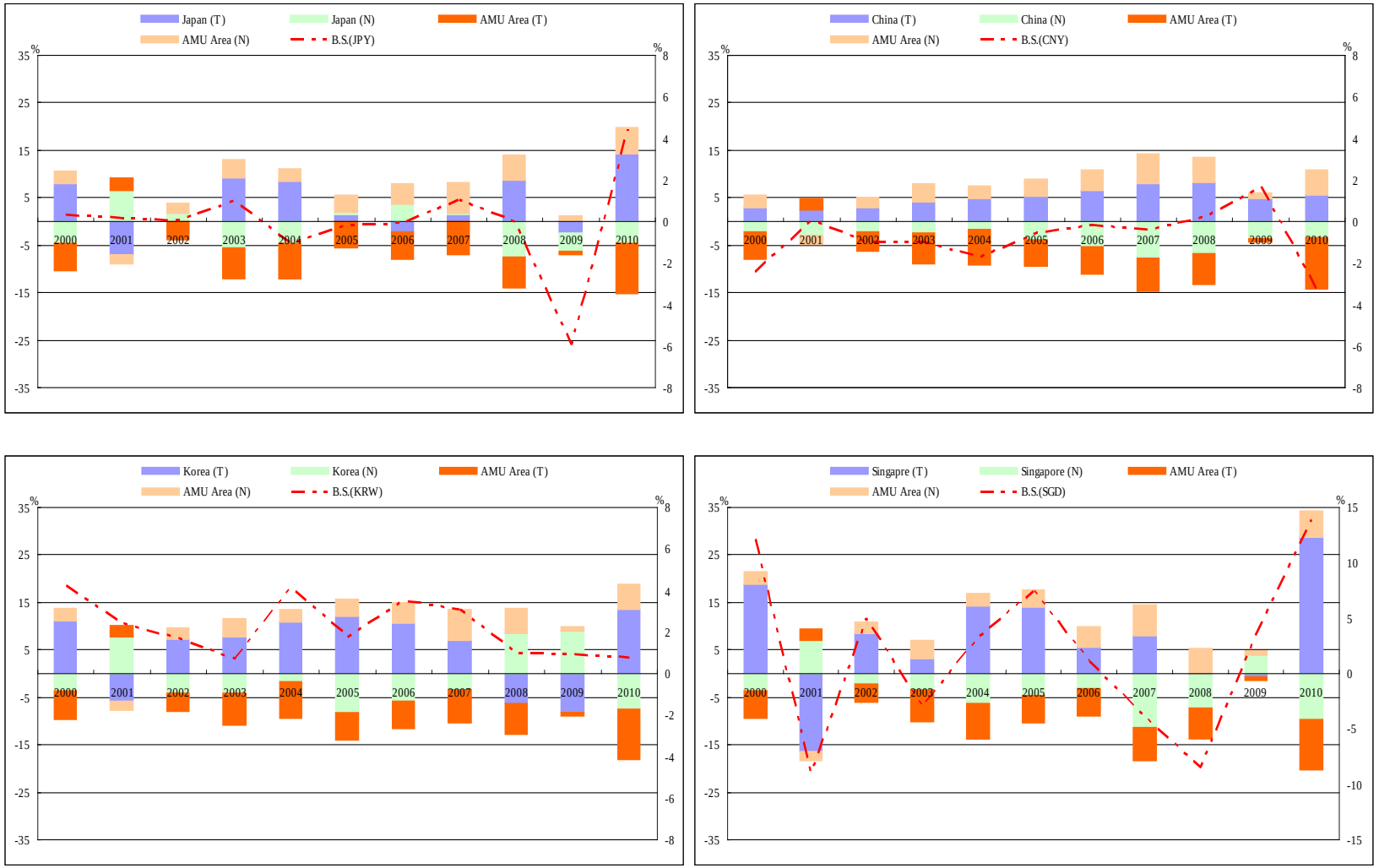
Source: Philippine Statistical Yearbook.

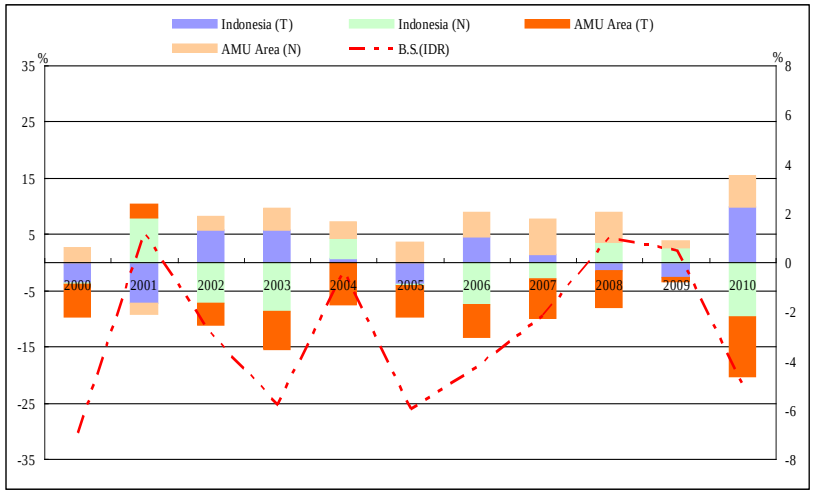
National Statistical Coordination Board.

Bureau of Labor and Employment Statistics.

Authors' calculation.

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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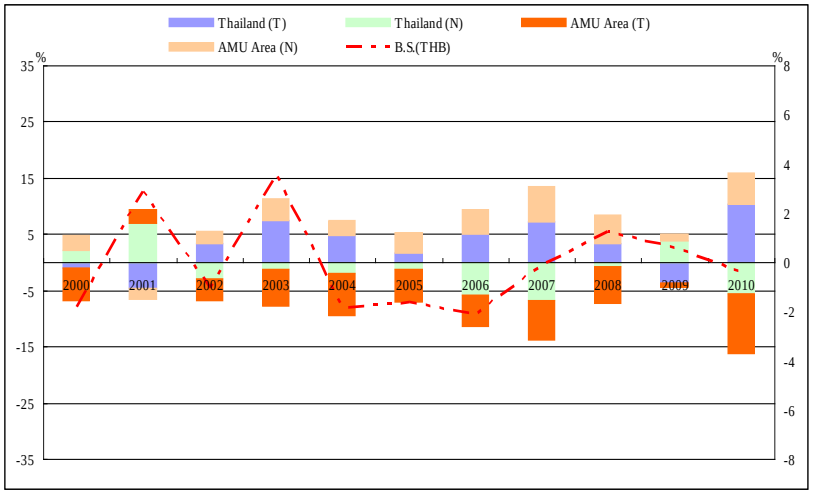
Thailand (T)
Thailand (N)
AMU Area (T)
AMU Area (N)
B.S.(THB)
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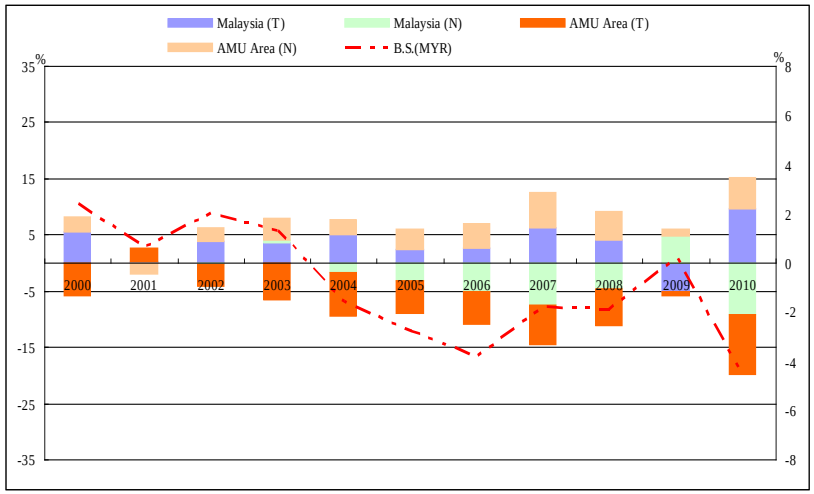
Malaysia (T)
Malaysia (N)
AMU Area (T)
AMU Area (N)
B.S.(MYR)
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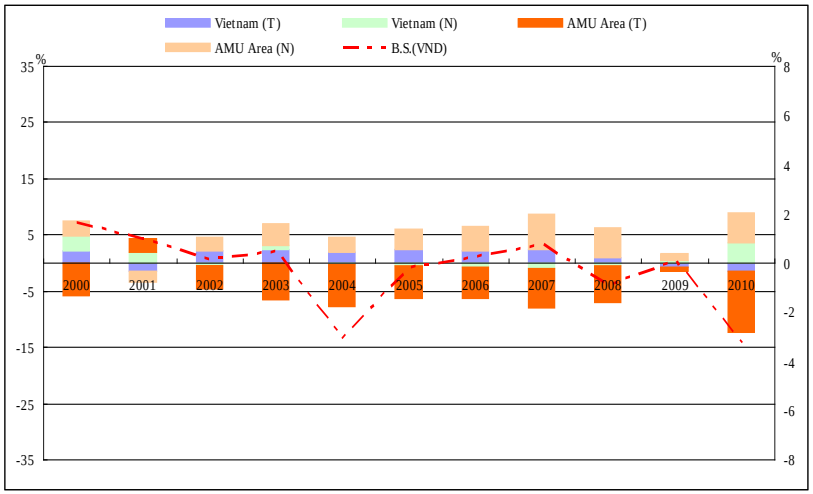
Vietnam (T)
Vietnam (N)
AMU Area (T)
AMU Area (N)
B.S.(VND)
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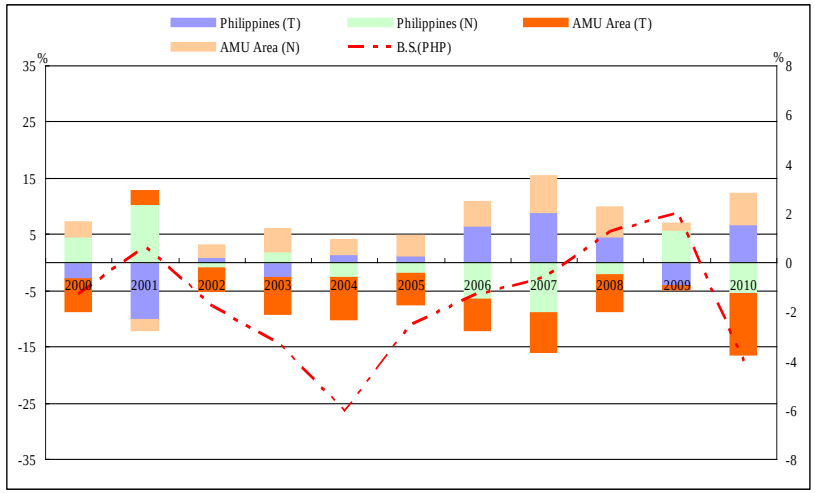
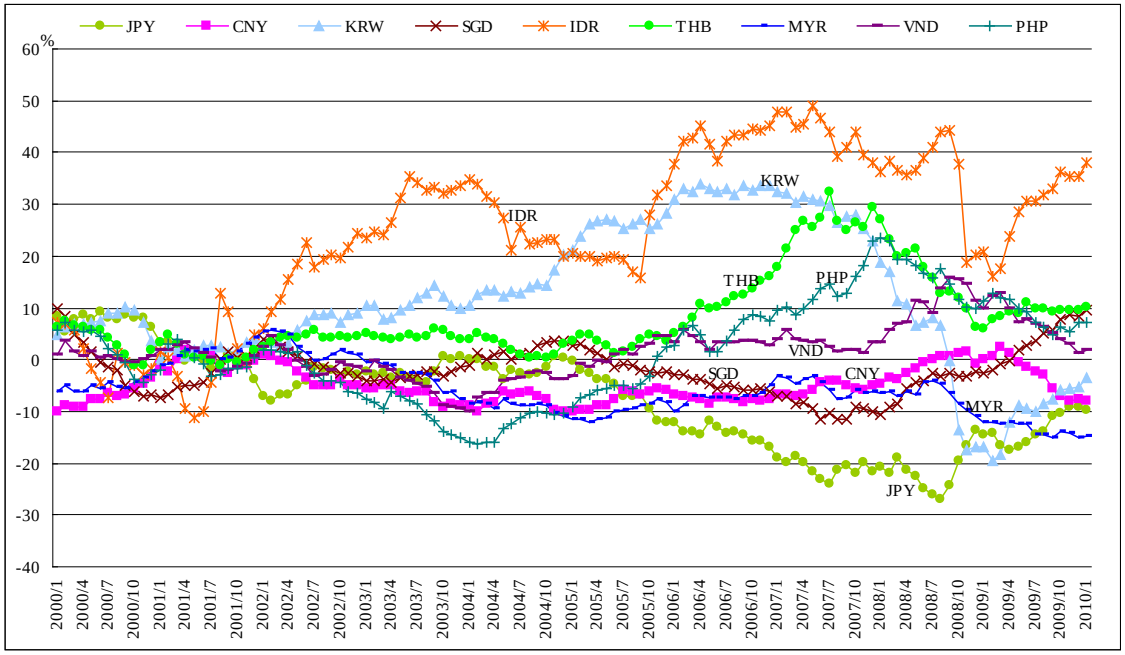


Note: Left scale is the rate of change of each variable; Right scale is the rate of change of the Balassa-Samuelson effect.

Source: Table 4-2-1 to 4-2-9.

Authors' calculation.

FIGURE 4-2. THE PPP-BASED AMU DEVIATION INDICATORS ADJUSTED BY THE BALASSA-SAMUELSON EFFECT OF ASEAN6+3



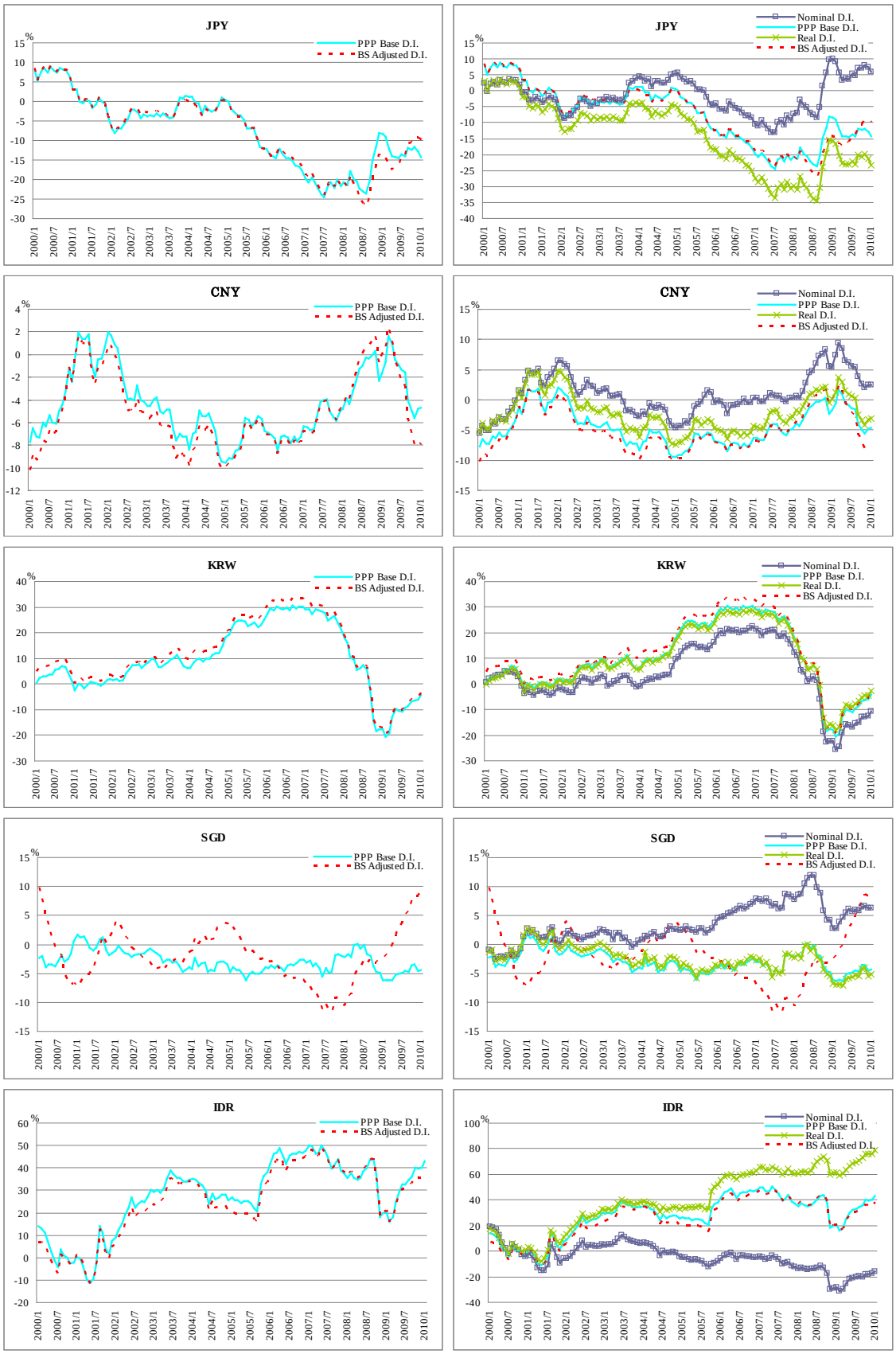
Source: RIETI online database.

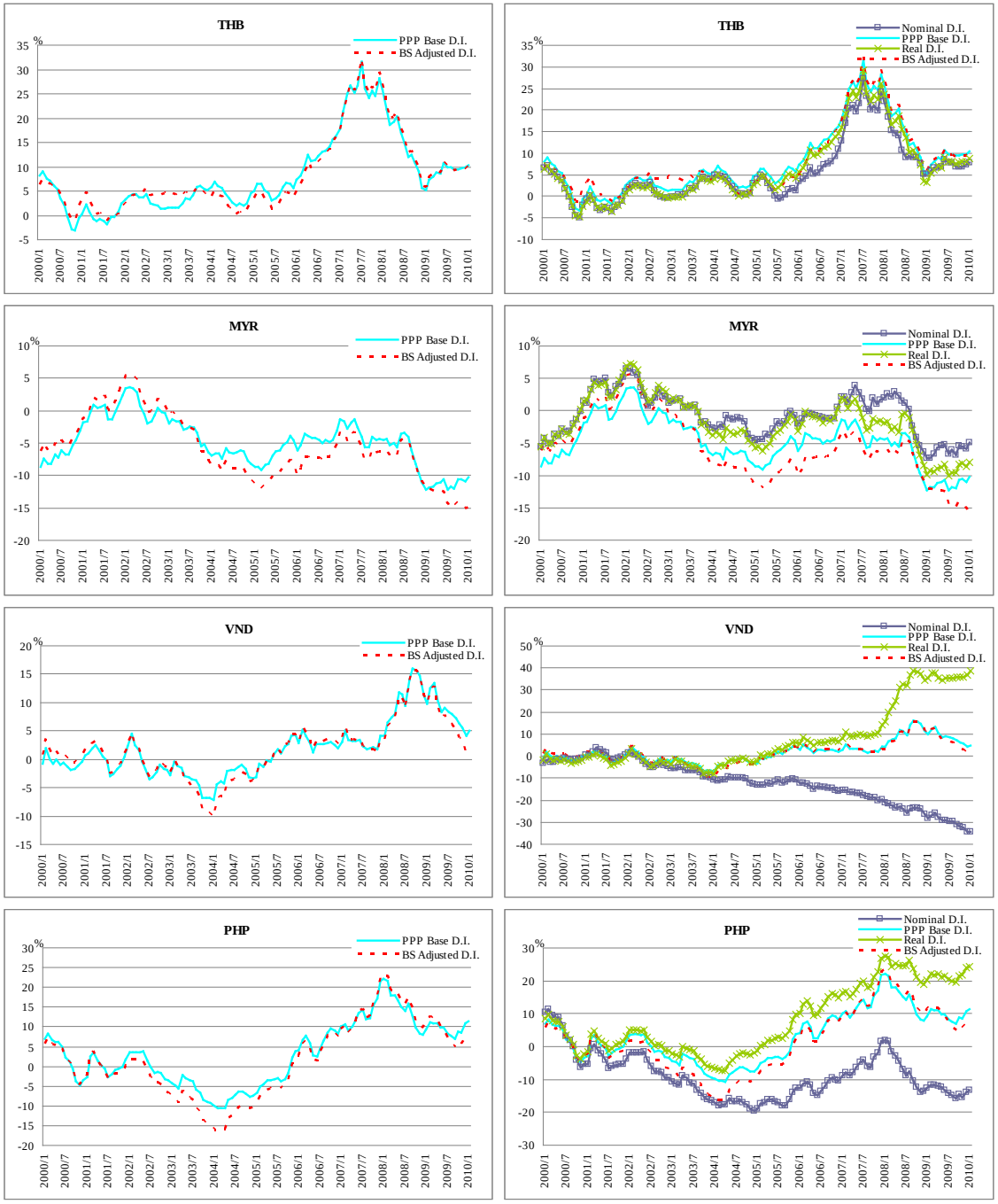
International Financial Statistics (IMF).

Table 4-2-1 to 4-2-9.

Authors' calculation.

FIGURE 4-3. THE AMU DEVIATION INDICATORS OF ASEAN6+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 online database.

International Financial Statistics (IMF).

Table 4-2-1 to 4-2-9.

Authors’ calculation.