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How Does the Regional Monetary Unit Work as a Surveillance Tool in East Asia?

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How Does the Regional Monetary Unit Work as a Surveillance Tool in East Asia? [§ ♣†]

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Abstract

To utilize the Chiang Mai Initiative Multilateralization (CMIM) for crisis management, macroeconomic surveillance of the member economies should be ex-ante conditionality. Hence, the Association of Southeast Asian Nations (ASEAN) plus Three Macroeconomic Research Office (AMRO) was established to detect possibilities of economic crises and to prompt the restructuring or reforming of a rigid structure or system. Although monitoring the exchange rates of the currencies of these countries vis-à-vis the U.S. dollar is essential for surveillance, the AMRO should have an original tool to consider region-specific factors and more efficient tools than the International Monetary Fund (IMF) surveillance.

Therefore, this paper proposes utilizing a regional monetary unit (RMU) in monitoring exchange rates. Empirical analysis has confirmed that deviation indicators of RMUs such as the Asian Monetary Unit Deviation Indicators (AMU DI) are expected to be useful for macroeconomic surveillance. This paper also tries to define the country's equilibrium exchange rate vis-à-vis a RMU to provide useful statistical information about exchange rate misalignments among East Asian currencies by employing the permanent-transitory decomposition proposed by Gonzalo and Granger (1995).

Keywords: Equilibrium exchange rate, Regional monetary unit, Co-integration, Permanent-transitory decomposition

JEL classification: F31, F33, F36

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1. Introduction

The turmoil in economic policy among G20 countries against the global financial crisis just after the Lehman Shocks still remind us of a hard time after Great Depression in 1929. Even in the present era of globalization, there still exists a threat of a ‘beggar-thy-neighbor’ policy, especially, on exchange rates. Since devaluation of home currency against the trade partner’s currency would help the export industry to recover from recession quickly by exporting their products, monetary authorities in the export-oriented industrialization economy might have a strong incentive to devaluate their currencies. Although the competitive devaluation is generally regarded as one of ‘beggar-thy-neighbor’ policies, Eichengreen and Sachs (1985) suggested that, while the individual devaluation gives negative impact on foreign economy, the ‘coordinated international devaluations’ taken by a group of countries would have hastened recovery from Great Depression. Namely, loosened monetary policy to fulfill currency depreciations happened to help to push up price level and stimulate economic recover. Therefore, the meaning of ‘competitive devaluation’ in the sense of Eichengreen and Sachs (1985) is to elaborate the strategy that country takes different policy from group actions. Because the country adopts the rigid exchange rate regime and its currency might be stuck at overvalued, the monetary authority of such county would have incentives to adopt trade restrictions and impose “exchange-rate dumping” duties. Therefore, once the international communities allowed a country to take different prescriptions, competitive devaluations for protectionism happened. A shred of hope for a fair global economy would threaten to collapse completely.

To avoid it, the leaders of the G20 could have archived to agree to deal with financial crisis and to overhaul the financial structure on November 2008. The practical meanings of the agreements at “*Bretton Woods II*” are that the policy makers should make a big effort to avoid competitive devaluation, coordinate their monetary policy, and expanding fiscal expenditures to boost the each economy. However, to enroot in any policy makers’ mind to strengthen the financial system, to keep sustainability of fiscal expenditures, and to improve fairness and efficiency in the world trade are the least common denominator for further development of world economy. At same time, we again recognized that the policy dialogues and coordination among countries are essential to diurnal growth of world economy in the globalization era.

Compared with serious impacts on the European economies from the sub-prime loan crisis and global financial crisis, negative impacts to Asian economies have been limited to their exports and equity markets. Indeed, the exports from Asian countries to the US and the Euroland have declined sharply and turmoil in the financial market have not calmed down yet. It seems that Asian economies still keep being in good shape so far. On the other hand, the irrational appreciating pressures on the certain currency: the Japanese yen and overloaded stresses on credit market become potential risks of future crisis on Asian economies.

As lessons from the previous crisis in Asia, the monetary authorities of ASEAN plus three (Japan, China, and Korea) has established a network of swap agreements among them under the Chiang Mai Initiative (CMI) and elevated it up to the multilateral agreement as the CMIM.[1] Although the CMIM would be expected to work as crisis-management tools as it stands, the demand for putting teeth into the CMIM for the further role of crisis preventions is growing among member countries. To utilize the CMIM not only for the crisis managements but also for the crisis prevention, the macroeconomic surveillance over the member economies should be ex-ante conditionality, which would be also expected to work as a function of deterrence to beggar-thy-neighbor policy or discipline of discretionary fiscal policy. For that purpose, the monetary authorities of these countries have also agreed to establish the ASEAN plus Three Macroeconomic Research Office (AMRO).

Although there would exist several items of economic indicators to be monitored in the surveillance framework by the AMRO, monitoring for the exchange rate and its related indicators is very helpful to detect a possibility of crisis, which is the simplest for the macroeconomic surveillance. If the AMRO have an original tool for their surveillance framework, which considers region-specific factors and more practical signals to detect a possibility of crisis than that of the IMF surveillance, the regional monetary unit expects to become a useful tool for an exchange rate monitoring and contribute to stabilize the exchange

[1] The monetary authorities of ASEAN plus 'three' countries: China, Japan, and Korea announced that the Chiang Mai Initiative Multilateralization (CMIM) Agreement come into effect on March 24, 2010

rates among the East Asian currencies.

Important aspect of adopting exchange rate monitoring with the regional monetary unit into the AMRO's surveillance frameworks is to avoid "coordination failure" in choosing exchange rates policy and monetary policy among member countries. Even if the surveillance and consultation by the IMF might works well to avoid the expected crisis in advance, there still exist rooms for a prudential discretion policy. Hence, local problems tend to be remained unsolved. As an important conditionality of swap contract among countries, a prudential discretion policy should be monitored or checked in regional political framework, mutual understandings and peer pressure by neighboring countries. Collective policy actions by employing the clear, simple, and standardized measures among CMIM member countries will obviously contribute to enhancing the credibility and the transparency in each county's economic policy.

Although there exist several items of economic indicators to be monitored in the surveillance framework, monitoring for the exchange rate and its related indicators is very helpful to detect a possibility of crisis, which is the simplest for the macroeconomic surveillance. Speaking to the exchange rate monitoring, one can ask that why those Asian countries need further monitoring for exchange rates by the AMRO beyond the surveillance and consultation by the IMF or the ADB. Although monitoring exchange rates of each currency vis-à-vis the USD is usual but essential for surveillance, the AMRO should have an original tool for their surveillance framework, which considers region-specific factors and more practical signals to detect a possibility of crisis than that of the IMF surveillance. Regarding the ideal of CMIM, monitoring for an effective exchange rate across member currencies should be included for macroeconomic surveillance as a conditionality of CMIM.

Therefore, this paper tries to explore how to establish efficient surveillance framework for exchange rates employing the regional monetary unit (RMU) among CMIM member countries. Recently, the RMU such as the Asian Currency Unit (ACU) or the Asian Monetary Unit (AMU) has been developed and it expects to become a useful tool for an exchange rate monitoring and contribute to stabilize the exchange rates among the East Asian currencies. Therefore, this paper proposes usage of the Regional Monetary Unit Deviation Indicator (RMU

DI) in monitoring exchange rates. Specifically, the empirical analysis in this paper establishes whether there exist significant differences in the movement of the RMU DI and the bilateral real exchange rate. If we confirm the advantages of the RMU DI for exchange rates monitoring over the usual monitoring for bilateral exchange rates, the AMRO will obtain more important and region-oriented role of surveillance unit than that of the IMF.

Although the regional monetary unit is expected to work as a useful tool for the macroeconomic surveillance as to conditionality of the CMIM, proper statistical indicators related to the long-term equilibriums among the exchange rates should also be provided. Hence, another purpose of this paper is to provide useful statistical measures about exchange rates misalignments among East Asian currencies. To capture the misalignment, this paper tries to define the country's equilibrium exchange rate vis-à-vis the RMU by employing the Permanent-Transitory decomposition proposed by Gonzalo and Granger (1995).

The rest of this paper composed as follows. The next section gives a basic explanation of the regional monetary unit such as the ACU or, the AMU and its Deviation Indicators (AMU DI). In Section 3, empirical analysis investigates whether there exist significant differences in the movement of the real RMU DI and the bilateral real exchange rate. In Section 4, the concept of equilibrium exchange rates and misalignment from the equilibrium tries to be adopted into the deviation indicators. Section 5 is saved for the concluding remarks.

2. ACU, AMU, and AMU DI

The concept of the RMU and its indicators as a possible measurement tool for exchange rate monitoring by the AMRO will be based on the AMU and AMU DI. The AMU and AMU DI are suggested by Ogawa and Shimizu (2006a 2006b), and by Kuroda and Kawai (2003) based on a similar proposal for the ACU. Ogawa and Shimizu (2006) proposed the creation of an AMU and AMU DIs for East Asian currencies as one part of the new surveillance criteria. The AMU would be calculated as a weighted average of East Asian currencies according to the method used to calculate the European Currency Unit (ECU) adopted by EU countries under the European Monetary System (EMS) prior to the introduction of the euro. The AMU DIs for each East Asian currency are measured to show the degree of deviation from the benchmark rate in terms of the AMU. The AMU DIs include both nominal AMU DIs on a daily basis and real AMU DIs, which are adjusted for differences in inflation on a monthly basis. They insisted that conducting surveillance on the real AMU DIs is more appropriate for examining the effects of changes in exchange.

Ogawa and Shimizu (2006) defined the real AMU DI (rdi) as follows;

$$rdi_{AMU/i,t} = ndi_{AMU/i} - \left(p_{AMU} - p_i \right) \tag{2.1}$$

where

$$ndi_{AMU/i,t} = \frac{NEX_{AMU/i,t} - NEX_{AMU/i,0}}{NEX_{AMU/i,0}} \times 100$$

where $ndi_{AMU/i,t}$ denotes the nominal AMU DI of currency i at time t from benchmark year at time 0 . p_{AMU} and p_i denote the inflation rate in AMU area and in country i , respectively. $NEX_{AMU/i}$ denotes the nominal exchange of Country i 's currency in terms of AMU. [2]

3. How to design the region-oriented surveillance tool for ASEAN + 3 countries

3.1. Monitoring the exchange rates of Asian currencies vis-à-vis the USD or RMU

As discussed above, the AMRO should have an original tool for their surveillance framework, which considers region-specific factors and more practical signal to detect a possibility of crisis than that of the IMF surveillance. In the context of the ideal of CMIM, not only monitoring for the exchange rate of each member's currency vis-à-vis the US dollar but also monitoring for an effective exchange rate across member currencies should be included for macroeconomic surveillance as a conditionality of CMIM. Hence, this section establishes whether there exist significant differences in the movement of the real Regional Monetary Unit Deviation Indicator (RMU DI) and the bilateral real exchange rate.

By examining the historical data of real exchange rates, the properties of fluctuations in the exchange rates can be classified statistically as: 1) a stationary convergence process, where the real exchange rates possesses the long-term mean and its reverting process when the

[2] See details of AMU: Ogawa and Shimizu (2005, 2006a, 2006b, 2007)

exchange rates deviate from it (mean-reversion), 2) a stationary divergent process, where the real exchange rates exhibit tendencies to increase deviations (real deviation), or 3) a non-stationary random walk process, where the changes in the real exchange rates are completely random (that is, the movement is unpredictable).

To detect whether the real exchange rates follow a stationary process or a random walk usual econometric approach is the unit root test, which involves testing the presence of the long-term mean and reverting process for fluctuations in exchange rates. One of the recently developed unit root tests is as follows: the momentum threshold auto-regressive (M-TAR) model is employed to investigate the property of the real exchange rate, where the unit root test with the momentum threshold separates the convergent speed toward the long-term mean when the exchange rate appreciates from the convergent speed as it depreciates; hence, the mean-reversion process is regarded as an asymmetric error correcting process.

3.2. The M-TAR Unit root test

Enders and Granger (1998) developed the methods of detecting the non-linearity of adjustment process considering the threshold autoregressive (TAR) model as below;

$$\Delta y_t = I_t \rho_1 (y_{t-1} - \tau) + (1 - I_t)\rho_2 (y_{t-1} - \tau) + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + \varepsilon_t \tag{3.1}$$

$$\rho_1 < 0, \rho_2 < 0, \; I_t = \begin{cases} 1 & if \quad y_{t-1} \geq \tau \\ 0 & if \quad y_{t-1} < \tau \end{cases},$$

where y_t indicates the changes of real exchange rates at time t, ρ_1 and ρ_2 indicate adjustment process respectively, and τ is a threshold. The threshold here is assumed that the mean reversion process of real exchange rates would converge to the value around the long-term mean but would not achieve to the exact value beyond the threshold around the long-term mean. This assumption might be able to be explained by the enormous discussion about the PPP theory.

As far as we could know exact value of the threshold: τ ,of the long-term mean, asymmetric adjustment process could be detected in Equation (3.1). When a threshold of mean reversion is unknown, we should employ the Momentum TAR model as follows;

$$\Delta y_t = I_t \rho_1 y_{t-1} + (1 - I_t)\rho_2 y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + \varepsilon_t \quad (3.2)$$

$$\rho_1 < 0, \rho_2 < 0 \quad I_t = \begin{cases} 1 & if \quad \Delta y_{t-1} \geq 0 \\ 0 & if \quad \Delta y_{t-1} < 0 \end{cases} .$$

In the M-TAR mode above, the adjustment process for currency's appreciation is assumed to be different from that of currency's depreciation.

If estimated values of ρ could not be rejected the null hypothesis of unit root: $\rho_1 = \rho_2 = 0$, the data generating process of series y_t might follow the white noise process. On the other hand, if the null of $\rho_1 = \rho_2$ could be rejected, the adjustment process might be asymmetric.

3.3. Data

The sample covers the period from January 3, 2000 to December 31, 2009. The data on the exchange rate and the AMU are obtained from *Datastream* and RIETI. The price data is obtained from IMF-*IFS* as monthly consumer price indices. The "Daily" real exchange rates and the real RMU DI are calculated from the daily nominal exchange rates, the AMU, and the monthly CPI which is converted to daily data.

3.4. Empirical analysis

3.4.1. The M-TAR unit root test results for all of ASEAN +3 countries

Table 1-a shows the empirical results of the M-TAR unit root test for each of "ASEAN plus three" exchange rates vis-à-vis the US dollar. For the case of the currencies of China (CNY), Hong Kong (HKD), Indonesia (IDR), Japan (JPY), Korea (KRW), Laos (LAK), Singapore (SGD), and Thailand (THB), the *F*-test statistics for Rho(+) = Rho(-) = 0 indicate that the null hypothesis of a unit root could not be rejected at conventional significance levels, and therefore, these exchange rates follow a random walk process, i.e., the best forecast is the current exchange rate.[3]

[3] The M-TAR unit root test also carried out for the first difference of logarithm of real

The coefficient of zeta-plus for the case of Brunei, which is regarded as the appreciation-correcting coefficient, and the coefficient of zeta-minus for the case of Malaysia, which is regarded as the depreciation-correcting coefficient, indicate negative (at 10% for Brunei or at 2.5% for Malaysia). On the other hand, the other coefficient for the real USD/BND and USD/MYR is insignificant. While a negative coefficient in the unit root test implies that real exchange rates revert to the long-term mean, the insignificant coefficient or positive coefficients suggest the real exchange rate does not possess a property of mean reversion. Therefore, although sudden appreciation in the real exchange rates of the Brunei dollar vis-à-vis the US dollar, and sudden depreciation in that of the Malaysian ringgit, will be corrected, and real exchange rates still follow "a random walk" when the BND depreciates or the MYR appreciates. In the case of Cambodia and Myanmar, both of the appreciation-correcting and the depreciation-correcting coefficients are significant at the conventional level. For Cambodia, although the depreciation-correcting coefficient is adequately negative at the 1% significance level, the appreciation-correcting coefficient is positive. This suggests that the deviation of the USD/KHR will be corrected when it appreciates but will be amplified when it depreciates. For Myanmar, both of the coefficients are positive enough at the 5% significance level. As a positive coefficient supposes a divergent process in which the sequence of real exchange rates does not reveal the mean reverting process, the sequence will deviate once the currency appreciates or depreciates. For the case of the Philippines and Vietnam, each exchange rate will also deviate once the USD/PHP appreciates or the USD/VND depreciates.

Table 1-b shows the empirical results for the RMU DI of each currency. For Singapore, the coefficients for the appreciation-correcting and the depreciation-correcting coefficients are negative at the 5% significance level, and for Malaysia, the same coefficients are negative at 10%. The *F*-statistics for the null hypothesis Rho(+) = Rho(-) = 0 indicate that the null of the unit root can be rejected, so then RMU DIs for SGD and MYR show properties of the mean-reversion for both the appreciation and depreciation direction. For Cambodia, Hong

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exchange rates vis-à-vis the USD. There were no unit roots for all cases, then, all sequences were not $I(2)$.

Kong, Indonesia, Korea, Myanmar, and Vietnam, the appreciation-correcting coefficients are positive enough at conventional significance levels, and therefore, these real exchange rates will deviate when each currency depreciates. In the Korean case, although the appreciation-correcting coefficient is significantly negative at the 1% level, the depreciation-correcting coefficient is positive. For the USD/KRW, the deviation of the real exchange rates will be corrected when it appreciates but will be amplified when it depreciates. [4]

In the tables above, significant coefficients reveal important information whether there exist factors for movements in exchange rates or not, which are certainly helpful for macroeconomic surveillance.

Depending on the time-range of the analysis, the properties of fluctuation of exchange rates may change, and therefore, there can exist several time-ranges for the analysis, depending on surveillance purposes or scope of an interest. Given a time-range, investigation of the properties of the fluctuation of the exchange rates may reveal signals of a possible crisis.

3.4.2. Sequential M-TAR unit root test for the selected countries

Next, the sequential M-TAR unit root test is carried out for the real exchange rates and the real RMU DIs of the selected currencies －the Singapore dollar (SGD), the Korean won (KRW), and the Thai baht (THB) － to consider the possibility of structure break, which would mean that the magnitude of both the appreciation-correcting and the depreciation-correcting coefficients would change over the time period. The sequential test can also compare the possibility of detecting the changes in the determinant of exchange rates by comparing the real RMU DI with the bilateral real exchange rates.

As for the sequential M-TAR unit root test, two different time-spanned regression models, the short-term model and the medium-term model, are defined, and the maximum number of samples for each of the estimations is limited to 250 and 500 samples, respectively.

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[4] For all cases, the sequences of first difference of logarithm of series did not contain unit roots. Therefore, all real AMU DI were not $I(2)$.

The rolling regressions for the sequential unit root test start from January 3, 2000. The first estimation using the short-term model covers from January 3, 2000, to December 18, 2000, and for the medium-term model covers from January 3r, 2000, to December 3, 2001. The final estimation using the short-term model covers from December 25, 2008, to December 10, 2009, and for the medium-term model covers from January 10, 2008, to December 10, 2009.

Figure 1a shows the magnitude of coefficients for mean reversion and the changes in the real exchange rate of the Singapore dollar vis-à-vis the US dollar. The left-side vertical axis indicates the magnitudes of the appreciation-correcting and depreciation-correcting coefficients. The zero is applied for insignificant coefficients in each estimation, which implies that fluctuations in real exchange rates display a random walk. The zeta-plus/minus 250 indicates magnitudes of coefficients for the short-term model, and the zeta-plus/minus 500 indicates that of the medium-term model. The right-side vertical axis indicates the deviation indicator of real USD/SGD exchange rates based on the 2000-2001 averaged value. The spreads of interest rates between the Singaporean short/long-term yields and those of the US are also drawn in the figures. Figures show that coefficients for the short-term model tend to switch from negative to positive suddenly. For example, from February 15, 2001, to July 2, 2004, and from October 5, 2007, to June 18, 2008, the real USD/SGD exchange rates seem to follow a random walk process. While the 1^{st} – 20^{th} short-term models contain significant negative coefficients for the zeta-plus, the 106^{th}, 107^{th}, and 115^{th} – 140^{th} short-term models contain significant positive coefficients for the zeta-plus. For the overlapping period among these models (5/29/2000 - 2/14/2001), it is not easy to identify whether the sequence of exchange rates deviates from or converges to the long-term mean. Mixed messages from an analysis are not helpful to a surveillance unit in detecting the possibility of misalignment of real exchange rates.

Figure 1b shows the magnitudes of coefficients for the mean-reversion in the real RMU DI of the Singapore dollar. While the sequence follows a random walk during the periods of 1/3/2000 - 6/20/2000 and 1/12/2005 - 12/16/2005, the significant coefficients satisfy the sign condition of the mean-reversion for both the zeta-plus and the zeta-minus. This suggests the real RMU DI for the SGD will follows a stationary process once it appreciates/depreciates. The most important feature in Figure 1b is that the magnitudes of adjustment speed in the mean-reverting process of the real RMU DI are larger than those of the real USD/SGD deviation indicators in Figure 1-a. Sudden depreciations in the RMU DI are corrected, up to a maximum of 15%.

Figure 2a shows the magnitudes of coefficients for the mean-reversion in the real USD/KRW exchange rates. In addition to the real USD/SGD case, the test results give us mixed messages to the effect that a stationary process suggests both a positive coefficient and a negative coefficient for the overlapping samples among the estimations. From late 2000 to mid-2004, coefficients for the zeta-minus 250/500 indicate negative significant. It means that the sequence seems to follow a convergent process when it depreciates. On the other hand, coefficients for the zeta-plus 250/500 from early 2003 to mid-2005 indicate positive significant. It follows a divergent process when it appreciates. The important point for the surveillance process is that we cannot detect these asymmetric properties of exchange rate fluctuations until 2005, while the gradual appreciation of the KRW against the USD had already started in 2002. Another feature for the Korean won exchange rates vis-à-vis the USD is that the convergence speed when correcting the depreciation did not exceed 6% (around 2002-2003) and that of appreciation is smaller than 10% (after 2008).

Figure 2b shows the magnitudes of coefficients for the mean-reversion in the real RMU DI of the Korean won. The features from the test results are clearer here than in Figure 2a. The changes in coefficients are well reflected as structural switches. From 2000 to mid-2002, the sequence of the real RMU DI follows a convergent process when it depreciates. From mid-2002 to mid-2003, it follows a random walk. From mid-2003 to mid-2005, the real RMU DI of the Korean won follows a divergent process. After 2007, the appreciations of real exchange rates are corrected rapidly, up to about 10%. From Figure 2b, we can note that the appreciation of the KRW against the RMU after 2002 should be differentiated from the appreciation of the KRW before 2002. This is because we obtained a structural switch from a convergent process to a random walk process on July 4, 2002. On the other hand, while the appreciation of the KRW against the USD happened in mid-2002, the signal for this appreciation, which is presumed to be the positive coefficients for the zeta-plus, was obtainable first in February 2004. The signals for unexpected appreciation should be obtained earlier than sudden rapid depreciation of the currency. In this case, the RMU DI was able to capture the beginning of the KRW appreciation earlier than the bilateral rates.

Figure 3a shows test results for the USD/THB real exchange rates. From the figure, the sequence of the Thai baht follows a mean-reverting process in 2001-2004 and also after 2007. Although a positive coefficient for the zeta-minus 250, zeta-plus 250, and zeta-minus 500 is detected only once from mid-2005 to mid-2007, in subsequent sample periods, no positive coefficient has ever been detected. If we wrongly assume that those estimations contain outliers, we must have failed to detect a sharp, real appreciation of a divergent process after 2005.

Figure 3b shows that the M-TAR unit root test for the real RMU DI of the THB could detect a positive coefficient continuously from 2004 to 2007. The positive coefficients for this period could be detected from February 2006 and were captured until the end of July 2007. Obviously, the sequence of the Real RMU DI reflects a continuous real deviation without a correcting process.

4. How to define misalignments and deviations from equilibrium

4.1. Benchmark and equilibrium

Although the surveillance with the AMU DI would become a useful tool for detecting the possible crisis among CMIM member countries, there still exists an argument about adequacies for application of measurement benchmark. The AMU DI needs to adopt the hypothetical benchmark year to calculate the deviation indicators. In Ogawa and Shimizu (2006), as year 2000-2001 average of each countries' exchange rates vis-à-vis the AMU is applied as the benchmark of AMU DI because total trade balance of East Asian countries were balanced in this period. The magnitude of deviation indicators might depend on the economic structures; determinant of intra-regional trade, FDIs, and consumptions at the benchmark year. Hence, the adequacy of benchmark for the deviation indicators might not be assured as time passed, then, the benchmark year should be revised regularly.

Another issue to be concerned for the surveillance is exchange rates volatility. Although there are various factors for movements of exchange rate, the surveillance agency needs to divide the deviations into the short-term movements and the long-term movements. Some currencies might be appreciating which reflects more rapid economic growth than other member countries. Other might be temporally appreciating by huge capital inflows, which reflects the economic booming and bubbles. Some continues depreciating because of "twin deficit," "*de-facto* dollarization," or decreasing of population, national wealth, and productivities. Other might continue depreciating in the post bubble period or just depreciate reflecting the over-shoot of nominal exchange rates.

To concern such volatile features of exchange rate movements, it is important not only to choose the adequate benchmark for proper measures of the deviation indicators, but also to define the equilibriums of exchange rates among currencies. Until the economic growth rates of all member states were linked and moved together, then, their business cycle might also be synchronized, exchange rates' movement of each currency vis-à-vis the AMU must be different among countries. As important feature in calculating the AMU as a basket currency, fluctuations in one currency in the basket would affect the value of AMU in terms of the numéraire currency such as the US dollar, then, the other currencies' exchange rates vis-à-vis the AMU would be changed. Hence, we should take into account not only the bilateral long-term equilibrium exchange among the member currencies but also the inter-relationships of movements in the composed currencies at same time.

Although it is not easy to define multiple equilibriums among exchange rates, the business cycles among countries become more synchronized, the movements of exchange rates would come to move together, because there exists a common trend of economic growth. These synchronization of economies come from openness of economy, tighten partnership of trade, shared technology by foreign direct investment, enhanced production capacity by production networks, or integrated regional markets. These factors are also related to the "Optimum Currency Area (OCA) theory."

Kawasaki and Ogawa (2006), Ogawa and Kawasaki (2007, 2008), and Kawasaki (2012) investigate the possibilities for adopting of a Currency basket policy or arrangements from an OCA standpoints. These papers stand on the long-term equilibrium suggested by the G-PPP theory. Therefore, one of the equilibrium among the CMIM members' currencies is also suggested from the G-PPP model. Next section tries to construct the deviation indicator concerning the equilibrium of exchange rates among member currencies. [5]

4.2. Model for the P-T decomposition of RMU

Here, we assumed the regional monetary unit (RMU) as a tool of the surveillance, which is composed of weighted average of the ASEAN plus three countries' currencies and denominated by the US dollar. Although there exists several type of definition for the regional monetary unit, the RMU in this paper can be defined as a product of the composed currency's nominal exchange rates vis-à-vis the US dollar: $NEX_{US\$/i}$, which denotes US dollar units per the national currency as follows;

$$NEX_{US\$/RMU} = \prod_{i=1}^{13} NEX_{US\$/i}^{\omega_i} \quad (4.1)$$

where, $\sum_{i=1}^{13} \omega_i = 1$.

The value of Country j's currency per the RMU can be defined as follows;

$$NEX_{j/RMU} = NEX_{US\$/RMU} / NEX_{US\$/j} \quad (4.2)$$

and it can be also written as a logarithm of exchange rate,

$$nex_{j/RMU} = nex_{US\$/RMU} - nex_{US\$/j} \quad (4.3)$$

To detect the equilibrium of exchange rates, the real exchange rates are useful. Here, the logarithm of real exchange rates of the regional monetary unit per the country j's national currency: $rex_{RMU/j}$ can be rewritten by using the logarithm of nominal exchange rates: nex and the logarithm of price indices: p as follows;

[5] See the definition of 'G-PPP' in Enders and Hurn (1994). Details discussions about G-PPP and Regional Monetary Unit (RMU) such as Asian Currency Unit (ACU) proposed by Asian Development Bank and Asian Monetary Unit (AMU) proposed by Research Institute of Economy, Trade, and Industry, Japan, are shown in Ogawa and Kawasaki (2006, 2008) and Kawasaki (2012).

$$\begin{aligned} rex_{j/RMU,t} &= nex_{j/RMU,t} - \left(p_{j,t} - p_{RMU,t} \right) \\ &= nex_{US\$/RMU,t} - nex_{US\$/j,t} - \left(p_{j,t} - \sum_{i=1}^{13} \omega_i \cdot p_{i,t} \right) \\ &= \sum_{i=1, i\neq j}^{13} \omega_i \left(nex_{US\$/RMU,t} + p_{i,t} \right) - \left(nex_{US\$/j,t} + p_{j,t} \right) \\ &= \sum_{i=1, i\neq j}^{13} \omega_i \cdot x_{i,t} - x_{j,t} \end{aligned} \tag{4.4}$$

where

$$p_{RMU,t} = \sum_{i=1}^{13} \omega_i \cdot p_{i,t}$$

where $x_i = ne_{US\$/i} - p_i$. $p_{i,t}$ denotes the price indices of Country i .

Here, Equation (4.4), can be written as a product of two vectors as follows;

$$rex_{j/RMU,t} = W \cdot X_t' \cdot \tag{4.5}$$

$$W = \left[\omega_1, \ldots, -1, \ldots \omega_{13} \right], X_t = \left[x_{1,t}, \ldots, x_{j,t}, \ldots x_{13,t} \right]..$$

In the standard textbook of international monetary theory, the real exchange rates would be constant if the relative PPP theory binds to the changes in the nominal exchange rates between two currencies, while the observable nominal exchange rates tend to deviate from the equilibrium which the PPP theory suggests. Hence, one condition for binding the movements in the real exchange rates of Country j vis-à-vis the regional monetary unit to $I(0)$ stationary process is that each of real exchange rates included in the currency basket of the regional monetary unit should be stationary. If all real exchange rates follow $I(0)$ stationary process, it would be able to define the equilibrium exchange rates among 13 member countries.

Another concept for the determinant of the equilibrium among exchange rates for the region is that, while the movements in the real exchange rates of Country j vis-à-vis the regional monetary unit follow $I(1)$ process themselves, if a non-zero matrix $\mathbf{Z}$ for the vector of real exchange rates: $\mathbf{re}_t$ exist and satisfy $\mathbf{Z}'\mathbf{re}_t = 0$, there exist a common stochastic trend among the real exchange rates, hence, there exists a long-term relationship among real exchange rates. In other words, although the movements in each country's nominal exchange rate vis-à-vis the US dollar follow $I(1)$ process, the Country j 's real exchange rates vis-à-vis the RMU, which is defined as a linear combination of real exchange rates, would possess a long-term equilibrium if the 'Generalized Purchasing Power Parity (G-PPP)' holds.

On the other hand, it is not difficult to assume the holding of G-PPP among the supposed fourteen CMIM member countries.[6] Some member countries who have small open economy may be suffered from the neighborhood economy or world economy but not affect the external one. Hence, Equation (4.5) can be rewritten as follows;

$$rex_{i/RMU,t} = W_1' \cdot X_{1,t} + W_2' \cdot X_{2,t} \tag{4.6}$$

where

$$W_1' = [\omega_1, \ldots, -1, \ldots \omega_m], W_2' = [\omega_{m+1}, \ldots\ldots \omega_{14}]$$

and

$$X_{1,t} = [x_{1,t}, \ldots, x_{j,t}, \ldots x_{m,t}], X_{2,t} = [x_{m+1,t}, \ldots x_{14,t}]$$

where $1 < j \le m < 14$, and m number of 14 member countries satisfy the holdings of the G-PPP, but the rest of member currencies do not. These currencies would dominate the level of RMU exchange rate and its movements in terms of the numéraire currency. Hence, each currency contained in Vector X_1 are called as the "dominate currency." Although some variables contained in Vector X_2 might follow $I(0)$ process, those would be assumed to be excluded as exogenous variables from the cointegrating spaces composed of variables contained in Vector X_1 .Hence, the currencies in Vector X_2 are called as a "dominated currency."

Considering mean-reversion of the real exchange rates, we assumed that the behavior of real exchange rates against the RMU can be affected by the complex of the short-term sequence and that of the long-term trend.

Following the feature of movements in exchange rates above, we assume Vector $X_{1,t}$ is composed of two vectors bellow;

$$X_{1,t} = X_t^P + X_t^T \tag{4.7}$$

where Vector X_t^P denotes the permanent components of exchange rates movements in Vector

6 ASEAN 10 plus 3 countries: China, Korea, and Japan and Hong Kong are included.

$X_{1,t}$ and Vector X_t^T denotes the transitory components as well.

Here, two vectors for Vector $X_{1,t}$ in Equation (4.7) are follows conditions of the permanent-transitory decomposition (P-T decomposition) proposed by Gonzalo and Granger (1995) are assumed; 1) Vector X_t^P is difference stationary and Vector X_t^T is covariance stationary, 2) $\text{var}(\Delta X_t^P) > 0$ and $\text{var}\left(X_t^T\right) > 0$, and 3) innovations: $u_{P,t}$ and $u_{T,t}$ for the autoregressive representation of $\left(\Delta X_t^P, X_t^T\right)$;

$$\begin{bmatrix} H_{11}(L) & H_{12}(L) \\ H_{21}(L) & H_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta X_t^P \\ X_t^T \end{bmatrix} = \begin{bmatrix} u_{P,t} \\ u_{T,t} \end{bmatrix}, \tag{4.8}$$

are assumed as uncorrelated. Hence, this condition would be defined as follows;

$$\lim_{h\to\infty} \frac{\partial E\left(X_{1,t+h}\right)}{\partial u_{P,t}} \neq 0 , \lim_{h\to\infty} \frac{\partial E\left(X_{1,t+h}\right)}{\partial u_{T,t}} = 0 . \tag{4.9}$$

where the innovation term: $u_{P,t}$ can affect the long-term forecast of Vector $X_{1,t}$. Hence, one of the factors in the matrix: $H\left(L\right)$ in Equation (4.8) will satisfy the following conditions;

$$H_{12}(1) = 0 \tag{4.10}$$

To include the features above into the factor model, let Vector $X_{1,t}$ in Equation (4.6) follows the Vector Error correction model: VECM below;

$$\Delta X_{1,t} = \underset{m\times 1}{\alpha} \cdot \underset{1\times m}{\beta'} X_{1,t-1} + \sum_{i=1}^{p} \Gamma_i \Delta X_{1,t-i} + \Phi D_t + \varepsilon_t \tag{4.11}$$

where $X_{1,t}$ is a $(m\times 1)$ vector of $I(1)$ time series that is cointegrated at rank 1, hence, α , β , and Γ are $(m\times 1)$ vectors. A $(m\times 1)$ vector of ΦD_t denotes the deterministic terms.[7] Equation (4.11) can be written as the moving average representation as follows;

$$X_{1,t} = C\sum_{i=1}^{t} \varepsilon_i + C\cdot \Phi D_t + C\left(L\right)\left(\varepsilon_t + \Phi D_t\right) \tag{4.12}$$

where

[7] In the section of empirical analysis in this paper, the deterministic terms are excluded from Equation (4.11).

$$C=\beta_{\perp}\left(\alpha_{\perp}'\left(I-\sum_{i=1}^{p-1}\Gamma_i\right)\beta_{\perp}\right)^{-1}\alpha_{\perp}' \ . \tag{4.13}$$

where $\alpha_{\perp}$ and $\beta_{\perp}$ denote the orthogonal complements to α and β, namely, $\alpha'\alpha_{\perp}=0$ and $\beta'\beta_{\perp}=0$.

Here, two vectors: f_t and $\tilde{X}_t$ are defined for the difference-stationary sequence: Vector $X_{1,t}$ as follows;

$$\underset{m\times 1}{X_{1,t}}=\underset{m\times k}{A_1}\cdot\underset{k\times 1}{f_t}+\underset{m\times 1}{\tilde{X}_t} \ . \tag{4.14}$$

where $k=m-1$. While Vector $\tilde{X}_t$ is composed of m number of $I(0)$ variables, Vector f_t is composed of $m-1$ number of $I(1)$ variables which is imposed as a linear combination of the Vector X_t;

$$\underset{k\times 1}{f_t}=\underset{k\times m}{B_1}\cdot\underset{m\times 1}{X_{1,t}} \ . \tag{4.15}$$

If $A_1 f_t$ and $\tilde{X}_t$ form a permanent-transitory decomposition shown in Equation (4.7) satisfying the conditions shown in Equations (4.8) - (4.10), the only linear combinations of $X_{1,t}$ such that $\tilde{X}_t$ has no long-run impact on X_t can be defined as follows;

$$f_t=a_{\perp}'X_{1,t} \ . \tag{4.16}$$

Once Vector f_t is identified which is called as the common factors, Substituting Equation (4.15) in Equation (4.14), $\tilde{X}_t=(I-A_1B_1)X_{1,t}$ is obtained. The P-T decomposition of X_t can be obtained as follows;

$$X_{1,t}=A_1\alpha_{\perp}'X_{1,t}+A_2\beta'X_{1,t} \tag{4.17}$$

where $A_1=\beta_{\perp}\left(\alpha_{\perp}'\beta_{\perp}\right)^{-1}$ and $A_2=\alpha\left(\beta'\alpha\right)^{-1}$.

Once the exchange rate movement only given by the permanent component: X_t^P, which indicate the movement of the long run mean, can be defined as in Equation (4.17), we can obtain the misalignment from the long run mean.

First, we define the benchmark of the regional monetary unit deviations from the benchmark year, as following the calculation of the Asian Monetary Unit Deviation Indicator (AMU DI);

$$\overline{rex}_{i/RMU} = W_1 \cdot \overline{X}_1 + W_2 \cdot \overline{X}_2 \,. \tag{4.18}$$

where

$$W = [\omega_1, \ldots, -1, \ldots \omega_m], \overline{X}_1 = \left[x_{1,0}, \ldots, x_{j,0}, \ldots x_{m,0} \right], \overline{X}_2 = \left[x_{m+1,0}, \ldots x_{14,0} \right].$$

where Vectors $\overline{X}$ contains x_i at the benchmark period; $t = 0$, respectively. Here, the deviation indicator based on the initial benchmark for the currency of Country i can be defined as below;

$$\begin{aligned} DI_{i,t} &= rex_{i/RMU,t} - \overline{rex}_{i/RMU} \\ &= W_1' \cdot \left(X_{1,t} - \overline{X}_1 \right) + W_2 \cdot \left(X_{2,t} - \overline{X}_2 \right) \\ &= W_1' \cdot \left(X_t^P + X_t^T - \overline{X}_1 \right) + W_2 \cdot \left(X_{2,t} - \overline{X}_2 \right) \end{aligned} \tag{4.19}$$

Although the deviation indicator above would be helpful to detect the total deviation of exchange rates, the deviation at time t would be included the movement of both permanent components and transitory components. Such deviation of exchange rates might be over-estimated.

Here, we define the misalignment of exchange rates. The movements related to the permanent components would drive the long-term movement of RMU value in terms of the numéraire currency. Letting $rex_{j/RMU,t}^{XP}$ be a logarithm of Country j's real exchange rates vis-à-vis the partial basket of the AMU which is composed of dominate currencies in Vector X_t and the permanent component of Vector X_t only is defined as follows;

$$rex_{j/RMU}^{XP} = W_1' \cdot X_t^P \tag{4.20}$$

Hence, the current misalignment for the currency of Country j at time t can be also defined as below;

$$\begin{aligned} cm_{j.t} &= rex_{RMU/j} - rex_{RMU/j,t}^{XP} \\ &= W_1' \cdot \left(X_{1,t} - X_t^P \right) \\ &= W_1' \cdot X_t^T \end{aligned} \tag{4.21}$$

hence, its indices can also defined as follows;

$$CDI_{j,t} = W_1' \cdot \left(X_t^T - \overline{X}^T \right) \tag{4.22}$$

For the currency of Country k; $(m+1 \leq k \leq 13)$, which is small open economy and its currency is included in Vector X_2 , the current deviation cannot be defined as in Equation (4.21), then, the total deviation can be only defined. However, it still contains permanent movement of variables in Vector X_1 , which might not affect to current deviation of currencies in Vector X_2 . Hence, the temporal misalignment for all currency can be defined as an indicator which fixes the initial values of the permanent component in Vector X_1 and set them unchanged as follows;

$$TDI_{i,t} = W_1' \cdot \left(\overline{X}^P + X_t^T - \overline{X}_1 \right) + W_2' \cdot \left(X_{2,t} - \overline{X}_2 \right) \tag{4.23}$$

The deviation indicator in Equation (4.23) should be monitored by the AMRO to avoid over-estimation of misalignment in the exchange rates movements.

4.3. Data

The real exchange rates are constructed from the monthly nominal exchange rate and the monthly consumer price indices from the *IMF-IFS*. The sample for the empirical tests covers the period from January 2000 to December 2011. Because the data of Lao kip exchange rates vis-à-vis the US dollar covers from January 2000 to February 2011, the coverage of calculated deviation indicators employing the Lao kip is limited from January 2000 to February 2011.

Fourteen CMIM member countries include ten ASEAN countries: Brunei, Cambodia, China, Indonesia, Lao, Malaysia, the Philippines, Singapore, and Thailand, "plus three countries:" China, Korea and Japan, and Hong Kong. As a possible candidate of countries in the common currency union, namely, "the dominate currencies" in Vector X_1, which should be suggested by the G-PPP, this paper follows the empirical results of cointegration analysis from Kawasaki (2012a). Hence, five groups of "dominate currencies" are constructed: ASEAN5 (Indonesia, Malaysia, the Philippines, Singapore and Thailand) + Korea, ASEAN5+Japan, ASEAN5 + China + Korea, ASEAN5 + China + Japan, ASEAN5 + Korea + Japan, and ASEAN5 + China + Korea + Japan. The weights of basket for each of countries are obtained from the RIETI (Research Institute of Economy, Trade, and Industry, Japan) web site.

4.4. Cointegrating test and P-T decomposition

Table 2 shows the result of the Johansen cointegration test. The table provides the estimated value of the eigen vector, "the small sample corrected lambda trace statistics," and its 5% critical value of the null hypothesis of the cointegration rank.[8] The lambda trace statistics in Table 1 suggests that all dominate currencies' group have one cointegrating relationship among the currencies in Vector X_1. The results here, excluding the result for the ASEAN5 plus three countries, supposes the empirical result of Kawasaki (2012a) which concerns the non-linear empirical models.

Table 3 shows the estimated values of cointegrating vector: β and of adjustment vector: α. Using these estimated vectors, the orthogonal vectors to calculate coefficients for the P-T decomposition in Equation (4.17).

Figure 4 shows the deviation indicator: $DI_{i,t}$ shown in Equation (4.19). As the concept and calculation of $DI_{i.t}$ follows those of AMU DI, Figure 4 is as same as the figure of Real AMU DI reported in RIETI-AMU home pages.

Figure 5s show the current deviations from benchmark: $CDI_{j,t}$, which suggests misalignments of each dominate currency. Figure 5a provides results for the case which the currencies of ASEAN5 + Korea are cointegrated as a dominate currency, 5b is for ASEAN5 + Japan, 5c is for ASEAN5 + China + Korea, 5d is for ASEAN5 + China + Japan, 5e is for ASEAN5 + Korea + Japan, and 5f is for ASEAN5 + China + Korea + Japan. For the Indonesia rupiah, current misalignments are greater than those of other currencies. The current misalignments of the Indonesian rupiah are exceed 10% and reached about 20% sometimes. The current misalignments of the Philippines peso is relatively higher than the rest of dominate currencies. But its deviations never exceed 10%.

Table 4s report the average of the temporal deviation indicator: $TDI_{i,t}$, and calculates the differences from $DI_{i,t}$ also as to sub sample divided into every three years. Table 4a provides results for the case which the currencies of ASEAN5 + Korea are cointegrated as a dominate currency, 4b is for ASEAN5 + Japan, 4c is for ASEAN5 + China + Korea, 4d is for ASEAN5 + China + Japan, 4e is for ASEAN5 + Korea + Japan, and 4f is for ASEAN5 + China + Korea +

[8] Small sample correction for the trace statistic and its hypothesis test is derived in Johansen (2000, 2002).

Japan. The differences between $DI_{i,t}$ and $TDI_{i,t}$ suggest the over- under-estimation of the deviation indicator. Because $TDI_{i,t}$ does not contain the structural movements of exchange rates suggested from the permanent component.

The results for the differences of $TDI_{i,t}$ from $DI_{i,t}$ shown in Table 4s can be summarized as follows; 1) deviations of the Indonesia rupiah from the benchmark of the RMU DI tends to be over-estimated at more than 30% in the full sample period. 2) deviations of the Philippines peso from the benchmark of the RMU DI tends to be over-estimated at more than 17%, 3) those of the Singapore dollar and the Thai baht tend to be under-estimated about 3-11%, 4) those of the Japanese yen are also under-estimated if the Japanese yen is included as a dominate currency, and 5) the deviations of dominated currencies are not suffered much from the temporal deviations of dominate currencies.

As the dominated currencies are cointegrated, current misalignments shown in CDI would be corrected in the long run, then, the surveillance agent should focus on TDI . However, if the huge deviations or continuing deviations happen in one currency, it might be shown as market turmoil. The surveillance agent should monitor what would be happened in the foreign exchange market, domestic money market and capital market carefully.

5. Conclusion

The empirical analysis for the three selected countries in Section 3 confirms that 1) the magnitudes of convergence speeds in the real RMU DI deviation are larger than those of the bilateral real exchange rates vis-à-vis the USD, 2) the unit root test for the RMU DI is able to detect the possibility of exchange rates' deviation earlier than the test for the bilateral real exchange rates, 3) the time series property of the exchange rate movement changes time to time, and 4) the unit root test for the RMU DI has the ability to capture the possibility of structural switches more clearly than the test for the bilateral rates. The sequential unit root test for the RMU DI employed here can detect the beginning of overvaluation, which usually happens several years before the sudden rapid depreciation of the currency in a crisis.

The first and second points combined indicate that the RMU DI is a helpful indicator for exploiting the information for deviation and mean reversion. This indicates that the RMU DI can be an early-warning signal of deviation from the mean and the possibility of large corrections ahead in some cases. The third and fourth points indicate that it is important to monitor and update the time-varying coefficients of exchange rate movement as well as the RMU DI. Obviously, it would be more helpful for the surveillance unit to combine the exchange rate surveillance for the RMU DI with the usual exchange rates monitoring for the bilateral rate.

The empirical analysis in Section 4 explored to provide proper statistical indicators related to misalignments of the exchange rates among East Asian currencies. By assuming that the monetary authorities in the selected eight East Asian countries adopt the regional monetary unit as a reference of exchange rates policy, this paper defined the country's equilibrium exchange rate vis-à-vis the RMU. Employing the Permanent-Transitory decomposition proposed by Gonzalo and Granger (1995), empirical analysis of this paper could detect over-/under-estimation of the deviation indicator, which would help the policy makers evaluate their exchange rate policy and its effects on the home economy and regional economy.

For an empirical analysis, accumulation of historical data is required, and hence, it might be impossible to forecast the beginning of an economic crisis with timeliness and accuracy. Therefore, it is important to monitor and update the time-varying coefficients of exchange rate movement using higher frequency data of exchange rates and the policy/market variables. By applying econometric methodologies to the RMU DI, we can detect changes in the determinant of exchange rates, e.g., innovative changes in real economies or unexpected booms in the market as the beginning of a bubble. Employing the RMU DI, the surveillance unit such as the AMRO can detect an early-warning signal of deviation from the mean and the possibility of large corrections ahead. By constructing the efficient economic surveillance framework to strengthen the soundness of economic structures, the governments of East Asian countries will be able to take further steps for regional financial cooperation from now onward. As proceeding economic dialogues among the East Asian countries for the economic/monetary cooperation, the establishment of stable exchange rate linkage across the region and the enhancement of a credibility of monetary policy in East Asia are expected.

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Table 1a: M-TAR Unit Root test for DI of Each of ASEAN+3 Countries Real Exchange rates against USD

Country	DF	Lag(s)	(Upper: Z-Plus) (Lower: Z-Minus)	Coefficients (with S.E.)			F statistics (Probability) H: Rho(+)=Rho(-)=0		F statistics (Probability) H: Rho(+)=Rho(-)	
Brunei	2598	4	Z_PLUS	-0.002345315	0.001417213	*	1.41667		1.208808	
			Z_MINUS	0.000111075	0.001434134		(0.24270704)		(0.27167011)	
Cambodia	2598	4	Z_PLUS	-0.002923534	0.001074036	****	9.90279	****	19.216009	****
			Z_MINUS	0.003728166	0.001023434	****	(0.00005195)		(0.00001214)	
China, Mainland	2606	0	Z_PLUS	-0.000299639	0.001053761		0.1521		0.022759	
			Z_MINUS	-0.000532341	0.001126433		(0.15356198)		(0.88009667)	
Hong Kong	2606	0	Z_PLUS	0.000229198	0.000251146		1.03588		0.013386	
			Z_MINUS	0.000269564	0.000242182		(0.35506004)		(0.90790209)	
Indonesia	2576	15	Z_PLUS	0.000325893	0.000487655		0.51537		0.001778	
			Z_MINUS	0.000356255	0.000497235		(0.59733842)		(0.96636780)	
Japan	2604	1	Z_PLUS	0.000448537	0.001273871		1.04239		1.255409	
			Z_MINUS	-0.001747083	0.001209992		(0.35275650)		(0.00125743)	
Korea	2576	15	Z_PLUS	-0.001614677	0.001475683		0.9241		0.049407	
			Z_MINUS	-0.001151685	0.001451923		(0.39702185)		(0.82411648)	
Lao	2576	1	Z_PLUS	0.000490616	0.00059621		0.49826		0.030398	
			Z_MINUS	0.000341776	0.0006085		(0.60764408)		(0.86160467)	
Malaysia	2600	3	Z_PLUS	0.001235792	0.00179256		2.79848	*	4.343579	**
			Z_MINUS	-0.00407873	0.001797343	***	(0.06108593)		(0.03724616)	
Myanmar	2606	0	Z_PLUS	0.000398909	0.000181233	**	8.42547	****	0.864038	
			Z_MINUS	0.000639312	0.000184506	****	(0.00022524)		(0.35269735)	
Philippines	2596	5	Z_PLUS	0.001761497	0.000804574	**	2.58646	*	4.004732	**
			Z_MINUS	-0.000636051	0.000835495		(0.07548018)		(0.04547662)	
Singapore	2598	4	Z_PLUS	-0.002154324	0.001644846		1.13779		0.161782	
			Z_MINUS	-0.001194341	0.00168219		(0.32068640)		(0.68755449)	
Thailand	2604	1	Z_PLUS	0.000098794	0.00097774		0.08844		0.126014	
			Z_MINUS	-0.000420243	0.001012755		(0.91536091)		(0.72263012)	
Vietnam	2600	3	Z_PLUS	0.002066018	0.000531242	****	8.20735	****	12.816281	****
			Z_MINUS	-0.000627274	0.000524546		(0.00027977)		(0.00034991)	

†: *:10%, **:5%, ***:2.5%, ****:1% Significance level

Table 1b: M-TAR Unit Root test for RMU DI of Each of ASEAN+3 Countries

Country	DF	Lag(s)	(Upper: Z-Plus) (Lower: Z-Minus)	Coefficients (with S.E.)			F statistics (Probability) H: Rho(+)=Rho(-)=0		H: Rho(+)=Rho(-)	
Brunei	2602	2	Z_PLUS	0.002951757	0.0021201		3.69388	**	6.509952	***
			Z_MINUS	-0.005540155	0.002146702	****	(0.02500581)		(0.01078398)	
Cambodia	2602	2	Z_PLUS	-0.00421332	0.001283607	****	10.19071	****	20.381289	****
			Z_MINUS	0.004398904	0.001317004	****	(0.00003904)		(0.00000663)	
China, Mainland	2606	0	Z_PLUS	-0.006962456	0.002141582	****	5.28524	****	5.452431	***
			Z_MINUS	0.000065556	0.002097678		(0.00512025)		(0.01961666)	
Hong Kong	2602	2	Z_PLUS	-0.000010939	0.000445321		1.875		1.498166	
			Z_MINUS	0.000832447	0.000438922	*	(0.15356198)		(0.22106457)	
Indonesia	2606	0	Z_PLUS	-0.000253844	0.000406308		3.60386	***	5.434462	***
			Z_MINUS	0.001130007	0.000432785	****	(0.02735431)		(0.01981906)	
Japan	2580	13	Z_PLUS	-0.00117458	0.001029231		0.77475		1.464366	
			Z_MINUS	0.000700862	0.000957379		(0.46092451)		(0.22634752)	
Korea	2580	13	Z_PLUS	-0.002819746	0.000980471	****	5.54524	****	10.427027	****
			Z_MINUS	0.001885789	0.001022008	*	(0.00395269)		(0.00125743)	
Lao	2606	0	Z_PLUS	-0.000047306	0.000496755		0.50748		0.612786	
			Z_MINUS	0.000508125	0.000506635		(0.60207028)		(0.43381186)	
Myanmar	2606	0	Z_PLUS	0.000259379	0.000185736		8.76666	****	3.261797	*
			Z_MINUS	0.000734046	0.00018595	****	(0.00016049)		(0.07102671)	
Malaysia	2604	1	Z_PLUS	-0.005061567	0.002692021	*	3.2045	**	0.022512	
			Z_MINUS	-0.004494986	0.002649756	*	(0.04073925)		(0.88074400)	
Philippines	2596	5	Z_PLUS	0.000950485	0.000872696		0.59996		0.560898	
			Z_MINUS	-0.000029235	0.000861802		(0.54890943)		(0.45396649)	
Singapore	2602	2	Z_PLUS	-0.008164961	0.0037659	****	4.09832	***	0.015176	
			Z_MINUS	-0.007490433	0.003988892	**	(0.01670785)		(0.90196541)	
Thailand	2580	13	Z_PLUS	0.00087246	0.001341092		1.10213		1.830497	
			Z_MINUS	-0.002088613	0.00143931		(0.33231944)		(0.17618743)	
Vietnam	2606	0	Z_PLUS	-0.000897775	0.000645432		7.22679	****	12.179913	****
			Z_MINUS	0.002297384	0.000649311	****	(0.00074151)		(0.00049109)	

†: *:10%, **:5%, ***:2.5%, ****:1% Significance level

Table 2: Johansen tests for 5 dominate currency groups

Combination	k	H_0	Eigen Vector	Rank test statistics			
				L-Trace †		Frac 95	p-value
ASEAN5 + Korea	4	0	0.290	101.245	****	83.82	0.001
		1	0.181	57.360	*	59.961	0.082
		2	0.119	33.195		40.095	0.214
		3	0.103	14.470		24.214	0.503
		4	0.053	5.041		12.282	0.559
		5	0.000	0.019		4.071	0.932
ASEAN5 + Japan	5	0	0.282	100.526	****	83.82	0.002
		1	0.160	54.538		59.961	0.135
		2	0.121	30.307		40.095	0.344
		3	0.057	12.340		24.214	0.679
		4	0.028	4.194		12.282	0.676
		5	0.002	0.262		4.071	0.681
ASEAN5 + China + Korea	4	0	0.312	127.651	***	111.676	0.003
		1	0.207	80.022	*	83.820	0.093
		2	0.179	54.361		59.961	0.139
		3	0.126	26.190		40.095	0.580
		4	0.076	15.199		24.214	0.445
		5	0.050	3.295		12.282	0.798
		6	0.002	0.152		4.071	0.766
ASEAN5 + China + Japan	4	0	0.330	115.419	**	111.676	0.028
		1	0.167	65.388		83.820	0.506
		2	0.142	45.383		59.961	0.460
		3	0.099	22.990		40.095	0.763
		4	0.079	13.766		24.214	0.561
		5	0.044	2.825		12.282	0.856
		6	0.002	0.191		4.071	0.734
ASEAN5 + Korea + Japan	4	0	0.313	121.277	****	111.676	0.010
		1	0.211	73.412		83.820	0.229
		2	0.128	44.846		59.961	0.485
		3	0.117	25.891		40.095	0.598
		4	0.089	14.173		24.214	0.527
		5	0.048	4.108		12.282	0.688
		6	0.001	0.095		4.071	0.823
ASEAN5 + China + Korea + Japan	4	0	0.346	152.864	***	143.530	0.013
		1	0.249	98.970		111.676	0.247
		2	0.179	67.907		83.820	0.409
		3	0.134	39.294		59.961	0.740
		4	0.118	28.475		40.095	0.444
		5	0.082	14.822		24.214	0.475
		6	0.042	2.911		12.282	0.846
		7	0.001	0.127		4.071	0.790

k: lag lengths

*:10%, **:5%, ***:2.5%, ****:1%

Table 3: Estimated value of cointegrating vector and adjustment vector

Combination		Indonesia IDR	Malaysia MYR	The Philippines PHP	Singapore SGD	Thailand THB	China CNY	Korea KRW	Japan JPY
ASEAN5 + Korea	Beta(tr)	10.999	-34.971	7.631	54.699	-21.35	-	-9.722	-
	Alpha(tr)	-0.014 (-5.031)	-0.000 (-0.064)	-0.006 (-3.627)	-0.004 (-3.582)	-0.003 (-1.966)	-	-0.004 (-1.595)	-
ASEAN5 + Japan	Beta(tr)	0.113	-33.281	13.669	-5.068	5.142	-	-	6.951
	Alpha(tr)	-0.002 (-0.594)	0.003 (3.127)	-0.005 (-3.494)	0.001 (0.611)	-0.001 (-1.034)	-	-	-0.001 (-0.259)
ASEAN5 + China + Korea	Beta(tr)	-8.536	29.147	-7.361	-39.329	5.657	11.637	7.299	-
	Alpha(tr)	0.017 (6.204)	0.000 (0.273)	0.007 (4.553)	0.004 (3.215)	0.004 (3.248)	-0.000 (-0.365)	0.006 (2.258)	-
ASEAN5 + China + Japan	Beta(tr)	1.330	-23.336	12.265	7.381	4.431	-16.72	-	5.554
	Alpha(tr)	-0.014 (-5.185)	0.001 (0.473)	-0.007 (-4.737)	-0.002 (-1.593)	-0.005 (-3.790)	0.001 (1.462)	-	-0.001 (-0.282)
ASEAN5 + Korea + Japan	Beta(tr)	11.056	-34.526	7.092	55.177	-18.123	-	-11.091	-1.29
	Alpha(tr)	-0.013 (-4.745)	-0.000 (-0.160)	-0.006 (-3.715)	-0.004 (-3.458)	-0.003 (-2.012)	-	-0.004 (-1.400)	0.001 (0.322)
ASEAN5 + China + Korea + Japan	Beta(tr)	-5.636	27.992	-9.385	-23.006	-0.846	14.247	4.600	-3.377
	Alpha(tr)	0.015 (5.649)	-0.000 (-0.157)	0.007 (4.773)	0.003 (2.404)	0.005 (3.723)	-0.001 (-0.878)	0.004 (1.521)	0.000 (0.043)

†: A value in the parenthesis indicates the standard value

Table 4a: Average of TDI and differences from DI (Case for the currencies of ASEAN5+Korea are cointegrated)

Currencies		Average of the TDI †					Differences from DI				
		2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:12	III 2006.1-2008.12	IV 2009.1-20011.2	2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:!2	III 2006.1-2008.12	IV 2009.1-20011.2
Dominate	Indonesia (IDR)	6.712% (0.067173939)	0.902% (0.056400112)	6.601% (0.031053286)	6.960% (0.05546981)	14.558% (0.048337864)	32.174%	2.284%	19.779%	50.304%	64.665%
	Korea (KRW)	2.741% (0.038880867)	-0.239% (0.011451723)	1.999% (0.012804867)	1.647% (0.026245898)	9.355% (0.021922084)	3.020%	1.391%	-0.703%	-5.329%	21.701%
	Malaysia (MYR)	0.884% (0.037661104)	-0.773% (0.029493466)	-0.154% (0.014308761)	-0.839% (0.025883278)	6.921% (0.015685951)	2.105%	0.340%	3.730%	3.712%	0.197%
	Philippines (PHP)	3.360% (0.041570255)	-0.062% (0.01383795)	2.716% (0.014460298)	2.474% (0.029162197)	10.166% (0.025460383)	18.345%	2.878%	23.187%	22.383%	27.839%
	Singapore (SGD)	2.549% (0.038252125)	-0.295% (0.011982288)	1.776% (0.012485686)	1.389% (0.025580314)	9.103% (0.02091628)	-9.065%	-0.540%	-5.558%	-13.704%	-19.033%
	Thailand (THB)	2.133% (0.037270244)	-0.414% (0.014871212)	1.293% (0.012172271)	0.832% (0.024606952)	8.558% (0.018952329)	-3.686%	-0.091%	-0.793%	-4.274%	-11.634%
Dominated	Brunei (BND)	-7.954% (0.079302957)	-1.050% (0.079302957)	-4.566% (0.079302957)	-15.408% (0.079302957)	-11.623% (0.079302957)	-2.628%	-0.521%	-1.838%	-1.926%	-7.549%
	Cambodia (KHR)	25.997% (0.25243637)	0.436% (0.027607046)	12.402% (0.058905215)	36.220% (0.154725984)	65.010% (0.046815569)					
	China (CNY)	2.689% (0.03742698)	-1.012% (0.02979928)	4.241% (0.031622723)	2.412% (0.013737478)	6.165% (0.030735281)					
	Hong Kong (HKD)	-0.873% (0.073136668)	-2.113% (0.045856789)	-7.031% (0.012967949)	-2.311% (0.05142352)	10.891% (0.03300943)					
	Japan (JPY)	-8.578% (0.122999024)	1.884% (0.057546731)	-6.804% (0.051564683)	-6.077% (0.065187323)	-28.849% (0.073190476)					
	Lao (LAK)	51.270% (0.279387038)	9.664% (0.181225487)	60.722% (0.083318113)	68.071% (0.021702617)	73.258% (0.029411295)					
	Myanmar (MMK)	92.384% (0.583949211)	16.151% (0.27865515)	79.754% (0.053166128)	127.127% (0.223225915)	166.350% (0.057244364)					
	Vietnam (VND)	40.091% (0.364207978)	2.178% (0.036777194)	22.542% (0.073511543)	51.760% (0.162705705)	99.376% (0.12238191)					

†: A value in the parenthesis indicates the standard value

Table 4b: Average of TDI and differences from DI (Case for the currencies of ASEAN5+Japan are cointegrated)

Currencies		Average of the TDI †					Differences from DI				
		2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:12	III 2006.1-2008.12	IV 2009.1-20011.2	2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:!2	III 2006.1-2008.12	IV 2009.1-20011.2
Dominate	Indonesia (IDR)	-0.529% (0.023664477)	0.101% (0.006895175)	0.173% (0.00726503)	0.767% (0.024774925)	-4.116% (0.015333331)	39.415%	3.085%	26.207%	56.497%	83.339%
	Japan (JPY)	-1.107% (0.022097681)	-0.073% (0.007203823)	-0.576% (0.006848026)	-0.092% (0.021615112)	-4.639% (0.011478681)	-10.099%	1.436%	-8.066%	-7.911%	-31.759%
	Malaysia (MYR)	-4.483% (0.036210798)	-1.088% (0.048018406)	-4.953% (0.011643581)	-5.111% (0.011815349)	-7.700% (0.021113294)	7.472%	0.655%	8.529%	7.984%	14.818%
	Philippines (PHP)	1.808% (0.03852677)	0.804% (0.0341718)	3.204% (0.011808539)	4.243% (0.038434562)	-1.996% (0.033498208)	19.897%	2.013%	22.698%	20.614%	40.001%
	Singapore (SGD)	-2.902% (0.025722768)	-0.613% (0.027859528)	-2.903% (0.00823795)	-2.760% (0.013436961)	-6.266% (0.01017193)	-3.614%	-0.222%	-0.879%	-9.555%	-3.664%
	Thailand (THB)	-1.320% (0.021852511)	-0.137% (0.009035319)	-0.852% (0.006802775)	-0.409% (0.020489166)	-4.832% (0.010257517)	-0.234%	-0.368%	1.352%	-3.034%	1.755%
Dominated	Brunei (BND)	-10.949% (0.0947746)	-0.652% (0.018025732)	-6.289% (0.018402588)	-16.153% (0.051978647)	-24.094% (0.047870902)	0.367%	-0.919%	-0.115%	-1.181%	4.921%
	Cambodia (KHR)	23.002% (0.210670366)	0.834% (0.0202986)	10.678% (0.065011131)	35.475% (0.120595056)	52.539% (0.03859221)					
	China (CNY)	-0.306% (0.042539046)	-0.614% (0.018231108)	2.517% (0.025852664)	1.667% (0.041132218)	-6.305% (0.019104497)					
	Hong Kong (HKD)	-3.867% (0.038136539)	-1.715% (0.034976521)	-8.755% (0.011953414)	-3.056% (0.021899959)	-1.579% (0.022214663)					
	Korea (KRW)	5.394% (0.139282498)	2.071% (0.081144366)	1.412% (0.054221008)	-2.501% (0.137306266)	26.135% (0.068555057)					
	Lao (LAK)	48.276% (0.26025015)	10.062% (0.186413841)	58.999% (0.086159837)	67.326% (0.034273124)	60.787% (0.018868954)					
	Myanmar (MMK)	89.390% (0.550092597)	16.550% (0.285132147)	78.030% (0.063488239)	126.382% (0.194926959)	153.880% (0.046307416)					
	Vietnam (VND)	37.096% (0.32047917)	2.576% (0.039128805)	20.819% (0.076638916)	51.015% (0.126943703)	86.905% (0.11036543)					

†: A value in the parenthesis indicates the standard value

Table 4c: Average of TDI and differences from DI (Case for the currencies of ASEAN5+China+Korea are cointegrated)

Currencies			Average of the TDI †					Differences from DI				
			2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:12	III 2006.1-2008.12	IV 2009.1-20011.2	2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:!2	III 2006.1-2008.12	IV 2009.1-20011.2
Dominate	China	CNY	1.053% (0.03594266)	-0.939% (0.034373053)	0.615% (0.018508455)	-0.325% (0.019272226)	6.293% (0.020410738)	-0.993%	-0.594%	1.787%	0.810%	-7.677%
	Indonesia	(IDR)	8.483% (0.079232593)	1.583% (0.09009536)	8.712% (0.040564665)	8.769% (0.045483206)	17.342% (0.037770856)	30.402%	1.602%	17.668%	48.495%	61.881%
	Korea	(KRW)	3.979% (0.041655082)	0.054% (0.018652971)	3.803% (0.015462093)	3.256% (0.025121868)	10.644% (0.022102301)	1.782%	1.098%	-2.507%	-6.938%	20.412%
	Malaysia	(MYR)	1.053% (0.03594266)	-0.939% (0.034373053)	0.615% (0.018508455)	-0.325% (0.019272226)	6.293% (0.020410738)	1.935%	0.506%	2.961%	3.198%	0.825%
	Philippines	(PHP)	4.086% (0.042294535)	0.091% (0.020130924)	3.920% (0.015826578)	3.387% (0.025508499)	10.803% (0.022342097)	17.619%	2.726%	21.982%	21.470%	27.201%
	Singapore	(SGD)	2.802% (0.036322802)	-0.346% (0.011252962)	2.520% (0.013580291)	1.815% (0.021512207)	8.893% (0.020215858)	-9.318%	-0.489%	-6.302%	-14.130%	-18.823%
	Thailand	(THB)	2.365% (0.035304206)	-0.494% (0.015340751)	2.044% (0.014040989)	1.280% (0.020546706)	8.243% (0.019912116)	-3.918%	-0.011%	-1.544%	-4.723%	-11.320%
Dominated	Brunei	(BND)	-7.784% (0.064625424)	-1.216% (0.022821519)	-3.796% (0.013779408)	-14.893% (0.03962477)	-12.251% (0.031283576)					
	Cambodia	(KHR)	26.166% (0.250003422)	0.270% (0.029538023)	13.171% (0.062402349)	36.735% (0.148622442)	64.382% (0.052158293)					
	Hong Kong	(HKD)	-0.703% (0.069870989)	-2.279% (0.050918574)	-6.262% (0.016747555)	-1.797% (0.045485109)	10.263% (0.038016952)					
	Japan	(JPY)	-8.409% (0.124337239)	1.718% (0.053259802)	-6.034% (0.045175344)	-5.562% (0.070328817)	-29.477% (0.067513438)	-2.798%	-0.355%	-2.608%	-2.441%	-6.921%
	Lao	(LAK)	51.440% (0.280340249)	9.498% (0.177026192)	61.492% (0.087573193)	68.585% (0.019117667)	72.630% (0.034960542)					
	Myanmar	(MMK)	92.554% (0.582598596)	15.985% (0.275049212)	80.523% (0.053947408)	127.641% (0.218560365)	165.722% (0.062905033)					
	Vietnam	(VND)	40.260% (0.362044133)	2.012% (0.036098666)	23.312% (0.078403403)	52.274% (0.156327428)	98.748% (0.128091701)					

†: A value in the parenthesis indicates the standard value

Table 4d: Average of TDI and differences from DI (Case for the currencies of ASEAN5+China+Japan are cointegrated)

Currencies			Average of the TDI †					Differences from DI				
			2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:12	III 2006.1-2008.12	IV 2009.1-20011.2	2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:!2	III 2006.1-2008.12	IV 2009.1-20011.2
Dominate	China	CNY	-2.981% (0.034381426)	-1.029% (0.039481889)	-2.419% (0.011360788)	-2.166% (0.024859432)	-7.547% (0.010999199)	3.042%	-0.504%	4.821%	2.651%	6.163%
	Indonesia	(IDR)	7.899% (0.0849551)	3.734% (0.1412935)	10.797% (0.042598463)	10.027% (0.037528499)	6.929% (0.033349594)	30.987%	-0.548%	15.582%	47.237%	72.295%
	Japan	(JPY)	-1.192% (0.024334202)	-0.246% (0.01073794)	-0.246% (0.007308733)	-0.161% (0.022947825)	-5.166% (0.009335778)	-10.015%	1.609%	-8.397%	-7.842%	-31.232%
	Malaysia	(MYR)	-2.812% (0.033166013)	-0.955% (0.036713661)	-2.214% (0.010771425)	-1.977% (0.024610407)	-7.323% (0.010700204)	5.801%	0.522%	5.791%	4.850%	14.441%
	Philippines	(PHP)	2.857% (0.039453062)	1.527% (0.057828687)	4.672% (0.019872451)	4.376% (0.025327033)	0.220% (0.017222295)	18.848%	1.290%	21.230%	20.481%	37.785%
	Singapore	(SGD)	-0.670% (0.023182485)	-0.017% (0.005070475)	0.388% (0.007583413)	0.424% (0.022723646)	-4.472% (0.009585456)	-5.846%	-0.817%	-4.170%	-12.739%	-5.457%
	Thailand	(THB)	1.472% (0.02945995)	0.920% (0.035017411)	2.990% (0.014075234)	2.824% (0.023494285)	-1.622% (0.013429203)	-3.026%	-1.426%	-2.490%	-6.267%	-1.455%
Dominated	Brunei	(BND)	-10.936% (0.096316782)	-0.920% (0.019447506)	-5.758% (0.012082112)	-15.745% (0.05592103)	-24.917% (0.041933515)	0.354%	-0.651%	-0.646%	-1.589%	5.744%
	Cambodia	(KHR)	23.014% (0.208807197)	0.566% (0.021349188)	11.209% (0.068560044)	35.883% (0.115541846)	51.716% (0.043566896)					
	Hong Kong	(HKD)	-3.855% (0.038214115)	-1.983% (0.0421943)	-8.224% (0.012542358)	-2.649% (0.022428176)	-2.402% (0.026800805)					
	Korea	(KRW)	5.407% (0.13224883)	1.803% (0.074316785)	1.942% (0.050156324)	-2.093% (0.130096099)	25.312% (0.06395662)					
	Lao	(LAK)	48.288% (0.26159925)	9.794% (0.180545938)	59.530% (0.090631263)	67.733% (0.040939742)	59.964% (0.02414432)					
	Myanmar	(MMK)	89.402% (0.54863504)	16.282% (0.279760305)	78.561% (0.064125695)	126.789% (0.190876628)	153.057% (0.051597367)					
	Vietnam	(VND)	37.108% (0.31857808)	2.308% (0.035948037)	21.350% (0.081786006)	51.422% (0.121236013)	86.082% (0.116169698)					

†: A value in the parenthesis indicates the standard value

Table 4e: Average of TDI and differences from DI (Case for the currencies of ASEAN5+Korea+Japan are cointegrated)

Currencies			Average of the TDI †					Differences from DI				
			2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:12	III 2006.1-2008.12	IV 2009.1-20011.2	2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:!2	III 2006.1-2008.12	IV 2009.1-20011.2
Dominate	Indonesia	(IDR)	3.878% (0.051107171)	1.323% (0.069363268)	4.741% (0.031287922)	5.098% (0.047679173)	4.597% (0.034158621)	35.008%	1.863%	21.639%	52.166%	74.626%
	Japan	(JPY)	-1.737% (0.016266279)	-0.209% (0.015065411)	-2.226% (0.012509737)	-2.575% (0.012998941)	-2.054% (0.012048804)	-9.469%	1.572%	-6.416%	-5.429%	-34.344%
	Korea	(KRW)	0.518% (0.012969349)	0.407% (0.019084643)	0.573% (0.008021757)	0.507% (0.012303463)	0.618% (0.008448073)	5.243%	0.745%	0.724%	-4.189%	30.438%
	Malaysia	(MYR)	-1.238% (0.011087017)	-0.072% (0.007749994)	-1.606% (0.009336511)	-1.892% (0.008073151)	-1.462% (0.008530703)	4.226%	-0.360%	5.183%	4.765%	8.581%
	Philippines	(PHP)	1.103% (0.019257455)	0.566% (0.027803347)	1.298% (0.01153306)	1.306% (0.01832473)	1.310% (0.012581348)	20.602%	2.251%	24.605%	23.551%	36.695%
	Singapore	(SGD)	0.336% (0.011144965)	0.357% (0.01637835)	0.347% (0.007123042)	0.259% (0.010479046)	0.402% (0.007294278)	-6.853%	-1.192%	-4.129%	-12.574%	-10.332%
	Thailand	(THB)	-1.612% (0.014921995)	-0.175% (0.013213796)	-2.071% (0.011683758)	-2.404% (0.01173146)	-1.906% (0.011137244)	-12.569%	-1.161%	-5.987%	-16.184%	-31.970%
Dominated	Brunei	(BND)	-10.075% (0.086227874)	-0.349% (0.020181492)	-6.018% (0.023834691)	-16.461% (0.04396901)	-20.007% (0.054260957)					
	Cambodia	(KHR)	23.875% (0.222734363)	1.137% (0.02175688)	10.950% (0.057472805)	35.167% (0.138403712)	56.626% (0.032070823)					
	China	CNY	0.567% (0.024372929)	-0.311% (0.010428317)	2.789% (0.019515655)	1.359% (0.021024667)	-2.218% (0.012630985)					
	Hong Kong	(HKD)	-2.994% (0.045074081)	-1.413% (0.025532333)	-8.483% (0.012113215)	-3.364% (0.033930778)	2.508% (0.017368375)	-0.507%	-1.222%	-0.386%	-0.874%	0.834%
	Lao	(LAK)	49.149% (0.263586354)	10.365% (0.194033405)	59.270% (0.079232747)	67.018% (0.021878043)	64.874% (0.012714321)					
	Myanmar	(MMK)	90.263% (0.560002144)	16.852% (0.291662083)	78.302% (0.057253475)	126.074% (0.209116633)	157.967% (0.041849219)					
	Vietnam	(VND)	37.969% (0.33310441)	2.878% (0.045092286)	21.090% (0.068189615)	50.707% (0.145560851)	90.992% (0.104679608)					

†: A value in the parenthesis indicates the standard value

Table 4f: Average of TDI and differences from DI (Case for the currencies of ASEAN5+China+Korea+Japan are cointegrated)

Currencies			Average of the TDI †					Differences from DI				
			2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:12	III 2006.1-2008.12	IV 2009.1-20011.2	2000:1-2011.2	I 2000:1-2002:12	II 2003:1-2005:!2	III 2006.1-2008.12	IV 2009.1-20011.2
Dominate	China	CNY	-1.948% (0.017970091)	-0.611% (0.026971149)	-1.808% (0.010486653)	-2.613% (0.004920417)	-3.061% (0.006472813)	2.009%	-0.922%	4.211%	3.099%	1.677%
	Indonesia	(IDR)	7.821% (0.083224834)	3.166% (0.137890744)	9.085% (0.050183708)	10.276% (0.02698218)	9.214% (0.030411251)	31.065%	0.019%	17.295%	46.988%	70.009%
	Japan	(JPY)	-1.204% (0.010681758)	-0.323% (0.014422688)	-0.979% (0.005887949)	-1.632% (0.003000823)	-2.127% (0.003840309)	-10.002%	1.686%	-7.663%	-6.371%	-34.271%
	Korea	(KRW)	1.481% (0.018331189)	0.715% (0.030893257)	2.015% (0.010841715)	1.910% (0.006960663)	1.247% (0.006793709)	4.280%	0.437%	-0.718%	-5.592%	29.809%
	Malaysia	(MYR)	-1.204% (0.010681758)	-0.323% (0.014422688)	-0.979% (0.005887949)	-1.632% (0.003000823)	-2.127% (0.003840309)	4.193%	-0.110%	4.555%	4.505%	9.245%
	Philippines	(PHP)	2.971% (0.033445897)	1.291% (0.056037048)	3.676% (0.020080982)	3.876% (0.011579735)	3.119% (0.012289815)	18.734%	1.526%	22.226%	20.981%	34.885%
	Singapore	(SGD)	0.601% (0.009741128)	0.375% (0.016042103)	1.034% (0.005400299)	0.749% (0.004386663)	0.141% (0.003677894)	-7.117%	-1.209%	-4.816%	-13.064%	-10.071%
	Thailand	(THB)	1.804% (0.021584153)	0.840% (0.036349674)	2.375% (0.012845507)	2.337% (0.007947963)	1.654% (0.007975745)	-3.358%	-1.345%	-1.875%	-5.780%	-4.730%
Dominated	Brunei	(BND)	-10.042% (0.086464393)	-0.600% (0.017941924)	-5.391% (0.016942509)	-16.201% (0.045852135)	-20.671% (0.049095409)	-0.540%	-0.971%	-1.013%	-1.134%	1.499%
	Cambodia	(KHR)	23.908% (0.220206303)	0.886% (0.018402375)	11.577% (0.060526681)	35.427% (0.13242118)	55.962% (0.035597066)					
	Hong Kong	(HKD)	-2.961% (0.041529261)	-1.663% (0.032451222)	-7.856% (0.008460182)	-3.104% (0.02859812)	1.844% (0.020457103)					
	Lao	(LAK)	49.182% (0.264178797)	10.114% (0.187696927)	59.897% (0.083632805)	67.278% (0.024384066)	64.210% (0.016346959)					
	Myanmar	(MMK)	90.296% (0.558339726)	16.601% (0.286172684)	78.929% (0.05711748)	126.334% (0.204949867)	157.303% (0.046694131)					
	Vietnam	(VND)	38.002% (0.330944962)	2.627% (0.040507854)	21.717% (0.073332682)	50.967% (0.139423074)	90.328% (0.109914062)					

†: A value in the parenthesis indicates the standard value

Figure 1a: M-TAR Unit Root Test for Indices of the SGD Real Exchange Rate vis-à-vis the USD

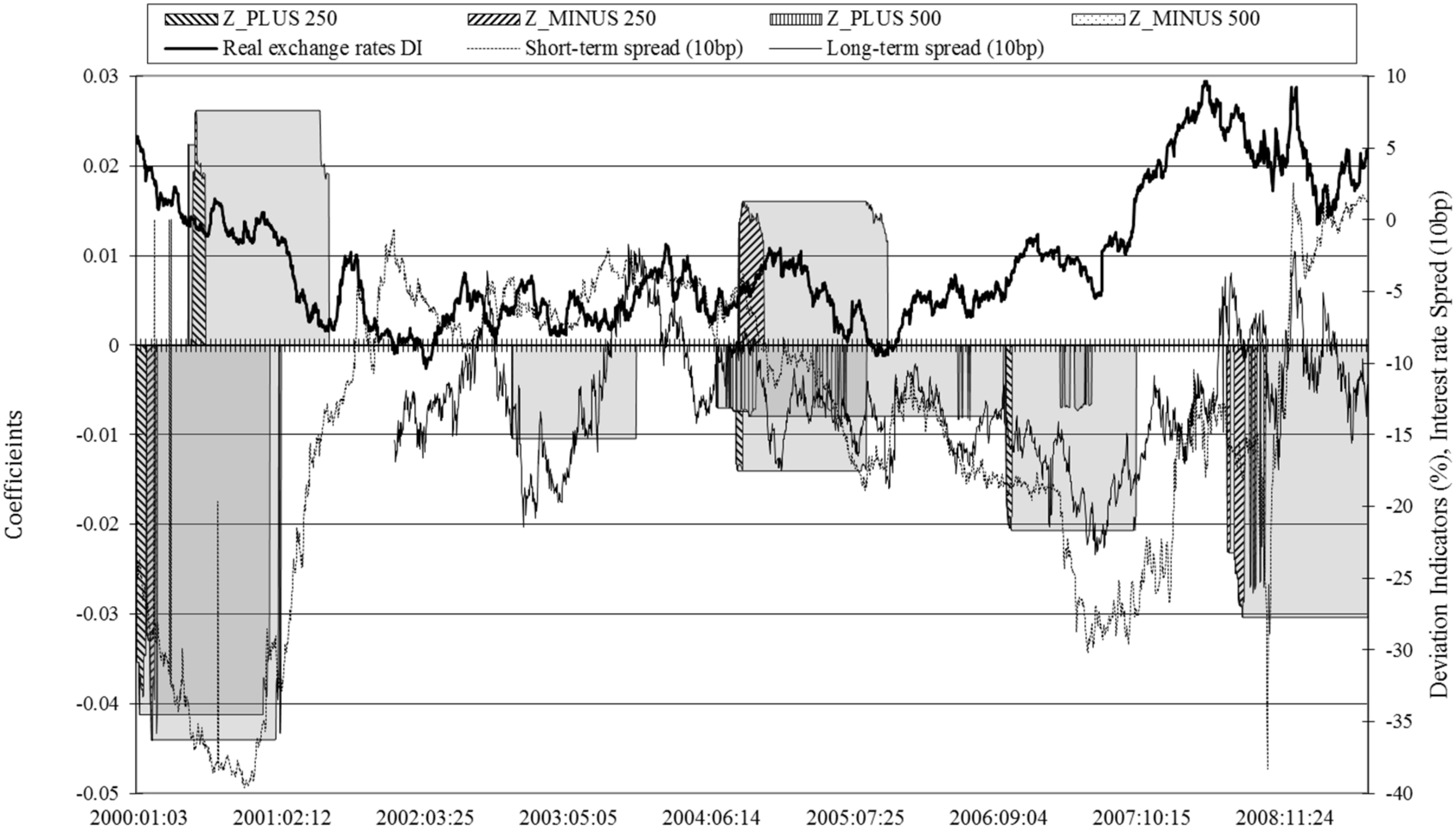

Figure 1b: M-TAR Unit Root Test for the Real RMU DI of the Singapore Dollar

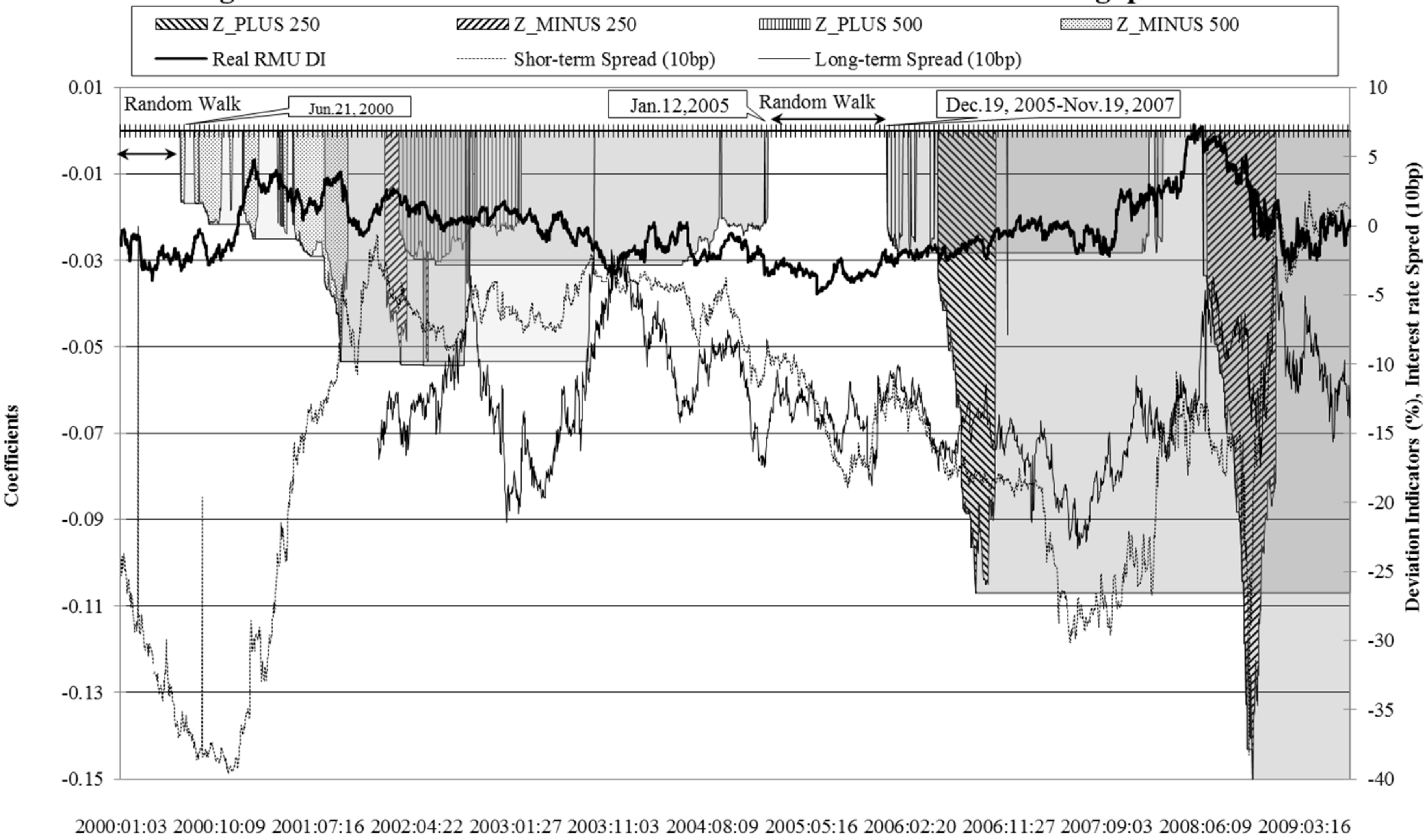

Figure 2a: M-TAR Unit Root Test for Indices of the KRW Real Exchange Rate vis-à-vis the USD

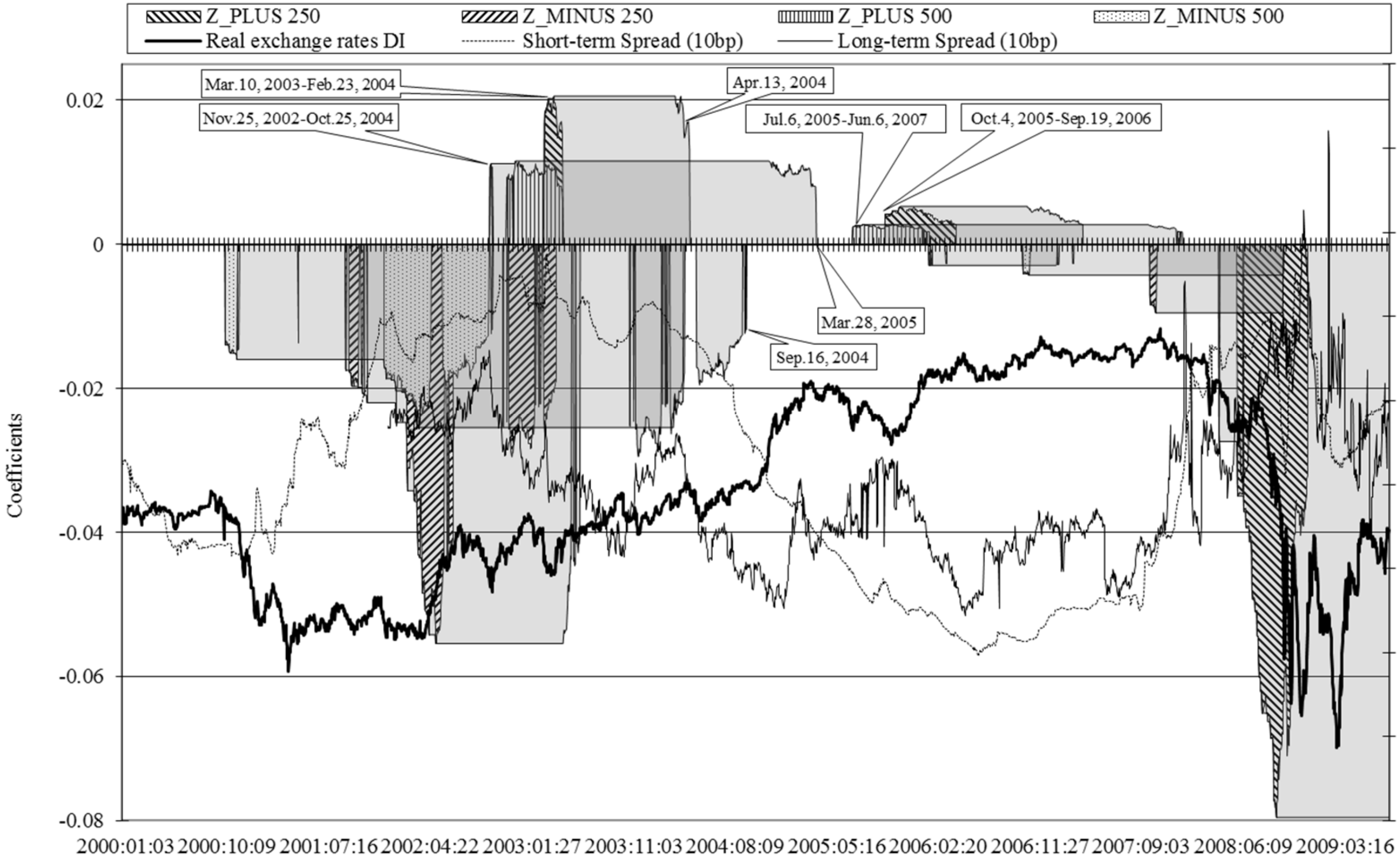

Figure 2b: M-TAR Unit Root Test for Real RMU DI of the Korean Won

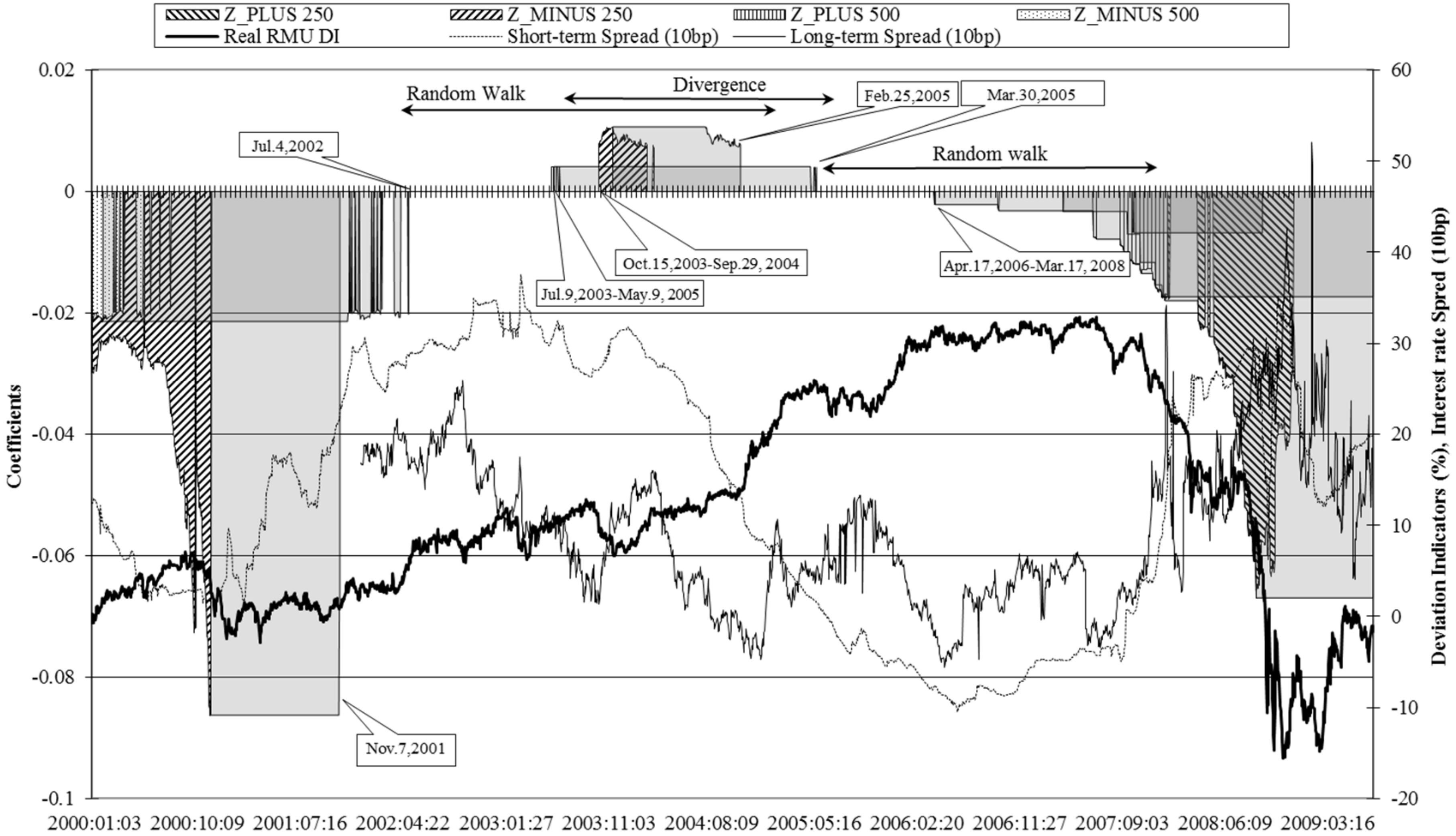

Figure 3a: M-TAR Unit Root Test for Indices of the THB Real Exchange Rate vis-à-vis the USD

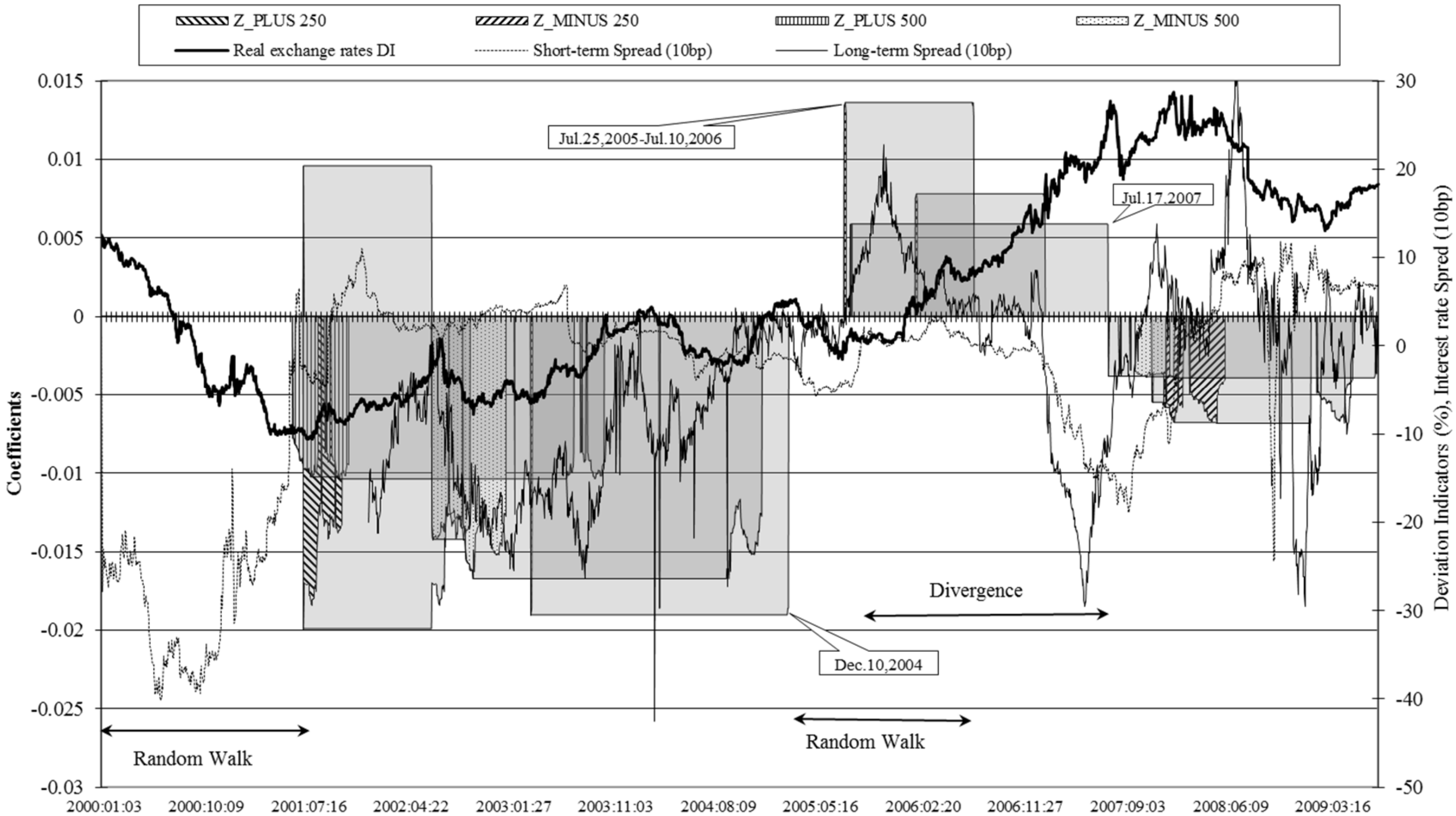

Figure 3b: M-TAR Unit Root Test for the Real RMU DI of the Thai Baht

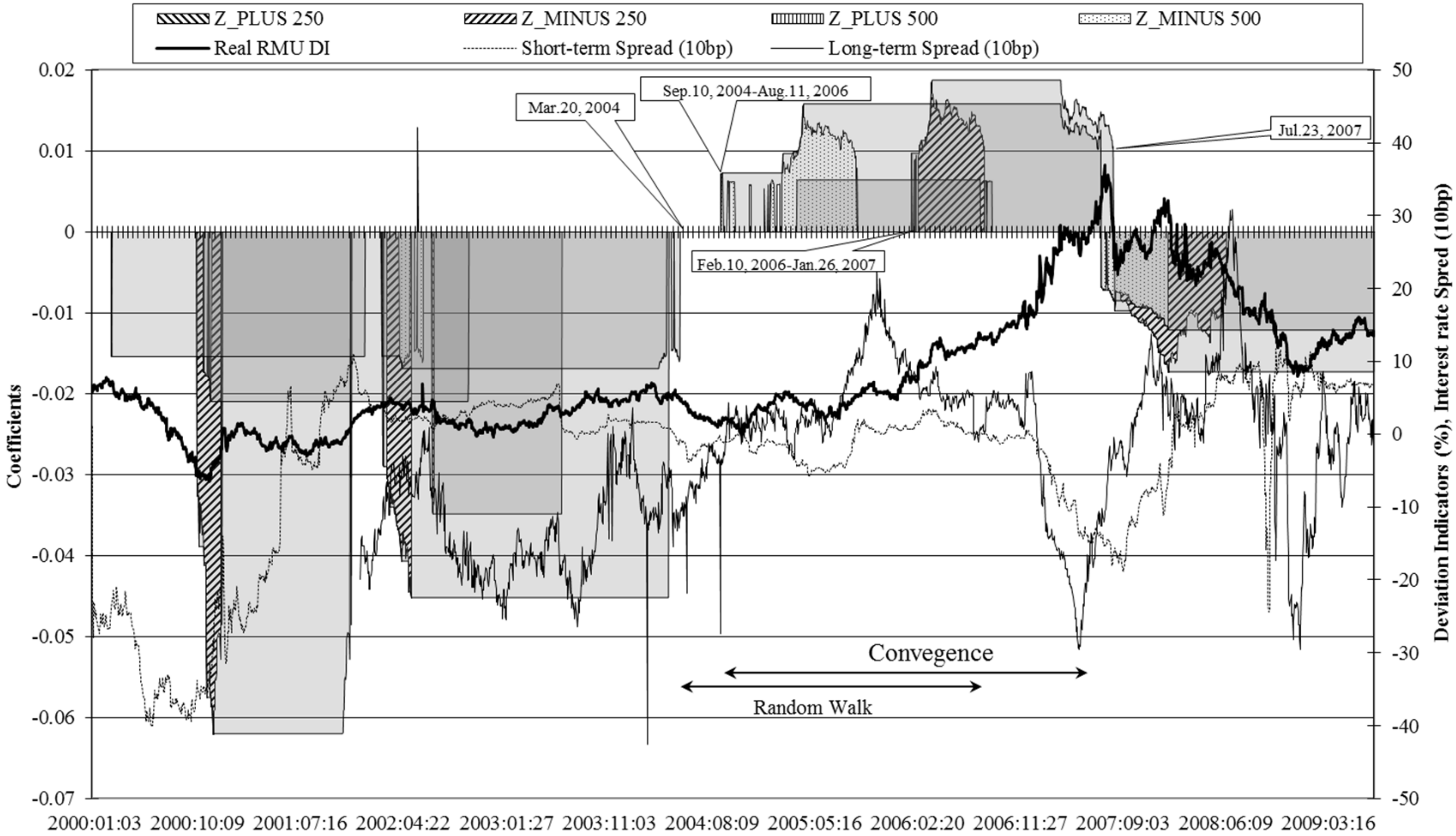

Figure 4: The Deviation Indicators of CMIM member currencies

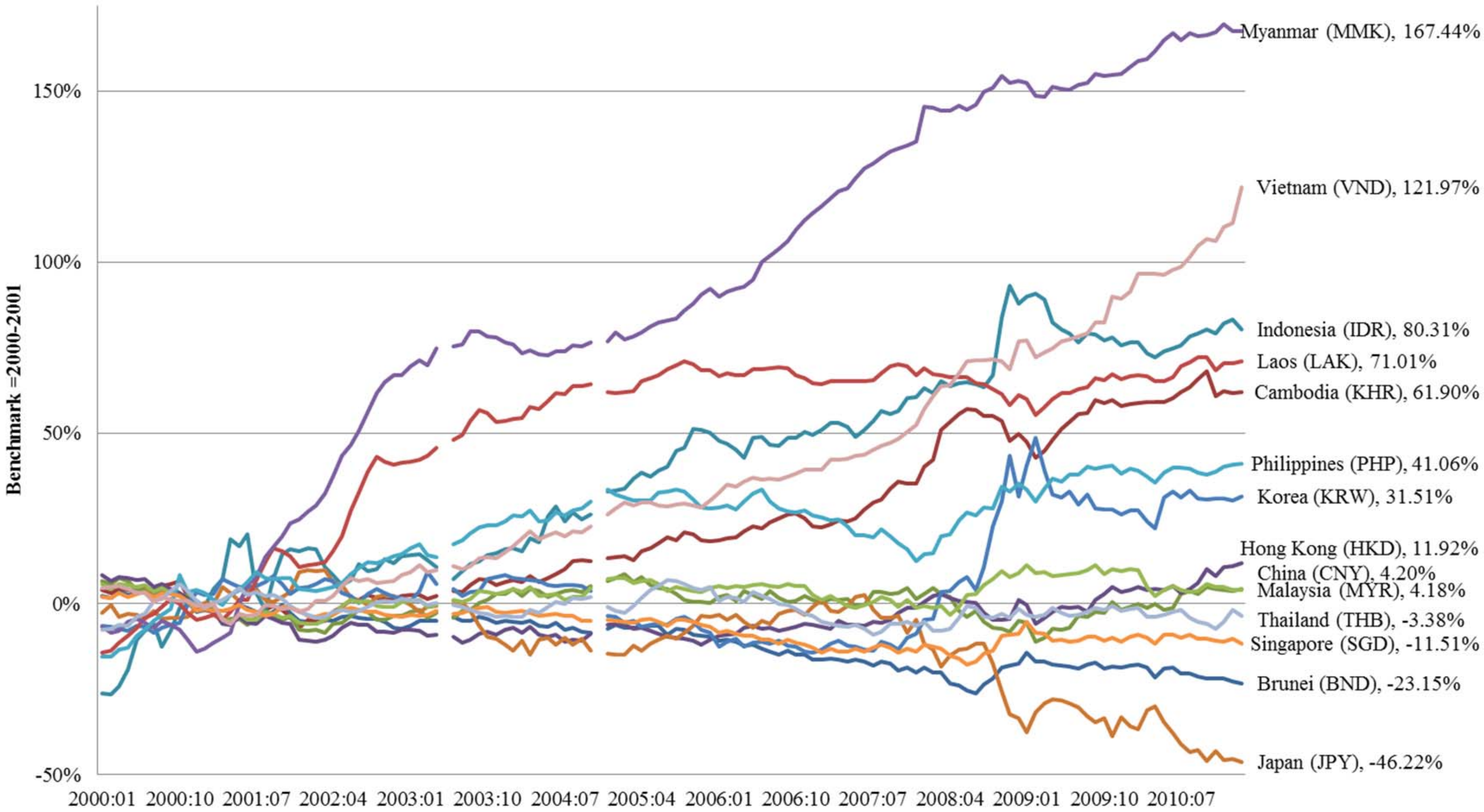

Figure 5a: Current Deviation Index for ASEAN5 + Korea

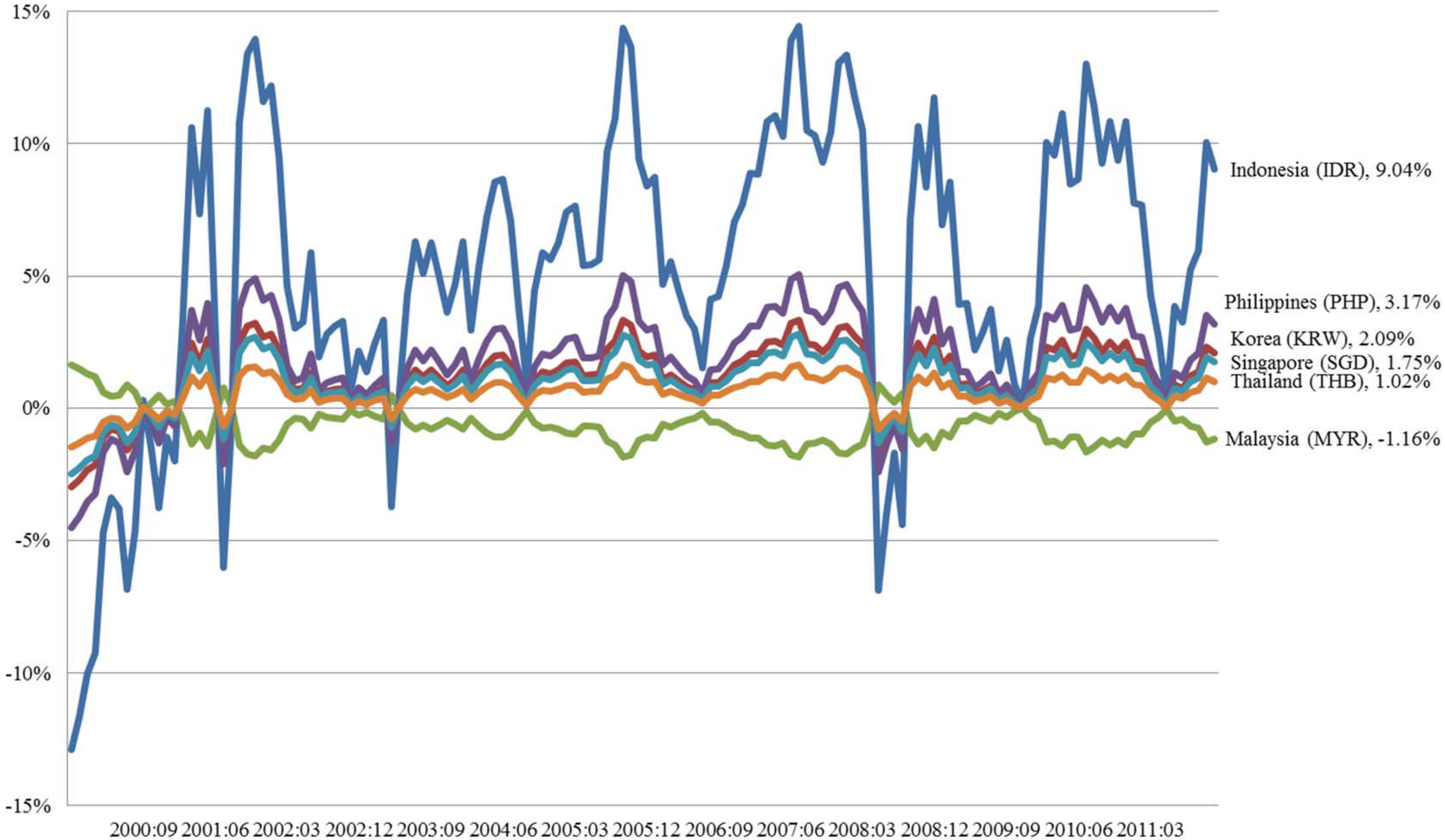

Figure 5b: Current Deviation Index for ASEAN5 + Japan

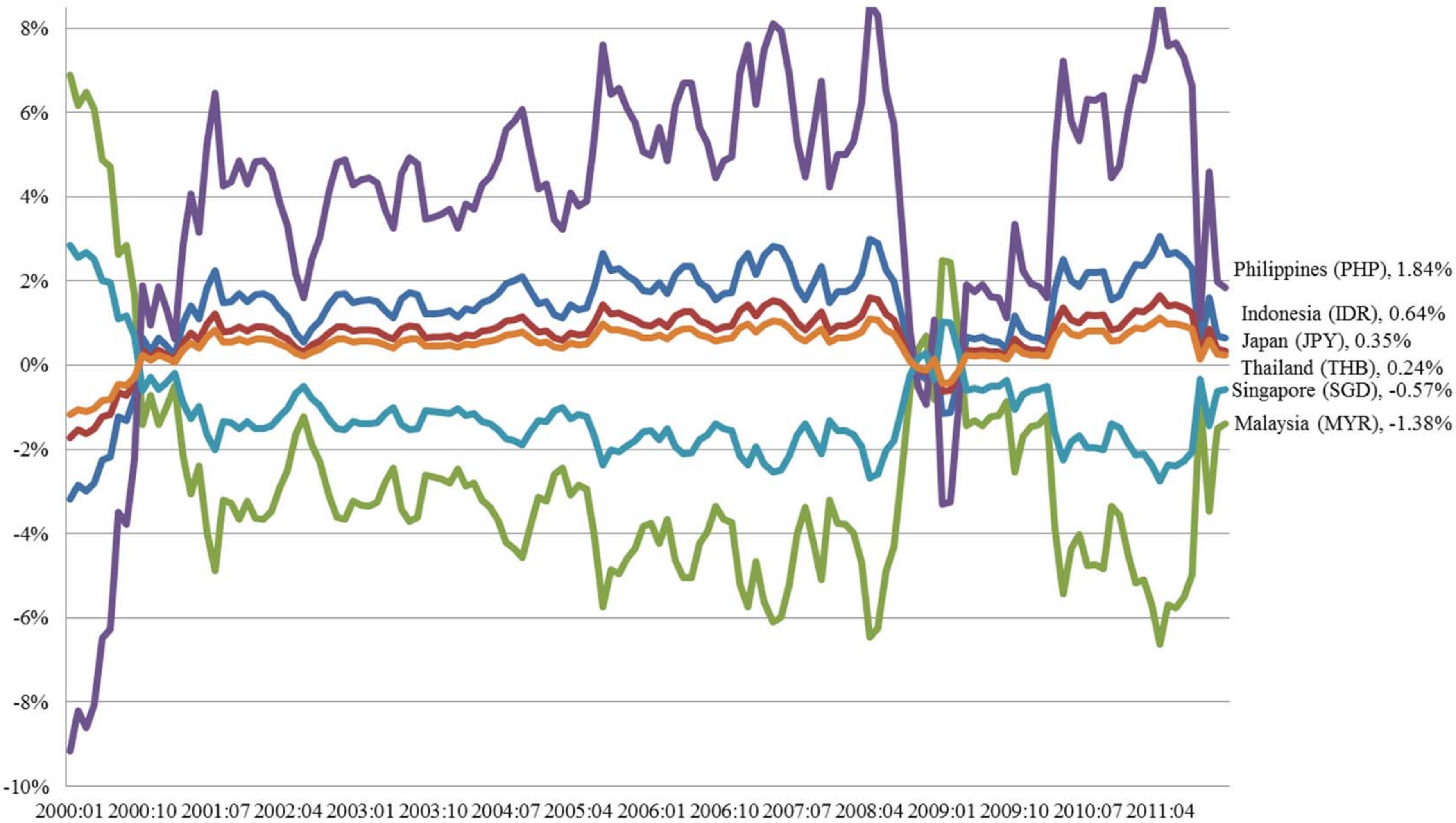

Figure 5c: Current Deviation Index for ASEAN5 + China + Korea

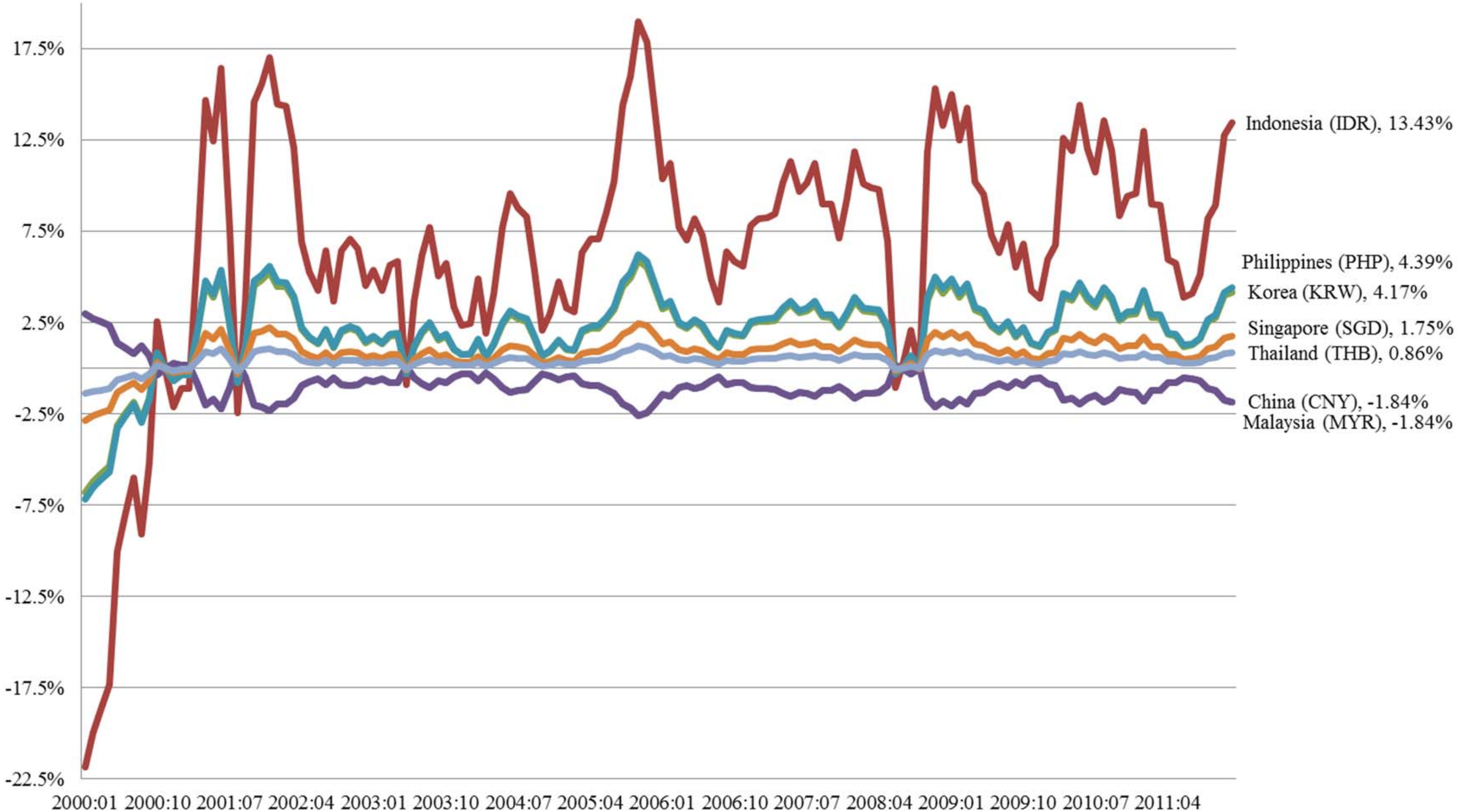

Figure 5d: Current Deviation Index for ASEAN5 + China + Japan

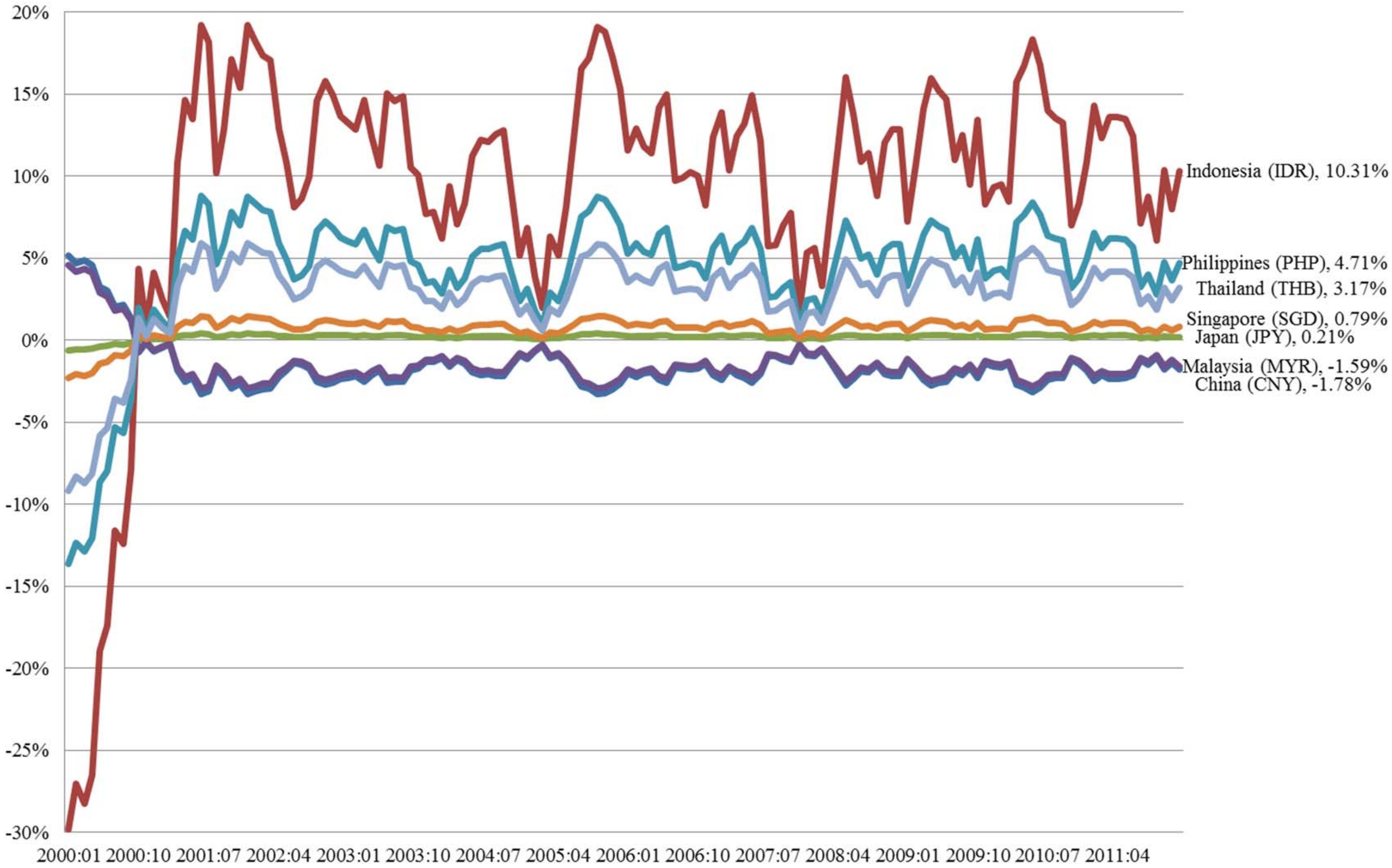

Figure 5e: Current Deviation Index for ASEAN5 + Korea + Japan

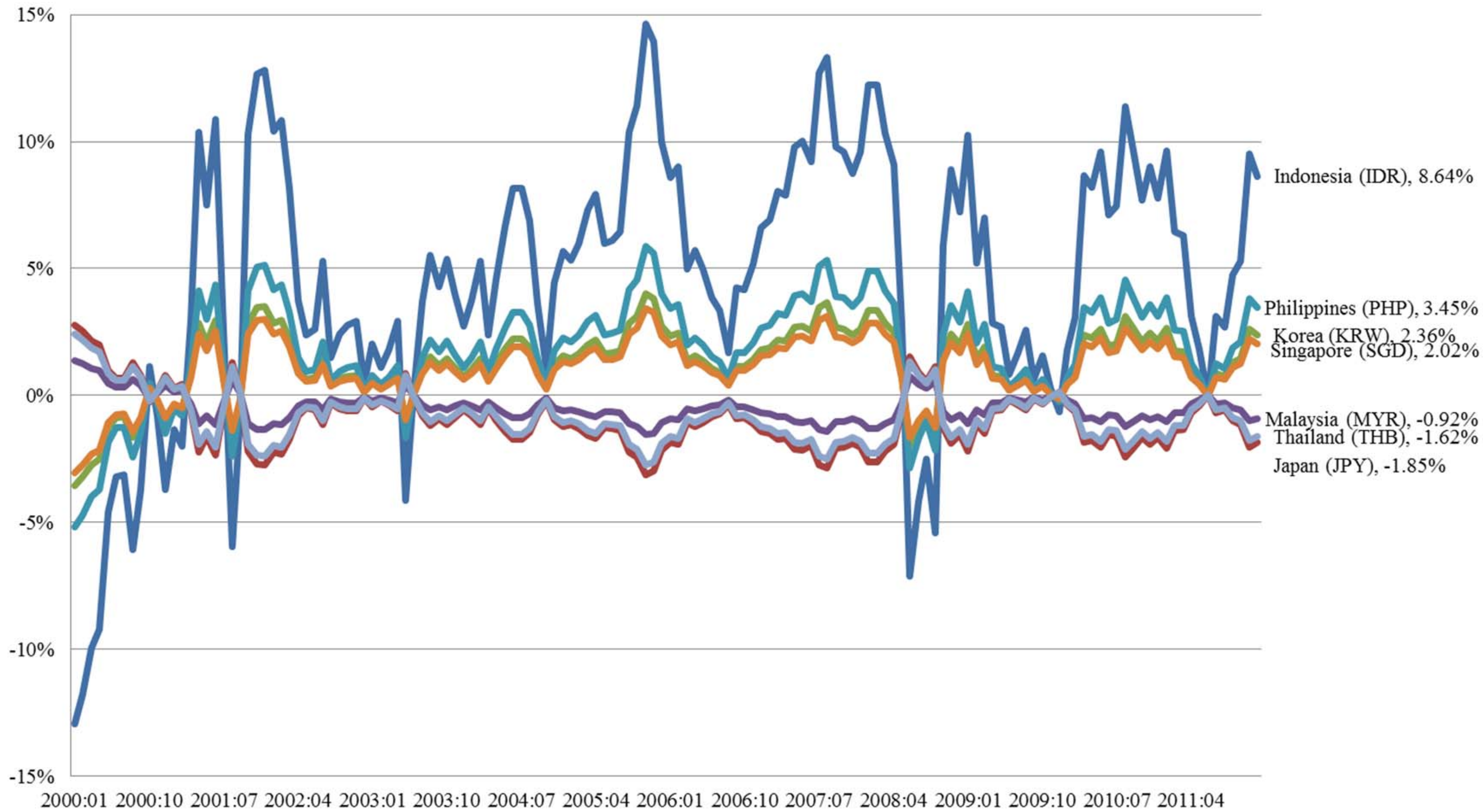

Figure 5f: Current Deviation Index for ASEAN5 + China + Korea + Japan