Financial Integration among ASEAN+3 Countries: Evidence from Exchange Rates

Lee, Chin and M., Azali

FACULTY OF ECONOMICS MANAGEMENT, UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR DARUL EHSAN, MALAYSIA.

2013

Financial Integration among ASEAN+3 Countries: Evidence from Exchange Rates Convergence

Lee Chin*
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM Serdang, Selangor, Malaysia

Tel: +603 89467769
Fax: +603 89486188
E-Mail: leechin@upm.edu.my

M. Azali
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM Serdang, Selangor, Malaysia

Tel: +603 89467626
Fax: +603 89486188
E-Mail: azali@upm.edu.my

* Corresponding author

Abstract

As the economies of Asian have moved towards closer economic ties in recent years, the establishment of regional exchange rate arrangement has become an important regional policy concern. A study by the Asian Development Bank forecast that Asian will be the world's largest economy by 2050. Hence, it is not reasonable for Asian to continuously depend on US dollar. Asian must have its own currency and must responsible for its own financial stability. Regional cooperation (including integration) is critical for Asia's march toward prosperity and facing vulnerabilities to global shocks. Financial integration in ASEAN+3 is assessed in this paper by examining the time-series stochastic behaviour and cointegration in a set of eight ASEAN+3 currencies. The findings imply that not all of the ASEAN+3 countries are financial integrated during the recent float. This finding provided weak support upon formation of regional monetary and exchange rate arrangement in Asia.

Keywords: Financial Integration, Exchange Rate, Convergence, Cointegration, Granger-causality, Asian

1. Introduction

In the era of globalization, economic interdependence of national across the world is increasing. There is a rapid increase in cross-border movement of goods, service, technology and capital. Regional economies, societies and cultures have become more integrated through communication, transportation, and trade. While economic globalization has been occurring for the last several hundred years (since the emergence of international trade), it has begun to occur at an increased rate over the last 20 – 30 years. This recent boom has been largely accounted by the formation of regional trade arrangement, the reduction of trade barriers and the increment in foreign direct investment. Many regional agreements aim to facilitate trade and spur economic growth had been emerged. One of them is The Association of Southeast Asian Nations (ASEAN).

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 in Bangkok by Indonesia, Malaysia, the Philippines, Singapore, and Thailand[1]. In the early 1970s, most of the South East Asia did not have a close relationship with the world economy. Economic linkages among the ASEAN have tightened, following the establishment of the Preferential Trade Agreement in 1977 and ASEAN Free Trade Area (AFTA) in 1993. The realization of the ASEAN Free Trade Area in no way lessens the importance of ASEAN's economic partners. The ASEAN Plus Three cooperation began in 1997 and was institutionalised in 1999 when the Leaders issued a Joint Statement on East Asia Cooperation at their 3rd ASEAN Plus Three Summit in

[1] Brunei Darussalam joined on 8 January 1984, Vietnam on 28 July 1995, Laos and Myanmar on 23 July 1997, and Cambodia on 30 April 1999.

Manila. Since then, cooperation in economic, and monetary and financial fields between ASEAN and their counterparts from East Asia, namely China, Japan and the Republic of Korea (ROK) had made substantive progress.

This study attempts to empirically assess the financial integration of ASEAN+3 by examining their exchange rates co-movements. Both the multilateral and bilateral relationship between the individual ASEAN+3 exchange rates is examined through the cointegration and Granger-causality techniques. A 2011 study by the Asian Development Bank forecast that Asia's per capita income could rises six fold by 2050. It forecasted that its share of global gross domestic product (GDP) could rises to 52 percent by 2050.[2] By then, Asian will be the world's largest economy. As its share of global GDP rises to 50 percent or more, Asia should also have about the same share of the world's financial assets, banks, and equity and bond markets, etc. Hence, Asian must have its own currency and Asian must take responsibility for its own financial and currency stability. It is not reasonable for Asian to continuously depend on US dollar. Therefore, it is the time for Asian countries to have their own Asian currency unit. Regional cooperation (including integration) is critical for Asia's march toward prosperity. It will cement the region's hard-won economic gains in the face of vulnerabilities to global shocks.

Henceforth, this paper is organized as follows. First section of the paper is the introduction Related literatures are reviewed in Section 2. The data set is described and the empirical results are discussed in Section 3, and the final section presents the conclusions.

[2] Asian Development Bank (2012).

2. Literature Reviews on Asian Exchange Rates Integration

Many authors have used the convergence of exchange rates to investigate financial integration in Asian countries. Except for Lee and Azali (2010), most of the studies are intended to examine the existence of a yen bloc. Aggarwal and Mougoue (1993) examined the existence of yen bloc by employing the time-series stochastic behavior and cointegration of five Asian currencies (Japanese yen, Hong Kong dollar, Malaysian ringgit, Philippines peso, and Singapore dollar). Based on daily exchange rates from 27 September 1982 to 22 December 1989, they found strong evidence of a yen bloc. Tse and Ng (1997) pointed out that the inclusion of Hong Kong dollar in the set of exchange rate by Aggarwal and Mougoue (1993) may be inappropriate as the currency has been pegged to U.S. dollar and countries like South Korea and Taiwan that have close trade relationship with Japan should be included in the analysis. They disaggregate the sample period into two sample-periods. First sample-period is from September 1982 to December 1989 that corresponded with Aggarwal and Mougoue (1993), and second sample-period ended in 30 June 1994. In contrast to the finding of Aggarwal and Mougoue (1993), they found that if South Korea won and Taiwan dollar are excluded from the set of currencies, the currencies are not cointegrated. They also indicated that the number of cointegrating vectors increased when sample period extended to 1994.

Aggarwal and Mougoue (1996) examined the cointegrating relationship of exchange rates between Japanese yen with two sets of Asian currencies. First set of currencies consisted of currencies of the Asian Tigers Hong Kong, South Korea, Singapore, and Taiwan; and second set, the currencies of ASEAN, Malaysia, the Philippines,

Thailand and Singapore. Daily exchange rates spanning from October 1983 to February 1992 are used. By using the procedure advocated by Park and Sung (1994), a structural break that coincided with October 1987 stock market crash was detected and further analysis were conducted on two sub-periods. Both sets of Asian currencies are found to be cointegrated. Besides, they also examined the influence of the Japanese yen among the other Asian currencies relative to the U.S. dollar. Their result showed that influence of Japanese yen in both sets of the currencies has increased relative to the U.S. dollar.

Chaudhry et al. (1996) examined the co-movement in the Japanese yen, Australian dollar, Singapore dollar, Malaysian ringgit and New Zealand dollar. The results from the VAR suggest that the Japanese yen, Australian dollar and Singapore dollar influence the behaviour of the other currencies. In addition, they also investigate the nature of change in these relationships over the two important currency-coordinating agreements, the managed-float Plaza Accord (January, 1985 to February, 1987) and the target-zone Louvre Accord (February 1987 to December 1989). Evidence of integration of these currencies during the target-zone Louvre Accord is found. However, evidence does not support integration for the managed-float Plaza Accord interval.

Baharumshah and Goh (2005) examined the exchange rates relationship between Japan and seven East Asian countries (Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand) using quarterly data from 1978:Q1 to 1998:Q3. In order to investigate whether several events that took place in 1990s (the Mexico tequila crisis, rise of U.S. dollar, devaluation of yuan) had affected these financial

markets, three sub-periods have been used in the analysis. Period 1 spans from 1978:Q1 to 1994: Q1; Period 2 covers from 1978: Q1 to 1996: Q2; Period 3 starts from 1978: Q1 and ends in 1998: Q3. They found that the Philippines peso and Korean won do not belong to the cointegrating relationship; and the macroeconomic shocks experienced in 1994-1996 have not distorted the yen's influence in the region.

Azali et al. (2009) investigated the possibility and feasibility to use Japanese yen as a future vehicle currency in the Asian region namely Malaysia, Singapore, Thailand, Indonesia, the Philippines, China, Korea and India by examining their daily exchange rate co-movements denominated in yen. The analyses of the data are divided into three sample-periods: first, pre-crisis period spanning from 1 November 1988 to 13 May 1997; second, crisis period from 14 May 1997 to 31 August 1998; and third, post-crisis period from 1 September 1998 to 31 December 2007. The results show that there is no cointegration relationship during the pre- and crisis period. However, for the post-crisis period, four out of eight countries namely Malaysia, the Philippines, Singapore and Korea support the hypothesis for Japanese yen as an alternative currency in this region.

Last but not least, Lee and Azali (2010) investigated the potential linkages among ASEAN-5 currencies, in particular the possibility of Singapore dollar bloc during the pre- and post crisis periods. Utilizing quarterly data from 1980:Q1 to 1997:Q2 as pre-crisis period, and data from 1997:Q3 to 2007:Q4 as post-crisis period, the results show that there is low financial integration before the crisis, but ASEAN countries are financially more integrated after the crisis. The finding indicated the increasingly

important role of the Singapore dollar in ASEAN. Therefore, Singapore dollar can be a possible candidate as the common currency for ASEAN.

This study attempts to extent the existing literatures in two ways. First, by including more Asian countries following the establishment of ASEAN+3 cooperation. Second, investigate the issue using more recent data. To our knowledge, there is no study examining this issue using recent data of ASEAN+3 until 2011.

3. Data and Empirical Results

The data set consists of the daily exchange rates for eight ASEAN+3 currencies covering the period from 22 July 2005 to 23 September 2011[3]. The exchange rates are Indonesian rupiah (ID), Malaysian ringgit (MY), Philippines peso (PH), Singapore dollar (SG), Thailand baht (TH), China yuan (CN), Japanese yen (JP) and Korean won (KR) against the US dollar.

First, the order of integration of the series was determined using the Dickey-Fuller (DF) / Augmented Dickey-Fuller (ADF) unit root test. Table 1 reports the results. The results of both unit root tests for constant with trend and without trend clearly show that the null hypothesis of a unit root cannot be rejected at the 5% level for all currencies in their levels. However, the null hypothesis is rejected at 5% level when all currencies have been tested in their first-differences. Thus, these indicated that all eight Asian currencies are integrated of order one, $I(1)$.

[3] The periods under consideration are starting from where the ringgit Malaysia had unpegged against the USD.

Table 1

Since the series are of same order, we proceed to test the existence of cointegrating relations among the exchange rate series using Johansen multivariate cointegration test. The results are reported in Table 2. The results indicated that the null hypothesis of no cointegrating vector is rejected. This implies that ASEAN+3 currencies are cointegrated with one cointegrating vector.

Table 2

We are aware that although the cointegration may exist among eight Asian currencies, not all of these currencies will enter the cointegration vector. To this purpose, we perform the exclusion test by imposing zero restriction on the β coefficient of cointegrating vector. Table 3 reports the results. The log-likelihood ratio (LR) showed that Indonesia rupiah, Malaysia ringgit, Philippines peso, China yuan, Japanese yen and Korea won rejected the hypothesis null of cointegrating parameter equal to zero. Since Singapore dollar and Thai baht failed to reject the null hypothesis, Singapore dollar and Thai baht could be excluded from the system of exchange rate. The currencies that remain in the system are Indonesia rupiah, Malaysia ringgit, Philippines peso, China yuan, Japanese yen and Korea won.

Table 3

The cointegration tests are re-estimated on the remaining series. Results of the cointegration tests are shown in Table 4. Both the maximum eigenvalue test and trace test rejected the null hypothesis of no cointegrating vector at 1 percent level of significance. The results indicated that these currencies are cointegrated with a unique cointegrating vector.

Table 4

The exclusion test had been performed again on this group of currencies. Table 5 presents the results. The log-likelihood ratio (LR) showed that Indonesia rupiah, Philippines peso, China yuan and Korea won rejected the hypothesis null of cointegrating parameter equal to zero. This suggested that Malaysian ringgit and Japanese yen could be excluded from the system of exchange rate.

Table 5

The cointegration tests are re-estimated on the second remaining series. As shown in Table 6, both the maximum eigenvalue test and trace test rejected the null hypothesis of no cointegrating vector. The results indicated that these currencies are cointegrated with a unique cointegrating vector. In addition, the exclusion test result rejected the null hypothesis of cointegrating parameter equal to zero for all currencies (Table 7).

Table 6

Table 7

As the presence of cointegrating vector had been ascertain, the next step would be identifying the direction of causality among these few Asian currencies. Table 8 reports the results of the Granger-causality test based on vector error-correction model (VECM). The negative and significant error-correction term (ECT) for the Philippines and Indonesia equations, implying that the currency of these countries endogenously react to past deviations from the cointegrating relationship and adjusts to restore the long-run equilibrium. The small magnitude of the coefficient of error-correction term indicates that the adjustment towards equilibrium is rather slow. Short-run unidirectional causal relationship is detected running from Indonesia rupiah to Philippines peso and Korea won. At the same time, there is also unidirectional causal relationships running from China yuan to Philippines peso and Korea won; and from Korea won to Philippines peso. Philippines peso is the most endogenous variable where it is found to be Granger-caused by Indonesia rupiah, Korea won and China yuan. In addition, Indonesia rupiah and China yuan are found to be weakly exogenous. These relationships are summarized as Figure 1.

Table 8

Figure 1

4. Conclusions

As the economies of the Asian countries expand and become more integrated following the establishment of ASEAN+3 cooperation, this study attempts to examine the financial linkages between the currencies of the ASEAN+3. Significant non-

stationarity, and the presence of unit roots were documented for each currency in the sample period. The results of cointegration analysis showed that the currencies of four Asian countries namely, Indonesia, Korea, Philippines and China are cointegrated. These findings imply that not all of the ASEAN+3 countries, but only Indonesia, Korea, Philippines and China are financial integrated during the recent float. This finding provided weak support upon formation of regional monetary and exchange rate arrangement. The absence of Japanese Yen in the common currency area is not desirable as Japan together with Korea and China comprises the ASEAN's largest trading partners. The economic interdependence between ASEAN member states and +3 states is significant. Without Japan, the ASEAN were likely to be less successful. A numbers of studies such as Zhang et al. (2004); Bacha (2008); and Bayoumi and Mauro (1999) also found similar results. Although countries that do not meet the optimum currency area (OCA) criteria may still join a monetary union as they are likely to meet the criteria only after joining one (Frankel and Rose, 1988). However, Frankel and Rose's view on the endogeneity of OCA criteria is not universally accepted. Employing the system Generalized Method of Moments, Lee and Azali (2010) tested this hypothesis for the East Asia and found that financial integration leads to less synchronized business cycles. Therefore, this study concluded that the idea of forming an ASEAN single currency cannot be realized in the near future.

References

Aggarwal, R. & Mougoue, M. (1993). Cointegration among Southeast Asian and Japanese currencies: Preliminary evidence of a Yen bloc? Economics Letters, 41, 161-166.

Aggarwal, R. & Mougoue, M., (1996). Cointegration among Asian currencies: Evidence of the increasing influence of the Japanese Yen. Japan and the World Economy, 8, 291-308.

Asian Development Bank, (2012), Asia 2050: Realizing the Asian Century. [Online] Available: http://www.adb.org/sites/default/files/asia2050-executive-summary.pdf (October 18, 2013).

Azali, M., R.C. Royfaizal & Lee, C. (2009). Japanese Yen as an alternative vehicle currency in Asian. The Icfai University Journal of Monetary Economics, 7, 6-16.

Bacha, O. I. (2008). A common currency Area for ASEAN? Issues and feasibility. Applied Economics, 40, 515-529.

Baharumshah, A. Z. & Goh, W. K. (2005). Financial integration of East Asia: Is there a Yen block? In A. Z. Baharumshah (Ed.), Open Economy Macroeconomics In East Asia (pp. 147-168). Ashgate: Aldershot.

Bayoumi, T. & Mauro, P. (1999). The suitability of ASEAN for a regional currency arrangement, IMF Working Paper (WP/99/162).

Chaudhry, M., Chatrath, A., & Kamath, R. (1996). The cointegration experience of Eastern currencies: Evidence from the 1980s. Finance India, 10, 49-59.

Dickey, D. A & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of American Statistical Association, 74, 427-431.

Dickey, D. A. & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49, 1057-1072.

Engle, R. F. & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation, and testing. Econometrica, 55, 251-276.

Frankel, J. A. & Rose, A.K. (1988). The endogeneity of the optimum currency area criteria. Economic Journal, 108, 1009–1025.

Johansen, S. (1988). Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12, 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. Econometrica, 59, 1551-1580.

Johansen, S. & Juselius, K (1992). Testing structural hypotheses in a multivariate cointegration analysis of the PPP and the UIP for UK. Journal of Econometrics, 53, 211-244.

Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration, with applications to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Lee, C. & Azali, M. (2010). Currency linkages among ASEAN. Singapore Economic Review, 55, 459-470.

Lee, G.H.Y. & Azali, M. (2010). The endogeneity of the optimum currency area criteria in East Asia. Economic Modelling, 27, 165-170.

MacKinnon, J.G., Haug, A.A. & Michelis, L. (1999). Numerical distribution functions of likelihood ratio tests for cointegration. Journal of Applied Econometrics, 14, 563-577.

Park, J.Y. & Sung. J. (1994). Testing for unit roots in models with structural change. Econometric Theory, 44, 917-936.

Schwert, G.W. (1987). Effects of model specification tests for unit root in macroeconomic data. Journal of Monetary Economics, 20, 73-103.

Tse, Y. K & Ng, L. K. (1997). The cointegration of Asian currencies revisited. Japan and the World Economy, 9, 109-114.

Zhang, Z., Sato, K. & McAleer, M. (2004). Is a monetary union feasible for East Asia? Applied Economics, 36, 1031-1041.

Table 1: DF/ADF Unit Root Tests

	Level		First Difference	
Nominal Exchange Rate	constant	constant with trend	constant	constant with trend
Indonesia rupiah (ID)	-2.11 (12)	-2.16 (12)	-9.61 (11) [a]	-9.60 (11) [a]
Malaysia ringgit (MY)	-1.40 (0)	-1.96 (0)	-38.93 (0) [a]	-38.92 (0) [a]
Philippines peso (PH)	-1.98 (1)	-1.77 (1)	-34.97 (0) [a]	-34.98 (0) [a]
Singapore dollar (SG)	-0.87 (2)	-2.25 (2)	-28.06 (1) [a]	-28.05 (1) [a]
Thailand baht (TH)	-1.78 (11)	-2.67 (11)	-36.19 (0) [a]	-36.19 (0) [a]
China (CN)	-1.04 (9)	-0.48 (9)	-9.33 (12) [a]	-9.22 (12) [a]
Japan (JP)	-0.25 (1)	-3.32 (1)	-40.08 (0) [a]	-40.09 (0) [a]
Korea (KR)	-1.68 (0)	-2.03 (0)	-37.58 (0) [a]	-37.57 (0) [a]

Notes: The tests employ a null hypothesis of a unit root. Numbers in parenthesis are lag length. All series are log transformed. a and b denotes significance at 1% and 5% levels.

Table 2: Johansen-Juselius Likelihood Cointegration Tests for ASEAN+3

Null Hypotheses	Eigen value	Trace	Critical Value (1%)	Critical Value (5%)	Max-Eigen	Critical Value (1%)	Critical Value (5%)
(r = 0)	0.035901	169.9987[b]	171.09	159.53	51.07651	58.67	52.36
(r ≤ 1)	0.024221	118.9222	135.97	125.62	34.25289	52.31	46.23
(r ≤ 2)	0.019469	84.6693	104.96	95.75	27.46691	45.87	40.08
(r ≤ 3)	0.013600	57.2024	77.82	69.82	19.12985	39.37	33.88
(r ≤ 4)	0.013110	38.07255	54.68	47.86	18.43574	32.72	27.58
(r ≤ 5)	0.009722	19.63681	35.46	29.80	13.64845	25.86	21.13
(r ≤ 6)	0.003585	5.988365	19.94	15.49	5.016832	18.52	14.26
(r ≤ 7)	0.000695	0.971533	6.63	3.84	0.971533	6.63	3.84

Notes: r indicates the number of cointegrating vectors. Trace and Max-Eigen denote the trace statistic and maximum eigenvalue statistic. The critical values are obtained from MacKinnon-Haug-Michelis (1999). a and b denote rejection of the hypothesis at 1% and 5% critical values.

Table 3: Exclusion Restriction Tests for ASEAN+3

Nominal Exchange Rate	Likelihood Ratio (LR)
ID	12.698[a]
MY	4.301[b]
PH	3.343[c]
SG	1.420
TH	0.326
CN	2.948[c]
JP	3.063[c]
KR	10.497[a]

Notes: Figures are the likelihood ratio statistics (asymptotically distributed χ^2) for testing the null hypothesis that each coefficient is statistically equivalent to zero in single cointegrating vector. a, b, and c denotes significance at 1% , 5% and 10% levels, respectively.

Table 4: Johansen-Juselius Likelihood Cointegration Tests for First Remaining Asian Countries

Null Hypotheses	Eigen value	Trace	Critical Value (1%)	Critical Value (5%)	Max-Eigen	Critical Value (1%)	Critical Value (5%)
(r = 0)	0.03243	106.3946[a]	104.96	95.75	46.05138[a]	45.87	40.08
(r ≤ 1)	0.01593	60.34324	77.82	69.82	22.43391	39.37	33.88
(r ≤ 2)	0.01388	37.90933	54.68	47.86	19.51963	32.72	27.58
(r ≤ 3)	0.01036	18.38969	35.46	29.80	14.54919	25.86	21.13
(r ≤ 4)	0.00236	3.840508	19.94	15.49	3.303166	18.52	14.26
(r ≤ 5)	0.00039	0.537342	6.63	3.84	0.537342	6.63	3.84

Notes: r indicates the number of cointegrating vectors. Trace and Max-Eigen denote the trace statistic and maximum eigenvalue statistic. The critical values are obtained from MacKinnon-Haug-Michelis (1999). a and b denote rejection of the hypothesis at 1% and 5% critical values.

Table 5: Exclusion Restriction Tests for First Remaining Asian Countries

Nominal Exchange Rate	Likelihood Ratio (LR)
ID	18.348[a]
MY	2.200
PH	7.974[a]
CN	3.770[c]
JP	1.375
KR	18.348[a]

Notes: Figures are the likelihood ratio statistics (asymptotically distributed χ^2) for testing the null hypothesis that each coefficient is statistically equivalent to zero in single cointegrating vector. a, b, and c denotes significance at 1% , 5% and 10% levels, respectively.

Table 6: Johansen-Juselius Likelihood Cointegration Tests for Second Remaining Asian Countries

Null Hypotheses	Eigen value	Trace	Critical Value (1%)	Critical Value (5%)	Max-Eigen	Critical Value (1%)	Critical Value (5%)
(r = 0)	0.02225	58.17006[a]	54.68	47.86	31.42977[b]	32.72	27.58
(r ≤ 1)	0.01357	26.74029	35.46	29.80	19.08516	25.86	21.13
(r ≤ 2)	0.00362	7.655132	19.94	15.49	5.06804	18.52	14.26
(r ≤ 3)	0.00185	2.587092	6.63	3.84	2.587092	6.63	3.84

Notes: r indicates the number of cointegrating vectors. Trace and Max-Eigen denote the trace statistic and maximum eigenvalue statistic. The critical values are obtained from MacKinnon-Haug-Michelis (1999). a and b denote rejection of the hypothesis at 1% and 5% critical values.

Table 7: Exclusion Restriction Tests for Second Remaining Asian Countries

Nominal Exchange Rate	Likelihood Ratio (LR)
ID	12.258[a]
PH	7.529[a]
CN	11.306[a]
KR	12.338[a]

Notes: Figures are the likelihood ratio statistics (asymptotically distributed χ^2) for testing the null hypothesis that each coefficient is statistically equivalent to zero in single cointegrating vector. a, b, and c denotes significance at 1% , 5% and 10% levels, respectively.

Table 8: Granger Causality Results based on VECM

Dependent Variable	Independent Variable χ^2-statistic				
	PH	KR	ID	CN	ECT
PH	-	161.998[a]	130.828[a]	3.945[b]	-0.002
KR	1.918	-	7.062[a]	3.608[c]	0.020[a]
ID	0.004	0.603	-	0.471	-0.012[a]
CN	0.411	0.383	1.145	-	0.000

Note: χ^2-statistic tests the joint significance of the lagged values of the independent variables, and t-statistic tests the significance of the error-correction term (ECT). a and b denotes significance at 1% and 5% levels.

Figure 1: Short-run Causal Relationships