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AN ANALYSIS ON THE CORRELATION BETWEEN RMB EXCHANGE RATE FLUCTUATION AND EAST ASIAN EXCHANGE RATE FLUCTUATIONS

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ABSTRACT

Before 2005 July 21st, RMB exchange rate was pegged to US Dollar and adopted a fixed exchange rate. The correlation between RMB exchange rate and exchange rates of other East Asian economies was not significant. Empirical findings indicated that since Mainland China changed its exchange rate regime to a basket of currencies on July 22nd, 2005, in addition to the insignificant correlation between RMB exchange rate and exchange rates of Hong Kong, Malaysia, Thailand, and Indonesia duration the certain period, the correlation between exchange rate fluctuations of RMB and other East Asian economies is significantly related. This shows that the exchange rate regime of East Asian economies is mostly pegged to a basket of currencies. In order to avoid effects of exchange rate fluctuations from other countries on trade interests, exchange rate fluctuations of East Asian economies have a clear regional linkage. However, Mainland China's exchange rate policy is gradually becoming more open, causing RMB exchange rate fluctuations to become an important reference for overall exchange rate structure in East Asia. RMB internationalization will continue in the future, cross-border trade with RMB settlement increasing, and RMB offshore market size will also expand. And currently Mainland China is leading East Asian economic and trade integration; hence RMB exchange rate fluctuations will have a significant impact on exchange rate fluctuations of other East Asian economies in the foreseeable future.

Contribution/ Originality: This study is one of very few studies which have investigated and found that after PRC started RMB exchange rate reform in 2005, RMB has become an important international currency in East Asia. Hence RMB exchange rate fluctuations have a significant impact on exchange rate fluctuations of East Asia.

1. INTRODUCTION

Before 1999, the exchange rate regime of East Asian economies was mainly pegged to US Dollar. However, because US Dollar, Euro, and Japanese Yen are 3 main international currencies today, and the United States, European Union, and Japan are also main trading partners of East Asian economies, hence, exchange rate fluctuations of these 3 international currencies will also cause exchange rate fluctuations in East Asia. After the global financial tsunami in 2008, US Dollar fell behind in the international currency system. Following, the

subsequent European debt crisis and the global stock market crash in August 2015 caused by RMB depreciation further increased the degree of exchange rate fluctuations of East Asian economies. The interaction effects between each other also increase the degree of instability of the foreign exchange markets in this region. Because economic activities of emerging economies in East Asia are dominated by foreign trade, they are also more sensitive to exchange rate fluctuations. In recent years, due to close interactions for cross-border trades, investments, finances, and the development of regional economic integration, East Asian economies have increased their demand for non-dollar currencies. Since the start of RMB exchange rate reform from July 22, 2005, as well as the accelerating internationalization of RMB, the use of RMB gradually has been expanded for cross-border trades and investments. In addition, Mainland China has become the world's second largest economy, and RMB was formally incorporated into the SDR of IMF on October 1st, 2016. This made the use of RMB more popular in East Asia, and its exchange rate fluctuations have a more significant impact on exchange rate fluctuations of other East Asian economies. Fankel and Wei (2008) observed that after the RMB exchange rate reform in July 2005, US Dollar weight of a basket of currencies in East Asian economies showed a significant downward trend, thus increasing the weight of non-dollar currencies. For example, Malaysia and Thailand's currency baskets increase the ratio of Singapore dollar. And RMB, Hong Kong Dollar, Malaysian Ringgit, Korean Won and other currencies have increased relative reference weight. Therefore, it is necessary to explore the relationship between the degree of exchange rate fluctuations of economies in certain region, from both a global and regional perspective. With regard to empirical studies on the relationship between exchange rate fluctuations of different currencies, mostly focus on major international currencies. For example, Kühl (2008) discussed the relationship between US Dollar, GBP, and Euro after the birth of the Euro in 1990. There are few empirical studies on the correlation between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies. The Asian Development Bank conducted an empirical research on the correlation between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies. However, ADB mainly uses the start of RMB exchange rate reform on July 22, 2005 as a separation point to investigate the relation between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies. It does not investigate the relation between significant structural changes at each stage of RMB exchange rate movements and exchange rate fluctuations of other East Asian economies after RMB exchange rate reform on July 2005.This paper analyzes the relationship between each stage of RMB exchange rate structure fluctuations and exchange rate fluctuations of other East Asian economies. It uses daily data for empirical analysis of each stage to investigate relation between RMB exchange rate fluctuations and exchange rate fluctuations of Korean Won, Hong Kong Dollar, Singapore Dollar, Vietnamese Dong, Philippine Peso, Thai Baht, Indonesian Rupiah, and Malaysian Ringgit. In addition, the impacts of gradual expansion of total RMB international income and expenses, easing RMB exchange rate restrictions in mainland China, and international financial market fluctuations, on exchange rate fluctuations in East Asian economies are also investigated.

This paper is divided into 5 sections. Section 1 is the introduction, which explains the background, the purpose and motive of this research. Section 2 is an overview on previous related literatures, which reviews the relationship between exchange rate fluctuations of different countries. Section 3 includes data source and basic descriptive statistics analysis to explain the choice of variables and data sources. Section 4 is empirical results and analyses, which explains the empirical method, empirical results, and implied characteristics. Section 5 is the conclusion.

2. LITERATURE REVIEWS

The difference of exchange rate regime in East Asian economies is limited. Kawai (2002) pointed out that Japanese Yen in the 1900s played an important role in the regional monetary system. However, US Dollar has long been the most important international currency in this region. Mainland China controls capital accounts and

intervenes on RMB exchange rate, which results in a less significant link between RMB exchange rate fluctuations and exchange rate fluctuations of other currencies.

The evolution of the exchange rate formation regime in East Asian economies mainly started after the Asian financial turmoil in 1997. Most of East Asian economies were concentrated in the managed floating exchange rate regime or pegged to US Dollar exchange rate. However McKinnon (2005) indicated that due to "fear of floating", East Asian region that have once been impacted by the Asian financial turmoil, resumed to peg to US Dollar exchange rate regime after the turmoil was over. Ito (2008) thought that in recent years, Mainland China has been gradually promoting financial reform and opening it's financial market, and RMB has become an important international currency in East Asia. Frankel and Wei (1994) used 1979 to 1992 as research period and conducted an empirical analysis on the relation between exchange rate fluctuations of East Asian economies and exchange rate fluctuations of US Dollar and Japanese Yen, and used this to explore exchange rate reform policies in Mainland China, Hong Kong, Korea, Taiwan, Philippines, Indonesia, Malaysia, Thailand, Singapore, and other East Asian economies. Empirical results indicated that US Dollar exchange rate fluctuations demonstrate a positive correlation to exchange rate fluctuations of East Asian economies; while Japanese Yen shows a significant effect with exchange rate fluctuations of Singapore Dollar and other minor currencies. This indicated that exchange rate policies of East Asian economies were mainly pegged to US Dollar.

Yu and Su (2009) used July 2005 to December 2008 as research period and conducted empirical analyses on the relationship between exchange rate fluctuations of main international currencies and East Asian economies. The main empirical results include: (1) East Asian economies commonly increase non-dollar currencies in a basket of currencies; (2) Except Korea, Singapore, and Philippines that have greater exchange rate fluctuations, other East Asian economies have smaller exchange rate fluctuations; (3) Exchange rate fluctuations of East Asian economies have a significant regional linkage. Kawai (2007) used January 1990 to April 2006 as research period for regression analysis. The exchange rate fluctuations of US Dollar, Japanese Yen, and Euro serve as explanatory variables, and exchange rate fluctuations of Hong Kong Dollar, Korean Won, Singapore Dollar, New Taiwanese Dollar, Indonesia Rupiah, Malaysian Ringgit, Philippine Peso, Thai Baht, RMB, Myanmar Kyat, and Vietnamese Dong serve as response variables. Empirical results indicated that US Dollar exchange rate fluctuations are positively related to exchange rate fluctuations of East Asian economies. The correlation between the exchange rate fluctuations of Japanese Yen and other East Asian economies is lower, and Euro is the least significant. The main reason is because the main international transaction currency in East Asia is US Dollar, and their exchange rate policies are based on pegging to US Dollar. Therefore, US Dollar is more significant correlation with East Asian currencies. The Japanese Yen is one of the major international currencies in East Asia with geographic advantage, and has closer financial relations with other East Asian economies. Thus, the correlation between Japanese Yen exchange rate fluctuations and exchange rate fluctuations of other East Asian economies is second highest after US Dollar. With regard to Euro, because of its relatively low circulation in East Asia, it has a weak significant relationship with exchange rate fluctuations of East Asian economies.

Huang *et al.* (2008) used January 1999 to June 2013 as research period, and used exchange rate fluctuations of 7 Asian economies, including Hong Kong Dollar, Indonesian Rupiah, Indian Rupee, Korean Won, Malaysian Ringgit, Singapore Dollar, and Thai Baht as response variables, US Dollar, Euro, Japanese Yen, and RMB used as explanatory variables. Empirical results indicated that before Mainland China started RMB exchange rate reform on July 21, 2005, US Dollar exchange rate fluctuations are positively correlated with exchange rate fluctuations of East Asian economies. Although RMB exchange rate has a positive correlation with these currencies' exchange rate, it is not significant. However, after RMB exchange rate reform on July 22, 2005, not only exchange rate fluctuations of East Asian economies show positive correlation with US Dollar exchange rate fluctuations, but also show significant positive correlation with RMB.

Ogawa (2002) validated the impact of exchange rate fluctuations on trade in East Asian countries. As long as

an economy of East Asia adopts pegging to US Dollar for exchange rate policy, other economies will also consider pegging to US Dollar, in order to eliminate trade losses. This has caused exchange rate policies of East Asian economies to orient towards pegging to US Dollar.

3. Data Source and Basic Descriptive Statistics Analysis

This paper aims to explore the relation between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies. The research period is from the start of RMB exchange rate reform in Mainland China on July 22, 2005 to December 31, 2016. Research subjects are exchange rate fluctuations of RMB, Korean Won, Hong Kong Dollar, Singapore Dollar, Thai Baht, Malaysian Ringgit, Philippine Peso, Indonesian Rupiah, and Vietnamese Dong. As these economies are important economies in East Asia, hence exchange rate changes will affect the international trade situation and financial market stability in this region. In addition, US Dollar, Euro, and Japanese Yen are selected as exogenous variables. The exchange rate of each currency is retrieved from International Financial Statistics, and the currency is converted into US Dollar to show daily data. US Dollar is based on the US Dollar daily index data also from International Financial Statistics.

Table 1 shows descriptive statistics analysis of exchange rate fluctuations of RMB, Korean Won, Hong Kong Dollar, Singapore Dollar, Indonesian Rupiah, Thai Baht, Malaysian Ringgit, Philippine Peso, and Vietnamese Dong to observe their standard deviation. Except for Indonesian Rupiah and Vietnamese Dong that have greater exchange rate fluctuations, other currencies' exchange rate fluctuations are less. With respect to coefficient of skewness, except for Vietnamese Dong that is negative, the rest are positive.

Table-1. Descriptive Statistics Analysis (from 2005/7/22 to 2016/12/31)

PANEL A					
	RMB	**Korean Won**	**Hong Kong Dollar**	**Singapore Dollar**	
Average	1.9120	6.9954	2.0499	0.3221	
Median	1.8966	7.0090	2.0488	0.3152	
Maximum Value	2.0934	7.359	2.0579	0.5327	
Minimum Value	1.7986	6.8032	2.0476	0.1830	
Standard Deviation	0.0877	0.0987	0.0024	0.0887	
Skewness	0.7829	0.2994	1.2169	0.4741	
Number of Observations	2,860	2,860	2,860	2,860	
PANEL B					
	Indonesia Rupiah	Philippine Peso	Thailand Baht	Malaysia Ringgit	Vietnam Dong
Average	9.2372	3.8225	3.5112	1.2329	9.8813
Median	9.1678	3.8086	3.5014	1.2174	9.9449
Maximum Value	9.5946	4.0311	3.7350	1.5010	10.034
Minimum Value	9.0437	3.6973	3.3557	1.0787	9.6684
Standard Deviation	0.1507	0.0722	0.0798	0.0994	0.1155
Skewness	0.7678	0.7205	0.6445	0.7305	-0.6213
Observations	2,860	2,860	2,860	2,860	2,540

Source: International Financial Statistics and this study.

4. EMPIRICAL METHOD AND RESULT ANALYSES

4.1. Empirical Method

This paper mainly uses the empirical structure of Frankel and Wei (1994); Huang *et al.* (2008) whereby exchange rate fluctuations of RMB against US Dollar serve as the explanatory variable, together with US Dollar, Euro, and Japanese Yen as exogenous variables, exchange rate fluctuations of Korean Won, Hong Kong Dollar, Singapore Dollar, Indonesian Rupiah, Thai Baht, Malaysian Ringgit, Philippine Peso, Vietnamese Dong against US Dollar used as response variables. After getting natural logarithm of all variables, OLS is used for regression analysis to investigate the relationship between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies. These variables are as follows:

Response Variable Y (Korean Won, Hong Kong Dollar, Singapore Dollar, Malaysian Ringgit, Indonesian

Rupiah, Philippine Peso, Thai Baht, Vietnamese Dong)

Explanatory Variable X: X1 - US Dollar Index; X2 - Japanese Yen; X3 - Euro; X4 - RMB.

Huang *et al.* (2008) conducted an empirical analysis on the relationship between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies before RMB exchange rate reform on July 21, 2005. Results indicated that because RMB exchange rate is pegged to US Dollar and implements a single fixed exchange rate, RMB exchange rate against US Dollar remains at 1 US Dollar to 8.27 RMB at most, and receives insignificant correlation results. Therefore, this paper will not repeat this part of the discussion. With respect to RMB exchange rate reform after July 22, 2005, empirical results showed that the relationship between RMB exchange rate fluctuations and exchange rate fluctuations of other East Asian economies is significant positive correlation, but obvious fluctuations in each stage of RMB exchange rate structure is not analyzed. Therefore, this article analyzes several obvious structural fluctuations of RMB exchange rate after RMB exchange rate reform on July 22, 2005.The empirical period starts from July 22, 2005, after the start of RMB exchange rate reform in Mainland China, to December 31, 2016. In order to take into account the various stages of RMB exchange rate reform, as well as the various periods before and after the global tsunami that caused major changes to RMB exchange rate structure, the empirical period is divided into 4 stages. Stage 1 is from July 22, 2005 to September 19, 2008, after the start of RMB exchange rate reform in Mainland China to the break out of global financial tsunami, before Mainland China restored RMB exchange rate to peg to US Dollar. Stage 2 is from September 20, 2008 to June 18, 2010, where Mainland China returned to peg to the US Dollar exchange rate to the global financial tsunami, before RMB managed floating exchange rate regime was restored. Stage 3 is from June 19, 2010 to August 10, 2015, where Mainland China restored RMB managed floating exchange rate regime to before the depreciation of RMB to reduce the exchange rate gap between onshore and offshore exchange rates. Stage 4 is from December 18, 2015 to December 31, 2016, where Mainland China allowed RMB depreciation.

4. 2. Empirical Results and Analyses

Stage-1

From July 22, 2005, after the start of RMB exchange rate reform in Mainland China to September 19, 2008, before Mainland China restored RMB exchange rate to peg to US Dollar due to the break out of global financial tsunami. During this period, the US Dollar index turned from rising to gradual declination after February 2006. However, because the market believed that RMB exchange rate has been underestimated in the long term, coupled with sustained economic growth in Mainland China, after abandoning fixed exchange rate and changing to floating exchange rate management, RMB showed a steady and one-way appreciating trend. From empirical results in Table 2, Hong Kong continued to adopt a linked exchange rate system to peg to US Dollar in this period, and maintained a single fixed exchange rate mechanism. Malaysian Ringgit, on the other hand, implemented managed floating exchange rate regime. In order to stabilize its financial market, at the beginning, exchange rate fluctuations of Ringgit were very low. Hence RMB exchange rate fluctuations have a insignificant negative correlation with exchange rate fluctuations of Hong Kong Dollar and Malaysian Ringgit, and with exchange rate fluctuations of other East Asian economies is significant. However, Korean Won, Indonesian Rupiah, and Vietnamese Dong faced depreciation same as the US Dollar index, thus they show a significant negative correlation with RMB exchange rate fluctuations. In order to increase foreign trade export competitiveness of Korea, especially in the intimate trade relation with Mainland China, Korean Won depreciation is greater than the US Dollar index, causing the association with RMB exchange rate fluctuations to be the highest. Thai Baht and Singapore Dollar exchange rates against US Dollar show appreciating trend, and have significant positive correlation with RMB exchange rate fluctuations.

Table-2. Correlation between Exchange Rate Fluctuations (2005/7/22 to 2008/9/19)

Y\X	Constant	USD Index	Japanese yen	Euro	RMB
Korean Won	3.8881*** (0.996)	2.0518*** (0.2029)	-0.7571*** (0.0234)	-0.5894*** (0.1848)	-1.3015*** (0.0604)
Hong Kong Dollar	1.3530*** (0.0796)	0.1143*** (0.0162)	0.0363*** (0.0018)	-0.1201*** (0.0147)	-0.0061 (0.0048)
Singapore Dollar	2.5216*** (0.5061)	-0.4230*** (0.1030)	-0.0661*** (0.0119)	0.9751*** (0.0938)	0.1805*** (0.0306)
Malaysian Ringgit	2.1739*** (0.5929)	-0.0047 (0.1206)	-0.1401*** (0.0139)	0.6683*** (0.1099)	-0.0185 (0.0335)
Philippine Peso	-10.5145*** (1.4747)	3.4922*** (0.3002)	-0.6081*** (0.0347)	-1.9949*** (0.2734)	0.6319*** (0.0894)
Thai Baht	0.5553 (1.0053)	1.2268*** (0.2046)	-0.5524*** (0.0236)	-0.0096 (0.1864)	0.1147* (0.0609)
Indonesian Rupiah	16.0329*** (1.2211)	-0.8287*** (0.2485)	-0.4446*** (0.0287)	1.2018*** (0.2264)	-0.3856*** (0.0740)
Vi□tnamese Dong	7.5674*** (0.3864)	0.4831*** (0.0782)	0.1582*** (0.0145)	-0.3243*** (0.0717)	-0.4236*** (0.0244)

Note: *, **, *** indicates significant levels at 10%, 5%, and 1% respectively

Stage-2

From September 22, 2008, where Mainland China increased the weight of non-dollar currencies in a basket of currencies in response to global financial tsunami and suspended managed floating exchange rate regime, until June 18, 2010, the short break away from global financial tsunami and before resuming managed floating exchange rate regime. During this period, RMB exchange rate was mainly pegged to US Dollar, and remained at the standard of 1 US Dollar to 6.82 RMB. Empirical results in Table 3 show that because the United States implemented QE currency policy in this period, large amounts of US Dollar was released into the market. This caused to decline to the US Dollar index, which relatively caused the appreciation of main currencies in East Asia. In order to reduce the impact of global financial tsunami on financial markets of East Asian economies, RMB and other non-dollar weights in the currency basket were increased. Reference weight between each currency in East Asian economies also increased as well. The exchange amount for RMB in this region also increased.

Table-3. Correlation between Exchange Rate Fluctuations (2008/9/22 to 2010/6/18)

Y\X	Constant	USD Index	Japanese yen	Euro	RMB
Korean Won	-37.2295*** (3.2645)	3.6011*** (0.1722)	0.5919 (0.0566)	-2.2602*** (0.1376)	14.3312*** (1.7965)
Hon□ Kong Dollar	2.5505*** (0.0693)	-0.0609*** (0.0036)	-0.0012 (0.0012)	0.0632*** (0.0029)	-0.1083*** (0.0381)
Singapore Dollar	-15.2341*** (1.1191)	1.4659*** (0.0590)	0.1352*** (0.0194)	-0.9480*** (0.0471)	4.2879*** (0.6158)
Malays□an Ringgit	-18.2747*** (1.6937)	1.7622*** (0.0893)	0.1078*** (0.0293)	-1.3920*** (0.0713)	5.6406*** (0.9320)
Philippine Peso	-10.0952*** (1.4785)	0.7651*** (0.0780)	0.1345*** (0.0256)	-0.6248*** (0.6232)	5.0880*** (0.8136)
Thai Baht	-13.1418*** (1.1018)	1.6020*** (0.0581)	0.1300*** (0.0191)	-1.2153*** (0.0464)	4.4997*** (0.6063)
Indones□an Rupiah	-32.0548*** (3.1739)	4.7687*** (0.1674)	-0.1073* (0.0550)	-3.3074*** (0.1337)	10.2734*** (1.7466)
Vietnamese Dong	34.7118*** (1.9352)	-1.1000*** (0.1021)	-0.3610*** (0.0335)	1.0071*** (0.0815)	-9.4315*** (1.0650)

Source: This study.

In addition to Hong Kong Dollar and Vietnamese Dong, RMB exchange rate fluctuations show significant positive correlation with exchange rate fluctuations of other East Asian economies. South Korea and Mainland China has close trade relations, and the appreciation of Korean Won exchange rate is also greater, hence, its correlation with RMB exchange rate fluctuations is more significant. As for Hong Kong Dollar and Vietnamese Dong, because Hong Kong Dollar is still pegged to US Dollar and adopts a single fixed exchange rate regime, its exchange rate is simultaneous with US Dollar depreciation, thus it shows a significant negative correlation with RMB exchange rate fluctuations. The Vietnamese Dong, on the other hand, increased financial risks and severe inflation at the time, and caused Vietnamese Dong depreciation. This results in a significant negative correlation between RMB exchange rate fluctuations and Vietnamese Dong exchange rate fluctuations.

Stage-3

From June 19, 2010, where Mainland China restored RMB managed floating exchange rate regime due to the gradual slow-down of the global financial tsunami, until August 10, 2015 the depreciation of RMB to reduce the exchange rate gap between on shore and offshore exchange rates. During this period, due to the slow-down of the global financial tsunami, the US Dollar index gradually picked up since the second quarter of 2011. RMB exchange rate showed a stable and rapid appreciating trend. Empirical results in Table 4 indicate that the relationship between RBM exchange rate fluctuations and exchange rate fluctuations of other East Asian economies, other than insignificant correlation with Thai Baht, shows a significant correlation. Korean Won, Hong Kong Dollar, Malaysian Ringgit, and Philippine Peso simultaneously appreciate with the US Dollar index and RMB, and show a positive correlation with RMB exchange rate fluctuations. The severe inflation of Indonesia and Vietnam brought about their capital outflow and currency depreciation.

Table-4. Correlation between Exchange Rate Fluctuations (2010/6/21 to 2015/8/10)

Y\X	Constant	USD Index	Japanese yen	Euro	RMB
Korean Won	0.9924** (0.4249)	1.6201*** (0.1159)	-0.4133*** (0.0208)	-0.7757*** (0.0829)	0.29213*** (0.0308)
Hong Kong Dollar	1.8615*** (0.2252)	0.0398*** (0.0061)	-0.0082*** (0.0011)	-0.0341*** (0.0043)	0.0219*** (0.0016)
Singapore Dollar	-6.8515*** (0.2390)	1.4089*** (0.0652)	-0.1127*** (0.0117)	-0.7570*** (0.0466)	0.6484*** (0.0173)
Malaysian Ringgit	-4.3317*** (0.4103)	1.1489*** (0.1119)	0.0455** (0.0201)	-0.4264*** (0.0801)	0.0609** (0.0298)
Philippine Peso	-1.9747*** (0.3805)	1.0312*** (0.1038)	0.0088 (0.0186)	-0.7922*** (0.0742)	0.5158*** (0.0276)
Thai Baht	2.3078*** (0.4516)	0.1528 (0.1231)	0.1084*** (0.0221)	0.0391 (0.0881)	-0.0087 (0.0328)
Indonesian Rupiah	10.7401*** (0.7850)	-0.6980*** (0.2141)	0.8132*** (0.0384)	0.7168*** (0.1532)	-1.0431*** (0.0670)
Vietnamese Dong	12.2297*** (0.2764)	-0.1737** (0.0754)	0.0172 (0.0135)	0.2172*** (0.0539)	-0.8358*** (0.0200)

Source: This study.

With respect to the Thai Baht, Thailand faced UDD and PAD opposition forces causing constant resistance waves, coupled with the encounter of century big flood, causing political, economic, and social turmoil. Under the increase of uncertain factors, Thai Baht exchange rate fluctuations are more significant, and show a insignificant correlation with RMB exchange rate fluctuations.

Stage-4

From August 11, 2015 where Mainland China allowed RMB depreciation in order to reduce RMB exchange rate gaps between onshore and offshore exchange rates until December 31, 2016. During this period, US Dollar

index showed a rising trend because of US economic recovery and US Dollar interest rate appreciation. However, RMB continued to demonstrate a depreciating trend since August 11, 2015. RMB is the world's 7th largest reserve currency, and its circulation in East Asia is more and more. Empirical results in Table 5 indicate that, other than Indonesia, RMB exchange rate fluctuations show a positive correlation with exchange rate fluctuations of other East Asian economies. Moreover, the correlation coefficient does not show a big difference. With respect to Indonesian Rupiah, in order to boost economy, Indonesia consecutively cut interest rates 5 times in 2016. This caused exchange rate market to be more unstable, exacerbating Indonesian capital outflow or turning to international currencies with more stable exchange rates. Due to the substantial depreciation trend of RMB, it is difficult for RMB assets to become safe-haven subjects, thereby reducing the exchange between the two currencies, resulting in the insignificant correlation between exchange rate fluctuations of RMB and Indonesian Rupiah.

Table-5. Correlation between Exchange Rate Fluctuations (2015/8/112 to 2016/12/31)

Y\X	Constant	USD Index	Japanese ye□	Euro	RMB
Korean Won	5.5351*** (0.7925)	-0.4079** (0.2017)	0.4389*** (0.0393)	-0.0224 (0.1728)	0.6984*** (0.1115)
Hong Kong Dollar	1.9932*** (0.0500)	-0.0014 (0.0127)	0.0045* (0.0024)	-0.0089 (0.0109)	0.0212*** (0.0070)
Singapore Dollar	-4.9274*** (0.4422)	0.8459*** (0.1125)	0.3600*** (0.0219)	-0.4541*** (0.0964)	0.3727*** (0.0622)
Malaysian Ringgit	-6.0434*** (0.7611)	1.1914*** (0.1937)	0.2802*** (0.0377)	-0.4685*** (0.1660)	0.3471*** (0.1071)
Philippine Peso	-0.6083** (0.3070)	0.6738*** (0.0781)	0.0529*** (0.0152)	-0.3193*** (0.0669)	0.5842*** (0.0432)
Thai Baht	2.4871*** (0.2757)	0.0362 (0.0702)	0.1666*** (0.0136)	0.0216 (0.0601)	0.0694* (0.0388)
Indonesian Rupiah	7.2436*** (0.6372)	0.0803 (0.1622)	0.3715*** (0.0316)	-0.3621*** (0.1390)	0.0570 (0.0897)
Vietnamese Dong	9.5202*** (0.1503)	-0.0524 (0.0383)	0.0777*** (0.0075)	0.0343 (0.0328)	0.1978*** (0.0213)

Source: This study.

4.3. Empirical Implications

This empirical study shows that since Mainland China started exchange rate reform from July 22, 2005 to December 31, 2016, RMB exchange rate fluctuations mostly show a significant correlation with exchange rate fluctuations of other East Asian economies. This matches the results of Huang *et al.* (2008). However, analyses of RMB exchange rate structure change in each stage show that RMB exchange rate fluctuations from July 22, 2005 to September 19, 2008 is insignificant to exchange rate fluctuations of Hong Kong Dollar and Malaysian Riggit; from June 21, 2010 to August 10, 2015, it is insignificant to exchange rate fluctuations of Thai Baht; from August 11, 2015 to December 31, 2016, it is insignificant to exchange rate fluctuations of Indonesian Rupiah. These results are quite similar to the characteristics of exchange rate fluctuations of East Asian economies proposed by Yu and Su (2009).

(1) In July 2005, after Mainland China started RMB exchange rate reform, RMB internationalization was aggressively promoted, which gradually liberalized RMB exchange rate, causing a gradual trend of appreciation in RMB. In addition, Mainland China is one of the major exporting regions in East Asian countries. After the global financial tsunami in 2008, each East Asian economy increased the weight of relatively stable exchange rates from RMB and other non-dollar basket currencies, thereby enhancing the acceptance of RMB in each economy in the region, resulting in tight exchange rate linkage between RMB and other East Asian currencies.

(2) Since July 2005, except for big exchange rate fluctuations of Indonesian Rupiah, exchange rate fluctuations of

other East Asian economies are lower. This means that maintaining currency stability of East Asian economy is the exchange rate policy objective. Although RMB exchange rate showed gradual appreciation from July 2005 to August 2015, the exchange rate is relatively stable compare to other currencies. This caused, to a certain extent, East Asian economies to reference RMB exchange rate fluctuations when adjusting their exchange rate structure.

(3) After 2005, the exchange rate regime of East Asian economies moved towards a basket of currencies and exchange rate in this region showed simultaneous appreciation or depreciation trend. This means that the exchange rate reform regime trend is similar. In view that Mainland China is an important and competitive country to other East Asian countries for trade exports, to avoid trade interest losses caused by big RMB exchange rate fluctuations, exchange rate fluctuations of East Asian economies will change accordingly to RMB exchange rate fluctuations, and when RMB exchange rate is stable, their exchange rate will be stable as well (according to Nash's the equilibrium theory). This shows that after gradually shifting to a basket of currencies in the exchange rate policies of East Asian economies in 2005, it fully reflects the regional linkage of exchange rate fluctuations, causing the exchange rate policies of economies within the region to be more consistent.

(4) After the global financial tsunami in 2008, the exchange rate policy of East Asian economies moved towards pegging to a basket of currencies. In face of changes of exchange rate structure of US Dollar, Euro, and Japanese Yen, each economy in this region tends to take initiative to change their exchange rate. In recent years, East Asian economies have grown steadily, and the current account balance has increased. However, Mainland China's RMB exchange rate is moving towards more open, and aggressively promoting cross-border trade and investment with RMB settlement, has caused a significant impact on the exchange rate fluctuations in East Asian economies.

5. CONCLUSION

For a long time, exchange rates of East Asian economies mostly have been pegged to US Dollar. US Dollar exchange rate fluctuations have significantly affected exchange rate fluctuations in East Asia. The empirical results of this paper and Huang *et al.* (2008) indicate that RMB exchange rate was pegged to US Dollar exchange rate before July 21, 2005 and adopted a single fixed exchange rate. Together with RMB exchange rate liberalization insufficiency, RMB exchange rate fluctuations are insignificant to exchange rate fluctuations of East Asian economies. On July 22, 2005, Mainland China started RMB exchange reform, and aggressively promoted the internationalization of RMB, gradually relaxing RMB exchange rate liberalization restrictions. RMB exchange rate fluctuations show significant correlation with exchange rate fluctuations of East Asian economies. This paper explores the various stages where RMB exchange rate structure shows big fluctuations, and carries empirical analysis on their relationship with exchange rate fluctuations of East Asian economies after RMB exchange rate reform. In the first stage (from 2005/7/22 to 2008/9/19), Hong Kong dollar was still pegged to US Dollar and implemented a single fixed exchange rate, and Malaysian Riggit changed to peg to a basket of currencies with smaller exchange rate fluctuations. In the third stage (from 2010/6/21 to 2015/8/10), political instability and raging floods caused extreme instability to the Thai Baht. In the fourth stage (from 2015/8/11 to 2016/12/31), 5 consecutive interest rate cuts caused Indonesian capital outflow and the depreciation of the Indonesian Rupiah, resulting in insignificant correlation with RMB exchange rate fluctuations.

Overall, in views of the above 4 stages, the relationship between RMB exchange rate fluctuations and exchange rate fluctuations of East Asian economies is mostly positively correlated, except for a few currencies within a certain period. This indicates that the exchange rate regime of East Asian economies is moving towards a basket of currencies and increasing the weight of non-dollar currencies. In order to avoid the effects of big exchange rate fluctuations from other countries on trade interests or currency market stability, the exchange rate

of each economy in this region shows simultaneous fluctuation trend, and has a clear regional linkage. In addition, Mainland China's RMB exchange rate regime is gradually moving towards a more open path, and aggressive promotion of RMB settlement policies for cross-border trade and investment, RMB will become more active in East Asia. This causes, to a certain extent, East Asian economies to reference RMB exchange rate fluctuations when adjusting their exchange rate structure.

Currently, RMB is important in the East Asian currency system. RMB internationalization will continue in the future, and cross-border RMB settlement will continue to grow. RMB offshore market size will also expand. In addition, Mainland China is currently constructing the FTA system in East Asian region. Under this situation, RMB circulation in East Asian region will be more extensive. In the foreseeable future, the impact of RMB exchange rate fluctuations on the exchange rate fluctuations of East Asian economies will be more significant.

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