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Defects of East Asia as an OCA

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Abstract

After the 1997 Asian crisis, the necessity of adopting common currency in East Asia
has discussed. However, the majority of economists showed skepticism about the possibility
of East Asian common currency. This report aims to show the insufficiency of East Asia as an
optimal currency area in economic and non-economic perspective. Economic analysis would
be the main content. The comparative analysis between ASEAN+3 and Eurozone would be
implemented in various criteria of the optimal currency area, such as symmetric shock, labor
mobility, the similarity of economic structure, convergence and similarity in the business cycle,
and risk sharing. Adding to these, non-economic obstacles of East Asian common currency
would be addressed in aspect the political and cultural situation of East Asia.

Contents

List of Graphs and Tables

Cambodia, China, Indonesia, Japan, Korea, Laos

Malaysia, Philippines, Singapore, Thailand, Vietnam

1. Introduction

The financial crisis triggered in the East and Southeast Asia in 1997 has imprinted the possible dangerousness of their monetary system.[1] Most East Asian countries used the pegged exchange rate to the U.S dollar to achieve price stability. However, it has mentioned as a cause of the crisis. Asian financial crisis showed the danger of pegged exchange rate in the open capital market (Bayoumi, Eichengreen, & Mauro, 2000). East Asian countries were enjoying rapid economic growth with encouraging export policy and huge short-term foreign-denominated debt before the crisis. When the speculative currency attack began, East Asia had no choice but gave up their peg. The domestic currency value declined dramatically than in the floating exchange rate, which made their debt huge (Mishkin, 1999). However, even the floating exchange rate regime was not a popular choice after the crisis. As East Asian countries were not economically mature enough, their fear for a potential adverse effect of the floating exchange rate was enormous (Rajan, 2002).

In such a tough circumstance, adopting a common currency has emerged as a possible solution. Stable exchange rates against major currencies and ample foreign exchange reserve were necessary to avoid recurrence of a currency crisis. Adopting a common currency means the region exists as one huge monetary entity. Their currency can emerge as a major currency and would have a more stable exchange rate than individual currencies. Besides, as East Asian countries form big currency union, countries can aid each other to cope with foreign exchange reserve solvency and liquidity problem. Of course, there is still an actual danger of currency crisis as exchange rate exists between inside and outside of the region. However, as countries in the region are integrated more economically, regional solidarity and support for members having trouble are strengthened. Also, more elaborate monitoring and rigid discipline in the region takes a role as a preventive step for a possible financial crisis (Shimizutani, 2009).

Launching of the Euro, the European common currency, also raised interest in making common currency in East Asia (Bayoumi, et al., 2000). The actual introduction of the Euro in 1999, and the political and economical procedure to reach such level of integration acted as good precedent and motivation for East Asia.

Attempts for financial and monetary cooperation in East Asia begin in earnest from

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[1] Hereafter, region 'East Asia' would be used as a term including both East Asia and Southeast Asia.

1997. Japan proposed establishing the Asian Monetary Fund(AMF) to overcome the Asian financial crisis in September 1997. On December, the Association of Southeast Asian Nations(ASEAN) invited three other countries(China, Japan, and South Korea) to summit meeting and established 'ASEAN+3' which agreed on enhancing economic cooperation in the region.[2] In 2000, ASEAN+3 had decided on the Chiang Mai Initiative(CMI), which was the most significant step toward financial and monetary integration ever. Currency swap and repurchase agreement network enlarged between members to support and aid each other in the currency crisis.

There was some minor progress after CMI. For instance, in 2006, the Asian Development Bank(ADB) submitted a blueprint for the Asian Currency Unit(ACU). However, meaningful and visible progress to a common currency in East Asia has stopped after CMI, and countries do not take a positive attitude on making the common currency. This report aims to figure out obstacles in adopting common currency in East Asia. The research has focused on 13 countries of ASEAN+3.

Before the start of economic analysis, the Optimal Currency Area (OCA) theory would be introduced. The OCA theory, pioneered by Robert Mundell, is mainly used when discussing whether a region is sufficient to adopt the optimal currency. It describes optimal characteristics for taking a common currency in respect of possible benefits and cost of it.

The economic analysis focused on evaluating the sufficiency of East Asia as OCA. To check qualification to be an OCA, Eurozone was used as a benchmark. Eurozone is the most famous region that adopted a common currency since 1999. However, it should be kept in mind that, it is not entirely sufficient as an OCA even if such region performed same or better than Eurozone in OCA criteria evaluation. Eurozone itself is not OCA and still lags in most of the criteria when compared to the U.S where common currency exists.[3] Nevertheless, Eurozone is used as a reference point in many types of research to assess the sufficiency as an OCA. Performing better than Eurozone cannot guarantee whether East Asia is perfectly suitable as an OCA, but it is undoubtedly unsuitable if it performs worse than Eurozone. In this sense,

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[2] ASEAN is regional intergovernmental organization. Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam are members of ASEAN now.

[3] Eichengreen (1992) claimed that Europe is insufficient as an OCA compared to North America, before the Euro was made. Krugman (2013) claimed same opinion after Eurozone crisis.

comparison between East Asia and Eurozone would help to judge in what criterion East Asia is good and have defected to have a common currency.[4]

There are many criteria for determining which region is OCA. Of these, this paper used the four criteria that are most representatively discussed. The first criterion is the symmetric economic shock. According to Mundell (1961), the symmetric economic shock in the currency area is an important criterion. The analysis of symmetric shock was done mainly with the variability of the real exchange rate and security prices. It has motivated from the research of Eichengreen (1992), that accessed eligibility of Europe as an OCA compared to North America.

The second criterion is labor mobility. Mundell (1961) emphasized the importance of factor mobility as a criterion. Mainly, a considerable degree of labor mobility is necessary to be an OCA. To access labor mobility, the data of migrant and foreign labor force were used.

The third criterion is similarity of the business cycle and economic structure. It is an essential criterion in the sense that countries are affected by the regional monetary policy when common currency is adopted. The data of industrial structure was used to measure similarity of economic structure. For measuring similarity in business cycle, the standard deviations and correlations of real GDP growth rate and inflation were used.

The last criterion is risk sharing. Risk sharing has the role of preventative measure when negative economic shock happens. A typical way of risk-sharing in a currency area is regional fiscal policy, which can be realized in the U.S. However, as Eurozone and ASEAN+3 do not have a federal government, measurement of risk sharing were done by estimating consumer risk sharing.

Economic analysis is the main subject of this report. However, adopting a common currency is also related to non-economic factors. For this reason, political and cultural obstacles in the way of making common currency in East Asia also argued at the end.

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[4] 22 countries in Europe use Euro as their common currency now. However, in this report Monaco, San Marino, and Vatican City would be excluded in analysis as data of these countries are hard to collect. Excluding these countries would not affect the validity of analysis much as they are city states. Remaining 19 countries would be mainly used in our research. I tried to search data from all the 19 countries, but it was impossible for some analysis due to lack of time and ability. Through the report, when some countries are missed on the analysis, it would be described on the footnote.

2. OCA Theory

In Mundell's theory, OCA is an economic area composed of regions or countries where it is optimal to have a common currency. It is more optimal when the benefit of having a common currency is bigger than the cost.

There are many benefits other than preventing the currency crisis. The most straightforward benefit is a reduced currency transaction cost. The economic participant who wants to exchange can save the commission fee supposed to pay when using a different currency. The benefit of saving transaction cost is usually larger in small countries as they do plenty of transaction with foreign currency.[5] The second benefit is that trade and investment are enhanced between countries using the same currency. As the world is not perfect, the nominal exchange rate does not reflect all information on economic conditions correctly, and this can trigger inefficiency. Notably, international trade with countries using the same currency has increased three times in small countries (Frankel, & Rose, 2000). Furthermore, countries can prevent inflation, and political cohesion increases as they decide on monetary policy together.[6]

Nevertheless, adopting a common currency got some possible side effects. The most obvious cost is that countries must give up independent monetary policy and exchange rate policy. This cost is more severe in the short run that nominal rigidity exists. Change in the nominal exchange rate can alter the real exchange rate when price and wages are fixed, and countries can use this to solve imbalance of trade balance and unemployment. For example, when demand shift from Japanese goods to Chinese goods, wage and price in Japan should fall, otherwise unemployment would occur. However, price is rigid in the short run, and devaluation of Japanese Yen can mitigate the problem as it will move demand back to Japanese goods. However, it is not possible if Japan and China have a fixed exchange rate as they are using the same currency.[7]

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[5] It is predicted that transaction cost savings of large countries like France and Germany are about 0.1%~0.2% of GDP, but those for small countries are about 1% of their GD (European Commission, 1990).

[6] European countries which experienced high inflation owes their successful price stabilization in 1980 to implementation of European Monetary System(EMS). They pegged their currency to Deutsche Mark which kept stabilized because of the fear of hyperinflation before.

[7] It is same example described by Eichengreen (Eichengreen, 1992).

3. Economic Analysis on OCA Criteria

3.1. Symmetric Shock

Mundell emphasized labor mobility as an essential criterion. However, it can be interpreted in a way that symmetrical shock in the region is another important criterion of the OCA (Mundell, 1961). High labor mobility is a solution for the asymmetric shock when the exchange rate policy is unusable. If economic shock happens symmetrically on the region, there would be no change in relative price between countries. Therefore, both the exchange rate policy and high labor mobility would be unnecessary. In the example above, if demand on Japanese products and Chinese product rises the same, there would be steady state automatically without movement of labor force and exchange rate policy. To check whether East Asia is deficient as OCA in respect of symmetric shock, this report followed the analyzing method of Eichengreen (Eichengreen, 1992).

3.1.1. Real Exchange Rate Variability

The low real exchange rate variability means more symmetrical shock. The disturbance in relative price triggered by asymmetrical shock can change the real exchange rate. The change of the nominal exchange rate can solve it, but it is unfeasible in the currency area. In other words, the cost of losing an independent exchange rate policy is higher when the real exchange rate is more variable. Eichengreen compared the variability of the real exchange rate by using the Consumer Price Index(CPI) data (Eichengreen, 1992). Following this process, relative CPI in the Eurozone is compared with relative CPI in ASEAN+3, converted into Chinese Yuan by the period average market exchange rate. Germany was selected in Eurozone as a country to which the real exchange rate is compared, as Germany is the most economically influential country in the region. China was selected in East Asia for same reason. The annual data was collected from the year 1999 to 2017, and it had separated into 2 periods, to check whether regions are improving in the criterion (1999 - 2008, 2009 - 2017).   The coefficient of variation for the real exchange rate in each period were used to judge the variability of the real exchange rate. The result is in Table 1.

Table 1 : Summary Statistics of Regional Real Exchange Rates

Other Eurozone Members Against Germany (1999-2017)

Period 1 (1999 – 2008)		Period 2 (2009 – 2017)	
	Coefficient of Variation		Coefficient of Variation
Austria/Germany	0.011	Austria/Germany	0.015
Belgium/Germany	0.016	Belgium/Germany	0.013
Cyprus/Germany	0.035	Cyprus/Germany	0.034
Estonia/Germany	0.076	Estonia/Germany	0.024
Finland/Germany	0.010	Finland/Germany	0.008
France/Germany	0.008	France/Germany	0.008
Greece/Germany	0.048	Greece/Germany	0.033
Ireland/Germany	0.059	Ireland/Germany	0.018
Italy/Germany	0.021	Italy/Germany	0.008
Latvia/Germany	0.125	Latvia/Germany	0.009
Lithuania/Germany	0.040	Lithuania/Germany	0.012
Luxembourg/Germany	0.023	Luxembourg/Germany	0.010
Malta/Germany	0.023	Malta/Germany	0.005
Netherlands/Germany	0.019	Netherlands/Germany	0.008
Portugal/Germany	0.038	Portugal/Germany	0.009
Slovakia/Germany	0.110	Slovakia/Germany	0.012
Slovenia/Germany	0.093	Slovenia/Germany	0.008
Spain/Germany	0.045	Spain/Germany	0.010
Average	**0.044**	**Average**	**0.014**
Median	**0.037**	**Median**	**0.010**

Notes: For CPI year 2009=100, coefficient of variation is standard deviation divided by mean, the number is rounded to the third decimal point.
Source: World Bank Databank

Other East Asia Country Against China (1999-2017)

Period 1 (1999 – 2008)		Period 2 (2009 – 2017)	
	Coefficient of Variation		Coefficient of Variation
Brunei/China	0.047	Brunei/China	0.069
Cambodia/China	0.099	Cambodia/China	0.017
Indonesia/China	0.190	Indonesia/China	0.072
Malaysia/China	0.015	Malaysia/China	0.017
Myanmar/China	0.505	Myanmar/China	0.083
Philippines/China	0.071	Philippines/China	0.007
Laos/China	0.208	Laos/China	0.041
Singapore/China	0.026	Singapore/China	0.022
Vietnam/China	0.130	Vietnam/China	0.105
Thailand/China	0.025	Thailand/China	0.023
Korea/China	0.040	Korea/China	0.020
Japan/China	0.063	Japan/China	0.057
Average	**0.118**	**Average**	**0.044**
Median	**0.067**	**Median**	**0.032**

Notes: For CPI year 2009=100, coefficient of variation is standard deviation divided by mean, the number is rounded to the third decimal point.
Source: World Bank Databank

In the 1st period (1999-2008), the average of the coefficient of variation of real interest rate in the Eurozone is 0.044, and 0.118 in East Asia. Median of the coefficient of variation is also calculated to remove the effects of outliers like Myanmar and Laos. Median is 0.037 in Eurozone, and 0.067 in East Asia in the first period, which means variability of real exchange rate is nearly twice bigger in East Asia than Eurozone. In the 2nd period (2009-2017), the average is 0.014 in the Eurozone, and 0.044 in East Asia. The median is 0.010 in Eurozone, and 0.032 in East Asia. Variability in the real exchange rate has declined in both regions, but it is still higher in East Asia than the Eurozone, which means that East Asia suffers more asymmetric shock than Europe. It seems East Asia is ready to adopt common currency in this criterion as East Asia in 2nd period compares well with Europe in 1st period. However, in the period between 1990 and 1998, the average of coefficient of variation of real interest rate in 11 European countries who were the member of Eurozone from its birth in 1999 was 0.028, and the median was 0.023.[8] This fact suggests that East Asia is not ready enough to introduce a common currency compared to the Eurozone when Euro was first introduced. A gap between East Asia and Eurozone in the variability of the real exchange rate after 1999 can be mostly due to emerging of Euro. Both real and monetary disturbance shakes real exchange rate in East Asia, but the region using the same currency mostly affected by only real disturbance (Eichengreen, 1992).[9]

3.1.2. Real Stock Price Variability

Second analyzing to check symmetric shock was done by comparing regional stock price differentials. The Equity price reflects the present value that shows the current value of future profit, in theory. When asymmetric shock happens in the currency area, the stock price of each of the members will move differently as the profit of stock would change. If the real stock price moves similarly, it can be evidence for more symmetric shock happens in the currency area, or evidence for fast rearrangement of production factor between countries in the currency area.

For analyzing, two representative countries were selected from both Eurozone and ASEAN+3. France and Germany were selected in Eurozone as their stock market are the largest

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[8] Please see Table 7 in Appendix for more detailed information. Only 11 countries were used to more rigorously judge the readiness of common currency in East Asia.

[9] Even when only most developed countries in Asia (China, Japan, and Korea) were compared with Germany, France and Italy. The real exchange rate variability was larger in Asia (Kang, 2007).

in Eurozone. China and Japan were selected for the same reason in ASEAN+3.[10] From January of 1990 to December of 2018, four countries' stock price of the last day of the month were collected. Data were separated into three different periods (1990 January-1998 December, 1999 January-2009 December, and 2010 January-2018 December). The reason for separating time range was to check the improvement of each region and to compare ASEAN+3 in today with Eurozone in before adopting Euro. As stock prices are usually denominated nominal, collected prices were deflated by CPI of each country to see real stock price. The real stock price differential between France and Germany were compared with the differential between China and Japan. For East Asia, one more statistic has calculated. Real Japanese stock prices are converted to Chines Yuan by using nominal exchange rate, for the case that Purchasing power parity does not hold. If symmetric shock happens more in Eurozone, we can expect that the real stock price in Europe moves closer than that of East Asia. Variability of the real stock price was represented by the coefficient of variation of relative prices. The result is in Table 2.

Table 2: Summary Statistics of Real Stock Price Indices

Coefficient of Variation

	France/Germany	Japan/China	Japan/China (Exchange Rate Corrected)
1990.01-1998.12	0.16	0.45	0.48
1999.01-2009.12	0.12	0.39	0.38
2010.01-2018.12	0.12	0.30	0.37

Notes: coefficient of variation is standard deviation divided by mean, the number is rounded to the second decimal point.
Source: Monthly stock price is collected from Investing.com, and CPI is collected from The World Bank Databank

Stock Prices in France and Germany move closely than that of Japan and China in all periods. As CPI deflates prices, the difference between the two regions is not related to the difference in the inflation rate. When the comparison is made with data corrected with the nominal exchange rate, the result is the same that prices are moving closer in France and German. Both regions are improving, but stock price variability in East Asia is more than twice of Europe. Variability between Japan and China in the 3rd period (the most recent period), is much bigger than the variability between France and Germany in the 1st period (the period

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[10] DAX Index, CAC 40 Index, SSEC Index, and Nikkei Index were used as representative index for German, France, China and Japan.

before adopting Euro) and 2nd period (a decade after adopting Euro). It leads to the same conclusion with real exchange rate analyzing. East Asia is on a way of improvement but still inferior apparently to the Eurozone in the criterion of symmetry shock between countries.

3.2. Labor Mobility

When asymmetric shock occurs in the situation that adjustment of the nominal exchange rate is impossible, factor mobility is critical to go back to steady state. Mundell emphasized labor mobility as a vital criterion to be an OCA. If labor is highly mobile in the currency area, the economy can adjust to steady state even if the wage is slow to adopt. Imagine demand shifts from Japanese products to Chinese products when they use common currency. It will bring unemployment on Japan and inflation pressure on China, as adjustment of nominal exchange rate is impossible. However, if the Japanese worker can move to China quickly, both unemployment problem in Japan and inflation pressure in China would be solved. Therefore, if labor mobility is high in some region, the cost of common currency can be minimized, and the region is suitable as OCA.

3.2.1. Intra-region Migration

To compare the labor mobility in the Eurozone and East Asia, intra-region migration data were used. The ratio of people who moved to a country from another country in the region was compared between Eurozone and ASENA+3. The result is in Table 3.

Table 3: Summary Statistics of Intra-region Migration

Ratio of Intra-region migration in ASEAN+3

Year	1960	1970	1980	1990	2000	2017
Number of Intra-region migration	4.4M	4.0M	3.0M	3.4M	5.1M	11.8M
Total Population	997.4M	1,235.0M	1,492.5M	1,745.0M	1,960.4M	2,212.0M
Intra-region migration %	0.0044	0.0034	0.0020	0.0020	0.0027	0.0053

Notes: Intra-region migration does not count movement in the same country. Data of emigration is used. Number of intra-region migration and total population is in million(M). Percentage of intra-region migration is rounded to fourth decimal point
Source: World Bank Databank

Ratio of Intra-region migration in Eurozone

Year	1960	1970	1980	1990	2000	2017
Number of Intra-region migration	3.2M	5.7M	5.8M	5.5M	5.4M	7.3M
Total Population	265.4M	287.4M	302.4M	311.5M	321.3M	341.4M
Intra-region migration %	0.0189	0.0197	0.0192	0.0177	0.0169	0.0215

Notes: Intra-region migration does not count movement in the same country. Data of emigrant. Number of intra-region migration and total population is in million(M). Percentage of intra-region migration is rounded to fourth decimal point
Source: World Bank Databank

The absolute number of migrants inside the region keep increased from 1980 in East Asia, and exceeded Eurozone in 2017. However, when it is compared as a ratio to the total population, the percentage of intra-region migration in East Asia at 2017 is even smaller than that of Eurozone in 1960. Even if the absolute number is increasing fast, East Asia still falls behind to Eurozone relatively in the perspective of labor mobility in the region.

3.2.2. Foreign Labor Force

Labor mobility also can be checked with a foreign labor force. Foreign labor force measures the ratio of foreign or foreign-born workers in the labor force, which can be an indirect indicator of labor market openness. If the labor market is more opened in a specific region, labor mobility would be high, and adverse unemployment shock to a particular country would be dispersed quickly. The data have collected from 2010 to 2017. The result of ASEAN+3 is in Table 4.

Table 4: Summary Statistics of Foreign Labor Force in ASEAN+3

Year	2010	2011	2012	2013	2014	2015	2016	2017
Indonesia	0.09	0.10	0.06	0.04	0.05	0.06	0.06	0.07
Japan	0.98	1.04	1.04	1.09	1.19	1.37	1.62	1.90
Malaysia	14.77	14.79	13.85	16.10	14.54	14.71	12.72	12.00
Philippines	0.04	0.04	0.05	0.06	0.06	0.07	0.10	0.11
Singapore	35.50	37.01	37.73	38.38	38.40	38.42	37.93	37.41
Average	10.28	10.60	10.55	11.13	10.85	10.92	10.49	10.30
Median	0.98	1.04	1.04	1.09	1.09	1.37	1.62	1.9

Notes: 7 countries of ASEAN+3 excluded for many missing data. The number is percentage of labor force of country, rounded to second decimal point.
Source: IMD World Competitive Online

The Average percentage of foreign labor force in 5 countries in ASEAN+3 usually stay between 10% and 11%, which shows slightly lower level of labor mobility compared to Eurozone where average is between 11% and 12%.[11] Small countries like Singapore and Luxembourg shows an extremely high level of labor mobility, but these countries are too small to absorb other big countries negative unemployment shock. They should be regarded as outliers, and median should be compared to rule out impact of outliers. Median is usually between 1% and 2% in East Asia which is big difference with average. On the contrary, median is usually between 8% and 9% in Eurozone which is not that different from average. The gap between median shows that East Asia is definitely insufficient as an OCA. By checking the intra-region migrant and foreign labor force, ASEAN+3 seems to have an overall low level of labor mobility. This can be a critical defect when we thought about a low level of symmetry of economic shock in East Asia, as they don't have a substitute for it.

However, there are some researches claiming that labor mobility's usefulness for the regional macroeconomic adjustment in currency area is not guaranteed for all situations. Specially, when demand imbalances are mostly internal, labor mobility cannot solve this problem in currency area (Farhi & Werning, 2017). For example, imagine Japan and China are using same currency. If there is demand shortfall on non-tradable sector like service sector in Japan, even if some Japanese workers move to China, the welfare of stayer would not enhance. Emigrants to China does not leave only with their labor, but also with their purchasing power.

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[11] To check foreign labor force in Eurozone, see Table 8 in Appendix. Only data of 14 countries in Eurozone were used in this analysis, rest are excluded for many missing data.

As people moved to China cannot buy the non-tradable goods in Japan, stayer in Japan still suffer from demand shortfall. This fact highlights the importance of symmetric regional shock, because labor mobility cannot always solve the problem of asymmetric shock.

3.3. Similarity of Economic Structure and Business Cycle

3.3.1. Similarity of Economic Structure

The similarity in economic structure is another critical criterion to be an OCA (Kenen, 1969). If countries in the currency union have a similar structure, the impact of regional economic shock would have a similar impact on all countries. Therefore, the economic policies that are necessary for countries would be similar. It means the cost of losing an independent monetary policy is low. If the economic structure is profoundly different between countries, regional monetary policy would have a different effect.

The percentage data of primary, secondary, and tertiary industry in GDP were collected for the year 2010 and 2017 in both regions to check similarity in economic structure. Dominant industry of the country and the trend of changing in economic structure has analyzed. The result of East Asia is in Table 5.

Table 5: Summary Statistics of Economic Structure in East Asia

Sector	Primary		Secondary		Tertiary	
Year	2010	2017	2010	2017	2010	2017
Brunei	1	1	69	60	30.6	40.9
Cambodia	34	23	22	31	38.3	39.7
China	10	8	46	40	44.1	51.6
Indonesia	14	13	43	39	40.7	43.6
Japan	1	1	28	29	70.2	68.8
Korea.	2	2	35	36	53.6	52.8
Lao PDR	23	16	30	31	43.6	41.5
Malaysia	10	9	40	39	48.5	51
Myanmar	37	23	26	36	36.7	40.4
Philippines	12	10	33	30	55.1	59.9
Singapore	0	0	26	23	68.3	70.4
Thailand	11	9	40	35	49.5	56.3
Vietnam	18	15	32	33	36.9	41.3

Notes: The numbers are percentage of GDP
Source: World Bank Databank

In East Asia, the tertiary industry was the most dominant in 2017 for all nations except Brunei. The overall trend in the primary and secondary industry is decreasing. The proportion

of primary industry has decreased or stayed in all 13 countries, and proportion of secondary industry has also decreased in 7 out of 13 countries. However, the ratio of tertiary industry increased in ten out of 13 countries. The countries where the proportion of tertiary industry decreased were Japan, Korea, and Laos. However, a decreased proportion in Korea and Japan is tiny as they are already economically developed and not experience many transitions in all three industries. So, if Korea and Japan are regarded as countries did not experienced the transition from 2010 to 2017, every country except Laos experienced the transition to tertiary industry in East Asia.

East Asia's economic structure seems to get more similar between countries, and likely to be affected in a similar way when there is a regional economic shock. However. Europe has higher similarity than East Asia, when we see the proportion of three industries.[12] Eurozone has the same trend as East Asia, and has transitioned to the tertiary industry, but the proportion of each three industries are much closer between countries in Europe.

This analysis can be a little clue of East Asia's deficiency as an OCA. However, this alone cannot completely generalize that East Asia is more heterogenous than Eurozone in economic structure, because it is divided to only three industries. Even if countries are showing high similarity in the proportion of three industries, there main industry can be different. For example, Italy and Germany shows high similarity in economic structure when it is measured by proportion of three industries. However, Germany's main secondary industry is automobile and Italy's main secondary industry is clothing. This fact suggests that homogeneity in economic structure is not as high as it seems in two countries, and regional shock cannot be guaranteed to have the same effect.

3.3.2. Convergence and Similarity of Business Cycle

Convergence and similarity of the business cycle are essential criteria in a sense that it reduces the cost of giving up an independent monetary policy of the country. When the business cycle is profoundly different between countries, regional monetary policy will bring different consequences. Bayoumi et al. (2000) claimed that monetary integration in Eurozone was possible as they have a high degree of similarity in the business cycle. To check whether business cycles stay close together and converge, the standard deviation of the annual real GDP

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[12] To check economic structure of Eurozone, please see Table 9 in Appendix

growth rate and inflation rate from 2000 to 2018 were used. If the standard deviation is low in a particular region, it is more suitable as an OCA. The result is in Graph 1 and 2.

Graph 1 : The Standard Deviation of the Real GDP Growth
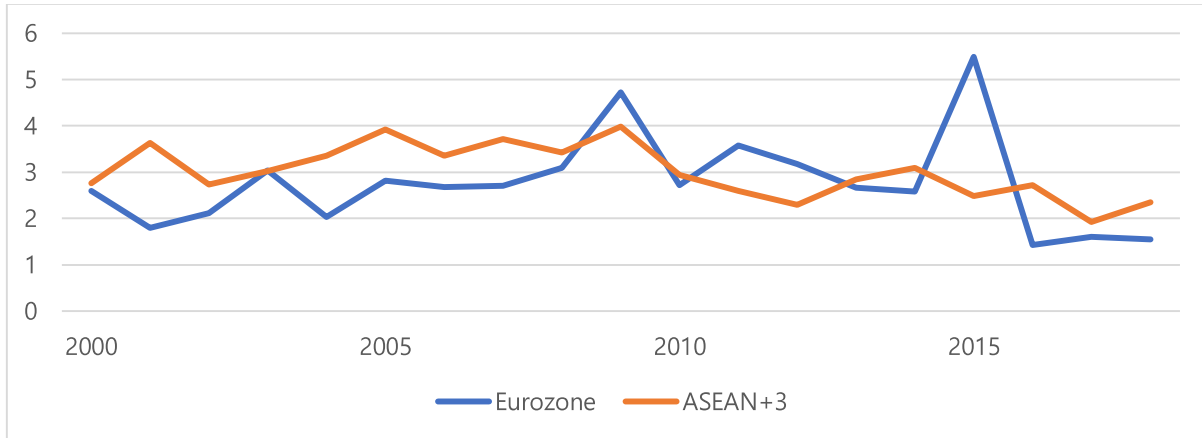
Source: International Monetary Fund(IMF) Data

Graph 2 : The Standard Deviation of the Inflation Rate
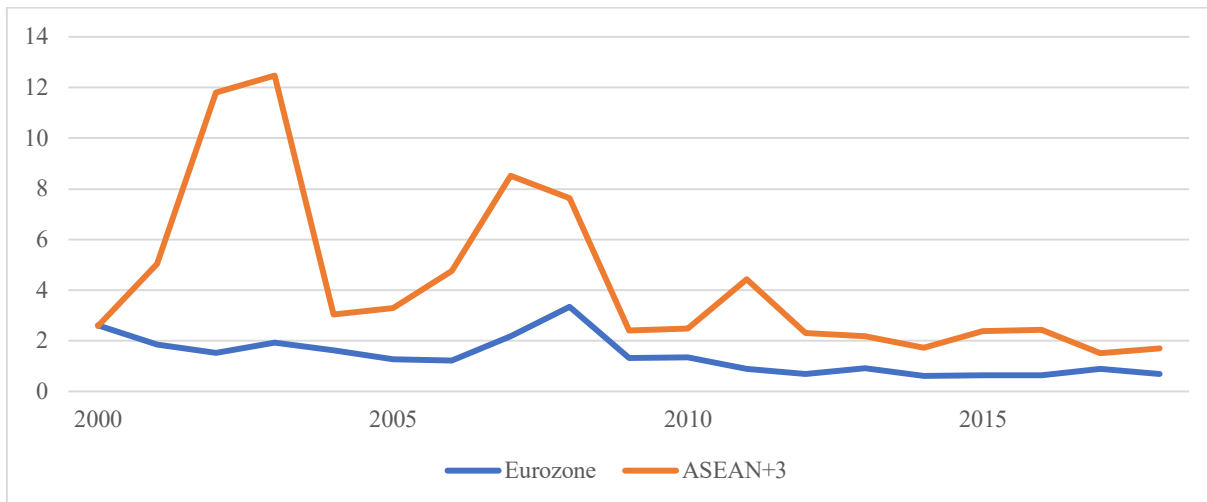
Source: International Monetary Fund(IMF) Data

In terms of the real GDP growth, it is hard to tell which region is more suitable for the OCA, as standard deviation is turned over and over between two regions. Eurozone was less similar than ASEAN+3 in the period of the great recession, but recently recovered a higher level of similarity. However, when the correlation of the real GDP growth was checked to see whether countries' real GDP growth moves to same direction, Eurozone show extremely higher

level of correlations.[13] Only Malta showed a negative correlation with the two countries.[14] However, in East Asia, a few more countries showed a negative correlation, especially Laos showed a negative correlation with six countries. Therefore, it can be concluded that East Asia is slightly under Eurozone in the aspect of similarity and convergence of the real exchange rate, but it is hard to tell which region is apparently better.

In terms of the inflation rate, it is apparent that East Asia does not reach the same level of similarity and convergence to Eurozone when looking at the standard deviation. The result was not different from the correlation between countries. The only correlation between Slovakia and Lithuania was negative in Eurozone, while Indonesia, Japan, and Myanmar had a negative correlation with more than four countries.[15] However, as Graph 3 shows, the level of inflation rate convergence and similarity in East Asia reaches to the level of Eurozone fast after extreme inflation in Myanmar mitigated.

In respect of convergence and similarity of the business cycle, East Asia did not reach to the level of Eurozone overall. Nevertheless, the gap is not big and going narrow rapidly, which means East Asia can be evaluated suitable for OCA more in this criterion than in other criteria checked before.

3.4. Risk Sharing

The last representative criterion to be an OCA is risk sharing between countries. When the exchange rate policy is impossible to implement, risk sharing between countries can be a solution to the asymmetric shock in the region. Fiscal integration is a typical way of risk sharing that can deal with asymmetric shock (Kenen, 1969). The excellent example of fiscal integration is the U.S. As the U.S is integrated as one nation, the federal government can implement fiscal policy at a regional level in their currency area.

If Japan and China exist as one country. There would be one federal government who decides fiscal policy. In normal time, Japan and China would pay tax to the government, and it

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[13] To check correlation of the real GDP growth of ASEAN+3 and Eurozone, please see Table 10 and 11 on Appendix

[14] Malta showed negative correlation of real GDP growth with Cyprus and Greece. However, it was only -0.06 and -0.009 each.

[15] Correlation of inflation rate between Slovakia and Lithuania was negative, but it was only -0.07. To check correlation of the inflation rate of ASEAN+3 and Eurozone, please see Table 12 and 13 on Appendix

would be saved on a national budget. If asymmetric adverse shock happens in Japan, it will pay less tax to the government and will get more benefit. It can be thought of as an automatic transfer from China to Japan because the tax paid by China were used to help Japan get out of a negative situation. However, if asymmetric adverse shock threatens China after, the federal government will implement fiscal policy advantageous to China, by using money collected from Japan. Like this, risk sharing can solve the problem of asymmetric shock or different business cycle, when the exchange rate is fixed.

Risk sharing is crucial, Krugman (2001, 2013) picked fiscal federalism as an essential regional stabilizer in the U.S. However, it is impossible to compare Eurozone and ASEAN+3 in perspective of fiscal federalism because both regions do not have a central government that controls fiscal policy of the whole region. Therefore, this report will access the degree of risk sharing in the perspective of consumption risk sharing, using a method suggested by Asdrubali, Sørensen, and Yosha (1996).

According to Friedman (1965), consumption over a lifetime is not just determined by current income. People think of permanent income, which is average income through the whole life, and arrange their consumption to that. In a currency union, even if asymmetrical shock changes the income of people living in a different country, consumption not necessarily follows the change of income. Countries can share the effect of country specific shock at the financial market, which is called 'consumption risk sharing' and it can solve the problem of asymmetric shock.

While analyzing inter-state consumer risk sharing in the U.S, Asdrubali, et al. (1996) explained three ways of consumption risk sharing. The first way is to share risk by cross-ownership of the productive asset in the capital market. A most common example of this is portfolio diversification. The second way is to rely on the tax-transfer system of the federal government. The last way is adjusting asset portfolio by borrowing and landing at the credit market.

S. Kim, Kim, and Wang (2006) applied it to consumer risk sharing at the inter-country level and explained two ways to share risk between countries. The first channel is the capital market. By purchasing equity issued by foreign economic subject, we can get a claim on the future product of capital market like a dividend. It means that the consumption of a country does not solely rely on the income of that country. If one company has plenty amount of its

right on the foreign capital market, it can escape the influence of negative shock on its country. In other words, the cost of asymmetrical shock decreases. It is similar to get insurance on income in the capital market, and also known as income insurance.

The amount of income insurance of a country can be measured by the difference between its aggregate product and aggregate income. In the national account, it is the same as the difference between Gross Domestic Product (GDP) and Gross National Income (GNI), which is equal to Net Factor Income (NFI). NFI measures two types of income. First is income from national employees working abroad, and the second is income from property or investment in a foreign country. However, Former one takes a negligibly small part of NFI so that we can regard NFI as income insurance.[16]

The second channel of consumer risk sharing in the inter-country level is using the international credit market. Through the credit market, people or institution can lend and borrow, and smooth their consumption. It can be view as investing one's current consumption for future consumption, so called consumption insurance. The amount of consumption insurance is the same with an investment which can be measured by the difference between GNI and consumption.

With the decomposition of GDP, the percentage of smoothing can be measured when there is a shock on GDP. This method is suggested by Asdrubali, et al. (1996) to analyze interstate consumer risk sharing and modified by S. Kim, et al. (2006) to analyze consumption risk sharing in inter-country level in the absence of regional fiscal policy.

GDP can be expressed with GNI and Consumption (C) :

$$GDP_i = \frac{GDP_i}{GNI_i}\frac{GNI_i}{C_i}C_i$$

i refers to specific country.

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[16] According to Nardo, Pericoli, and Poncela (2017) only 0.2 % of GDP shock were smoothed through the channel of cross border labor compensation.

By taking log and difference on both sides of the equation, it can be modified to :

$$\Delta \log(GDP_i) = \Delta \log(GDP_i) - \Delta \log(GNI_i) + \Delta \log(GNI_i) - \Delta \log(C_i) + \Delta \log(C_i)$$

Multiplying $\Delta \log(GDP_i)$, and taking expectation on both sides, decomposition of cross-sectional variance in GDP is obtained :

$$\mathrm{Var}\{\Delta \log(GDP_i)\} = cov\{\Delta \log(GDP_i) \ , \Delta \log(GDP_i) - \Delta \log(GNI_i)\}$$
$$+ \ cov\{\Delta \log(GDP_i) \ , \Delta \log(GNI_i) - \Delta \log(C_i)\}$$
$$+ \ cov\{\Delta \log(GDP_i) \ , \Delta \log(C_i)\}$$

Dividing both sides by $\mathrm{Var}\{\Delta \log(GDP_i)\}$, it can be changed:

$$1 = \frac{cov\{\Delta \log(GDP_i) \ , \Delta \log(GDP_i) - \Delta \log(GNI_i)\}}{\mathrm{Var}\{\Delta \log(GDP_i)\}} + \frac{cov\{\Delta \log(GDP_i) \ , \Delta \log(GNI_i) - \Delta \log(C_i)\}}{\mathrm{Var}\{\Delta \log(GDP_i)\}} + \frac{cov\{\Delta \log(GDP_i) \ , \Delta \log(C_i)\}}{\mathrm{Var}\{\Delta \log(GDP_i)\}}$$

The first term on the right-hand side is the coefficient in the Ordinary Least Square(OLS) regression of $\Delta \log(GDP_i) - \Delta \log(GNI_i)$ on $\Delta \log(GDP_i)$. The second term is the coefficient in the OLS regression of $\Delta \log(GNI_i) - \Delta \log(C_i)$ on $\Delta \log(GDP_i)$. The last term is the coefficient in the OLS regression of $\Delta \log(C_i)$ on $\Delta \log(GDP_i)$. If we define each of these coefficients as $\beta_{k,i}$, $\beta_{C,i}$, and $\beta_{u,i}$, we can find that the sum of these coefficients is 1.

$$1 = \beta_{k \ ,i} + \beta_{C,i} + \beta_{u,i}$$

When $\Delta \log(GDP_i)$ is GDP shock on the specific country, $\beta_{k,i}$ can be interpreted as

the percentage of smoothing by the capital market, $\beta_{C,i}$ can be defined as the percentage of smoothing by the credit market, $\beta_{u,i}$ can be defined as the percentage of GDP shock unsmoothed. This report used three regression model to estimate the coefficients.

$$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t) = d_{k,t,i} + \beta_{k,i} \Delta \log(GDP_i^t) + e_{kt}^i$$

$$\Delta \log(GNI_i^t) - \Delta \log(C_i^t) = d_{c,t,i} + \beta_{c,i} \Delta \log(GDP_i^t) + e_{ct}^i$$

$$\Delta \log(C_i^t) = d_{u,t,i} + \beta_{u,i} \Delta \log(GDP_i^t) + e_{ut}^i$$

Term $d_{k,t,i}$, $d_{c,t,i}$, and $d_{c,t,i}$ are time fixed effects which were introduced to eliminate the year-specific effect on GDP growth from coefficient we are interested. Term e_{kt}^i , e_{ct}^i , and e_{ut}^i are the error terms.

Nardo, et al. (2017) analyzed consumption risk sharing of 11 countries in Eurozone with similar method, from time range 1960-2016. Nardo, et al. (2017) decomposed GDP with four factors to measure fiscal risk sharing.[17] Nevertheless, the way to measure percentage of GDP shock unsmoothed ($\beta_{u,i}$) is almost same with this report, as it is measured by coefficient in regression of percentage change in consumption on GDP shock. The only technical difference between method used in this report and Nardo, et al. (2017) is that they used SURE panel regression while I used OLS regression. However, Nardo, et al. (2017) presented the result of OLS regression and mentioned that the results of OLS regression and SURE estimation are very close. Therefore, this report will use the result of OLS regression. To compare Europe and East Asia, this report collected the panel data of GDP, GNI, and Consumption of ASEAN+3 countries at the same time range (1960-2016). However, Brunei and Myanmar were excluded as most of their data on the early period were non-exist. The result

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[17] Nardo, et al. (2017) decomposed GDP as $GDP = \frac{GDP}{GNI}\frac{GNI}{GDI}\frac{GDI}{C}C$. GDI is Gross Disposable Income. The coefficient in SURE (Seemingly Unrelated Regression Equations) panel regression of $\Delta \log(GNI_i^t) - \Delta \log(GDI_i^t)$ on GDP shock measures percentage of smoothing done by tax-transfer system of government. The coefficient in SURE panel regression of $\Delta \log(GDI_i^t) - \Delta \log(C_i^t)$ on GDP shock measures percentage of smoothing done by credit market. It was unable to get GDI data for most of the ASEAN+3 countries as they are developing countries and there are insufficient data on them. To solve this problem this report used the method recommended by S. Kim, et al. (2006) in analyzing ASEAN+3 countries.

is in Table 6.

Table 6: Summary Statistic of Consumption Risk Sharing

Eurozone

	Capital Market (%)	Fiscal risk sharing (%)	Credit Market (%)	Unsmoothed (%)
Austria	-2	2	23	77
Belgium	5	-3	58***	40
Finland	-6**	0	56***	50
France	1	1	28	70
Germany	1	1	25**	77
Greece	3	0	31***	66
Ireland	15***	0	50***	35
Italy	2	-1	26	73
Netherlands	10	0	44***	46
Portugal	-4	3**	10	91
Spain	2	0	22**	76
Average	2.45	0.27	33.91	63.73
Median	2	0	28	70

Notes: The symbols ** and *** indicate significant at 5 and 1% level. The numbers are percentage of GDP shock smoothed in each market, and percentage of GDP shock unsmoothed. Nardo, et al. (2017) only represented the percentage of GDP shock smoothed in each market. Therefore, percentage of unsmoothed were calculated by deducting total smoothed percentage from 100.
Source: Nardo, et al. (2017) Annex : Table A5

ASEAN+3

	Capital Market (%)	Credit Market (%)	Unsmoothed (%)
Cambodia	0	5	94***
China	0	24***	76***
Indonesia	-1**	6	95***
Japan	1	20	80***
Korea	-1	15**	86***
Laos	1	1	98***
Malaysia	2**	16***	82***
Philippines	2	-3	101***
Singapore	1	21***	78***
Thailand	-1	11***	90***
Vietnam	0	5	94***
Average	0.36	11.00	88.55
Median	0	11	90

Notes: The symbols ** and *** indicate significant at 5 and 1% level. The numbers are percentage of GDP shock smoothed in each market, and percentage of GDP shock unsmoothed.
Source: World Bank Databank

Percentage of GDP shock smoothed through the channel of the capital market was relatively small than the credit market in all countries. With the percentage of unsmoothed GDP shock, the degree of risk sharing can be evaluated. If it is close to 100% in a specific country,

the degree of risk sharing is small. Relatively small countries like Belgium, Netherlands, and Singapore showed a high level of risk sharing in the region. Several economically developed countries in East Asia like China, Japan, and Singapore showed better risk sharing than other countries in the region, but most of the Southeast Asian countries unsmoothed GDP shock was bigger than 90 %. Eurozone showed a significantly high level of risk sharing compared to East Asia. The average of the percentage of unsmoothed GDP shock was about 25 % points higher in East Asia than Europe. To eliminate the biased effect of outliers like Belgium and Ireland, the median was also calculated. The median of the percentage of unsmoothed GDP shock was about 20 % points higher in East Asia, which means East Asia is not suitable for OCA in the criteria of risk sharing as much as Eurozone. Even developed East Asian countries' risk sharing level was not reached to the average of Eurozone.

4. Non-economic Obstacle in East Asia

Although East Asia is gradually reaching as a suitable region of OCA in several economic criteria, many economists show skeptical points of view to emergence of common currency because of non-economic obstacles in East Asia.

The first obstacle is the insufficient political condition. East Asia is premature to be an OCA in political aspect rather than in the economic aspect (Bayoumi & Eichengreen, 1996). East Asia, unlike Europe, has no experience of political and economic cooperation over a long time of period. More to this, there is no country to have a leading role like Germany and France did in the formation of Eurozone.

Japan and China are expected to take a leader role. However, they are not showing enough effort. Surely, there are some economic incentive for both countries to make common currency. The proportion of intra-region trade is increasing every year in both countries, which means they can reap huge benefit when use same currency. Also, politically, they can take a leader role in one of the largest economic union if they integrate currency. Nevertheless, China has larger economic incentives to oppose to common currency. As one of the major exporting countries, China does not want their currency to be appreciated. However, there are possibility of appreciation than present level when China use same currency with Japan. It is hard for Japan to play this role also, because of the history of invading neighboring countries, and Japan's own will to do that is weak.

The second obstacle is that heterogeneity exists in various aspect. East Asia is heterogeneous in its political, economic development and stage. Not only this, there is a wide range of heterogeneities in various aspects such as religion, race, and language; it is challenging to be one political and economic entity (Fabella, 2000).

Lastly, East Asia has no experience in organizing and operating a supranational organization. For the operation and maintenance of the monetary union, it is essential to establish and operate a transnational organization such as a regional central bank. However, according to Narine (2001), East Asian countries, unlike European countries, have traditionally preferred a loose level of cooperation, so they are lack of effort and experience to have such institution.

5. Conclusion

Throughout this report, the factors that are stumbling block to adopting East Asian common currency were examined in the aspect of the economy, politic, and culture. The main content was economic analysis, and OCA theory was used to analyze in what aspect East Asia is sufficient and lack to be an OCA in comparison with Eurozone.

The first analysis was about symmetric regional shock. East Asia has improved in this criterion, but revealed that still not reach to the level of Eurozone in 1999. The second analysis was about labor mobility. In this analysis East Asia was insufficient to be an OCA yet, but labor mobility is less important as OCA criterion these days, because many countries main industry is service sector which is mostly regarded as non-tradable goods. The third analysis was about similarity in economic structure and business cycle. In here, East Asia showed most comparable result in this criterion, but still slightly fall short to the Eurozone. The last economic analysis was to access the degree of risk sharing. Since there is no federal government both in East Asia and Eurozone, consumer risk sharing was chosen to evaluate the overall degree of risk sharing, and East Asia was analyzed to lag to Eurozone.

In addition to these economic analyses, non-economic obstacles such as lack of political cooperation experience and cultural heterogeneity were also briefly addressed.

Overall, East Asia is showing an improvement in economic criteria to become an OCA, but it is still somewhat lacking compared to Eurozone, which is a representative currency union. This relative inferiority to be an OCA were also revealed in non-economic areas such as politics and culture. Nevertheless, since East Asia is going close to the OCA in economic standards, the emergence of East Asian common currency is not an entirely unrealistic thing.

Although ASEAN+3 countries were the main subject in this paper, it is more likely that more optimistic results would be obtained if analyzing was done with relatively developed countries in Asia such as China, Japan, Korea, Singapore, Hong Kong, and Taiwan. This report evaluated East Asia through a comparative analysis with the Eurozone, but the result can be different when compared with other regions. There is still disagreement about whether Eurozone is an OCA. In addition to this, some economists claim East Asia depends too much on the experience of Eurozone in their plans of making common currency although circumstances are different between Europe and Asia (Wyplosz, 2001). Therefore, the possibility of East Asian common currency cannot be determined by only in comparison with

Eurozone, and more various comparative analysis is necessary.

8. Appendix

Table 7 : Summary Statistics of Regional Real Exchange Rates

Other Eurozone Members Against Germany (1990-1998)

Period Before Adopting Euro (1990 – 1998)	
	Coefficient of Variation
Austria/Germany	0.007
Belgium/Germany	0.020
Finland/Germany	0.031
France/Germany	0.026
Ireland/Germany	0.021
Italy/Germany	0.038
Luxembourg/Germany	0.016
Netherlands/Germany	0.015
Portugal/Germany	0.067
Spain/Germany	0.037
Average	0.028
Median	0.023

Notes: For CPI year 2009=100, coefficient of variation is standard deviation divided by mean, the number is rounded to the third decimal point. Data of only 11 countries which was the member of Eurozone in 1999 to accurately check whether East Asia is ready to adopt common currency.
Source: World Bank Databank

Table 8 : Summary Statistics of Foreign Labor Force Eurozone

Year	2010	2011	2012	2013	2014	2015	2016	2017
Belgium	9.37	9.87	9.99	10.38	10.75	11.33	11.28	11.64
Estonia	0.95	0.71	0.40	0.33	0.40	0.51	0.61	0.66
Finland	3.15	3.46	3.72	3.99	4.20	4.34	4.55	4.60
France	5.50	6.02	6.14	6.08	5.96	6.03	6.30	6.61
Greece	9.55	7.16	5.83	8.38	8.28	7.25	6.67	6.10
Ireland	15.26	15.12	14.89	14.77	14.36	14.73	15.00	15.79
Italy	8.80	9.36	9.72	10.44	10.82	11.04	11.01	10.91
Latvia	12.21	11.90	11.89	10.66	10.27	9.65	9.74	9.57
Lithuania	0.12	0.22	0.31	0.34	0.36	0.60	1.33	2.75
Luxembourg	63.87	64.18	64.11	64.34	67.46	67.86	68.65	69.45
Portugal	4.37	3.61	3.02	3.02	2.62	2.51	2.45	2.38
Slovak Republic	0.67	0.64	0.79	0.82	0.81	0.93	1.27	1.79
Slovenia	9.50	9.41	9.07	9.52	9.56	9.72	10.35	10.62
Spain	14.97	14.56	14.03	13.19	12.27	11.97	11.83	12.00
Average	11.31	11.16	11.00	11.16	11.29	11.32	11.50	11.78
Median	9.085	8.26	7.605	8.95	8.92	8.45	8.205	8.09

Notes: 5 countries of Eurozone excluded for many missing data. The number is percentage of labor force of country, rounded to second decimal point.
Source: IMD World Competitive Online

Table 9: Summary Statistics of Economic Structure in Eurozone

	Agriculture		Manufacturing		Service	
	2010	2017	2010	2017	2010	2017
Austria	1	1	26	25	62.3	62.7
Belgium	1	1	21	20	67.9	69
Cyprus	2	2	15	11	71.3	73.6
Estonia	3	2	24	24	60.2	60
Finland	2	2	26	24	58.9	59.6
France	2	2	18	17	70.7	70.2
Germany	1	1	27	28	62.2	61.4
Greece	3	4	14	15	71.6	68.7
Ireland	1	1	23	36	66.5	56.5
Italy	2	2	22	22	66.3	66.2
Latvia	4	3	21	20	64.2	64.5
Lithuania	3	3	26	26	60.8	60.7
Luxembourg	0	0	11	11	78.3	79.5
Malta	1	1	18	12	68.7	74.9
Netherlands	2	2	20	17	68.4	70.3
Portugal	2	2	20	19	66.2	65.2
Slovak	3	3	32	31	56.3	55.6
Slovenia	2	2	27	29	58.7	56.4
Spain	2	3	24	22	65.4	66.1

Notes: The numbers are percentage of GDP
Source: World Bank Databank

Table 10 : Correlation of the Real GDP Growth in ASEAN+3

	BN	KH	CH	ID	JP	KR	LA	MY	MM	PH	SG	TH	VN
BN		0.32	0.36	-0.15	0.34	0.61	-0.12	0.29	0.42	-0.20	0.39	0.50	0.47
KH	0.32		0.42	0.09	0.66	0.44	-0.06	0.54	0.77	0.33	0.45	0.46	0.65
CH	0.36	0.42		0.38	0.11	0.35	0.39	0.16	0.54	-0.09	0.55	0.29	0.35
ID	-0.15	0.09	0.38		0.15	-0.05	0.69	0.38	-0.26	0.30	0.43	0.02	-0.32
JP	0.34	0.66	0.11	0.15		0.55	0.02	0.81	0.32	0.75	0.71	0.72	0.41
KR	0.61	0.44	0.35	-0.05	0.55		-0.08	0.59	0.52	0.06	0.62	0.47	0.47
LA	-0.12	-0.06	0.39	0.69	0.02	-0.08		0.27	-0.26	0.31	0.45	-0.07	-0.37
MY	0.29	0.54	0.16	0.38	0.81	0.59	0.27		0.26	0.64	0.75	0.56	0.33
MM	0.42	0.77	0.54	-0.26	0.32	0.52	-0.26	0.26		-0.10	0.25	0.43	0.72
PH	-0.20	0.33	-0.09	0.30	0.75	0.06	0.31	0.64	-0.10		0.50	0.49	0.07
SG	0.39	0.45	0.55	0.43	0.71	0.62	0.45	0.75	0.25	0.50		0.56	0.33
TH	0.50	0.46	0.29	0.02	0.72	0.47	-0.07	0.56	0.43	0.49	0.56		0.47
VN	0.47	0.65	0.35	-0.32	0.41	0.47	-0.37	0.33	0.72	0.07	0.33	0.47	

Notes: Country notation is as follow: BN for Brunei, KH for Cambodia, CH for China, ID for Indonesia, JP for Japan, KR for Korea, LA for Laos, MY for Malaysia, MM for Myanmar, PH for Philippines, SG for Singapore, TH for Thailand, and VN for Vietnam
Source: International Monetary Fund (IMF)

Table 11 : Correlation of the Real GDP Growth in Eurozone

	AT	BE	FI	FR	DE	IE	IT	LU	NL	PT	ES
AT		0.89	0.96	0.92	0.85	0.36	0.87	0.73	0.90	0.66	0.68
BE	0.89		0.91	0.92	0.77	0.46	0.88	0.84	0.82	0.73	0.69
FI	0.96	0.91		0.95	0.81	0.34	0.93	0.78	0.89	0.72	0.76
FR	0.92	0.92	0.95		0.84	0.45	0.94	0.82	0.87	0.72	0.70
DE	0.85	0.77	0.81	0.84		0.37	0.80	0.73	0.82	0.58	0.46
IR	0.36	0.46	0.34	0.45	0.37		0.54	0.52	0.46	0.53	0.57
IT	0.87	0.88	0.93	0.94	0.80	0.54		0.80	0.90	0.86	0.84
LU	0.73	0.84	0.78	0.82	0.73	0.52	0.80		0.73	0.69	0.63
NL	0.90	0.82	0.89	0.87	0.82	0.46	0.90	0.73		0.84	0.81
PT	0.66	0.73	0.72	0.72	0.58	0.53	0.86	0.69	0.84		0.84
ES	0.68	0.69	0.76	0.70	0.46	0.57	0.84	0.63	0.81	0.84	

Notes: I checked correlation of all 19 countries, buy only the correlation of 11 countries which were member of Eurozone in 1999 are represented in this table. Country notation is as follow: AT for Austria, BE for Belgium, FI for Finland, FR for France, DE for Germany, IE for Ireland, IT for Italy, LU for Luxembourg, NL for Netherland, PT for Portugal ES for Spain.
Source: International Monetary Fund (IMF)

Table 12 : Correlation of the Inflation Rate in ASEAN+3

	BN	KH	CH	ID	JP	KR	LA	MY	MM	PH	SG	TH	VN
BN		0.51	0.44	-0.03	0.05	0.44	0.06	0.20	-0.23	0.58	0.49	0.47	0.39
KH	0.51		0.73	0.27	0.43	0.42	0.07	0.78	0.10	0.60	0.68	0.68	0.81
CH	0.44	0.73		-0.12	0.36	0.34	0.08	0.50	-0.08	0.33	0.76	0.63	0.77
ID	-0.03	0.27	-0.12		-0.05	0.39	0.43	0.33	0.48	0.54	-0.04	0.41	0.14
JP	0.05	0.43	0.36	-0.05		-0.32	-0.24	0.52	-0.16	0.08	0.13	0.16	0.15
KR	0.44	0.42	0.34	0.39	-0.32		0.60	0.18	0.34	0.70	0.55	0.53	0.56
LA	0.06	0.07	0.08	0.43	-0.24	0.60		-0.05	0.63	0.36	0.16	0.43	0.12
MY	0.20	0.78	0.50	0.33	0.52	0.18	-0.05		-0.05	0.44	0.47	0.59	0.60
MM	-0.23	0.10	-0.08	0.48	-0.16	0.34	0.63	-0.05		0.02	-0.14	0.02	0.00
PH	0.58	0.60	0.33	0.54	0.08	0.70	0.36	0.44	0.02		0.44	0.76	0.51
SG	0.49	0.68	0.76	-0.04	0.13	0.55	0.16	0.47	-0.14	0.44		0.69	0.85
TH	0.47	0.68	0.63	0.41	0.16	0.53	0.43	0.59	0.02	0.76	0.69		0.70
VN	0.39	0.81	0.77	0.14	0.15	0.56	0.12	0.60	0.00	0.51	0.85	0.70	

Notes: Country notation is as follow: BN for Brunei, KH for Cambodia, CH for China, ID for Indonesia, JP for Japan, KR for Korea, LA for Laos, MY for Malaysia, MM for Myanmar, PH for Philippines, SG for Singapore, TH for Thailand, and VN for Vietnam
Source: International Monetary Fund (IMF)

Table 13: Correlation of the Inflation Rate in Eurozone

	AT	BE	FI	FR	DE	IE	IT	LU	NL	PT	ES
AT		0.84	0.67	0.77	0.93	0.36	0.69	0.78	0.49	0.60	0.70
BE	0.84		0.61	0.82	0.80	0.40	0.71	0.82	0.36	0.64	0.75
FI	0.67	0.61		0.55	0.56	0.38	0.68	0.54	0.63	0.46	0.52
FR	0.77	0.82	0.55		0.81	0.60	0.90	0.90	0.53	0.77	0.89
DE	0.93	0.80	0.56	0.81		0.45	0.74	0.81	0.50	0.65	0.78
IR	0.36	0.40	0.38	0.60	0.45		0.69	0.59	0.67	0.80	0.77
IT	0.69	0.71	0.68	0.90	0.74	0.69		0.87	0.67	0.82	0.90
LU	0.78	0.82	0.54	0.90	0.81	0.59	0.87		0.45	0.73	0.92
NL	0.49	0.36	0.63	0.53	0.50	0.67	0.67	0.45		0.76	0.67
PT	0.60	0.64	0.46	0.77	0.65	0.80	0.82	0.73	0.76		0.88
ES	0.70	0.75	0.52	0.89	0.78	0.77	0.90	0.92	0.67	0.88	

Notes: I checked correlation of all 19 countries, but the correlation of 11 countries which were member of Eurozone in 1999 are represented in this table. Country notation is as follow: AT for Austria, BE for Belgium, FI for Finland, FR for France, DE for Germany, IE for Ireland, IT for Italy, LU for Luxembourg, NL for Netherland, PT for Portugal ES for Spain.
Source: International Monetary Fund (IMF)

Table 14 : Summary of Regression Analysis 1 – Cambodia, China, Indonesia, Japan, Korea, Laos

Cambodia	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0041 (0.36)	0.0516 (0.78)	0.9443*** (15.16)
Constant	0.0012 (0.99)	0.0025 (0.34)	-0.0038 (-0.54)
R^2	0.0043	0.0199	0.8846
Observation	32	32	32
China	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0014 (0.28)	0.2362*** (3.84)	0.7624*** (12.57)
Constant	-0.0001 (-0.13)	-0.0190*** (-2.35)	0.0191*** (2.39)
R^2	0.0014	0.2117	0.7417
Observation	57	57	57
Indonesia	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	-0.0145** (-2.03)	0.0611 (1.59)	0.9534*** (25.11)
Constant	0.0019 (1.32)	0.0014 (0.18)	-0.0034 (-0.43)
R^2	0.0790	0.0499	0.9293
Observation	50	50	50
Japan	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0059 (2.55)	0.2021 (-0.10)	0.7962*** (50.49)
Constant	-0.0012*** (-3.74)	0.0047 (-1.67)	0.0058*** (2.16)
R^2	0.1267	0.2142	0.7860
Observation	47	47	47
Korea	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	-0.0055 (-1.45)	0.1466** (1.89)	0.8588*** (40.17)
Constant	0.0007 (1.04)	0.0028 (0.62)	-0.0036 (-0.80)
R^2	0.0367	0.1612	0.8670
Observation	57	57	57
Laos	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0071 (0.47)	0.0140 (0.20)	0.9789*** (14.18)
Constant	0.0002 (0.05)	0.0040 (0.24)	-0.0042 (-0.26)
R^2	0.0117	0.0020	0.9137
Observation	21	21	21

Notes: The symbols ** and *** indicate significant at 5 and 1% level. t statistics in parenthesis.
Source: World Bank Databank

Table 15 : Summary of Regression Analysis 2 – Malaysia, Philippines, Singapore, Thailand, Vietnam

Malaysia	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0193** (1.94)	0.1582*** (3.09)	0.8225*** (15.62)
Constant	-0.0020 (-1.42)	-0.0082 (-1.12)	0.0102 (1.36)
R^2	0.0641	0.1478	0.8160
Observation	57	57	57
Philippines	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0230 (1.50)	-0.0328 (-1.09)	1.0073*** (42.38)
Constant	-0.0050 (-2.42)	0.0042 (1.12)	0.0008 (0.25)
R^2	0.0394	0.0213	0.9703
Observation	57	57	57
Singapore	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0084 (0.33)	0.2119*** (4.21)	0.7797*** (18.86)
Constant	0.0007 (0.19)	-0.0115 (-1.62)	0.0108 (1.86)
R^2	0.0019	0.2437	0.8660
Observation	57	57	57
Thailand	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	-0.0106 (-1.12)	0.1080*** (2.79)	0.9026*** (23.5)
Constant	0.0017 (1.41)	-0.0076 (-1.54)	0.0059 (1.20)
R^2	0.0224	0.1243	0.9094
Observation	57	57	57
Vietnam	$\Delta \log(GDP_i^t) - \Delta \log(GNI_i^t)$	$\Delta \log(GNI_i^t) - \Delta \log(C_i^t)$	$\Delta \log(C_i^t)$
$\Delta \log(GDP_i^t)$	0.0034 (0.04)	0.0525 (0.48)	0.9441*** (40.17)
Constant	0.0015 (0.12)	0.0002 (0.01)	-0.0017 (-0.20)
R^2	0.0001	0.0612	0.9136
Observation	28	28	28

Notes: The symbols ** and *** indicate significant at 5 and 1% level. t statistics in parenthesis.
Source: World Bank Databank

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