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The Impact of the Exchange Rate and Its Volatility on Output in Asia: The Role of Global Value Chains

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***Abstract*— As a consequence of global value chains (GVCs), the exchange rate and its volatility become more important in influencing the output of a country. An interesting question has surfaced that concerns the alteration of exchange rate effects toward output in the GVC context. This study tries to fill the research gap from previous studies to include research that directly examines the impact of participation in GVCs on output in a region with similar exchange rate schemes. This study aims to investigate the relationship of the exchange rate and its volatility on output, and also explores the impact of GVC participation on output. We employ panel data that covers five countries in Asia, including Indonesia, Thailand, Japan, South Korea, and Malaysia, with annual data series through 1990-2015. The analytical method used in this study is the econometric approach with system generalized method of moment (SYS-GMM) approach. The result reveals that, first; the exchange rate volatility has a negative relationship to output; second, the exchange rate appreciation is found to increase output significantly; and third, an increase in GVC participation significantly leads to increased output. Therefore, the impact of exchange rate on output depends very much on the GVC pattern in respective country.**

Keywords*— *Exchange rate; exchange rate volatility; global value chains; output; system generalized method moment

I. INTRODUCTION

In a climate of economic openness, exchange rate movements cause the prices of goods and services to rise and fall, affecting countries' export-import activities. Depreciation makes domestic prices cheaper abroad and prices of imported goods or services more expensive [1]. This is consistent with conventional theory and perspective on international trade: that exchange rate depreciation leads to an increase in a country's net exports, which eventually increases the output of an economy. However, in the context of the global era, several studies have found that depreciation may decrease exports and increase imports. This paradox is thought to be the result of economic openness, technological development, and the ease of communication and information access that encourage fragmentation in the process of producing goods and services across countries, known as global value chains (GVCs).

Under GVCs, goods and services are no longer produced from beginning to end in a single country; rather, they are traded across boundaries in intermediate form. This activity represents 56 percent of total merchandise trade and 73 percent of total service trade [2]. In GVCs, imports represent foreign value added (FVA) used as domestic value added (DVA) complementary inputs in exports production. The integration in the global production process means that currency depreciation only increases the competitiveness of the part value of final goods exports; subsequently, the greater the participation of a country in GVCs, the lesser the elasticity of its real exchange rate [3, 4]. Other than that, exchange rate volatility has a negative impact on trade flows [5]. The level of exchange rate misalignment also affects the pricing strategy of companies involved in international trade and global production networks, in the short run. The impact depends on a number of factors, one of which is the level of economic integration between countries.

A country's export-import activity as part of a GVC is closely related to the exchange rate because of the interaction between foreign and domestic economies; this ultimately affects the country's output, for instance, increased volatility and uncertainty of the real effective exchange rate (REER) had a negative and significant effect on export demand, both in the short run and the long run [6], and an appreciation of China's currency, the Renminbi, decreased Chinese imports from other Asian countries [7]. The trend of GVCs has important macroeconomic implications [8]. First, it helps increase interconnectedness among countries. Second, it alters the relationship between exchange rate movements and competitiveness, because in a GVC, an imported intermediate good is an input to exports. The effect of a change in the exchange rate on internal trades may vary and be strengthened, depending on a transaction's economic position in a GVC. This shows that there is indeed a certain relationship between the exchange rate, its volatility, and trade, which eventually affects output, as well as the paradox of exchange rates that arise in GVCs. Thus, this topic is very interesting and calls for investigation.

This study tries to fill the research gap of previous studies. To our knowledge, there has been no research that directly examines the impact of participation in a GVC on output at the country level. It is also quite rare to explore this phenomenon in a cohesive region. To address this gap, this research focuses on five major Asian countries that have a similar exchange rate system, in an attempt to sharpen the analysis. The selection of these five countries is also due to the availability of data covering the scope of research. This further research on this topic is to explore the facts and uniqueness that arise from each of the countries studied, so

that in the end, the findings can be used to provide a rational recommendation in policy making. Based on the background and the problems that have been presented, this study has three goals: first, to investigate the relationship between exchange rate and output; second, to investigate the effect of exchange rate volatility on output; and third, to explore the impact of GVC participation on output.

This research uses annual data from 1990 to 2015 for five countries in Asia, including Indonesia, Thailand, Japan, South Korea, and Malaysia, which all operate on a floating exchange rate system. The variables used are real gross domestic product, exchange rate volatility, REER, and GVC participation. We employ the GMM method to avoid the endogeneity problems that typically occur in panel data models. In addition, the GMM method can capture the dynamic nature of the relationship of economic variables. Hereinafter, this paper is organized as follows. Section 2 discusses the theoretical review and previous findings related to the research topic and the frame of thought. Section 3 discusses the research methodology, including detailed data, variable descriptions, and analytical technique. Section 4 presents the stylized facts and empirical results. Section 5 presents the concluding remarks, policy implications, and recommendations.

II. Literature Review

A. Theoretical Review

Prior to empirically reviewing the impact of exchange rates on output in the global value chains (GVC), this subsection presents the underlying theories.

1) The Exchange Rate, Volatility, and Output

The exchange rate or exchange rate is divided into two, namely the nominal exchange rate (e) and the real exchange rate (ε). The nominal exchange rate is the relative price of the two countries' currencies. The real exchange rate is the relative price of goods between the two countries which equal to nominal exchange rate times the ratio of domestic price level on foreign price level (P/P^*) [9]. Mathematically, the meaning of the real exchange rate can be written with the following equation:

$$\textit{Real Exchange Rate} = \frac{\textit{Nominal Exchange Rate x Domestic Price}}{\textit{Foreign Price}} \quad (2.1)$$

$$(\varepsilon) = (e) \text{ x } (P/P^*) \quad (2.2)$$

The real exchange rate used in this study is the multilateral exchange rate or so-called as the Real Effective Exchange Rate (REER). The Real Effective Exchange Rate (REER) can be interpreted as the weighted average of bilateral exchange rate adjusted to relative consumer price. It can be written as follows:

$$REER_i = \prod_{j=1}^{N} \left(\frac{e_i}{e_j} \; x \; \frac{P_i}{P_j}\right) \wedge w_j \quad (2.3)$$

with j =1, …, N. Where $REER_i$ is the Real Effective Exchange Rate of origin country i; e_i is the nominal exchange rate of the country of origin i against USD; e_j is the foreign exchange rate j against USD; P_i is the price level of country of origin i; P_j is the price level of country of origin j; w_j is the bilateral trade-weight country of origin i with trading partner j; N is the number of competitor countries in the trading partner of reference group [10].

Meanwhile, The exchange rate has volatile nature and its volatility varies considerably; it depends on the exchange rate system, the monetary policy, and the expectations of other macroeconomic variables. Exchange rate volatility can be defined as the standard deviation of the exchange rate (S) divided by the average exchange rate ($\overline{X}$), which can be written mathematically as follows:

$$\textit{Exchange Rate Volatility} = \frac{\left(\sqrt{\frac{\sum_{i=1}^{n}(X_i-\overline{X})^2}{n-1}}\right)}{\overline{X}} \quad (2.4)$$

Countries that operate with flexible exchange rates, such as Indonesia, Thailand, Japan, and Korea are expected to have more volatility than countries under a fixed exchange rate system.

When the real exchange rate is depreciated, domestic prices become relatively cheaper abroad and foreign prices are relatively more expensive, thus it will increase the net exports [1, 8]. The relationship between the real exchange rate and net exports can be written as follows:

$$NX = NX(\varepsilon) \quad (2.5)$$

where net export (NX) is a function of the real exchange rate (ε). This equation shows that the real exchange rate is negatively related to the trade balance and output in the end. The condition can be inferred by the curve in Figure 1 below.

The way that changes in the real exchange rate affect trade balances and output can be described using what is known as the Marshall-Lerner condition. As mentioned above, real depreciation makes domestic goods relatively cheaper abroad. This leads to increased foreign demand for domestic goods, increasing exports. Real depreciation also makes foreign goods relatively more expensive in the country. This causes domestic demand for foreign goods to decrease, so imports decrease as well. The exports should be sufficiently increase and imports should be sufficiently decrease to offset the increase in import prices. If the condition is met, then real depreciation will increase the trade balance that ultimately affects output. This flow is simplified into the following equation:

$$\frac{\Delta NX}{X} = \frac{\Delta \varepsilon}{\varepsilon} + \frac{\Delta X}{X} - \frac{\Delta M}{M} \quad (2.6)$$

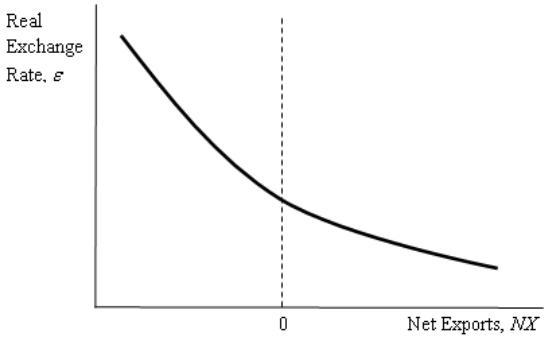


Fig 1. Net Exports and Real Exchange Rate

where *NX* is the balance of trade / net exports; ε is the real exchange rate; *X* is export; *M* is import [11]. Based on equation 2.6, the Marshall-Lerner condition is met if the sum of the right-hand side of the equation is positive, which means real depreciation increases the trade balance. The effect of the exchange rate on the trade balance as described in the Marshall-Lerner condition flow takes time. There are so-called dynamics, where exchange rate changes such as depreciation, indirectly responded by an increase in the trade balance, but result in a temporary decrease in the trade balance and contraction of output. This is because consumers need time to realize that there has been a change in relative prices and shift to cheaper ones. Over time, consumers will adjust and ultimately depreciate the trade balance. The dynamics can be explained by the curve in Figure 2 below.

J-Curve shows the dynamics of adjusting trade balance in response to exchange rate changes, for example in this case is real depreciation. The OA point shows the position of the trade balance deficit prior to depreciation. It can be seen that initially depreciation increases the deficit to the point of OB. Then over time, exports increase and imports decrease, reducing the deficit. In the end, assuming the Marshall-Lerner condition is met, real depreciation increases the trade balance beyond its initial position.

1) Global Value Chains (GVC)

Global value chains (GVCs) are networks of interrelated production operations in the process of producing goods and services across countries. Generally, a GVC involves the combination of imported intermediate goods and domestic goods and services into products that are then exported to be used as intermediate components in later production stages [8]. Therefore, GVC participation defined as a form of integration of international trade [12]. In line with this, there has been developed a measuring tool known as the GVC participation index to gauge how far an economy is involved in GVCs [13]. In essence, the GVC participation index is the ratio of FVA components in domestic gross exports (gross exports / EXP); this is referred to as backward linkage (BL). When considering intermediate components produced domestically that become part of output in other countries, it is referred to as forward linkage (FL).

Domestic value added (DVA) is constructed from the sum of three subcomponents: direct domestic value added content of gross exports, indirect domestic value added content of gross exports, and re-imported domestic value added content of gross exports. Meanwhile, FVA is estimated by interpolating foreign added value and intermediate import growth. Mathematically, the definitions can be written as follows:

$$GVC\_FL = \frac{DVA}{EXP} \tag{2.7}$$

$$GVC\_BL = \frac{FVA}{EXP} \tag{2.8}$$

$$GVC\_Participation = \frac{DVA+FVA}{EXP} \tag{2.9}$$

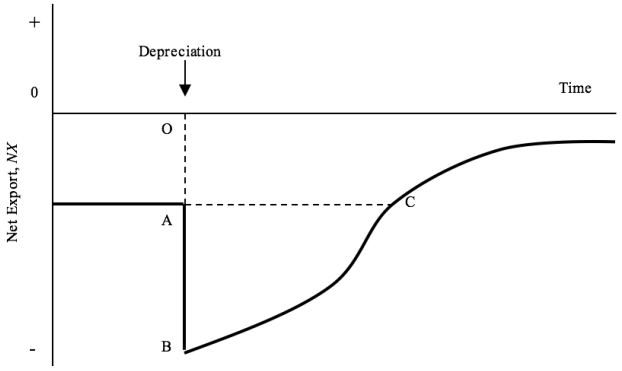


Fig 2. The J-Curve

B. Previous Findings

The paradox of exchange rates in GVCs is becoming an increasingly popular topic in some countries. One of the prior studies investigated the exchange rate elasticity to export-import in GVCs in 57 emerging market countries. It separately identified the impact of exchange rate changes on DVA and FVA for trades in GVC, and trades that are not in GVCs [7]. Then examined the effect of REER changes on the real trade balance. The result showed that real appreciation reduces the export of DVA and also the imports of FVA, while real depreciation increases the export of FVA and DVA. The size of the exchange rate elasticity is found to be smaller when the imported content for exports to GVCs is greater. In another study, under Marshall-Lerner conditions, real exchange rates remain an effective tool in influencing real output. Through exploring how the GVC formation affects the exchange rate elasticity of exports, it was found that GVC participation reduced the REER elasticity of exports in 46 countries, including Indonesia [3, 4]. The distinction is in the research coverage; it focused only on manufacturing exports because of the importance of cross-country linkages in the sector. Meanwhile, if examined in terms of volatility using the daily spot rate and adding new variables—the uncertainty of foreign revenues, the effect of exchange rate volatility on trade flows is not linear, depending on its interaction with the economic volatility of the importing country. The variation greatly depends on the country's partner [14].

The findings make this issue even more important, especially for countries that switch from a fixed exchange

rate to a floating exchange rate regime. The previous study regarding the impact of exchange rate volatility on the export of eight Latin America countries that adopted the floating exchange rate regime [6], revealed that increased in REER volatility and uncertainty have a negative and significant effect on export demand, both in the short and long term. Moreover, from the study of the impact of exchange rate uncertainty on bilateral exports from six European countries to the United States [15], found that exchange rate volatility has a negative relationship with trade, robust and significant inter-sector affects in 22 industries, especially in the export of differentiated goods.

Specifically, four kinds of short-term and long-term exchange rate volatility in intra-Asian trade on intermediate goods at the industry level results showed that exchange rate volatility has a negative and significant impact only on the general machinery industry and parts of the electric machinery industry with more differentiated products [16]. The different effects of exchange rate volatility in those industries are closely related to the characteristics of the goods traded in each industry. Furthermore, by decomposing the gross bilateral trade using the Global Input-Output table to explore how and to what extent a GVC affects the relationship between exchange rate volatility and trade in the Asian region [17], revealed three main things. First, exchange rate volatility has a negative effect on exports, but the effect is very small. Second, GVC participation reduces the negative impact of exchange rate volatility on exports, even up to 84 percent of manufacturing exports. Third, if a country's GVC participation exceeds a threshold, exchange rate volatility will have a positive effect on the country's exports. In addition, in the study concerning the importance of GVC participation in a country, which examined the impact of GVC participation on firm-level productivity in Canada. The result showed that the companies which participate in GVC are larger and it showed a positive and significant relationship towards their productivity [18].

Among the eight studies mentioned above, there are similarities between them, although those studies had difference scopes. They used REER to examine the exchange rate volatility on exports and imports. Some found that the exchange rate volatility has a negative effect on exports, and others found a relationship between REER's elasticity and GVC. However, there are also several distinctions. Some used different proxy variables, each of which has advantages in the distinction of data interpolation and extrapolation techniques, as well as in constructing the variables in the model. Besides that, the used of econometrics approach is also quite diverse, including, GARCH as the most common model in testing volatility [14], the combination of ARCH and ECM methods [6], the combination of the gravity model, ARCH, and OLS [16], dynamic panel with two-step system GMM [17], static panel with fixed-effects model [3, 7, 15], and the combination of propensity-score matching and difference-in-difference regression [18].

III. METHODOLOGY

A. Research Method

This research used secondary data obtained from the WB World Development Indicators, the Bank for International Settlements, and the 2016 release of OECD TiVA Database. The dataset contains annual time series data from 1990 to 2015 and cross section data of five countries in Asia: Indonesia, Thailand, Japan, South Korea, and Malaysia. All of the variables were converted into a natural logarithm. A detailed explanation of the data can be seen in Table I.

B. Analytical Technique and Data Analysis

This research employed an econometric approach with the generalized method of moment (GMM) method developed by Arellano and Bond (1991). This dynamic panel model allows the researcher to enter the lag of the dependent variable as a regressor in the regression, to reflect the fact that there is a dynamic relationship between economic variables. The use of the GMM method is expected to capture the dynamic nature of trade [17]. Moreover, although the error term is not correlated, if there is a lag of dependent variable in the pooled least squares (PLS) model, fixed effects (FE) and random effects will produce a biased and inconsistent estimator [19]. Therefore, the GMM method is selected in this research to avoid the endogeneity problems that typically occur in panel data models.

TABLE I. VARIABLES AND DATA SOURCES

No	Variables	Descriptions	Sources
	Dependent Variable		
1	*LnRGDP*	Real Gross Domestic Products as a proxy of real output (constant 2010 US$)	WB WDI
	Independent Variables		
2	*LnVOL*	Standard deviation divided by yearly average of Real Effective Exchange Rate as a proxy of exchange rate volatility (indices)	BIS Statistics (Processed)
3	*LnREER*	Real Effective Exchange Rate as a proxy of exchange rate (indices)	BIS Statistics (Processed)
4	*lnPGVC*	Sum of Domestic and Foreign Value Added divided by Gross Exports as a proxy of Global Value Chains participation (indices)	OECD TiVA Database (Processed)

C. Generalized Method of Moment (GMM)

There are two estimation procedures commonly used in a dynamic panel framework using the GMM approach: the first differences GMM and the systems GMM.

Here are some of the criteria used to find the best GMM model: (1) the model is unbiased, meaning the estimator is between a biased upwards PLS estimator and biased downward FE estimator, (2) it has a valid instrument, meaning that the Sargan Test does not reject the null hypothesis, and (3) it is consistent, meaning that the obtained estimator can be statistically checked [20].

The specification of empirical model is estimated as follows:

$$Ln\,RGDP_{i,t} = \beta_1\,Ln\,RGDP_{i,t-1} + \beta_2\,Ln\,VOL_{i,t} + \beta_3\,Ln\,REER_{i,t} + \beta_4\,Ln\,PGVC_{i,t} + \varepsilon_{i,t} \quad (3.1)$$

Where i = 1,..., N and t = 1,..., T. $LnRGDP_{i,t}$ is the dependent variable. $LnVOL_{i,t}$, $LnREER_{i,t}$, and $LnPGVC_{i,t}$ are the independent variables. The variables in the equation are selected based on previous studies on related topics. We adopted the procedure to construct the GVC participation indices as defined in Section 2, then we extrapolated the indices for the years before 2000 and after 2011 [3, 17]. As well as we extrapolated the indices of REER and VOL for the years before 1995.

The parameters in Equation (3.1) were estimated using the FD-GMM model, followed by the SYS-GMM model, both one-step and two-step approach. By comparing the results of both approaches, the best estimation results were used to analyze the impact of each independent variable. In addition, the Sargan Test and Arellano-Bond Test (m_1 and m_2) were used to check the validity of the instruments and the consistency of the model. The null hypothesis for the Sargan Test states that there is no problem with the validity of the instruments, in the sense that the instruments are either not correlated with some sets of errors or there are no omitted variables in the model. The decision to not reject the null hypothesis supports the use of the model. Whereas, performing an autocorrelation test using Arellano-Bond statistic m_1 and m_2 determines if the model is consistent. This consistency is indicated by a significant statistical value of m_1 and an insignificant statistical value of m_2.

IV. Result and Discussion

A. Empirical Result

The estimation began with a regression of dynamic panel data using the FD-GMM approach. If the model in the first procedure did not meet the criteria of the best GMM model, which is to be unbiased, valid, and consistent, then the next step is to perform the estimation a SYS-GMM approach. Table II shows the estimation results of the SYS-GMM that met the best model criteria.

Table II show that the $LnRGDP_{i,t-1}$ variable has a positive and significant relationship to *LnRGDP*. That is, if there is a one percent increase in the current real output, *cateris paribus*, then the real output will increase by 1.837 percent in the next period. The *LnVOL* variable, which is a proxy of exchange rate volatility, has a negative relationship to *LnRGDP*, but it is not significant. This result is reasonable since it is in line with some of the previous findings which reveal that exchange rate volatility only has a negative and significant impact on the general machinery industry and parts of the electric machinery industry [16]. In addition, exchange rate volatility has a negative, but very small, effect on exports [17]. As is known theoretically, net exports and output have a positive relationship; therefore, it makes sense if the increase in exchange rate volatility decreases exports will lead to a decrease in the real output. If the effect is very small on exports, it reduces the effect on the real output as well.

TABLE II. ESTIMATION RESULT

Variable	Coefficient	
	FD-GMM	SYS-GMM
$LnRGDP_{i,t-1}$	1.864524**	1.836684**
	(0.037)	(0.035)
$LnVOL_{i,t}$	-0.0457862	-0.042911
	(0.388)	(0.419)
$LnREER_{i,t}$	0.7793757**	0.7790982**
	(0.029)	(0.022)
$LnPGVC_{i,t}$	19.43501 (0.072)*	20.05503 (0.073)*
AB Test		
m_1	1.6119	2.0494**
	(0.107)	(0.0404)
m_2	0.3266 (0.744)	0.27475 (0.7835)
Sargan Test		
Chi2	0.7470603	0.7674549
Pob>Chi2	(1.0000)	(1.0000)

Notes : *, **, *** are respectively 10 percent, 5 percent, and 1 percent significance level. ( ) probability.
Source : Data processed

The *LnREER* variable, which is a proxy of the exchange rate, has a positive and significant relationship to *LnRGDP*. This means that if there is an increase in an exchange rate or appreciation by one percent, *cateris paribus*, the real output will increase by 0.779 percent. This finding confirms, the alteration of exchange rate effects toward output in today's climate of GVCs, which is inconsistent with the theory of exchange rates, that appreciation should increase imports and eventually decrease the real output. Intuitively, this might have happened because some countries in this study, such as Thailand, Japan, and Korea, have a greater backward participation in GVCs dominated by downstream activities; they produce export goods with many imported components, that are raw or intermediate components. Likewise, Indonesia and Malaysia are also involved in backward participation in global value chains, for instance, Indonesia in the mining and basic metal industry and Malaysia in the computers and electronics and food and beverage industries. Thus, real appreciation does not necessarily decrease output, because the cost of producing exports that contain import components decreases (or imports cost less to buy) because the relative price of foreign goods in terms of domestic goods decreases, pushing up exports in return, so that the real output increases.

In line with the analysis of the previous study that examined the impact of the exchange rate on output at the sectoral-specific levels in Indonesia, where a one percent depreciation of the exchange rate, *cateris paribus*, led to a decrease in the output of the manufacturing sector. That was owing to the manufacturing sector's intensive dependence on import components [21]. This is also confirmed in the prior study that used imports as the export determinant in describing the model as a simultaneous problem, which then reformulated the Marshall-Lerner condition as an alternative model because the theory is not always suited to the actual circumstances of the open economy, in which many industries import intermediate goods and then export the

final goods [22]. Briefly, it can be said that real appreciation followed by a larger increase in exports will eventually improve the trade balance and output.

The *LnPGVC* variable has a positive and significant relationship with *LnRGDP*. If there is an increase in global value chains of one percent, *cateris paribus*, then the real output will increase by 20.055 percent. In line with the study towards the impact of GVC participation on firm-level productivity in Canada. It revealed that the firms that participate in GVC are larger and have positive and significant relationship to their productivity [18]. Moreover, this finding is also in accordance with one of the eight GVC objectives in KEIN, that is increasing state revenues [23].

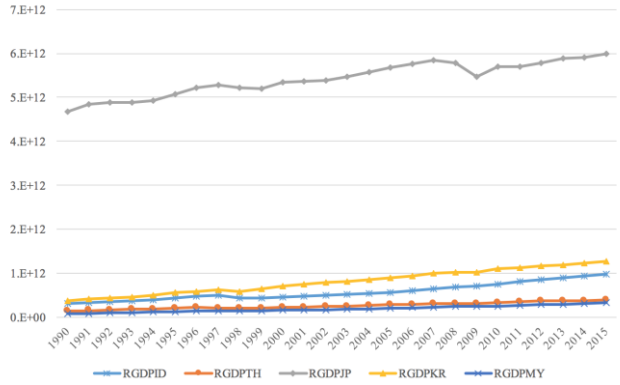
The magnitude of *PGVC* coefficient indicates that there is a great distinction between the value of this variable and the value of other variables in the datasets. It also may indicate that the greater the country's participation in GVC, the better the increase in real output. However, the data shows that it is very difficult to reach one percent increase of GVC participation, then of course the right strategy and extra effort is really needed.

B. Stylized Facts

In this subsection, the analysis is aimed to observe the movements and trends of each variable in each country over the period 1990-2015.

Figure 3 is a graph of real gross domestic product used as proxy of output in Indonesia (ID), Thailand (TH), Japan (JP), Korea (KR), and Malaysia (MY). During the period of 1990-2015, the trend of output in Indonesia, Thailand, Japan, Korea, and Malaysia were positive. As shown in Figure 3, Japan has the highest output among the observed countries: 470 billion USD in 1990 (the first year of the study period). Japan is the leading economy in both aggregate and per capita terms in East Asian: the GDP of Japan is larger than the total GDP of all of the other East Asian economies [24]. Korea is second at 380 billion USD, Indonesia is third with 310 billion USD, Thailand is fourth with 140 billion USD, and Malaysia is fifth among the group at 82 billion USD. Those five countries experienced an increase in output year after year, but declined sharply in 1998, due to the Asian financial crisis shocks at that time. A study gave empirical data indicating that crises negatively affected countries' economies, as illustrated by the effect of the financial crises on Asian countries in 1997-1998 [25]. The weakening of the exchange rate made imported goods, such as raw materials, capital goods, and consumer goods more expensive and resulted in an increase in the price of goods in the country. In addition, the weakening of the exchange rate resulted in increased foreign debt obligations. Companies' and banks' balance sheets worsened. Therefore, the crisis not only caused prices to soar, but also resulted in a considerable contraction in the economy as reflected in countries' output.

In the post-crisis period, the output of those countries showed fairly stable improvement. Interestingly, only Japan and Malaysia experienced a decline in the next global crisis in 2008 – 2009, which called the worst crisis of the past eight years or "*the mother of all crises* [26]. This was due to a steep fall in Japan's foreign demand, a shift in global demand, and the impact of Yen appreciation that led to lower net exports. Japan specializes in the production of high-end goods and exports key components to developing countries that export final products to the US [27]. Then, with the sudden decline in US imports during the global crisis and a shift in consumer demand from pricey items to more affordable items, Japan's exports suffered a fairly sharp decline. Likewise, Malaysia has a very open economy that is highly dependent on trade. Its total exports and imports is two times its national gross domestic product [28] Therefore, it is understandable that a decline in the demand of a major trading partner, such as Japan, the US, or the EU, would cause Malaysia's exports to slip along with its entire economy, as seen in the 2008-2009 crisis.



Source : World Development Indicator, World Bank

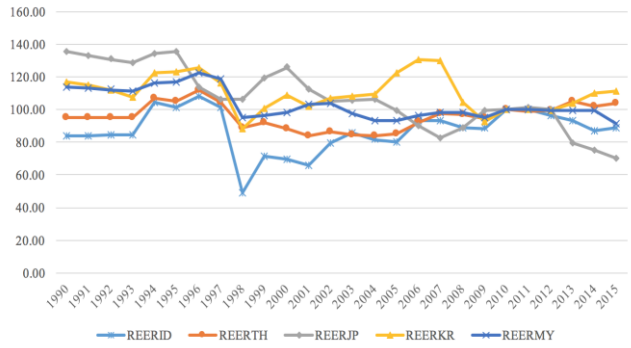
Fig 3. Real Gross Domestic Product (RGDP)

Figure 4 describes the exchange rate movement in Indonesia (ID), Thailand (TH), Japan (JP), Korea (KR), and Malaysia (MY), proxied by the real effective exchange rate (REER) indices from the Bank for International Settlement. These are calculated as weighted averages of bilateral exchange rates adjusted by relative consumer prices, where an increase of the index indicates appreciation and vice versa[1]. REERID showed a more stable movement in the 1990-1997 period when Indonesia used a managed floating exchange rate, then REERID suffered a sharp depreciation in 1998 due to the Asian crisis. In the post-crisis period, REERID appreciated with more fluctuating movements after Indonesia implemented a floating exchange rate system its currency, the Rupiah, which is determined by market mechanisms. REERTH also suffered depreciation during the Asian crisis due to the large deficit in current accounts. The reason that Thailand was the first Southeast Asian country to collapse during the financial crisis was because Thailand was too receptive on foreign investment. In the aftermath of the crisis, the government has restructured the financial sector that led to the less-volatile appreciation its currency, the Baht [29]. In 1998, the Asian crisis also hit the REERMY, causing a steep fall, which then caused Malaysia to switch to using a pegged exchange rate system. Meanwhile, depreciation in 2015, was due to the implementation of goods and services taxes. In contrast, Korea was one of the last countries hit by the financial crisis[2], Korea's won was the last currency depreciated; after other Asian currencies were devaluated, the REERKR could not maintain its position. Notably, the

[1] BIS. (2017). Effective Exchange Rate Indices. Retrievied from https://www.bis.org/statistics/eer.htm [Accessed on November 207].

[2] Gidwani, K. *Korea and the Asian Financial Crisis*. Retrieved from https://web.stanford.edu/class/e297c/trade_environment/global/hkorea.html [Accessed on October 2017].

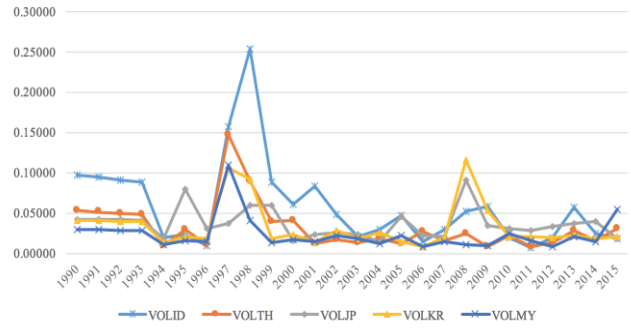
REERJP was the only rate that experienced a negative trend throughout the study period. The Japanese yen lost its value after Japan performed quantitative easing.



Source : Bank for International Settlement Statistics (Processed)

Fig 4. Real Effective Exchange Rate (REER)

Figure 5 shows the exchange rate volatility (VOL) of Indonesia (ID), Thailand (TH), Japan (JP), Korea (KR), and Malaysia (MY). The values of VOLID and VOLTH during the Asian crisis of 1998 were very high compared to the other countries and were considerably volatile after the crisis. On the other hand, VOLJP showed very volatile movements of moderate values throughout almost the entire study period. Comparatively, the value of VOLKR was very high only during the crises of 1997-1998 and 2008-2009 and the value of VOLMY was very high only during the Asian crises and in 2015 when the exchange rate was depreciated.



Source : Bank for International Settlement Statistics (Processed)

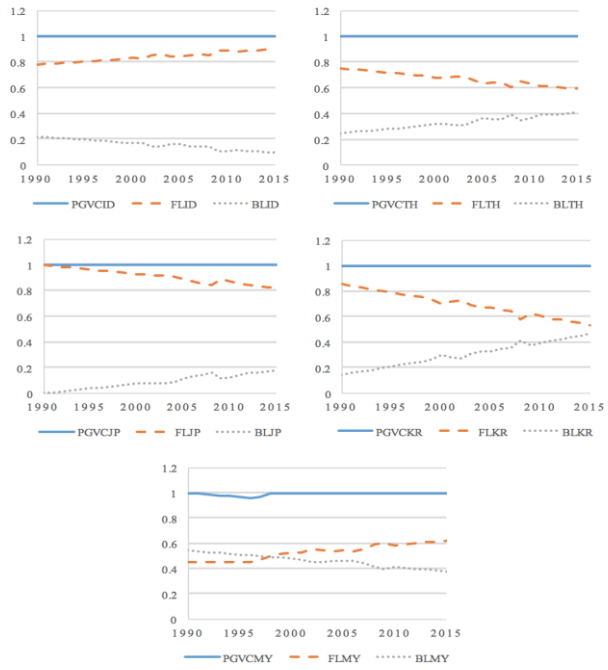
Fig 5. Volatility of the Real Effective Exchange Rate (VOL) in Five Asian Countries

The last variable is global value chain participation (PGVC) in Indonesia (ID), Thailand (TH), Japan (JP), and Korea (KR) as illustrated in Figure 6. Participation in global value chains (PGVC) is constructed from two elements, namely forward linkage participation (FL) and backward linkage participation (BL). Based on the data shown in Figure 6, all five countries have greater FL than BL. This means the participation of those five countries is dominated by upstream activities, in which other countries extensively use those countries' raw or intermediate goods to create their exports.

Based on the data, Indonesia and Malaysia have the same characteristics in GVC participation, where the tendency of BL decreased and FL increased. This shows that their PGVC was mainly driven by upstream activities, which grew over time. In Indonesia, the mining industry and wholesale trade are the two industries most involved in GVC through their upstream activities, as for downstream activities dominated by the mining industry, basic metals and chemical products [23, 30]. Whlist the two Malaysian industries most involved in GVC through upstream activities are the mining industry and wholesale trade industry, as for the downstream activities are dominated by the computer and electronic industry and the food and beverage industry. Another significant difference was that at the beginning of the study period, Malaysia's backward linkage participation was greater than its forward linkage, this might be because in the early 1990s, Malaysia was emphasizing the growth of the computer and electronic industry [31], where generally requires a lot of foreign input for its downstream activities so that its participation in backward linkage is greater.

On the other side, PGVC by Thailand, Japan, and Korea have been mainly driven by downstream activities through the use of imported raw or intermediate components from third countries as inputs to produce their exports.

Where the computer and electronics industry and the motor vehicle industry are the two industries most involved in GVC through downstream activities in Thailand and Japan. As for upstream activities, Thailand is dominated by the wholesale trade industry and agriculture industry, while Japan is dominated by the trade industry and the computer and electronic industries [30]. The computer and electronics industry and the petroleum industry are the two industries most involved in GVC through downstream activities in Korea. While the trade industry and the computer and electronic industry are most involved through upstream activities [30].



Source : OECD Trade in Value Added Database (Processed)

Fig 6. Participation of Global Value Chains (PGVC) in Five Asian Countries

Countries that are increasingly involved in forward linkage participation are countries that are still dominated by

the primary sector. Conversely, countries that are increasingly involved in backward linkage participation are countries dominated by the secondary sector. This is because the primary sector does not use many foreign inputs compared to the secondary sector [32].

V. CONCLUSION

A. Concluding Remarks and Policy Implications

This study has three main conclusions. First, the exchange rate volatility in sample countries—Indonesia, Thailand, Japan, South Korea, and Malaysia—has a negative relationship to output. Second, appreciation of the exchange rate significantly increases output in GVCs. Third, increasing GVC participation significantly leads to increased output. Therefore, the impact of the exchange rate on output depends very much on the GVC pattern of respective country.

Furthermore, these findings have several policy implications. Since the regions follow a floating exchange rate regime and the exchange rate significantly affects output, the central bank in each country must maintain a stable exchange rate. Besides, since GVC participation significantly affects output, the government and the related policymakers should work to improve the quality of institutions and deepen trade integration.

B. Recommendations

Based on these findings and their policy implications, there is a need for exchange rate cooperation to support financial integration and stability, and to reduce dependence on certain currencies, as well as the risks of global uncertainty. The central bank and the government also need to coordinate in maintaining the inflation rate so that the exchange rate remains stable. The central bank must maintain the demand and supply of foreign currency by controlling the use of foreign currency in exports, imports, and capital flows. Moreover, governments and the related policymakers have to strengthen trade integration by standardizing tariff and non-tariff policies to increase GVC participation. In addition, since this study found that GVC participation has a significant impact on output, hence for further research is expected to be able to examine what factors are significant to boost GVC participation. Furthermore, if possible, make the time panel (divided into certain periods) to explore the development of GVC participation and how it impacts output over time.

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