

Kang, Jong Woo

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# INTERNATIONAL TRADE AND EXCHANGE RATE

*Jong Woo Kang*

**NO. 498**

October 2016

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WORKING PAPER SERIES**

ADB Economics Working Paper Series

## International Trade and Exchange Rate

Jong Woo Kang

No. 498 | October 2016

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## ABSTRACT

Tepid trade growth since the 2008/2009 global financial crisis (GFC) has been partly attributed to sluggish demand from developed countries. However, data reveals that developing countries play a bigger role in holding back trade growth, while developed countries show quite robust import growth. Post-GFC, the exchange rate volatility has grown significantly. As decomposition of country groups by changes in currency valuation shows, however, local currency depreciation is not contributing to export growth as much as conventional wisdom dictates. On the other hand, countries with appreciating currencies show rising import intensity and significant export growth. This implies that the more countries undergo currency devaluation—the deeper the degree of devaluation and even competitive devaluations—the more likely international trade will grow slower.

*Keywords:* gravity model, real effective exchange rate, trade volume

*JEL codes:* C23, F10, F31



## I. INTRODUCTION

After a short period of quick recovery following the 2008/2009 global financial crisis (GFC), there have been protracted periods of slumping world trade growth. What bewilders policy makers and academia alike is that not only trade value has stagnated—significantly affected by volatile and low commodity prices, especially oil—but trade volume seems to have stagnated as well. Pre-GFC, global trade growth outpaced gross domestic product (GDP) growth—trade growth from 1990 to 2008 averaged 5.9%, while GDP grew 3.7%. Since the GFC, however, global trade volume growth averaged behind the global GDP growth (*World Economic Outlook 2015*, International Monetary Fund; *International Trade Statistics 2015*, World Trade Organization). Historically then, the GFC posits an important structural change in the pattern of global trade. Not only has the growth rate slumped, but the dynamics between what drives trade growth and how it responds has changed significantly from pre- to post-GFC.

One example is the effect of price movements in local currency. Depreciation would normally increase a country's exports and reduce imports due to changes in terms of trade and the effect of price elasticity of demand. Changes in trade volume should capture this effect better than trade value—by looking at the pure elasticity effect, excluding the short-term terms-of-trade effect. The linkage between exchange rates and trade has long been studied to investigate the impact of exchange rates and exchange rate policies in calibrating a country's external position as well as domestic economic stability. While much literature shows the significant impact in level and volatility of the exchange rate on trade, myriad research also points to some ambiguous or counterintuitive results when it comes to the impact on real rather than nominal trade.

Against this background, this paper examines whether structural changes have occurred in trade growth pattern pre- and post-GFC; and to what extent it can be explained by currency movements. In examining the latter, we also test the impact of exchange rate movements on trade volume to see if its impact changed pre- and post-GFC. The paper is organized as follows. Section II examines changing trends in trade growth during the 2000s, focusing on differences between developed and developing countries. Section III investigates the impact of exchange rates on trade growth through both factor decomposition methodology and empirical analysis, focusing on structural changes between pre- and post-GFC periods. Section IV concludes.

## II. CHANGING TRENDS IN TRADE GROWTH

### A. Trade Volume Growth

Fast growing trade suffered large fluctuations during the GFC period and began stagnating afterward. Thus, when examining trade growth trends during the 2000s, we need to compare pre- and post-GFC periods to discern any change in trade growth patterns. The export and import volume index—which captures annual trade growth—grew rapidly until 2004, when both export and import volumes surpassed 10% growth. But they began tapering in 2005, and dropped precipitously in 2009 in the midst of the GFC. Trade volume rose steeply in 2010 partly due to the base effect, but growth has stagnated since 2011. For 2001–2015, average annual export and import volume growth was 4.4% and 5% respectively, while growth was 2.4% and 2.1%, respectively for the period 2012–2015 (Figure 1).<sup>1</sup>

---

<sup>1</sup> Based on World Trade Organization trade value data, our 60 country sample—chosen by available real effective exchange rate (REER) data—cover some 91% of total world trade.

**Figure 1: Trade Volume**



Source: Author's calculation based on the World Trade Organization's trade volume index.

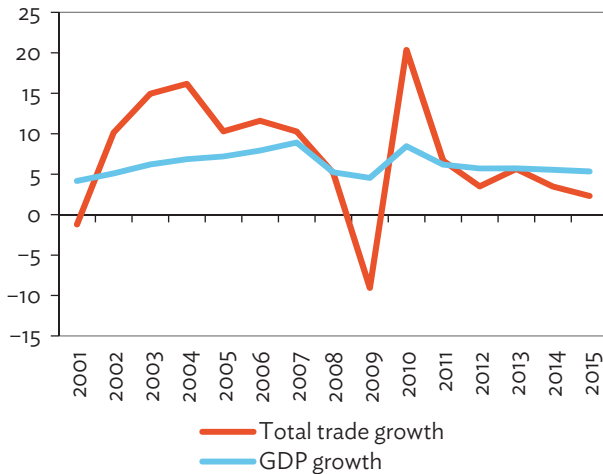
**Figure 2: Growth Difference (export-import)**



Source: Author's calculation based on the World Trade Organization's trade volume index.

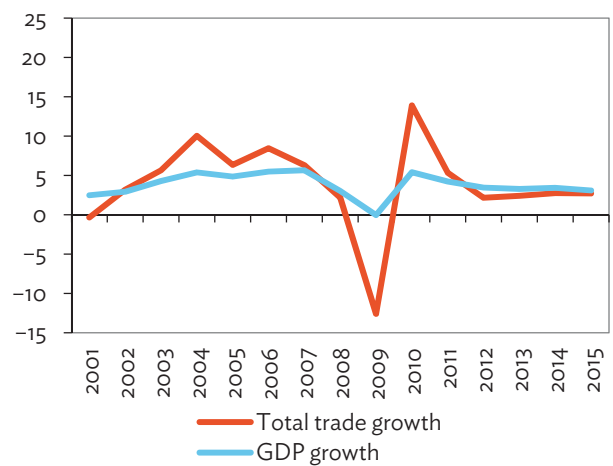
With the exception of 2000, 2001, 2009, and more recently 2013 and 2015, import growth exceeded export growth (Figure 2). And overall trade growth fell below economic growth beginning 2012. This phenomenon is more pronounced in Asia than the rest of the world, growing wider in 2015 (Figures 3 and 4).

**Figure 3: Asia**



GDP=gross domestic product.  
 Notes: GDP growth is weighted using GDP at purchasing power parity. Total trade growth is the average of export volume growth and import volume growth from the World Trade Organization.  
 Source: ADB calculations using data from *World Economic Outlook April 2016 Database*, International Monetary Fund and *International Trade Statistics 2015*, World Trade Organization.

**Figure 4: World**



GDP=gross domestic product.  
 Notes: GDP growth is weighted using GDP at purchasing power parity. Total trade growth is the average of export volume growth and import volume growth from the World Trade Organization.  
 Source: ADB calculations using data from *World Economic Outlook April 2016 Database*, International Monetary Fund and *International Trade Statistics 2015*, World Trade Organization.

Seemingly dramatic decline since 2012, however, is less pronounced if trade weight average By trade-weighted average—which gives a more accurate picture of trade growth trends—international trade grew in 2012–2015 not far below the 2001–2002 level. Volume jumped ahead in 2003 and maintained a moderate growth trend (in the 2%–4% range) until the GFC (Figure 5). With the exception of 2003 and 2004, export growth was consistently higher than import growth (Figure 6).

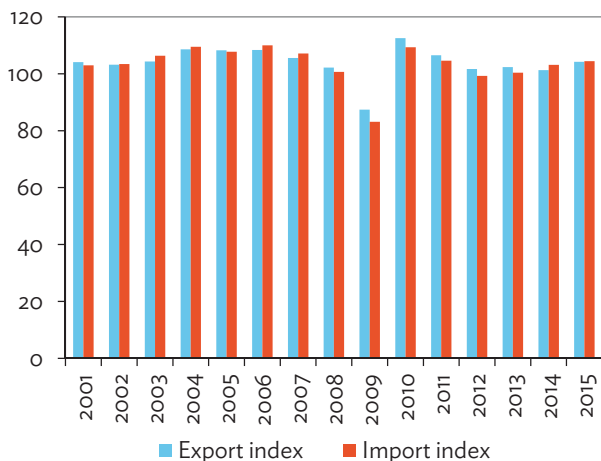


## B. Role of Developed and Developing Countries in International Trade<sup>2</sup>

It is widely believed the slump in international trade growth is largely due to weak demand from advanced economies. To test its accuracy, we can assess trade growth for developed and developing country groups separately. By both simple average and trade-weighted average, growth of exports and imports recovered in developed countries beginning 2013, while in developing countries it has remained stagnant (Figures 7 and 8). In developed countries, export and import trade-weighted growth averaged 2.1% and 1.8%, respectively during 2012–2015, against 2.8% and 2.4% for the entire 2001–2015 period (Figures 9 and 10). In contrast, developing country growth rates for exports and imports averaged 3.8% and 3.4%, respectively during 2012–2015, a more drastic decline in growth momentum compared with their respective 7.3% and 7.4% rates over the entire 2001–2015 period.

<sup>2</sup> Country classifications are based on the *World Economic Situations and Prospects 2014* report. Of the 60 economies in this sample, 36 are classified as developed economies and 24 are developing economies (see Appendix 1).

**Figure 7: Trade Volume Growth**  
(developed)



Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 8: Trade Volume Growth**  
(developing)



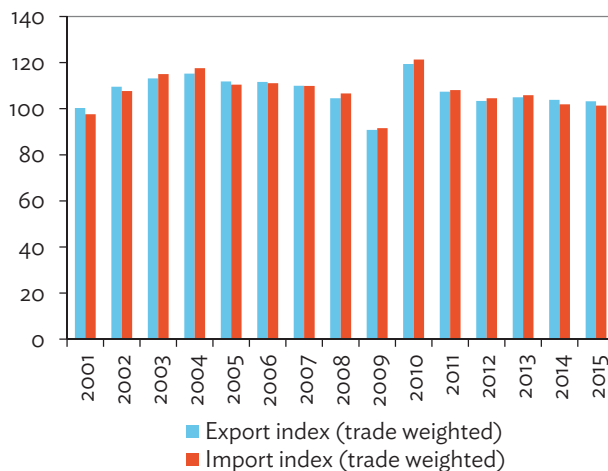
Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 9: Trade Volume Growth**  
(developed, trade weighted)



Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 10: Trade Volume Growth**  
(developing, trade weighted)



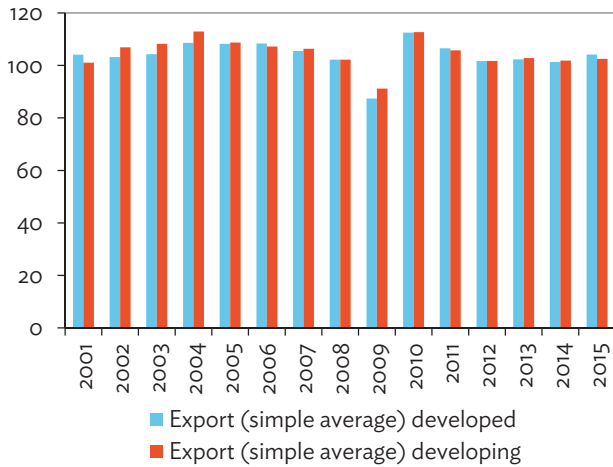
Source: Author's calculation based on the World Trade Organization's trade volume index.

The comparison between developed and developing countries becomes starker when placing export and import growth rates side by side. The gap in trade-weighted average export growth between developed and developing countries has narrowed since 2011—by 2015 the gap was less than one percentage point (Figure 11). For imports, developed countries have recovered more strongly (Figure 12). In trade-weighted terms, developed countries' average import growth surpassed

developing countries beginning 2014—and quite dramatically in 2015 (4.3% compared with 1.4% for developing countries [Figures 13 and 14]).

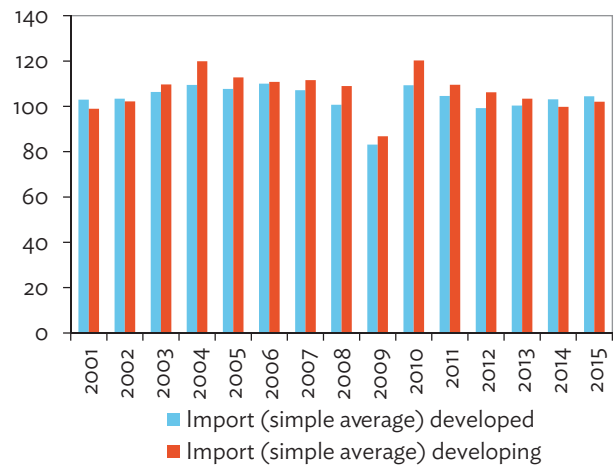
So attributing the slump in global trade growth to weak demand in developed countries does not jive with what is actually happening. The recent trade growth slump is increasingly due to sluggish trade growth in developing countries.

**Figure 11: Export Volume Growth**



Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 12: Import Volume Growth**



Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 13: Export Volume Growth (trade weighted)**



Source: Author's calculation based on the World Trade Organization's trade volume index.

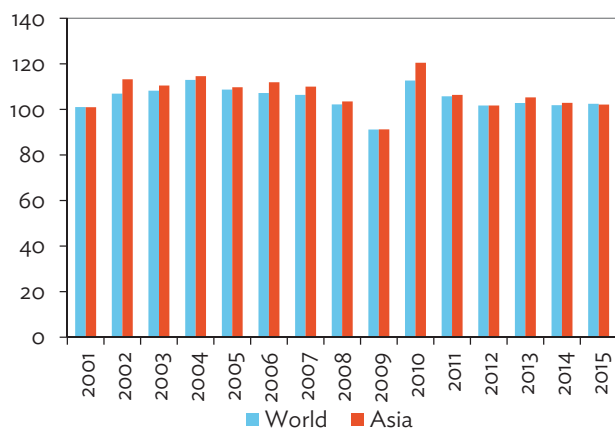
**Figure 14: Import Volume Growth (trade weighted)**



Source: Author's calculation based on the World Trade Organization's trade volume index.

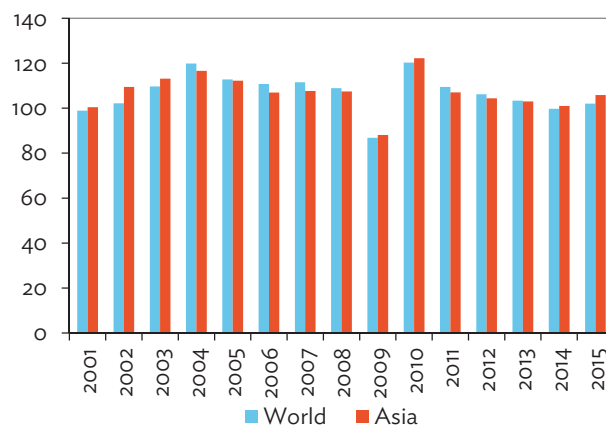
Now, let us see if developing Asia is faring relatively better in trade among the developing country group. It appears developing Asia indeed outperformed the developing world in the 2000s.<sup>3</sup> But trade performance is less pronounced since the GFC. This is particularly true in imports. While export volume growth remains higher in developing Asia than in the developing world overall, import growth has been almost the same and was even lower in 2012 and 2015 (Figures 15, 16, 17, and 18). Post-GFC, Asia's contribution to global trade growth has tapered quickly.

**Figure 15: Export Volume Growth**  
(simple average, developing world versus developing Asia)



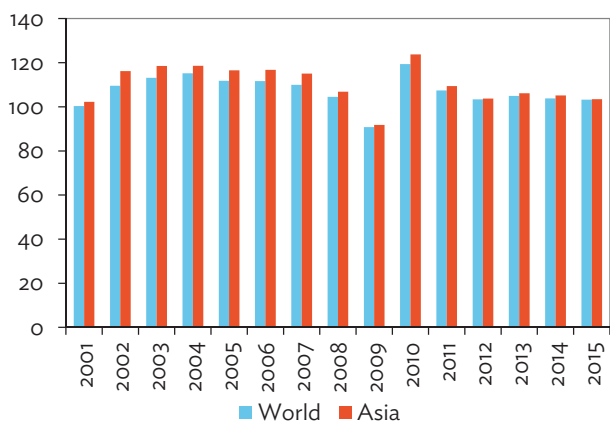
Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 16: Import Volume Growth**  
(simple average, developing world versus developing Asia)



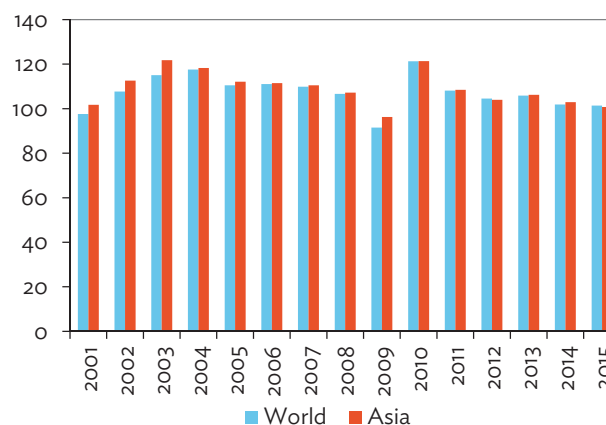
Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 17: Export Volume Growth**  
(trade-weighted average, developing world versus developing Asia)



Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure 18: Import Volume Growth**  
(trade-weighted average, developing world versus developing Asia)



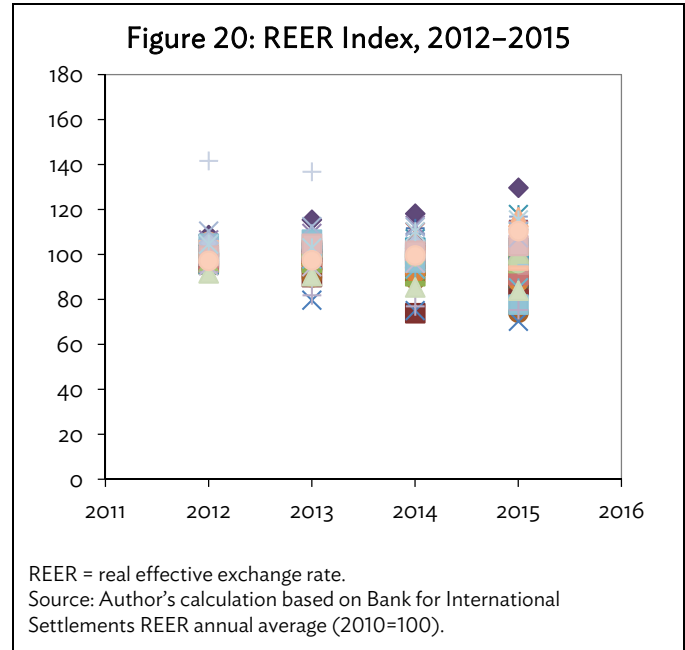
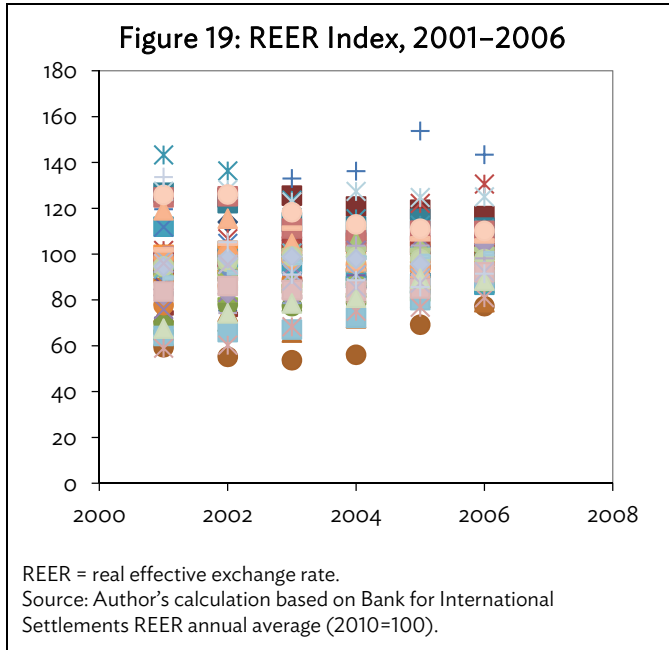
Source: Author's calculation based on the World Trade Organization's trade volume index.

<sup>3</sup> In our sample of countries with available REER data, developing Asia includes the People's Republic of China (PRC), India, Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand.

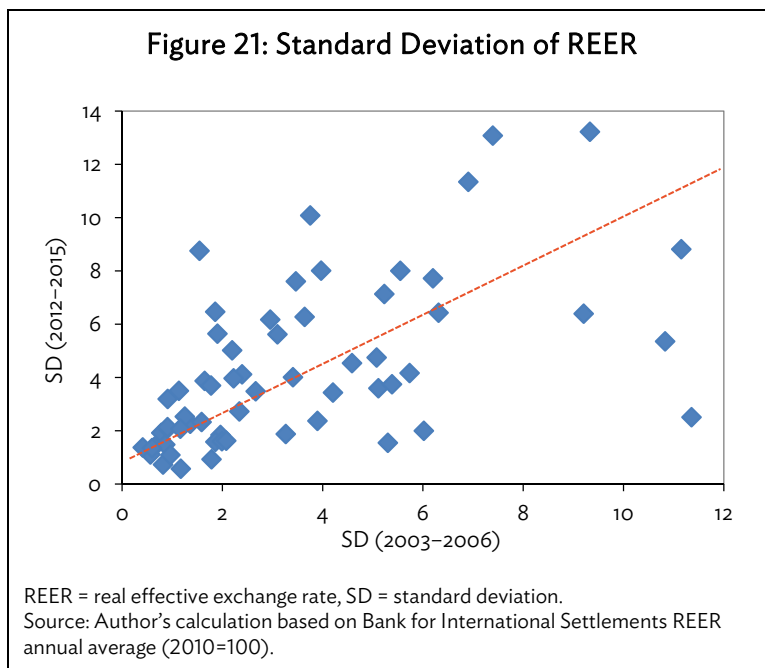
### III. IMPACT OF EXCHANGE RATES ON TRADE GROWTH

#### A. Exchange Rate Movements and Their Impact on Trade

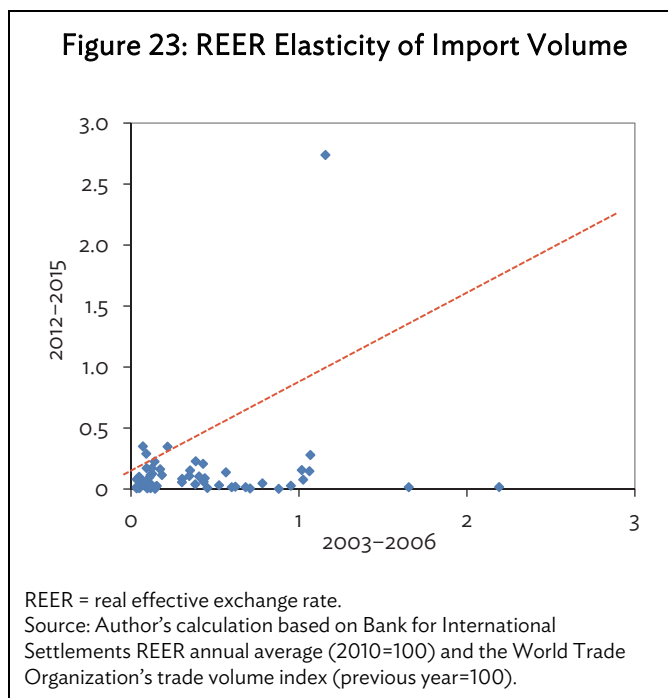
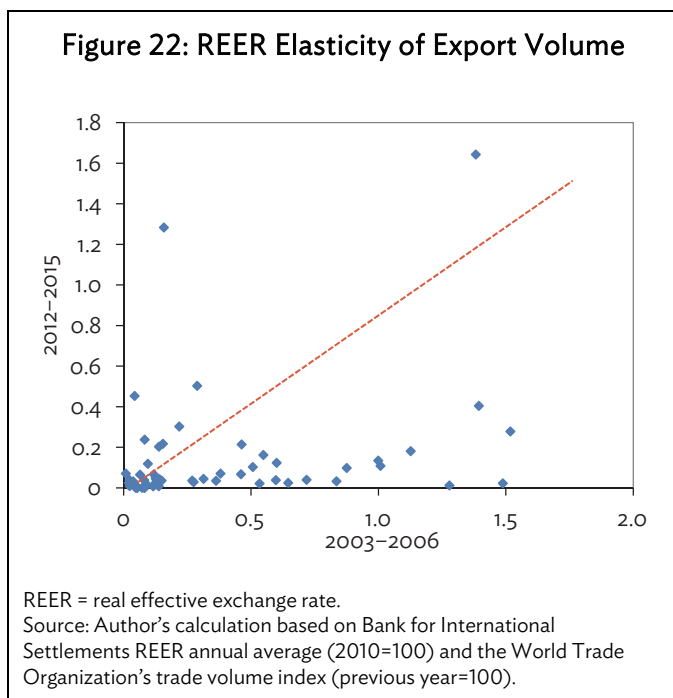
Analyzing the recent trade growth pattern—a slump in trade growth or convergence toward moderate longer-term growth rates—and comparing it with the pre-GFC period reveals some interesting changes in trade growth patterns. Given conventional wisdom—that exchange rate appreciation contributes to an increase in imports and decreased exports, with depreciation acting vice versa—we examine the average export and import growth based on whether countries experienced local currency depreciation or appreciation. First, we review the exchange rate movements since 2000 to see if there are different patterns between pre- and post-GFC periods. Examining exchange rate movements over time, we find that variations in real effective exchange rate (REER) movements across countries decreased pre-GFC (Figure 19). However, exchange rate variations across countries rapidly increased post-GFC (Figure 20). In fact, the standard deviation was as high as 37 for REER in 2015 (with 2010 as base year).



This also applies to exchange rate fluctuations over time within individual countries. When we consider the standard deviation of REER for 2003–2006 and 2012–2015, more countries experienced higher exchange rate fluctuations post-GFC than pre-GFC (Figure 21). This corroborates the observation that recent exchange rate movements have been unusually large.



On the other hand, the trade response to exchange rate changes has been smaller post-GFC. Many more countries had lower elasticity of both exports and imports with respect to changes in REER post-GFC than pre-GFC (Figures 22 and 23).



This posits the possibility that the effect of exchange rate changes on trade growth may have changed over time. So let us examine how exchange rate movements affected trade volume growth post-GFC compared with the pre-GFC period. When we look at trade-weighted average trade growth from 2001 to 2006, those experiencing REER depreciation showed an overall increase in both export



and import growth rates, except in 2005. And except for 2003, export volume growth was higher than import growth, supported by a depreciating REER (Figure 24). For those where REER appreciated, both export and import volumes grew, with import growth higher than export growth—basically in line with what would be expected (Figure 25). However, pre-GFC, the overall trend of export and import growth outweighed the impact of currency movements.

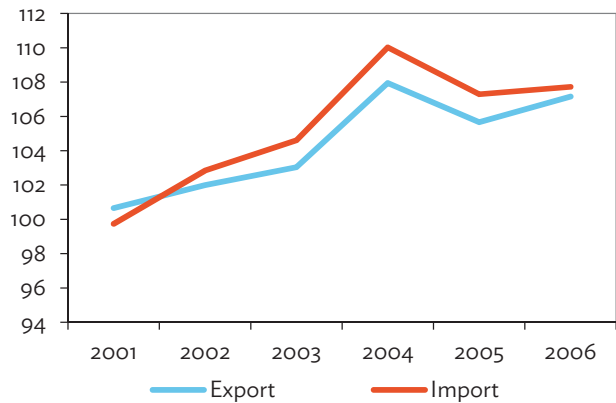
**Figure 24: Trade Volume Growth—depreciation, 2001–2006**



REER = real effective exchange rate.

Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

**Figure 25: Trade Volume Growth—appreciation, 2001–2006**



REER = real effective exchange rate.

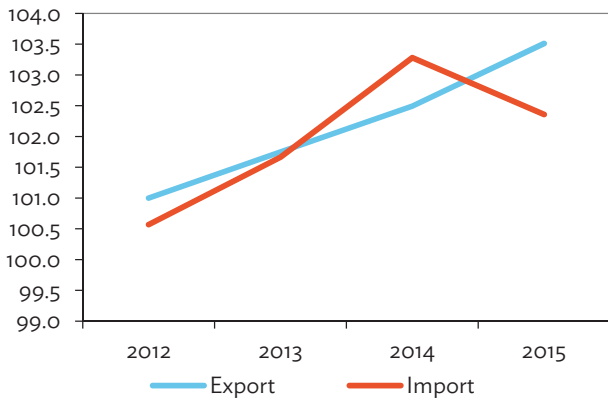
Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

After the GFC, those whose local currencies depreciated saw both export and import growth increase, but export growth was tepid—falling below import growth in 2014 before recovering in 2015 (Figure 26). Unlike the overall pre-GFC trend of increasing export and import growth, both were tepid post-GFC, dipping in 2014 in countries whose REER appreciated in 2012–2015 (Figure 27). The higher pre-GFC import to export growth reversed post-GFC, only starting to recover in 2015. This contradicts the conventional wisdom that currency appreciation should boost imports more than exports.

Overall, while the trade-weighted average export and import volume growth index for those with depreciating currencies was 108.6 and 107.1 pre-GFC, it fell significantly to 102.2 and 102 post-GFC. The respective indexes for those with appreciating currencies declined from 104.4 for export and 105.4 for import pre-GFC to 103.3 and 102.8 post-GFC. We can thus infer that tepid export growth in countries with depreciating currencies, coupled with sluggish import growth in those with appreciating currencies, underlie the slump in trade growth post-GFC. This could imply currency depreciation might not help shore up flagging exports and appreciation might not support import growth as much as those used to. Nevertheless, the most recent trend in 2015 indicates a recovery in both exports of the depreciation country group and imports of the appreciation country group, suggesting the usual relationship between export and import growth rates and currency movements has been restored, at least for now.

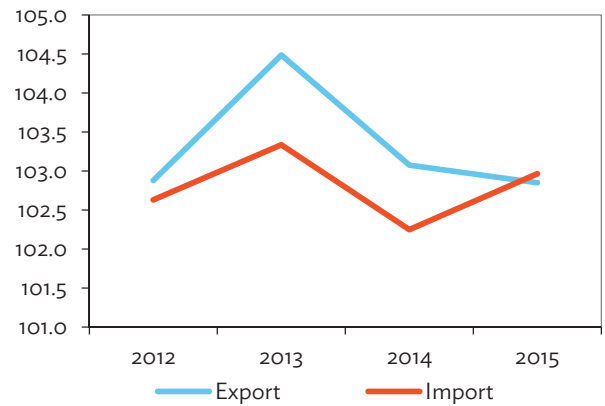
The tepid growth of both exports and imports in countries with depreciating currencies is quite pronounced, reflected in drastic decline in growth rates post-GFC, even below those with appreciating currencies. Overall, it appears that weaker currencies do not contribute to trade growth as before.

**Figure 26: Trade Volume Growth—depreciation, 2012–2015**



REER = real effective exchange rate.  
 Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

**Figure 27: Trade Volume Growth—appreciation, 2012–2015**

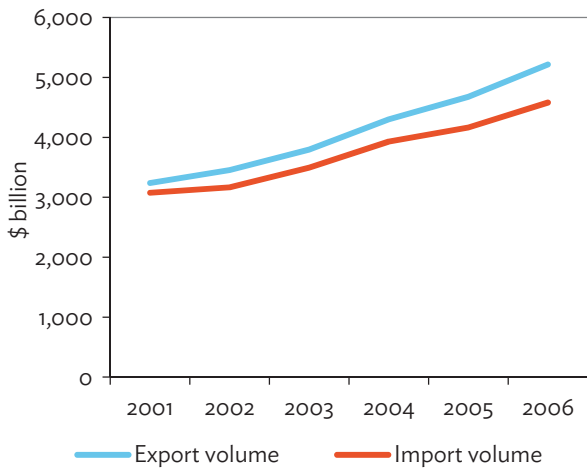


REER = real effective exchange rate.  
 Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

**B. Decomposition of Factors Affecting Sluggish Trade Growth**

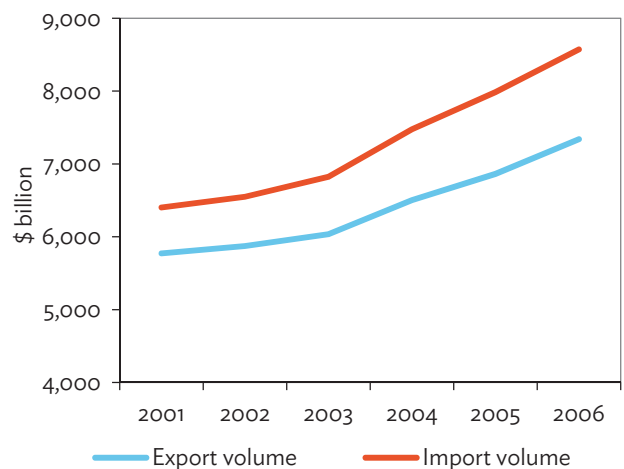
The slump in trade growth also appears in recent aggregate export and import volume data. Both aggregate export and import volumes for countries with depreciating currencies are increasing much slower post-GFC than during the pre-GFC period. The same applies to those with appreciating currencies, but with a stark contrast in aggregate import volume between pre- and post-GFC. And import volumes underperformed aggregate export volumes post-GFC (Figures 28, 29, 30, and 31).

**Figure 28: Trade Volume—depreciation, 2001–2006**



Sources: Bank for International Settlements and World Trade Organization.

**Figure 29: Trade Volume—appreciation, 2001–2006**



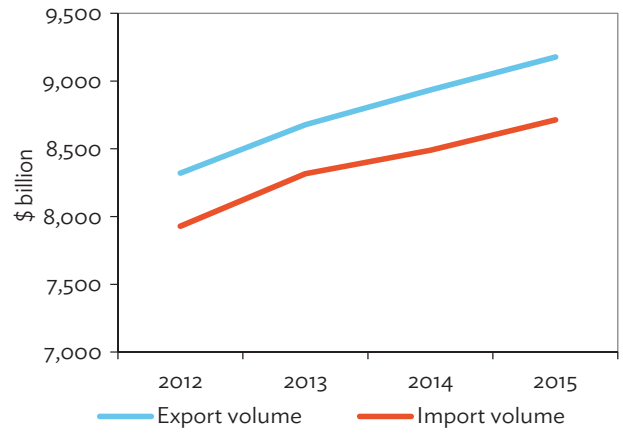
Sources: Bank for International Settlements and World Trade Organization.

**Figure 30: Trade Volume—depreciation, 2012–2015**



Sources: Bank for International Settlements and World Trade Organization.

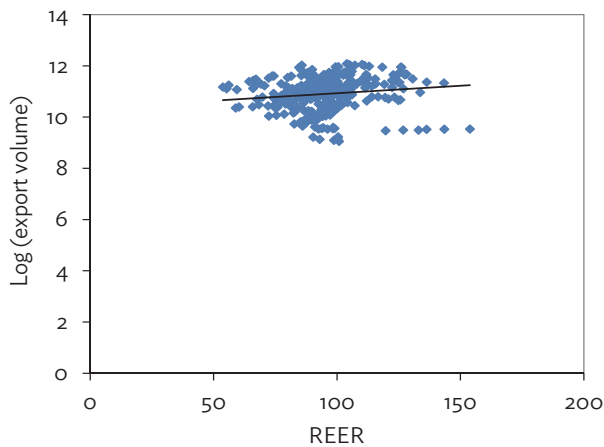
**Figure 31: Trade Volume—appreciation, 2012–2015**



Sources: Bank for International Settlements and World Trade Organization.

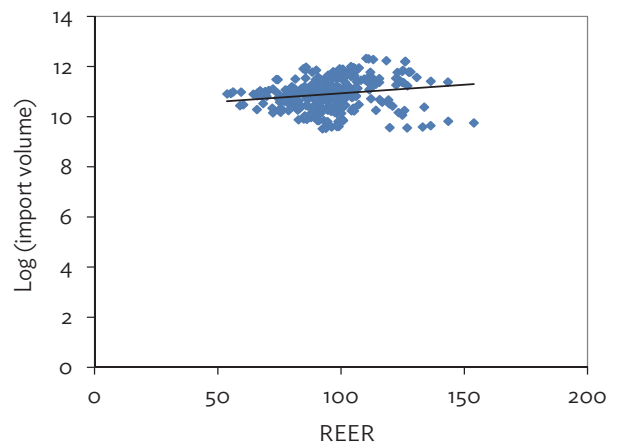
The same pattern appears when we look at the overall relationship between exchange rate movements and trade performance pre- and post-GFC. For the 59 countries in our sample, currency appreciation was accompanied by increases in both exports and imports pre-GFC. This relationship became muted for exports and even slightly negative for imports post-GFC (Figures 32, 33, 34, and 35). This corroborates the finding that before the GFC, the growing overall export and import trend outweighed the impact of currency movements—and that import growth was tepid even for those with appreciating currencies post-GFC.

**Figure 32: REER versus Export Volume, 2001–2006**

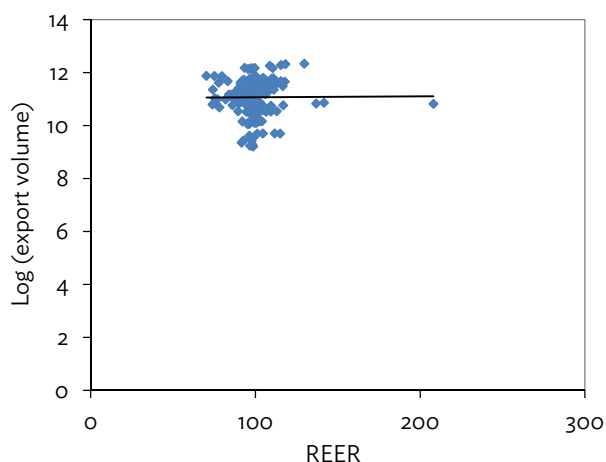


REER = real effective exchange rate.  
 Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

**Figure 33: REER versus Import Volume, 2001–2006**

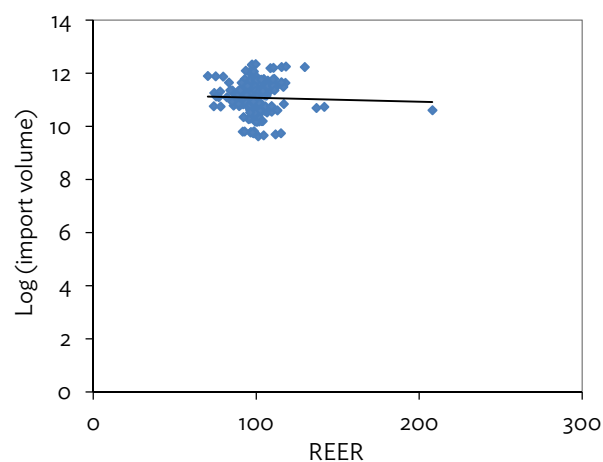


REER = real effective exchange rate.  
 Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

**Figure 34: REER versus Export Volume, 2012–2015**

REER = real effective exchange rate.

Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

**Figure 35: REER versus Import Volume, 2012–2015**

REER = real effective exchange rate.

Source: Author's calculation based on Bank for International Settlements REER annual average (2010=100) and the World Trade Organization's trade volume index (previous year=100).

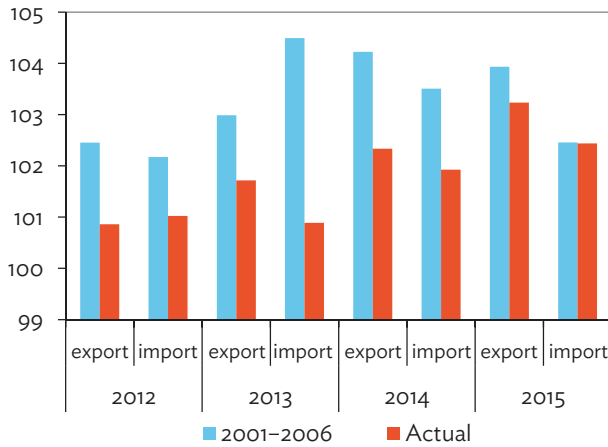
In our sample data, there were 18 economies with depreciating local currencies (based on REER) during 2001–2006. But this increased to 38 during 2012–2015. By contrast, the number of economies with appreciating local currencies decreased from 40 during 2001–2006 to 20 during 2012–2015.<sup>4</sup> Those whose currencies appreciated more than 3% during 2012–2015 included the People's Republic of China (PRC) 6.1%; Hong Kong, China 5%; Saudi Arabia 5.1%; Iceland 4.4%; United Arab Emirates 4.2%; the United States (US) 3.8%; the Republic of Korea 3.7%; the Philippines 3.5%; and the United Kingdom 3.3%. Given the significant weights of these economies—the PRC and the US in international trade in particular—their currency appreciation should have induced currency depreciation in the large group of economies in effective trade-weighted terms. The second factor is average strength of export and import volume growth—measured through trade-weighted average export and import volume growth.

The figures below are based on simulations of how countries with depreciating and appreciating currencies during 2001–2006 performed during the period 2012–2015, compared with how those with depreciating and appreciating currencies during 2012–2015 actually fared during the same period (Figures 36 and 37). Figure 36 shows that the average export and import growth of 18 countries with depreciating local currencies during 2001–2006 actually had much higher export and import growth during the period 2012–2015. The original 2001–2006 country group's trade-weighted average export and import growth should have been much higher at 103.4 and 103.2 during 2012–2015 compared with the new country group's actual 102.2 and 102 levels, respectively. On the other hand, 2001–2006 local currency appreciation group posted lower average export and import growth during 2012–2015 compared with actual 2012–2015 appreciation group. In addition, the 22 countries with appreciating local currencies during 2012–2015 in fact posted higher export and import volume growth at 103.3 and 102.8, respectively, above their 2001–2006 levels of 102.6 and 101.6. This means lower

<sup>4</sup> In the analysis below, we exclude the United Arab Emirates due to some missing trade data, thus 59 countries are covered.

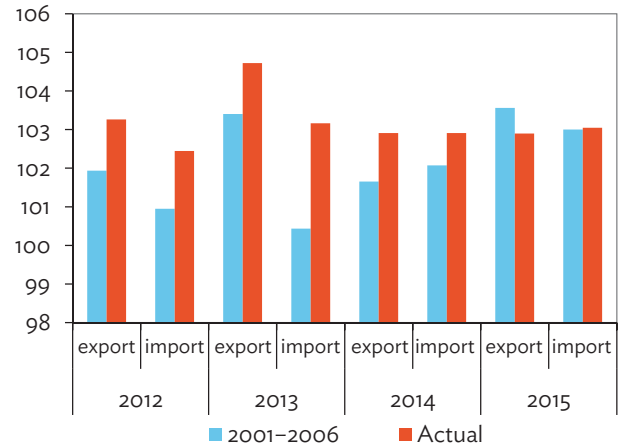
aggregate import growth of these countries might be due to a composition change effect of the country group rather than an intensity effect—and also due to the smaller number of those countries whose local currencies appreciated.

**Figure 36: Counterfactual versus Actual—depreciation, 2012–2015**



Source: Author's calculation based on the World Trade Organization's trade volume index (previous year=100).

**Figure 37: Counterfactual versus Actual—appreciation, 2012–2015**



Source: Author's calculation based on the World Trade Organization's trade volume index (previous year=100).

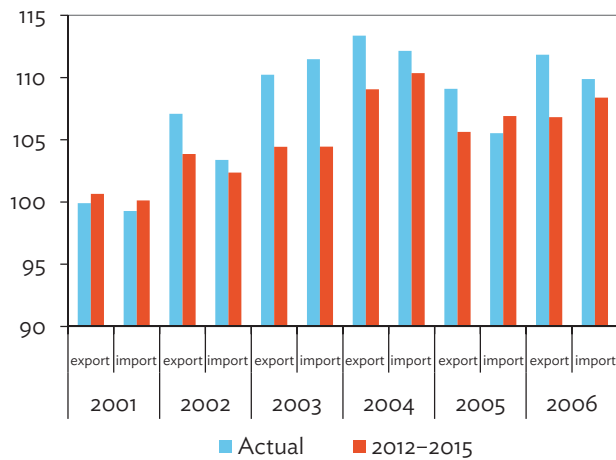
The same can be inferred from another set of simulations that compare actual export and import growth per currency group during 2001–2006 with the performance of new country groups for the same period retrospectively. Except for 2001, 2012–2015 depreciation country group during 2001–2006 performed much better than 2012–2015 depreciation country group performed during the period 2001–2006, while the appreciation country group did worse during 2001–2006 (Figures 38 and 39). Those with depreciating currencies during 2012–2015 not only did worse than the 2001–2006 depreciation currency group performed during the period 2012–2015, but they also underperformed the latter group back in the period 2001–2006. This structural factor could hit the trade performance of this group twice. In reverse, countries with appreciating currencies during 2012–2015 performed better in fact than the 2001–2006 appreciation currency group performed during the period 2012–2015, and also performed better during 2002–2006.

Hence, we can infer that (i) the number of countries with appreciating currencies significantly declined post-GFC, and (ii) on average, those with depreciating currencies had more tepid export and import growth compared with the pre-GFC period. And countries with appreciating currencies—while showing tepid import growth compared with export growth—are faring much better overall than those with depreciating currencies. In this sense, both composition and intensity effects worked toward more sluggish trade growth.

This has several significant implications. First, the relationship between trade and growth has become less conspicuous post-GFC. In fact, the *Asian Economic Integration Report 2015* showed that Asia's income elasticity of imports declined to 1.30 post-GFC from 2.69 pre-GFC. There was a more pronounced slump in import growth of those with appreciating local currencies, contributing to an overall smaller aggregate import volume than export volume. Second, those with depreciating

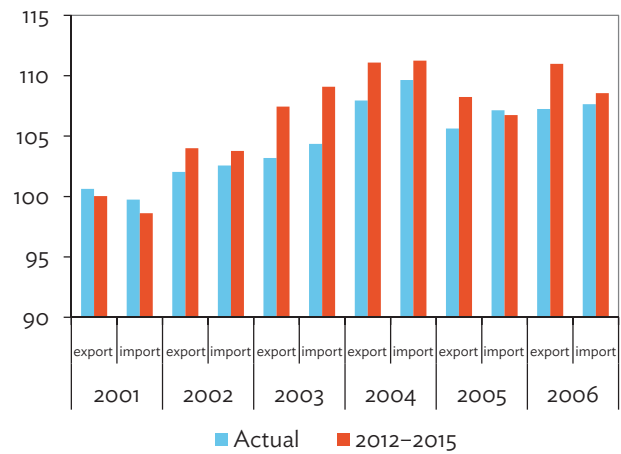
currencies are having a significantly negative impact on global trade growth, in particular for exports. Against conventional wisdom, weaker currencies are not contributing much to an increase in exports, let alone imports. And third, changes in the composition of groups by currency movement are negatively affecting trade growth.

**Figure 38: Counterfactual versus Actual—depreciation, 2001–2006**



Source: Author's calculation based on the World Trade Organization's trade volume index (previous year=100).

**Figure 39: Counterfactual versus Actual—appreciation, 2001–2006**



Source: Author's calculation based on the World Trade Organization's trade volume index (previous year=100).

Now, we further decompose the difference in export and import volumes for 2006 and 2015 for each currency group.<sup>5</sup> For both exports and imports, volume growth between 2006 and 2015 for the depreciating group is explained most by the change in the number of group members—from 18 to 38 countries. In contrast, the drop from 40 to 22 had a negative effect on exports and imports of appreciating currency group members. The change in country composition between 2006 and 2015 acted negatively for both exports and imports of the depreciating currency group. On the other hand, those with appreciating currencies are doing better, in particular in exports. The appreciating currency group's trade performance benefited most from the change in country composition, while the decrease in number had a negative impact on overall volume growth (Table 1).

<sup>5</sup> Let export volume 2006 A and export volume 2015 B. And let per country average export volume in 2006 a and number of countries N, and those for 2015 b and M respectively, i.e.,  $a \cdot N = A$ ,  $b \cdot M = B$ . Then,  $(B-A)/A = \{(b \cdot M)/(a \cdot N)\} - 1 = \{[(b-a)/a] + 1\} \cdot \{(M-N)/N\} + 1 - 1 = (b-a)/a \cdot (M-N)/N + (M-N)/N + (b-a)/a$ .  $(B-A)/A$  needs to be a weighted average to get the percentage point contribution of  $(b-a)/a$  and  $(M-N)/N$ .

**Table 1: Factor Decomposition of Trade Volume Growth between 2006 and 2015**

		2006 (\$ billion, A)	2015 (\$ billion, B)	% change (B-A)	Composition Change Effect (percentage point)	Intensity Effect of Original Group (percentage point)	Effect of Change in Numbers (percentage point)
World exports	Depreciation	5,379	7,086	32	-32	15	48
	Appreciation	7,179	9,493	28	35	6	-13
World imports	Depreciation	4,739	6,589	39	-28	11	56
	Appreciation	8,461	8,714	3	6	0	-3

Source: Author's calculation.

### C. Impact of Exchange Rates on Trade Volumes

We further examine how the change in exchange rate affected trade flows in the 2000s. Given our main focus on trade volume growth—excluding the volatile price factor—the empirical analysis investigates how real exchange rate movements lead to changes in trade volumes. While much literature tests the impact of exchange rate volatility on trade flows, there are few that examine the impact of the exchange level itself on trade, in particular trade volume. In investigating the relationship between changes in trade and exchange rates, we employ a panel gravity model with various fixed effects included to control for omitted variable bias and its associated endogeneity.

The base model specification is:

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln xrate_{ijt} + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_4 R_{ij} + \varphi_i + \omega_j + \tau_t + \Phi_{ijt}$$

where the subscript  $i$  and  $j$  denote the importer and exporter, respectively and  $t$  denotes time.  $X$  is the annual bilateral export volume, calculated by deflating the export value by producer price index of the exporting country.  $xrate$  is the bilateral real exchange rate, calculated by  $nrate \times \frac{CPI_i}{CPI_j}$ , where  $nrate$  is the nominal exchange rate, and  $CPI_i$  and  $CPI_j$  are consumer price indexes of importing and exporting countries, respectively.  $GDP_{it}$  and  $GDP_{jt}$  denote the GDP of importing and exporting countries, respectively, and  $R_{ij}$  controls the usual gravity variables including distance, colonial relationship, common language, and geographical contiguity.  $\varphi_i$  denotes importer fixed effects,  $\omega_j$  captures exporter fixed effects, and  $\tau_t$  denotes time fixed effects. Finally,  $\Phi_{ijt}$  is error term.

To control for endogeneity stemming from omitted variables, we consider an extension of this base model, i.e., one with time-varying importer fixed effects and exporter fixed effects as below:

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln xrate_{ijt} + \beta_2 \ln GDP_{jt} + \beta_3 R_{ij} + \gamma_{it} + \delta_j + \Phi_{ijt}$$

where  $\gamma_{it}$  and  $\delta_j$  are time-varying importer fixed effects and exporter fixed effects, respectively. To avoid potential problem of overspecification by including both time-varying importer and exporter fixed effects, the combination of which might be collinear to the movement of the real exchange rate (RER), we include time-varying importer fixed effects along with exporter fixed effects and GDP of exporters. In this model, importer GDP variables and time fixed effects are dropped with the inclusion of time-varying

importer fixed effects. This time-varying importer fixed effects can control for the time-varying effect of import barriers such as tariffs, nontariff barriers and other trade restrictive policies specific to importers in a given year thereby helping address endogeneity problem. The data cover 72 exporters and 158 importers, generating more than 121,348 observations for the 2001–2015 period regressions.

The regression results presented in Table 2 point to the significance and expected direction of influence of the usual gravity factors such as distance, colonial relationship, common language and geographical contiguity on trade volume. While the effect of importer country's GDP on trade is positive, exporter country's GDP has much less significant impact on trade.<sup>6</sup> For the 2001–2015 period, the RER effect of the year is positive and significant at the 1% level, suggesting the weaker an exporter's currency, the larger the export volume vis-à-vis trading partners. A 1% depreciation of an exporter's RER on average leads to a 0.07% increase in export volume of the same year. When a lagged variable of RER is considered, its impact on export growth becomes insignificant, and the magnitude decreases over time. When a 1-year lag is tested, the coefficient becomes 0.005 and with 2-year lags, 0.003. This suggests the impact of currency depreciation is greatest in the same year but dissipates over time. But the impact of geographical factors such as distance and border contiguity increase over time and in tandem with this.

**Table 2: Gravity Model Estimation Results (2001–2015) under Base Model**

[Dependent variable: Log (exports)]			
	(1)	(2)	(3)
Log(distance)	-1.72*** (0.03)	-1.75*** (0.03)	-1.75*** (0.03)
Log(GDP_Importer)	0.65*** (0.03)	0.67*** (0.03)	0.65*** (0.03)
Log(GDP_Exporter)	0.08** (0.04)	0.04 (0.04)	0.03 (0.04)
Colonial relationship dummy	0.59*** (0.12)	0.57*** (0.12)	0.56*** (0.12)
Common language dummy	0.89*** (0.05)	0.87*** (0.05)	0.88*** (0.05)
Contiguity dummy	0.53*** (0.15)	0.60*** (0.15)	0.60*** (0.15)
Log(real exchange rate)	0.07*** (0.01)		
Log(real exchange rate(-1))		0.005 (0.004)	
Log(real exchange rate(-2))			0.003 (0.004)
Sample size	127,378	126,888	119,112
$R^2$	0.78	0.78	0.78

Notes and sources: Importer and exporter fixed effects and time fixed effects are included but not shown for brevity. Trade data are based on Board Economic Categories. Global bilateral exports data covering the period 2000–2015 is from United Nations Commodity Trade database. Producer Prices Index (PPI) and exchange rate data are from International Monetary Fund *International Financial Statistics* database. The base year of PPI data is 2010 and is available for 73 economies. Gross domestic product and consumer price index (CPI) data are from the World Bank *World Development Indicators*. Gravity variables such as distance, common language, common colonizer, and contiguity are from CEPII database. Exports volume is computed by deflating the export value with PPI. Bilateral real exchange rate (RER) data is calculated by first computing for bilateral exchange rates and multiplying by the ratio of CPI of importer and exporter. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Robust standard errors are in parentheses.

<sup>6</sup> Theoretically, while import is a function of GDP, export constitutes GDP through the channel of net exports. In this sense, measuring sheer impact of exporter's GDP on trade via gravity model could be a bit challenging.



We now analyze the exchange rate effect on export volume for different time periods separately, given the 15-year time period may obscure distinctive features of different effects across time periods. For this purpose, we consider three periods—2003–2006 (pre-GFC), 2007–2010 (GFC) and 2012–2015 (post-GFC). Table 3 shows that while usual gravity model variables point significantly to the expected direction of impact on trade, the impact of the exporter's RER is significant and positive at the contemporary level for pre-GFC and GFC periods, but not significant for post-GFC period. Impact of RER on exports decreases over time in general as suggested by smaller size of coefficients of one lagged value of RER and further two lags of RER. In the meantime, impact of exporter's GDP on exports turns out to be significant and large post-GFC.

**Table 3: Gravity Model Estimation Results under Base Model  
(2003–2006 versus 2007–2010 versus 2012–2015)**

[Dependent variable: Log (exports)]									
	2003– 2006	2007– 2010	2012– 2015	2003– 2006	2007– 2010	2012– 2015	2003– 2006	2007– 2010	2012– 2015
Log(distance)	-1.73*** (0.03)	-1.80*** (0.03)	-1.70*** (0.03)	-1.73*** (0.03)	-1.80*** (0.03)	-1.72*** (0.03)	-1.72*** (0.03)	-1.80*** (0.03)	-1.71*** (0.03)
Log(GDP_Importer)	0.43*** (0.07)	0.64*** (0.08)	0.41*** (0.08)	0.40*** (0.08)	0.64*** (0.08)	0.41*** (0.07)	0.43*** (0.08)	0.64*** (0.08)	0.48*** (0.07)
Log(GDP_Exporter)	0.13 (0.12)	0.12 (0.08)	0.55*** (0.13)	0.17 (0.12)	0.18** (0.08)	0.52*** (0.12)	0.16 (0.12)	0.19** (0.08)	0.48*** (0.12)
Colonial relationship dummy	0.71*** (0.13)	0.59*** (0.14)	0.57** (0.14)	0.71*** (0.13)	0.59*** (0.14)	0.57*** (0.14)	0.71*** (0.13)	0.59*** (0.14)	0.57*** (0.14)
Common language dummy	0.77*** (0.06)	0.87*** (0.06)	0.85*** (0.07)	0.77*** (0.06)	0.87*** (0.06)	0.84*** (0.07)	0.78*** (0.06)	0.87*** (0.06)	0.86*** (0.07)
Contiguity dummy	0.52*** (0.16)	0.47*** (0.17)	0.49*** (0.17)	0.52*** (0.16)	0.47*** (0.17)	0.52*** (0.17)	0.52*** (0.16)	0.46*** (0.17)	0.56*** (0.18)
Real exchange rate	0.11* (0.06)	0.07** (0.03)	-0.02 (0.05)						
Log(real exchange rate(-1))				0.10** (0.04)	0.008 (0.02)	-0.02 (0.05)			
Log(real exchange rate(-2))							0.009 (0.02)	-0.006 (0.02)	0.02 (0.03)
Sample size	32,571	33,593	31,061	32,360	33,413	30,704	32,141	33,245	31,061
R <sup>2</sup>	0.79	0.79	0.80	0.79	0.79	0.80	0.79	0.79	0.80

Notes and sources: Importer and exporter fixed effects and time fixed effects are included but not shown for brevity. Trade data are based on Board Economic Categories. Global bilateral exports data covering the period 2000–2015 is from United Nations Commodity Trade database. Producer Prices Index (PPI) and exchange rate data are from International Monetary Fund *International Financial Statistics* database. The base year of PPI data is 2010 and is available for 73 economies. Gross domestic product and consumer price index (CPI) data are from the World Bank *World Development Indicators*. Gravity variables such as distance, common language, common colonizer and contiguity are from CEPII database. Exports volume is computed by deflating the export value with PPI. Bilateral real exchange rate (RER) data is calculated by first computing for bilateral exchange rates and multiplying by the ratio of CPI of importer and exporter. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Robust standard errors are in parentheses.

Below presented in Table 4 are estimation results for the period 2001–2015 based on the extended model. The results demonstrate clearer picture in terms of RER effect on exports. We take the results from the extended model more robust given this model controls for time-varying importer fixed effects, not only the impact of importer country's GDP in addition to all the control variables used in the base model. Trade resistance factors point to the significance and expected direction of influence on trade volume, including the slight yet still significant impact of exporter GDP. For the 2001–2015 period, the RER effect of the year is positive and significant at the 1% level, suggesting the weaker an exporter's currency, the larger the export volume vis-à-vis trading partners. A 1% depreciation of an exporter's RER on average leads to a 0.14% increase in export volume of the same

year. When a lagged variable of RER is considered, magnitude of the impact decreases over time but still significant. When a 1-year lag is tested, the coefficient becomes 0.10 and with 2-year lags, 0.034. This suggests the impact of currency depreciation is greatest in the same year but decreases over time with the pace of declining impact accelerating over time. Again the impact of geographical factors such as distance and border contiguity increase over time and in tandem with this.

**Table 4: Gravity Model Estimation Results (2001–2015) under Extended Model**

[Dependent variable: Log (exports)]			
	(1)	(2)	(3)
Log(distance)	-1.73*** (0.03)	-1.74*** (0.03)	-1.75*** (0.03)
Log(GDP_Exporter)	0.09** (0.04)	0.09** (0.04)	0.03 (0.04)
Colonial relationship dummy	0.59*** (0.13)	0.58*** (0.13)	0.56*** (0.13)
Common language dummy	0.89*** (0.05)	0.88*** (0.06)	0.88*** (0.05)
Contiguity dummy	0.51*** (0.15)	0.52*** (0.15)	0.57*** (0.15)
Log(real exchange rate)	0.14*** (0.01)		
Log(real exchange rate(-1))		0.10*** (0.01)	
Log(real exchange rate(-2))			0.034*** (0.01)
Sample size	120,922	121,553	120,885
$R^2$	0.79	0.79	0.79

Notes and sources: Time-varying importer fixed effects and exporter fixed effects are included but not shown for brevity. Trade data are based on Board Economic Categories. Global bilateral exports data covering the period 2000–2015 is from United Nations Commodity Trade database. Producer Prices Index (PPI) and exchange rate data are from International Monetary Fund *International Financial Statistics* database. The base year of PPI data is 2010 and is available for 73 economies. Gross domestic product and consumer price index (CPI) data are from the World Bank *World Development Indicators*. Gravity variables such as distance, common language, common colonizer and contiguity are from CEPII database. Exports volume is computed by deflating the exports value with PPI. Bilateral real exchange rate (RER) data is calculated by first computing for bilateral exchange rates and multiplying by the ratio of CPI of importer and exporter. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Robust standard errors are in parentheses.

We now analyze the exchange rate effect on export volume for different time periods separately, given the 15-year time period may obscure distinctive features of different effects across time periods. For this purpose, we consider three periods—2003–2006 (pre-GFC), 2007–2010 (GFC), and 2012–2015 (post-GFC). Table 5 shows that while usual gravity model variables point significantly to the expected direction of impact on trade, the impact of the exporter's RER is significant and positive at the contemporary level for pre-GFC and GFC periods, but not significant for post-GFC period. Impact of RER on exports decreases over time in general as suggested by smaller size of coefficients of one lagged value of RER and further two lags of RER. In the meantime, impact of exporter's GDP on exports turns out to be significant and large post-GFC.

The term structure of the RER impact on trade reveals interesting, consistent patterns. First, the size of the RER coefficient shrinks from level RER to lag(1) and lag(2) RERs until GFC. For example, for pre-GFC, 0.56 → 0.20 → 0.05, for GFC, 0.09 → 0.03 → 0.01. Even the significance of RER is not retained for lag(2) RER across all three periods, retained only for pre-GFC and post-GFC with lag(1) RER, while being retained for all three periods with the level of RER. This indicates the effect of the real exchange rate over export volume is greatest during the contemporaneous year and dissipates over

time. This result is in line with the results for the entire 2001–2015 period. Post-GFC, however, a slightly different pattern emerges, posting larger impact of RER after 1 year with coefficients of 0.28 → 0.38 → 0.06. This might imply slower response of trade vis-à-vis changes in exchange rate in tandem with lower trade elasticity of exchange rate as presented in section III.A. Second, the magnitude of the RER coefficient is consistently larger for pre-GFC and post-GFC and smaller during the GFC. The exchange rate effect was significantly dampened during the GFC period. Third, compared to the pre-GFC period, the exchange rate effect on export volume post-GFC was halved during the same year although its lagged effect was a bit larger than pre-GFC. It remains a topic for further study to see if the GFC brought about structural changes in the channels of the exchange rate impact on trade. But during 2012–2015 at least, we find the exchange rate effect significantly weakened.

**Table 5: Gravity Model Estimation Results under Extended Model**  
(2003–2006 versus 2007–2010 versus 2012–2015)

[Dependent variable: Log (exports)]

	2003– 2006	2007– 2010	2012– 2015	2003– 2006	2007– 2010	2012– 2015	2003– 2006	2007– 2010	2012– 2015
Log(distance)	-1.73*** (0.03)	-1.80*** (0.03)	-1.70*** (0.03)	-1.74*** (0.03)	-1.81*** (0.03)	-1.72*** (0.03)	-1.73*** (0.03)	-1.80*** (0.03)	-1.70*** (0.03)
Log(GDP_Exporter)	0.10 (0.11)	0.13 (0.08)	0.26** (0.12)	0.17 (0.12)	0.20** (0.08)	0.42*** (0.11)	0.17 (0.13)	0.20** (0.08)	0.48*** (0.12)
Colonial relationship dummy	0.71*** (0.13)	0.59*** (0.14)	0.56*** (0.14)	0.71*** (0.13)	0.58*** (0.14)	0.56*** (0.14)	0.71*** (0.13)	0.59*** (0.14)	0.57*** (0.14)
Common language dummy	0.77*** (0.06)	0.87*** (0.06)	0.86*** (0.07)	0.77*** (0.06)	0.87*** (0.06)	0.85*** (0.07)	0.77*** (0.06)	0.87*** (0.06)	0.87*** (0.07)
Contiguity dummy	0.51** (0.16)	0.46** (0.17)	0.49** (0.17)	0.51*** (0.16)	0.46*** (0.17)	0.51*** (0.17)	0.51*** (0.16)	0.45** (0.17)	0.56*** (0.17)
Real exchange rate	0.561*** (0.10)	0.086** (0.03)	0.281*** (0.08)						
Log(real exchange rate(-1))				0.203*** (0.06)	0.027 (0.02)	0.376*** (0.15)			
Log(real exchange rate(-2))							0.052 (0.04)	0.010 (0.02)	0.055 (0.05)
Sample size	32,812	33,981	30,213	32,601	34,032	30,213	32,382	33,630	31,511
R <sup>2</sup>	0.79	0.79	0.80	0.79	0.79	0.80	0.79	0.79	0.80

Notes and sources: Time-varying importer and exporter fixed effects are included but not shown for brevity. Trade data are based on Board Economic Categories. Global bilateral exports data covering the period 2000–2015 is from United Nations Commodity Trade database. Producer Prices Index (PPI) and exchange rate data are from International Monetary Fund *International Financial Statistics* database. The base year of PPI data is 2010 and is available for 73 economies. Gross domestic product and consumer price index (CPI) data are from the World Bank *World Development Indicators*. Gravity variables such as distance, common language, common colonizer and contiguity are from CEPII database. Exports volume is computed by deflating the exports value with PPI. Bilateral real exchange rate (RER) data is calculated by first computing for bilateral exchange rates and multiplying by the ratio of CPI of importer and exporter. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Robust standard errors are in parentheses.

#### IV. CONCLUSION

Global trade growth has slowed—and significantly during the post-GFC period. This has been reflected into stagnating trade value growth since 2011 and even negative trade growth in 2015 in value term due to widespread slump in commodity prices (see Figures A2.3 and A2.4 in Appendix 2). From a longer-term perspective, however, global trade volume has not deviated much from its long-term trend—as can be seen from Figures A2.1 and A2.2 in Appendix 2. The rapid growth pre-GFC was rather exceptional, supported by a favorable international trade environment anchored on the PRC’s World Trade Organization accession in late 2001 and the expanding global value chain, among others. With

the GFC as turning point, global trade growth is returning to its long-term growth trajectory. Although recovery may be slow, global trade is forecast to maintain steady growth in the future—particularly given its slight recovery in 2015. Nevertheless, the impact of BREXIT and other geopolitical and global economic factors remain potential threats in sustaining recovery in the future.

The tepid trade growth post-GFC has been partly attributed to sluggish demand from developed countries. However, data reveals that developing countries are playing a bigger role in dragging down the trade growth recovery, while developed countries are showing quite robust import growth. Among developing countries, those in Asia are seeing a faster decline in trade growth compared with other regions, potentially due to the PRC's decelerating economic growth and drop in trade growth.

Post-GFC, exchange rate volatility has grown significantly. As examined by decomposing country groups by currency movement, however, local currency depreciation is not contributing to export growth as much as theory dictates. On the other hand, import intensity for those with appreciating currencies have risen recently and are also contributing quite significantly to export growth. This implies that the more countries undergo currency devaluation and the deeper the degree of devaluation, the more likely international trade will grow slower. We also find that, while exchange rate volatility has substantially grown over time—in particular post-GFC—its impact on trade has been tapering off. Given the high weights of the US dollar, euro, and renminbi in REER for many countries—due to the high trade dependence on these countries as trade partners—further appreciation of these three currencies may not help spur international trade growth through induced depreciation of other trading partner currencies. The stronger import intensity effect of countries/regions with appreciating currencies may not be enough to make up for both the negative composition and intensity effect for countries with depreciating currencies. Not only the realization of impact currency depreciation on trade seems to be protracted. Overall, the impact of currency depreciation on trade has become much smaller post-GFC compared to pre-GFC. All these analyses combined, recent trend suggests that competitive devaluations may not spur exports as much as earlier expected—and it may further undermine the nascent recovery of international trade.

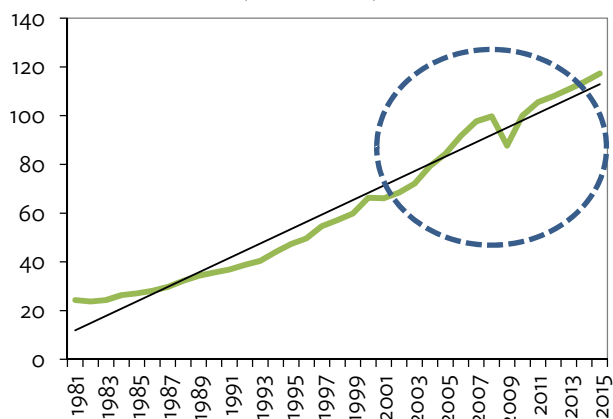
## APPENDIX 1: LIST OF DEVELOPED AND DEVELOPING ECONOMIES IN THE DATA SET

Developed Economies	Developing Economies
Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States	Algeria; Argentina; Brazil; Chile; People's Republic of China; Taipei, China; Colombia; Hong Kong, China; India; Indonesia; Israel; Republic of Korea; Malaysia; Mexico; Peru; Philippines; Saudi Arabia; Singapore; South Africa; Thailand; Turkey; Venezuela

Source: United Nations Conference on Trade and Development. *World Economic Situation and Prospects 2014*. Geneva.

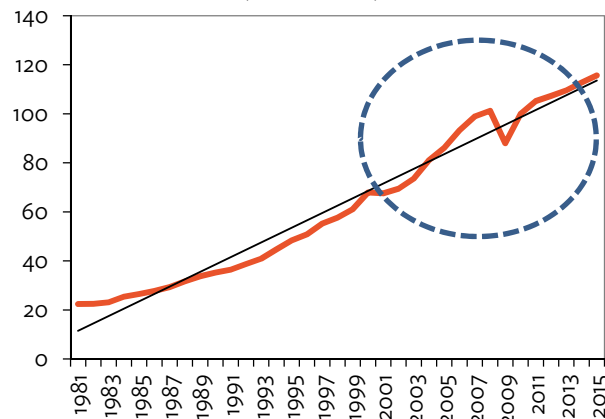
## APPENDIX 2: TRENDS OF WORLD TRADE VOLUME AND VALUE

**Figure A2.1: World Export Volume**  
(2010=100)



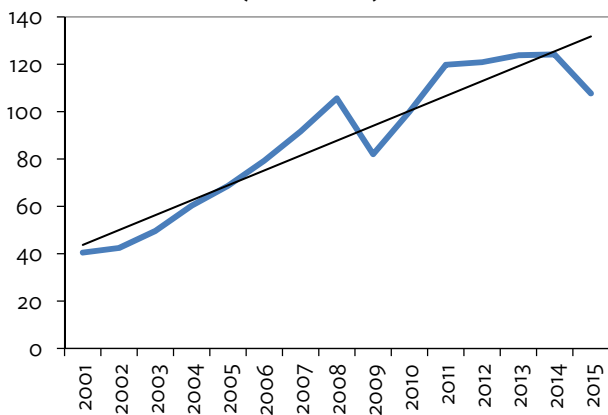
Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure A2.2: World Import Volume**  
(2010=100)



Source: Author's calculation based on the World Trade Organization's trade volume index.

**Figure A2.3: World Export Value**  
(2010=100)



Source: Author's calculation based on the World Trade Organization's trade value data.

**Figure A2.4: World Import Value**  
(2010=100)



Source: Author's calculation based on the World Trade Organization's trade value data.

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## International Trade and Exchange Rate

International trade volume data indicates developing countries play a bigger role in holding back trade growth, while developed countries show quite robust import growth. From a longer-term perspective, however, global trade volume has not deviated much from its long-term trend. Postglobal financial crisis, the exchange rate volatility has grown significantly. Countries with appreciating currencies show rising import intensity and significant export growth. However, the impact of currency depreciation on trade has become much smaller postglobal financial crisis. All these analyses suggest that competitive devaluations may not spur exports as much as earlier expected—and it may further undermine the nascent recovery of international trade.

## About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to half of the world's extreme poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

