Anatomy of the Trade Collapse, Recovery, and Slowdown: Evidence from Korea

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Abstract

The last decade of the world trade has been marked by an unprecedented collapse, quick recovery, slowdown, another drop, and recovery. To study cyclical and structural aspects of the recent trend of trade, I use both aggregate and disaggregated trade statistics of a small open economy, South Korea, whose economic success and growth have been heavily dependent on exports. The aggregate trend of the country is surprisingly similar to that of the world, which is why the trend of Korea's export is called a proxy for the world. I show that while the last drop of trade after 2015 has cyclical aspects, there is evidence that the continued slowdown from 2012 is structural: (1) the so-called 'China factor' is found in the analysis of trade-income elasticity of the world and China for imports from Korea. (2) The bilateral trade barriers between Korea and its important trading partners are universally tightening. I also show that the firm sizes, destination countries, and the mode of transactions affect disaggregated trade flows during the slowdown periods. It is advisable to diversify main export products to lower the effect of oil prices on export prices and to strengthen the cooperation with ASEAN countries, whose trade barriers have exceptionally diminished throughout the last decade.

Keywords: the Great Trade Collapse, trade slowdown, trade elasticity, trade barriers, Korea

JEL Classification Numbers: F14, O24

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1 Introduction

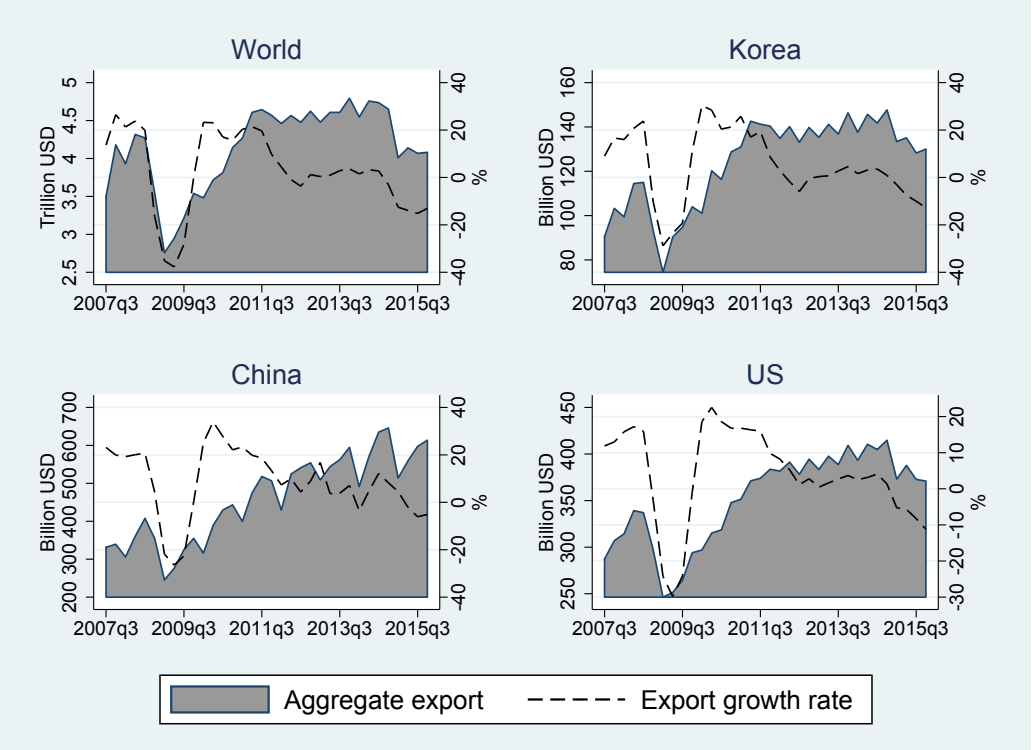
In the last decade, the world trade has experienced an unprecedented collapse, remarkable recovery, and persistent slowdown. At the end of the slowdown, the world trade entered another period of negative growth rates, which finally turned positive in late 2016. Figure 1 presents the level and growth rate of exports for the world, South Korea, and its two largest trading parters, China and the US, in the last decade. The trends of aggregate exports across the three countries are similar to that of the world.[1] The trends show distinct phases, which are quite different from the long monotonic increase before the financial crisis of 2008-09. The dynamic behaviors of international trade in the last decade worry policy makers and intrigue trade economists for its cause.[2] In this paper, I focus on the recent trade collapse, recovery, and prolonged slowdown to shed light on the discussions about whether the current slowdown is structural or cyclical. I use detailed trade statistics of a small open economy, South Korea, whose economic success and growth have been heavily dependent on exports. I present evidence that although the current drop of trade has cyclical aspects, the continued slowdown from 2012 has structural aspects. I also show that the destination countries, firm sizes, and organization of firms matter for the detailed aspects of trade slowdown and drop.

I attempt to answer the following questions in this paper. The first question is about whether the current trade slowdown is structural or cyclical. While there are studies on this topic as in Hoekman (2015) and Constantinescu et al. (2015), detailed studies at a country level regarding the trade slowdown are rare as of now. To answer this question, I use the following methods. First, I analyze the relationship between oil prices and export prices of Korea, to see their cyclical effect on export volumes. I decompose the trade growth into the extensive margin (the sum of entry and exit effect) and the intensive margin (the sum of quantity and price effects) and observe the effect of prices over time. Second, I estimate the

[1] However, the exports volume of China looks different from Korea and the US because of China's more pronounced seasonality. Historically, in China, exports of first quarter tend to be lower than other quarters, but China's trend of quarter-on-quarter export growth rate is similar to the world's export growth rate. Vietnam exhibits a similar type of seasonality in its export statistics.

[2] See Bems et al. (2010), Levchenko et al. (2010), or Baldwin (2009), for example.

Figure 1: The export trends in the last decade



Sources: IMF Direction of Trade Statistics (http://www.imf.org/en/Data, accessed on January 1, 2017).
Note: Own calculation of the author. The left axis is the level of exports in USD, and the right axis is the quarter-on-quarter growth rate of exports.

trade-income elasticities focusing on the world's import demand, separately for goods from the world and from Korea. To address the serial correlations between the world trade and income statistics, I employ the error correction model. Third, I estimate the tariff-equivalent bilateral trade barriers between Korea and its important trading partners. If the discussions about the new protectionism by scholars and policy makers have actual substance, the trend of trade barriers should be increasing.[3]

The second question I pose is regarding the heterogeneous trade flows at a disaggregate level. I expect that, although the overall export has its distinct trend in each period, which I discuss more in detail in the next section, firm sizes, destination countries, and organization of firms affect trade flows at the disaggregated level. The literature reports that, during the

[3]See Evenett and Fritz (2015), for details.

Great Trade Collapse, the negative shock originated from the developed countries and spread through the global values chains (Eaton et al., 2016; Bussière et al., 2013). I compare the drop of goods exports in slowdown and trade collapse, which are the two unusual periods in the recent history when world trade has substantially dropped altogether. (Korea's annual exports dropped by 20.9 percent during the collapse and 9.5 percent during the 2015 drop.) Destination countries matter if the trade collapse originated from advanced countries and the trade slowdown is due to the weak growth of emerging countries as UNCTAD (2016) reports. Also, Bernard et al. (2009) show that intrafirm trade stayed resilient during the 1997 Asian financial crisis. I check whether Korea's intrafirm trade stayed resilient during the last decade as well. Since the Korean intrafirm trade statistics is inaccessible by policy, I combine the US related-party trade statistics with Korean exports statistics to observe the intrafirm flows between Korea and the US.

Results show that, since 2012, exceptionally low oil prices drove down export prices and the value of exports started diverging from the quantity of exports, which showed steady growth. The decomposition results indicate that the price effect is statistically significant only in 2015. Thus, the trade drop in the last two years largely stems from the price effects. The overall slowdown of trade, which started from 2012, however, seems to have structural aspects. The world's long-run income elasticity of imports from the world fell from 2.4 before the global crisis to 1.1 after the crisis. The world's long run elasticity of imports from Korea also fell from 2.2 to 1.1. Also, the bilateral trade barriers between Korea and its important trading partners have universally increased since 2012. So although the trade drop in 2015 appears to be temporary, the structural slowdown of world trade started from 2012, and Korea's sluggish exports in 2012-16 are in line with this world trend.

Regarding the heterogeneous trade flows, I first find that large corporations are more resilient to both the trade collapse in 2008 and trade drop in 2015. Large firms' exports to emerging countries, however, fell relatively more in 2015 than in 2009 while small firms' exports to emerging countries fell relatively less in 2015 than in 2009. Large firms' exports to

emerging countries fell 5 percentage point more in 2015 compared to 2009, mostly because of weak intermediate goods exports. Small firms' exports to emerging countries fell 7 percentage point less in 2015 compared to 2009. Korea's intrafirm exports to the US deeply dropped in but also quickly recovered from the Great Trade Collapse. Intrafirm exports fell by 47 percent in 2009 but recovered by 55 percent in 2010, while arm's length trade fell by 8.3 percent in 2009 and recovered by 0.6 percent in 2010. Intrafirm trade stayed more stable during the trade slowdown. When I decompose the intrafirm exports' growth rate into the quantity, price, entry, and exit effects, all of them stayed far more stable than those of arm's length exports throughout the last decade.

This paper contributes to the debate regarding whether the current trade slowdown is structural or cyclical. I provide two pieces of concrete evidence that the export drop in 2015 stems from low oil prices: one is the divergence of Korean export value index from its export quantity index, which started from late 2014 when oil prices plunged. The export prices fell so much that while export quantity index was growing, export value index was diminishing. The other evidence is the decomposition results that price effect is significant only in 2015. Therefore, the drop of trade in 2015 looks largely cyclical. While trade slowdown is widely discussed in the literature, this paper is the first one to specifically discuss the trade drop in 2015 and its causes to the best of my knowledge.

I also contribute to the literature by providing evidence that the slowdown of trade from 2012 has structural aspects. I identify the so-called "China factor" in the drop of trade-income elasticity after the global financial crisis, by showing that the pattern of the world's trade-income elasticity for imports from Korea (as well as for imports from the world) is similar to that of China. At the same time, there is evidence that Korea's trade barriers with important trading partners are steadily increasing after 2012. Trade barriers have been increasing as protectionism measures toward Korea's export products are steeply increasing after the global financial crisis.[4]

[4]According to the Korea International Trade Association (http://ntb.kita.net), the number of protectionism measures including anti-dumping, safeguards, and countervailing duties toward Korean products has

The trend of international trade has changed after the global financial crisis, and it is unlikely that the world's trade or Korea's trade will grow in the near future as they did before 2007. Policy makers, however, can still find ways to strengthen Korea's export growth. Diversifying export products will make export flows less susceptible to oil price fluctuations. Since export prices of homogeneous goods fluctuate more along with oil prices, increasing the share of heterogeneous goods in total will be helpful for stabilizing export flows. Also, the finding that trade barriers with Vietnam are steadily decreasing suggests that the relationship with ASEAN countries will be more important for Korea in the future. It is advisable to further utilize the Korea-Vietnam and Korea-ASEAN FTAs, whose utilization rate is 52.3 percent and 36.0 percent as of 2016, and enhance economic cooperations between Korea and ASEAN.

2 Overview of the last decade's trade

In this section, I divide export trends of Korea in the last decade into 6 periods and explore each event's characteristics as in Table 1. The first period is pre-crisis (-2008Q3) when exports showed steady growth. The second period is crisis (2008Q4-2009Q2) when exports collapsed by 39 percent.[5] The third period is recovery 1 (2009Q3-2012Q1), when the volume of exports bounced back and reached beyond the pre-crisis level. The fourth period is slowdown (2012Q2-2014Q4), when the volume of trade plateaued at around 4.6 trillion USD. The fifth period is drop (2015Q1-2016Q2), when the volume of trade again fell by 9.5 percent, and the last period is the recovery 2, when exports recovered from the drop (2016Q2-2016Q4). Note that I refer to the fifth period's export drop as "drop" throughout the paper. I have briefly listed the possible cause of each event in Table 1, and will explore them in detail in the following sections.

increased from 4 in 2010 to 42 in 2016.

[5]The quarter-on-quarter growth rate of world exports in 2009Q2 was 30 percent, which was the lowest growth rate in the modern history of the world trade.

Table 1: The division of the last decade's Korean exports into 6 sub-periods

Name	Period	GR	Possible main cause
Pre-crisis	2006q1-2008q3	14.2	Growth of China
Collapse	2008q4-2009q2	-20.9	Global financial crisis
Recovery 1	2009q3-2012q1	15.1	Recovery from the crisis
Slowdown	2012q2-2014q4	0.9	Structural changes of world trade
Drop	2015q1-2016q1	-9.5	Low oil prices
Recovery 2	2016q2-2014q4	-3.4	Recovery of oil prices

Source: : Export statistics from the Korea Customs through Trade Statistics Service (Accessed on January 19, 2017).
Notes: Own calculation of the author. Before the trade collapse, the monotonic increase of international trade continued from 2002q1. (See appendix for details.) I set the beginning of pre-crisis at 2006q1, from which disaggregated Korean statistics is available from TRASS. GR refers to the average quarter-on-quarter export growth rate of each event in percentage.

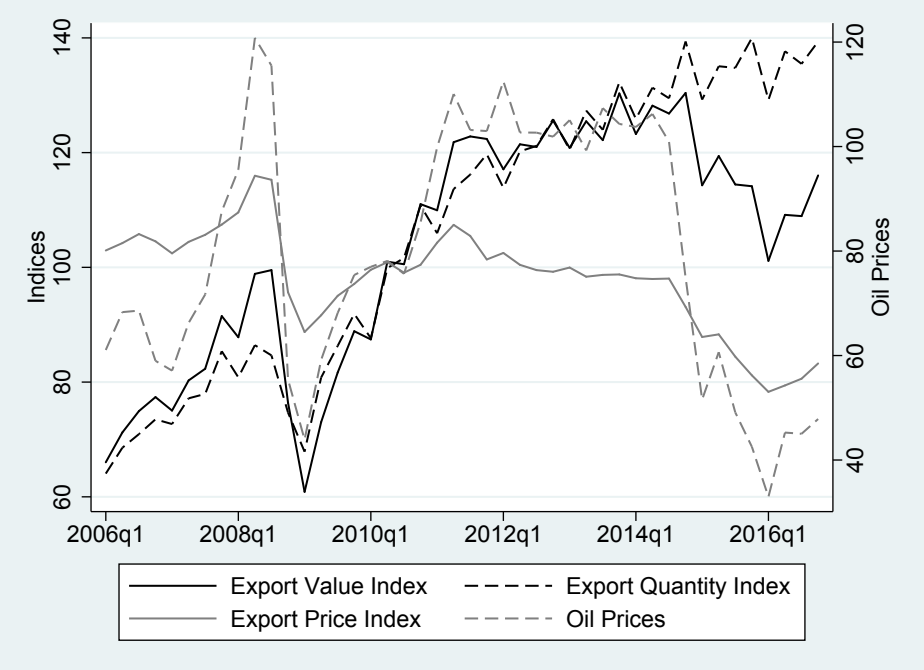
3 Cyclical aspects of the trade drop in 2015

Korean exports dropped by 9.5% during the drop period, and it seems that the price effect was strong during this period due to extremely low oil prices. To explore the cyclical aspect of the trade drop, I first check the export price, quantity, and volume index, which are available from the Bank of Korea. Figure 2 shows that the export value index and the export quantity index have moved together until mid-2014, when crude oil prices started plunging. The export value and quantity are diverging because export prices sharply fell with oil prices. Oil prices are highly correlated with the export price index.

To further investigate the effect of prices, I perform the following decomposition.[6] The method is based on the identity, $V_d(t) = \sum_j v_d(j,t)$, where the volume of exports from Korea to destination country d is the sum of exports of each products j, $v_d(j,t)$. The volume of exports of product j is price times quantity of the product, $v_d(j,t) \equiv p_d(j,t)q_d(j,t)$. Then I

[6]The definition of extensive and intensive margins matters. Trade economists generally take the approach that the extensive margin measures the number of traded products and the intensive margin measures the average trade volume of each product. But detailed definitions differ depending on the studies: for example, some studies define the extensive margin as the number of goods sold by a firm, and others define it as the number of goods sold by a firm to a specific country. I apply the approach by Haddad et al. (2010) because their decomposition takes account the contribution of extensive margin, intensive margin, and the effect of prices to the trade growth. Unlike Haddad et al. (2010), though, I apply a mid-point method when calculating the growth of exports in spirit of Eaton et al. (2008).

Figure 2: Export indices and oil prices



Sources: Bank of Korea (http://ecos.bok.or.kr/, accessed on January 23, 2017), Korea Statistical Information Service (http://kosis.kr/, accessed on January 24, 2017).

Notes: The left axis indicates the level of export value, quantity, and price indices, whose yearly averages are normalized to be 100 in 2010. The right axis indicates the oil prices in USD per barrel. Oil prices are the average of Dubai crude oil, Brent crude oil, and West Texas Intermediate.

decompose the growth of Korea's exports between t and $t-1$, calculated using the mid-point method, as follows:

$$\begin{aligned}
&\underbrace{\frac{V_d(t)-V_d(t-1)}{[V_d(t-1)+V_d(t)]/2}}_{\text{Growth of exports between } t \text{ and } t-1} \\
&= \underbrace{\frac{\sum_{j\in C_d^t}\frac{p_d(j,t)+p_d(j,t-1)}{2}[q_d(j,t)-q_d(j,t-1)]}{[V_d(t-1)+V_d(t)]/2}}_{\text{Quantity effect}} \\
&+ \underbrace{\frac{\sum_{j\in C_d^t}[p_d(j,t)-p_d(j,t-1)]\frac{q_d(j,t)+q_d(j,t-1)}{2}}{[V_d(t-1)+V_d(t)]/2}}_{\text{Price effect}} \\
&+ \underbrace{\frac{\sum_{j\in N_d^t}p_d(j,t)q_d(j,t)}{[V_d(t-1)+V_d(t)]/2}}_{\text{Entry effect}} - \underbrace{\frac{\sum_{j\in X_d^t}p_d(j,t-1)q_d(j,t-1)}{[V_d(t-1)+V_d(t)]/2}}_{\text{Exit effect}}
\end{aligned} \tag{1}$$

$V_d(t)$ denotes Korea's exports to destination d in year t, $p_d(j,t)$ denotes price of product j to destination d in period t, and $q_d(j,t)$ denotes quantity. C_d^t denotes the set of continuing products, which are exported to d in both the previous year $t-1$ and the present year t. N_d^t denotes the set of entering products, which are exported to d in the present year t but not in the previous year $t-1$. E_d^t denotes the set of exiting products, which are exported to d in the previous year $t-1$ but not in the present year t. Finally, I define the number of each group as follows: nC_d^t denotes the number of products in the set C_d^t, nN_d^t denotes the number of products in the set N_d^t and nE_d^t denotes the number of products in the set E_d^t.

In equation (1), the growth of exports between t and $t-1$ in the left-hand side is broadly decomposed into the intensive and extensive margins. The intensive margin measures the contribution of continuing products, which is further decomposed into the price effect and quantity effect. The extensive margin measures the contribution of the entering and exiting

products. Therefore, the growth of exports in the left-hand side is decomposed into the quantity effect, price effect, entry effect, and exit effect.

I use a disaggregated Korean exports data from the Trade Statistics Service, which collects all exports and imports information from the Korean Customs. The export statistics use the Korean Harmonized System at the 10-digit level, but, for better concordances, I aggregate them into HS 6-digit, which comprises 4,386 products. Since there was a revision of the Harmonized System in 2012, I convert the 2012 system to 2007 using the concordance table from the United Nation Statistics Divisions.

Table 2: The numbers of continuing, entry, and exit group

Year	Continuing		Entry		Exit	
	mean	SD	mean	SD	mean	SD
2006-2007	260.1	466.9	116.9	128.0	96.0	102.0
2007-2008	286.3	497.0	109.5	113.3	94.0	96.9
2008-2009	287.0	498.2	108.3	112.0	103.7	108.5
2009-2010	294.3	509.2	117.1	122.2	95.8	97.1
2010-2011	308.6	525.3	114.0	117.6	101.1	105.2
2011-2012	317.6	535.3	113.6	115.0	101.4	102.8
2012-2013	330.6	550.9	120.4	120.4	100.6	99.3
2013-2014	345.4	561.7	124.2	120.9	105.7	102.6
2014-2015	353.9	570.0	115.6	111.5	115.7	110.4
2015-2016	353.9	574.8	120.9	118.2	113.6	109.8

Source: Export statistics from the Korea Customs through Trade Statistics Service (Accessed on January 19, 2017).
Notes: Own calculation of the author. Each row reports the mean and standard deviation of the number of continuing (nC_d^t), entry (nN_d^t), and exit (nE_d^t) group across countries.

Once the decomposition is complete, I get the growth rate of the exports from the previous year and its decomposition into the four effects for each country and each year. For each year, I regress the growth rate by each margin. Since equation (1) is an identity, the coefficients have the following equality in each year: (quantity effect)+(price effect)+(entry effect)-(exit effect)=1.[7] Each coefficient shows the percentage contribution of each effect.

Table 2 lists the average and standard deviation of products in continuing, entry, and exit groups. The sample years range from 2007 to 2016. The number of products in continuing

[7]The regression method is similar to Osnago and Tan (2016).

Table 3: OLS results - Effect of margins on export growth

Year	Quantity	Price	Entry	Exit	N. of Observations	
					Regressions	Base
2006-2016	0.189**	0.0113	0.442***	-0.356***	241	242,324
	(0.0855)	(0.0780)	(0.0279)	(0.0342)		
2006-2007	0.269***	-0.0215	0.338***	-0.415***	230	210,500
	(0.0549)	(0.0287)	(0.0521)	(0.0502)		
2007-2008	0.338***	-0.0469	0.348***	-0.361***	228	222,021
	(0.0826)	(0.0474)	(0.0587)	(0.0623)		
2008-2009	0.294***	-0.0388	0.419***	-0.299***	231	230,476
	(0.0475)	(0.0246)	(0.0467)	(0.0480)		
2009-2010	0.234***	-0.0380	0.360***	-0.415***	234	237,773
	(0.0475)	(0.0246)	(0.0531)	(0.0509)		
2010-2011	0.164***	0.0123	0.430***	-0.394***	235	246,035
	(0.0320)	(0.0165)	(0.0542)	(0.0476)		
2011-2012	0.258***	-0.0245	0.361***	-0.404***	237	252,796
	(0.0515)	(0.0295)	(0.0532)	(0.0563)		
2012-2013	0.232***	-0.0382	0.496***	-0.311***	237	261,637
	(0.0505)	(0.0284)	(0.0577)	(0.0531)		
2013-2014	0.432***	-0.123	0.300***	-0.391***	237	273,101
	(0.111)	(0.0770)	(0.0518)	(0.0630)		
2014-2015	0.405***	-0.166**	0.413***	-0.347***	237	277,610
	(0.100)	(0.0842)	(0.0508)	(0.0582)		
2015-2016	0.0407	0.180	0.489***	-0.289***	238	278,633
	(0.202)	(0.192)	(0.0522)	(0.0524)		

Source: Export statistics from the Korea Customs through Trade Statistics Service (Accessed on January 19, 2017)
Note: Own calculation of the author. The independent variable is the growth rate by country, $[V_d(t) - V_d(t-1)]/[(V_d(t-1) + V_d(t))/2]$, in all cells. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

group has plateaued between 2015-16, while that in entry (exit) group slightly increased (decreased). Table 3 presents the results of the decomposition. The four effects are from the decomposition of the growth rate of the present year from the previous year. The number of observations for regressions ranges from 228 to 241, which is equal to the number of Korea's export destination countries. The number of observations of the base dataset ranges between 210,500 to 278,633. The base dataset for each year contains the non-zero export flows at the HS 6-digit product, country, and (the current and previous) year.

The first row of Table 3 exhibits the decomposition results of export growth between 2006 and 2016: quantity effect contributed 19 percent of the growth and price effect contributed

1 percent, which means that the effect of the intensive margin contributed 20 percent to the growth between 2006 and 2016. The contribution of the extensive margin is 80 percent. The smaller contribution of intensive margin compared to extensive margin is due to the fact that I consider all trading partner countries with an equal weight.

The overall relationship between the export growth rate and all but price effect are generally significant at 1 percent. The quantity effect dominates the intensive margin. But after 2013, the price effect becomes larger in absolute values: from -3 percent in 2013, it becomes -12 percent in 2014, and -17 percent in 2015. Also the relationship between the export growth rate and the price effect is significant at the 5 percent level in 2015. Such trends during the periods of slowdown and drop are consistent with the export price index of Korea that starts diverging with the export quantity index as oil prices plunges. The strong price effect is a distinct feature of the trade drop in 2015 compared to the trade collapse in 2009, when the price effect was only 1 percentage point more negative from that of 2008. Also, the result is consistent with Gopinath et al. (2012), who show that prices stayed largely stable during the GTC.

4 Structural aspects of trade slowdown

4.1 Trade-income elasticity

I estimate the world's income elasticity of imports from Korea. The trade-income elasticity literature generally measures the income elasticity of imports using the world's GDP and imports statistics. I apply this concept to the case of Korea and measure how the world's import demand for Korean goods responds to the world's income. I use a wildly-used version of the error correction model, which is able to address the serial correlation between the GDP and trade flows (Constantinescu et al., 2015, p.9). The specification is

$$\Delta m_t = \alpha + \beta_1 m_{t-1} + \beta_2 \Delta y_t + \beta_3 y_{t-1} + \epsilon_t \tag{2}$$

where α is a constant, m_t is the log of world's import from Korea (or Korean exports to the world) in time t, y_t is the log of world's income (GDP) at time t, Δ denotes first differences. The model is based on the simple relationship of trade and GDP, $M_t = QY_t$, where imports (M_t) is a proportion (a constant Q) of GDP (Y_t). Some algebra show that, in equation (2), β_2 is the short run trade elasticity, $-\beta_3/\beta_1$ is the long run trade elasticity, and β_1 is the speed of adjustment of import to GDP, or the error correction term.[8]

I use quarterly statistics of trade from IMF DOTS and GDP from Bloomberg to run the error correction model in equation (2). Since I give special attention to how the long-run trade-income elasticities are shifting before and after the global financial crisis, I divide the total time periods into 2000q1-2008q4 and 2010q1-2016q2. In addition to the world's income, I calculate the sensitivity of trade with respect to incomes and imports of China, the US, and the European Union. For each economy, I separate the elasticity with respect to imports from Korea and imports from the world.

Table 4 presents the estimation results of the error correction model when considering how the imports from Korea and the imports from the world respond to the changes of the importing party's income in the cases of the world, China, US, and EU. Panel A presents the case when the importing party is the world, and the first three columns of Panel A show how the world's imports from Korea respond to the world's income for 2000-2016, before crisis and after the crisis.

I analyze the results mainly in two aspects: the change in the significance of the beta coefficients, β_1, β_2, and β_3, and the change in the level of the long-run elasticity. If the relationship between trade and income gets weaker after the global financial crisis, I would observe either statistically insignificant coefficients or significant but lower implied long-run elasticity. In Panel A, the long-run trade-income elasticity of the world for imports from Korea became weaker after the global financial crisis. In the second column of panel A, all three beta coefficients are statistically significant at 1 percent and the long-run elasticity is

[8]See Escaith et al. (2010), pp.23-24 for the detailed derivation of the short-run and long-run trade elasticity from the simple relationship, $M_t = QY_t$.

Table 4: Estimation results of the error correction model

A. World

Imports from		Korea			World	
Period	00q1-16q2	00q1-08q4	10q1-2016q2	00q1-16q2	00q1-08q4	10q1-16q2
m_{t-1}	-0.460***	-0.783***	-0.420*	-0.195	-0.999***	-0.150
	(0.168)	(0.153)	(0.230)	(0.149)	(0.267)	(0.176)
Δy_t	1.659***	1.904***	0.848	1.723***	1.296***	1.516***
	(0.376)	(0.541)	(0.664)	(0.343)	(0.426)	(0.485)
y_{t-1}	0.999**	1.843***	0.442	0.351	2.184***	0.170
	(0.385)	(0.342)	(0.522)	(0.276)	(0.567)	(0.385)
Constant	-11.91**	-22.73***	-2.723	-3.102	-22.45***	-0.647
	(4.708)	(4.174)	(7.627)	(2.529)	(5.745)	(4.493)
Observations	57	31	26	57	31	26
R-squared	0.357	0.539	0.291	0.407	0.681	0.451
LR elasticity	2.172	2.354	1.052	1.800	2.186	1.133

B. China

Imports from		Korea			World	
Period	00q1-16q2	00q1-08q4	10q1-2016q2	00q1-16q2	00q1-08q4	10q1-16q2
m_{t-1}	-0.0179	0.0408	-0.115	-0.0352	0.0668	-0.192
	(0.0351)	(0.0663)	(0.115)	(0.0633)	(0.121)	(0.128)
Δy_t	0.428***	0.336***	0.485***	0.374***	0.296*	0.350**
	(0.0550)	(0.102)	(0.0664)	(0.0884)	(0.150)	(0.127)
y_{t-1}	-0.0162	-0.118	-0.00940	0.00139	-0.152	-0.0490
	(0.0294)	(0.109)	(0.0666)	(0.0579)	(0.182)	(0.0923)
Constant	0.410***	1.201	1.322*	0.430**	1.253	3.206***
	(0.135)	(0.866)	(0.648)	(0.171)	(1.079)	(0.909)
Observations	61	35	26	61	35	26
R-squared	0.498	0.358	0.729	0.298	0.253	0.510
LR elasticity	-0.905	2.892	-0.082	0.039	2.275	-0.255

C. United States

Imports from		Korea			World	
Period	00q1-16q2	00q1-08q4	10q1-2016q2	00q1-16q2	00q1-08q4	10q1-16q2
m_{t-1}	-0.404***	-0.356**	-0.835***	-0.132	-0.353**	-0.350**
	(0.106)	(0.136)	(0.165)	(0.0904)	(0.172)	(0.129)
Δy_t	6.152***	5.192***	8.449***	4.379***	3.645**	5.520***
	(1.518)	(1.558)	(2.671)	(1.026)	(1.423)	(1.666)
y_{t-1}	0.612***	0.393**	1.495***	0.169	0.639**	0.0998
	(0.162)	(0.173)	(0.263)	(0.122)	(0.299)	(0.120)
Constant	-6.327***	-3.184*	-16.87***	-1.101	-5.920**	2.929
	(1.753)	(1.875)	(3.250)	(0.931)	(2.787)	(2.027)
Observations	61	35	26	61	35	26
R-squared	0.388	0.397	0.590	0.331	0.419	0.483
LR elasticity	1.515	1.104	1.790	1.280	1.810	0.285

D. European Union

Imports from		Korea			World	
Period	00q1-16q2	00q1-08q4	10q1-2016q2	00q1-16q2	00q1-08q4	10q1-16q2
m_{t-1}	-0.387***	-0.314***	-0.702***	-0.434***	-0.467***	-0.582***
	(0.0874)	(0.0951)	(0.164)	(0.0872)	(0.148)	(0.194)
Δy_t	0.500**	0.516**	0.481	0.562***	0.645***	0.568***
	(0.226)	(0.219)	(0.505)	(0.0883)	(0.139)	(0.115)
y_{t-1}	0.484***	0.427***	0.351	0.561***	0.573***	0.826***
	(0.114)	(0.123)	(0.341)	(0.114)	(0.173)	(0.242)
Constant	-3.733***	-3.530***	1.272	-2.431***	-2.167***	-4.379**
	(0.980)	(1.092)	(5.214)	(0.576)	(0.697)	(1.689)
Observations	61	35	26	61	35	26
R-squared	0.261	0.325	0.328	0.516	0.538	0.557
LR elasticity	1.251	1.360	0.500	1.293	1.227	1.419

Sources: IMF DOTS (http://data.imf.org, accessed on January 26, 2017), Bloomberg (www.bloomberg.com, accessed on January 26, 2017).

Notes: Own calculation of the author. The name of the economy on top of each panel indicates the subject of the trade-income elasticity. For each economy, I separately calculate the elasticity for imports from Korea (the first three columns) and for imports from the world (the next three columns). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

2.354. But in the third column of Panel A, beta coefficients are mostly insignificant and the elasticity went down to 1.052. Thus, the relationship between trade and income became weaker in two aspects: the coefficients became insignificant unlike before, and the level of trade-income elasticity fell down. I observe the same pattern in the next three columns. The long-run trade-income elasticity of the world for imports from the world fell from 2.186 before crisis to 1.133 after crisis. The coefficients became mostly insignificant after the crisis except for β_2. Thus, the results of the trade-income elasticity of the world show that the increase of income creates lower trade after the global financial crisis than before the crisis, and the relationship itself between trade and income became weaker.

The results slightly vary at the country level. In Panel B, where I present the results for China, the long-run trade-income elasticity for imports from Korea (to China) fell from 2.892 to -0.082 after the crisis. The elasticity for imports from the world (to China) also fell from 2.275 to -0.255. China's decreasing pattern of elasticity is the same as the case of the world, implying that China played an important role in shaping the pattern of the decreasing trade-income elasticity. In Panel B, however, both β_1 and β_3, which are used to calculate the long-run elasticity, are insignificant in all six columns. This implies that, in the case of China, the relationship between the current imports growth and the lagged GDP or lagged imports varies a lot. Thus, the long-run elasticity of China is calculated based on statistically insignificant coefficients, but China's decreasing pattern of elasticity is similar to the world's.

In Panel C, where I present the results for the US, the long-run trade-income elasticity for imports from Korea (to US) has increased (from 1.104 to 1.79), and all beta coefficients are statistically significant both before and after the crisis. The stronger relationship between US income and its imports from Korea is impressive since the elasticity for imports from the world went down from 1.810 to 0.825 and β_3 is insignificant in the sixth column. The long-run elasticity of the US for Korean imports may have increased due to the Korea-US (KORUS) FTA, which came into effect in 2012.

In the last panel, I present the results for the EU. The trade-income elasticity for imports from Korea (to the EU) has the same pattern as the case of the world: β_2 and β_3 are significant before crisis but insignificant after crisis, and the elasticity went down from 1.360 to 0.5. The elasticity for imports from the world (to the EU), however, slightly went up after the crisis, from 1.227 to 1.419. Also, all coefficients are significant both before and after the crisis.

To sum up, the relationship between the world's income and the world's import from both the world and Korea became weaker after the financial crisis. Such a trend is consistent with that of China, which confirms the "China factor" in the slowdown literature (Hoekman, 2015). The long-run trade-income elasticity went down in all cases except for the elasticity of the US for the imports from Korea and the elasticity of the EU for the imports from the world. Further investigation regarding why there are such exceptions is out of the scope of this paper but could be a future research topic.

4.2 Bilateral trade barriers

Table 5: Top 10 trading partners of Korea in 2015

Country name	Export Share	Import Share	Total Share
China	26.0	20.7	23.6
United States	13.3	10.1	11.9
Japan	4.9	10.5	7.4
Vietnam	5.3	2.2	3.9
Hong Kong	5.8	0.3	3.3
Saudi Arabia	1.8	4.5	3.0
Taiwan	2.3	3.8	3.0
Australia	2.1	3.8	2.8
Germany	1.2	4.8	2.8
Singapore	2.8	1.8	2.4

Source: IMF DOTS (http://data.imf.org, accessed on January 31, 2017)
Notes: All units are percentages. Total Korean export in 2015 is 527 billion USD, and total import is 436 billion USD.

The slowdown of international trade could be associated with the bilateral trade costs. I adopt Novy (2013) to calculate the bilateral trade barriers between Korea and its important

trade partners, which are listed in Table 5. Novy (2013) derives an analytical way from the gravity equation to measure bilateral trade barriers. The trade barriers conceptually measure the costs of international trade compared to domestic trade. The main benefit of the approach is that it allows one to calculate bilateral trade barriers using directly observable statistics, such as GDPs and bilateral trade. Specifically, the tariff equivalent trade barrier between country i and country j is derived as the following:

$$\tau_{ij} \equiv ((t_{ij}t_{ji})/(t_{ii}t_{jj}))^{1/2} - 1 = ((x_{ii}x_{jj})/(x_{ij}x_{ji}))^{1/(2(\sigma-1))} - 1, \tag{3}$$

where t_{ij} is trade cost that country i faces when exporting to country j, and x_{ij} is country i's export to country j. t_{ii} is country i's domestic trade costs. Similarly, x_{ii} captures country i's domestic sales of its total production, which is defined as $x_{ii} \equiv y_i - \sum_j x_{ij}$ where y_i is the aggregate goods production of country i. The parameter σ is elasticity of substitution.

Calculation of the trade barriers requires international and domestic trade statistics. While bilateral trade statistics are readily available from the IMF Direction of Trade Statistics (DOTS), domestic trade statistics need to be constructed. Domestic trade refers to goods that a country exports to itself (or goods that a country imports from itself), as x_{ii} is defined. The crucial part of measuring x_{ii} is to construct the aggregate goods production y_i. Since bilateral trade statistics are gross shipments, which include intermediate goods, the aggregate goods production needs to be in terms of gross output. The OECD Structural Analysis (STAN) database offers the statistics but its time coverage is limited to 2011. So I take the three-step approach of Wei (1996) to construct the aggregate production.[9] The first step is to collect the goods part of quarterly nominal GDP, which generally includes agriculture, mining, and manufacturing. I obtain the statistics from each trading partner country's statistics bureau.[10] The second step is to compute the ratio between shipment and

[9]UN ESCAP and World Bank jointly constructed the annual International Trade Costs database using the approach of Novy (2013), but the time coverage is still limited to 2013 as of now. Since I focus on the recent trade slowdown and the collapse of trade, I calculate the trade costs until 2016.

[10]See appendix for detailed information about the coverage of the goods part of GDP and data source for each country.

value-added using the OECD STAN database. The third step is to calculate the aggregate goods production as

$$\text{(Aggregate goods production)} = \frac{\text{(shipment)}}{\text{(value added)}} \times \text{(goods part GDP)}.$$

The value of elasticity of substitution, σ, is known to range between 5-10 in the literature. I set $\sigma = 8$, but the overall trends are robust to different numbers within the range.

Table 6: Change in bilateral trade barriers between 2012 and 2016

Country	2012	2016	Difference	Country	2012	2016	Difference
China	0.56	0.58	0.02	Saudi Arabia	0.66	0.76	0.10
United States	0.79	0.80	0.01	Taiwan	0.36	0.58	0.22
Japan	0.70	0.80	0.10	Australia	0.66	0.76	0.11
Vietnam	0.69	0.59	-0.09	Germany	0.63	0.65	0.03
Hong Kong	0.42	0.53	0.11	Singapore	0.32	0.58	0.26

Source: The calculated trade barriers in Figure 3.
Note: The unit of trade barriers is tariff equivalence.

Figure 3 shows the recent trends of bilateral trade costs between Korea and its trading partners. The vertical axis indicates the level of bilateral trade barriers in terms of tariff equivalence. Since the value of trade barriers is sensitive to the assigned value of elasticity of substitution, it is more appropriate to interpret the tariff equivalent values as a relative measure. The main finding in the results in Figure 3 is that the bilateral trade barriers are increasing in most of the top trade partner countries since the beginning of the global trade slowdown around 2011. As Table 6 shows, the increasing trend of bilateral trade barriers is common to most trade partner countries. Trade barriers with large countries tend to increase to a smaller extent: the tariff equivalent trade barrier increases 2 percentage points for China, 1 percentage point for United States, and 3 percentage points for Germany between 2012 and 2016. On the contrary, the barriers with middle or smaller countries tend to increase over 10 percentage points. The decrease of trade barriers with Vietnam is exceptional. Over the periods of the Great Recession and global trade slowdown, the trade barriers with Vietnam have consistently decreased from 2000. This is related to the exceptional growth of and the

Figure 3: Korea's bilateral trade barriers in terms of tariff equivalence

Sources: IMF DOTS (http://data.imf.org, accessed on March 9, 2017), Bloomberg (www.bloomberg.com, accessed on March 9, 2017), Bank of Korea (http://ecos.bok.or.kr/, accessed on February 23, 2017), Census and Statistics Department of Hong Kong (http://www.censtatd.gov.hk/home.htm, accessed on March 8, 2017), Department of Statistics Singapore (http://www.singstat.gov.sg/, accessed on March 9, 2017), OECD Structural Analysis database (http://www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm, accessed on March 8, 2017).

Notes: The unit of trade barriers is tariff equivalence. The 2016 values are the average of the first and second quarter of the year, while all other values are the yearly average of the four quarters. Data for Saudi Arabia is available from 2010.

trade with Vietnam over the past decade.

From the results, it is clear that the bilateral trade barriers that Korea faces have increased during the period of the global trade slowdown. It is worth noting that the trade barriers show an overall trend of increasing, except for Vietnam. The trend shows that the cost of international trade is increasing relative to the cost of domestic transactions. While Korea's international trade plateaued between 2012 and 2014, the trade barriers were increasing. In this context, the steady decrease of the trade barrier with Vietnam emphasizes the importance of the relationship between Korea and Vietnam.

There is a caveat when interpreting the trade barrier results. The Novy (2013) method considers all trade flows that are unexplained by the gravity equation as trade barriers, which is similar to the concept of the Solow residuals. Thus, the trade barriers could be overestimated if the global value chains have shrunken after 2011, which is the last year that the OECD STAN offers the actual ratio of shipment and value added. Unfortunately, the actual information of the gross shipments after 2012 is unavailable as of now. But when I use GDP instead of gross shipments to estimate the trade barriers, the increasing pattern is consistent with the current results. Therefore, while trade barriers seem to be increasing after around 2012, the magnitude could be adjusted when actual gross-shipment statistics are available.

5 Heterogeneous aspects of the slowdown

5.1 Destination countries and firm sizes

In this section I ask whether the trade slowdown is concentrated on the trade with emerging countries. UNCTAD (2016) claims that the trade slowdown is more severe in emerging countries while the Great Trade Collapse in 2008-09 started from the developed countries and spread to the rest of the world through the global value chains. I test whether trade between Korea and emerging countries fell more than trade between Korea and developed

countries. I compare the trade growth rate in the trade drop in 2015 and in the midst of the trade collapse in 2009. While the aggregate trade dropped more severely during the financial crisis than during the trade slowdown, the effect of destination country could be different in the two periods because of the different origins of the shocks.

I employ the difference-in-differences method in line with Ariu (2016) to test whether the effect of destination countries on export growth is different in 2009 and 2015 as below:

$$\Delta v_{jidt} = \alpha + \beta_0' T_t + \beta_1' W_{dt} + \beta_2' W_{dt} \times T_t + \delta_i + \epsilon_{jidt} \tag{4}$$

where $\Delta v_{jidt} \equiv \log v_{jid,t+1} - \log v_{jid,t}$ denotes the growth of export volume of product j in industry i from Korea to destination country d between year t and $t-1$. To address a possible seasonality problem, I only use the first half year's exports in each year in the dataset. Thus, the dependent variable is the growth rate of exports between the first half of year $t-1$ and the first half of year t. Note that v_{jidt} denotes exports of the first half of year t, and v'_{jidt} denotes exports of the full year t. The time dimension comprises two periods: $t \in \{2009, 2015\}$, which are the periods of trade collapse and trade drop. T_t is a dummy variable, which is 1 if the period is 2015 and 0 if the period is 2009. W_{dt} is a vector of two variables that contain country-level characteristics: one is a destination dummy variable, which is 1 if the destination d is an emerging country and 0 otherwise. Another variable in the vector W_{dt} is the income (GDP) growth rate of the destination country. δ_i is an industry fixed effect and ϵ_{jidt} is an error term.

The TRASS dataset tells me the total volume of exports of product j to destination country d by the size of firms, small, medium, and large. For example, Korea exported 1.31 million USD worth of HS 6-digit product 820570 (vices, clamps & the like) to China in the first half of 2008. Of 1.31 million USD, large firms sold 1.26 million USD, medium firms sold 0.4 million USD, and small firms sold 0.01 million USD. I omit the firm dimension in the subscripts of the dependent variable in equation (4) for brevity, but I report results for each

group of firms. The industry classification for the industry dummy variable is from TRASS, which contains 69 industries. The statistics of yearly growth rate of GDP of destination countries are from the IMF World Economic Outlook.

Table 7: Descriptive statistics of the dataset for the estimation of equation (4)

Variable	Firm Size	Obs	Mean	Std. Dev.	Min	Max
Δv_{jidt}	All	255,916	-0.122	3.050	-17.624	18.532
	Large	53,498	-0.3149	3.350	-17.624	18.532
	Medium	53,512	-0.60	3.181	-15.774	14.831
	Small	142,406	0.226	2.766	-17.006	16.297
v'_{jidt}	All	255,916	1,646,328	3.60e+07	1	7.58e+09
	Large	53,498	4,995,152	7.61e+07	1	7.58e+09
	Medium	53,512	1,336,513	1.85e+07	1	2.77e+09
	Small	142,406	574,129	4,221,590	1	4.46e+08
T_{dt}	All	255,916	0.582	0.49	0	1
GDP growth	All	255,916	1.57	4.44	-28.1	26.28

Sources: Export statistics from the Korea Customs through Trade Statistics Service (accessed on January 19, 2017), IMF World Economic Outlook (https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx, accessed on February 16, 2017).
Notes: Δv_{jidt} is the growth of export volume of product j in industry i to destination country d between periods t and $t-1$; v'_{jidt} is the unit of yearly exports to a country-product pair in year t, whose unit is USD. T_{dt} is 1 if the period is 2015 and 0 if the period is 2009. The GDP growth is year-on-year growth rate in percentage.

Table 7 reports descriptive statistics. The dataset contains 255,916 observations, of which 21 percent are large firms, 21 percent are medium firms, and 56 percent are small firms.[11] The large firms' average growth rate is the lowest and their standard deviation of growth rate is the highest among the three groups of firms. More than half of the number of country-product pairs, or the extensive margin, belongs to small firms. They export a larger number of products to more countries than large and medium firms. Small firms export 890 more intermediate varieties and 378 more consumption varieties than large firms. But large firms export 5 million USD to a country-product pair on average, which is 8.7 times larger than the small firms' average exports to a country-product pair. Although the share of large firms' exports is falling in Korea, it is still 62.3% in 2016.

[11]Firm size information was unavailable for the remaining 2 percent.

Table 8: Number of exporting countries and products

A. Number of Products

Product type	Firm size			
	All	Large	Medium	Small
All	4386	2884	3288	4286
Intermediate	2683	1727	2015	2617
Capital	601	467	473	592
Conumption	1068	668	776	1046
Not classified	34	22	24	31

B. Number of Countries

Country type	Firm size			
	All	Large	Medium	Small
All	187	178	181	185
Emerging	148	140	143	146
Advanced	39	38	38	39

Sources: Export statistics from the Korea Customs through Trade Statistics Service (accessed on January 19, 2017), Broad Economic Categories from United Nations Statistics Division (https://unstats.un.org/unsd/cr/registry/regot.asp?Lg=1, accessed on February 3, 2017).
Notes: The product type is classified using Basic Economic Categories, and the country type is classified following IMF.

Table 9: Results of the difference-in-differences estimation

	(1) All goods		(2) Intermediate		(3) Capital		(4) Consumption		(5) Durable consumption	
A. All firms	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	0.0342	-0.0363	0.0529*	-0.0225	0.0101	-0.0178	0.0325	-0.116**	-0.0708	0.0140
	(0.0211)	(0.0270)	(0.0277)	(0.0358)	(0.0488)	(0.0619)	(0.0445)	(0.0568)	(0.0701)	(0.0927)
GDP growth	0.00890***	0.00104	0.00646**	0.00279	0.0135***	0.00186	0.00851*	-0.00104	0.0164**	-0.00923
	(0.00208)	(0.00314)	(0.00274)	(0.00419)	(0.00454)	(0.00664)	(0.00471)	(0.00704)	(0.00727)	(0.0109)
Constant	-0.186**		-0.270***		-0.417***		-0.161*		-0.256***	
	(0.0845)		(0.0887)		(0.0719)		(0.0886)		(0.0628)	
Observations	255,791		146,882		51,422		54,140		23,642	
R-squared	0.001		0.001		0.003		0.003		0.002	
B. Large firms	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	0.275***	-0.0554	0.280***	-0.0961	0.304**	0.00159	0.255*	-0.0178	-0.0920	0.166
	(0.0526)	(0.0660)	(0.0658)	(0.0842)	(0.128)	(0.158)	(0.131)	(0.157)	(0.157)	(0.206)
GDP growth	0.0110**	-0.0193**	0.00473	-0.0132	0.0212*	-0.0200	0.0117	-0.0329*	0.0499***	-0.0431*
	(0.00510)	(0.00758)	(0.00648)	(0.00972)	(0.0115)	(0.0165)	(0.0131)	(0.0192)	(0.0163)	(0.0245)
Constant	-1.665***		-0.499***		-0.744***		-1.691***		0.00792	
	(0.184)		(0.159)		(0.159)		(0.201)		(0.136)	
Observations	53,432		32,107		10,760		9,176		5,347	
R-squared	0.039		0.039		0.026		0.055		0.053	
C. Medium firms	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	0.209***	-0.168***	0.0992	-0.0194	0.182	-0.307*	0.490***	-0.427***	0.431**	-0.237
	(0.0539)	(0.0648)	(0.0698)	(0.0838)	(0.136)	(0.160)	(0.108)	(0.134)	(0.198)	(0.252)
GDP growth	-0.0194***	0.0241***	-0.0218***	0.0276***	-0.0227*	0.0439**	0.000555	-0.0171	-0.0181	0.0562*
	(0.00521)	(0.00734)	(0.00670)	(0.00936)	(0.0124)	(0.0171)	(0.0111)	(0.0167)	(0.0213)	(0.0313)
Constant	-0.533***		-1.414***		-1.486***		-0.715***		-1.095***	
	(0.189)		(0.216)		(0.203)		(0.197)		(0.164)	
Observations	53,501		32,732		9,515		10,832		3,787	
R-squared	0.015		0.020		0.008		0.029		0.005	
D. Small firms	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2
Emerging	-0.251***	0.0695**	-0.182***	0.0828*	-0.315***	0.104	-0.381***	0.0292	-0.417***	0.0543
	(0.0244)	(0.0322)	(0.0320)	(0.0429)	(0.0560)	(0.0725)	(0.0511)	(0.0671)	(0.0817)	(0.110)
GDP growth	0.0333***	-0.00491	0.0331***	-0.00429	0.0354***	-0.0105	0.0305***	0.00371	0.0253***	-0.0104
	(0.00242)	(0.00385)	(0.00318)	(0.00526)	(0.00521)	(0.00785)	(0.00546)	(0.00837)	(0.00831)	(0.0129)
Constant	0.668***		0.374***		0.234***		0.718***		0.111	
	(0.106)		(0.121)		(0.0848)		(0.110)		(0.0766)	
Observations	142,358		79,959		29,875		31,390		13,398	
R-squared	0.013		0.015		0.012		0.016		0.026	

Sources: Export statistics from the Korea Customs through Trade Statistics Service (accessed on January 19, 2017), IMF World Economic Outlook (https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx, accessed on February 16, 2017), Broad Economic Categories from United Nations Statistics Division (https://unstats.un.org/unsd/cr/registry/regot.asp?Lg=1, accessed on February 3, 2017).
Notes: Own calculation of the author. β_1 is the coefficient of W_{dt} and β_2 is the coefficient of $W_{dt} \times T_t$ in equation (4). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

A positive and significant β_1 for the emerging country variable will show that export growth to emerging countries was higher than that to advanced countries in 2009, after controlling for the changes in exports due to GDP growth. Such a result will be consistent with the claim that the Great Trade Collapse was more severe among developed countries. It is important to note that I control for the GDP growth rate in the regression. Thus, I measure the effect of the destination countries in 2015 compared to 2009, which is a "pure country" effect. Intermediate goods export is about 2/3 of all Korean exports to emerging countries, and 1/3 of all Korean exports to advanced countries. Thus, the "pure country" effect considers the composition of goods rather than income growth effect.

A negative and significant β_2 for the emerging country variable will show that Korean export growth to emerging countries has weakened in 2015 compared to 2009, which is consistent with the claim that weakening emerging economies partly caused the trade slowdown. If the sum of β_1 and β_2 is positive, then the average export growth to emerging countries was higher than that to advanced countries in 2015.

I present the results of the estimation in equation (4) in Table 9. β_1's are positive and significant for all goods in the case of large firms and medium firms, but negative and significant in the case of small firms. The change in export growth rate to emerging countries during the 2008-09 trade collapse was 27.5 percent higher than advanced countries for large firms and 20.9 percent higher for medium firms. Thus Korean exports to emerging countries by large and medium firms did stay resilient in 2009 compared to exports to advanced countries. But the change in export growth rate during 2008-09 to emerging countries was 25.1 percent lower for small firms. Such severe drop of exports to emerging countries by small firms is prevalent in all goods categories: -18.2 percent for intermediate goods, -31.5 percent for capital goods, -38.1 percent for consumption goods, and -41.7 percent for durable consumption goods.

As expected, the signs reverse for β_2's. They are negative but largely insignificant for large firms. Overall, the large firms' export growth to emerging countries is 5.5 percent

lower than export growth to advanced countries in 2015 compared to 2009, but the effect is statistically insignificant. The β_2 coefficients are negative and significant at 1 percent for medium firms for all goods, and the consumption goods drive the result. Overall, the export growth of medium firm exports to emerging countries dropped by 16.8 percent for all goods, and by 42.7 percent for consumption goods in 2015 compared to 2009. The results imply that the 2015 trade drop was due to weak demand in the emerging countries suffering from the low oil prices. Stronger drop in consumption goods exports to these countries is evidence of this. Then why did medium firms suffer more severely than large firms during the trade slowdown? One possibility is that while the trade collapse was shockingly sudden, the 2015 trade drop occurred after more than two years of trade slowdown. And larger firms were able to stay more stable than medium firms thanks to their uncertainty managements.

The β_2 coefficients for small firms are positive and significant, indicating that the small firms' export growth to emerging countries is 7.0 percent higher in the 2015 trade drop than in the 2009 trade collapse. The coefficient for the intermediate goods sector is the most significant. But a caveat here is that the exports by small firms most severely dropped among all groups of firms in 2009. As explained above, the sum of β_1 and β_2 is the effect of emerging countries on Korea's exports in 2015, and it is still the lowest for small firms, -0.18, where the sum is 0.22 for large firms and 0.04 for medium firms. Thus, exports of small firms to emerging countries were impacted the most during the trade drop in 2015, but they did better compared to when financial crisis hit. The export of large and medium firms to emerging countries suffered more in 2015 compared to the trade collapse.

It is interesting that, after controlling for the GDP growth rates, the export drop in 2015 to emerging countries was more severe among large and medium firms than that of small firms. Such differing patterns between large and medium firms versus small firms hold in all goods categories, intermediate, capital, consumption, and durable consumption products, except for the capital goods categories of medium firms. Investigating the reason behind the relatively sound performances of small firms will be a meaningful future research topic.

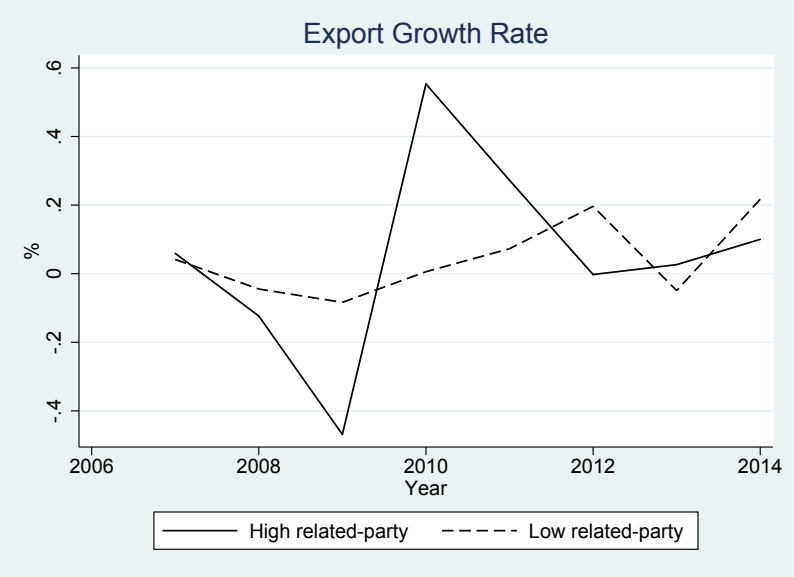
5.2 Intrafirm trade

Bernard et al. (2009) report that international transactions between related parties, or intrafirm trade, stayed largely intact during the Asian financial crisis in 1997, and Altomonte et al. (2011) show that intrafirm trade dropped and recovered faster than arm's length trade during the Great Trade Collapse. So I ask whether Korean intrafirm trade is relatively intact during the trade collapse in 2009 and the recent trade slowdown. Unfortunately, the access to Korean intrafirm trade statistics is restricted as of now and there is no public source of the data. But I measure the intrafirm trade between Korea and the US by combining two available datasets. One is TRASS and the other is the US related-party trade database from the US Census. The related-trade database offers information on all international transactions between the US and all of its bilateral trading partners at the 5-digit NAICS (North American Industrial Classification) level. For each industry and year, the database reports total transactions, related-party transactions and non-related party transactions for both export and import. A transaction is classified as related party if one party of the transaction owns more than 10 percent of the other party in the case of exports and more than 6 percent in the case of imports. Thus related-party transactions information is often used as a proxy of intrafirm trade in the international trade literature. From the related-trade database, I use the information on the share of intrafirm trade between the US and Korea in each NAICS 5-digit industry i as follows:

$$(\text{Intrafirm share})_{it} = \frac{(\text{total related-party transactions})_{it}}{(\text{total transactions})_{it}}.$$

I match the related-party trade database with the Korean exports statistics from TRASS using the concordance table between NAICS 5-digit and HS 6-digit published from the US Census Bureau. The sample periods are from 2006 to 2014, since the most recent statistics are for 2014. The related-party trade database gives the intrafirm trade share information for each HS 6-digit product. I repeat the decomposition exercise of section 3 for the group

Figure 4: Growth rates of related-party exports to the US

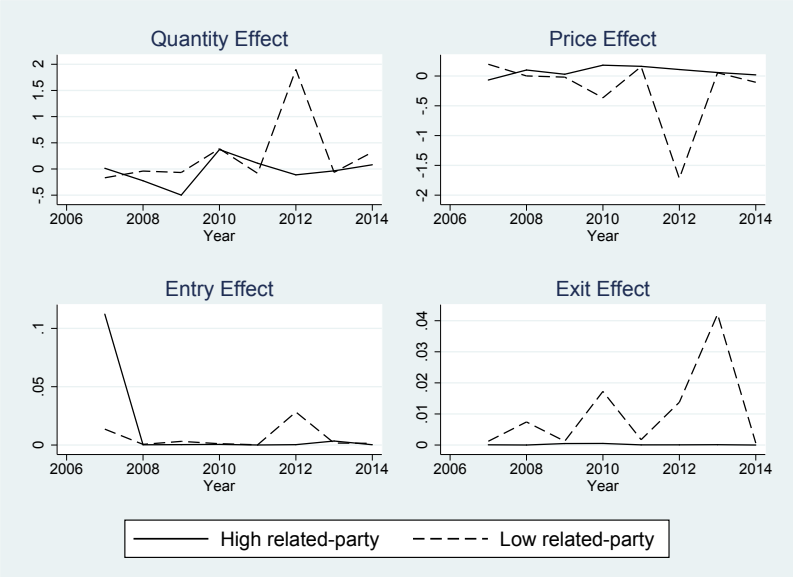


Sources: Export statistics from the Korea Customs through Trade Statistics Service (accessed on January 19, 2017), (http://sasweb.ssd.census.gov/relatedparty/, accessed on March 27, 2017).
Notes: The left axis indicates the year-on-year growth rates of high and low related-party exports from Korea to the US. High (low) related-party group captures exports by the industries whose share of related-party exports out of total exports is below (above) the first (third) quartile.

of products whose related-party share is above the third quartile, which I call "high related-party" and another group of products below the first quartile, which I call "low related-party". I use the high related-party share group as a proxy for intrafirm exports, and the low related-party share group as a proxy for arm's length exports to the US from Korea.

Figure 4 presents the year-on-year export growth rate separately for the high and low related-party group. Intrafirm trade fluctuated more but recovered faster during the Great Trade Collapse, and stayed more stable during the slowdown. The response of intrafirm trade during the GTC is similar to that of French intrafirm trade reported by Altomonte et al. (2011) in that the intrafirm exports to the US promptly adjust to the macroeconomic shock. The high related-party exports dropped by 46.8 percent in 2009 and recovered by 55.3 percent in 2010, whereas the low related-party exports dropped by 8.3 percent in 2009

Figure 5: Decomposition of related-party exports growth



Sources: Export statistics from the Korea Customs through Trade Statistics Service (accessed on January 19, 2017), (http://sasweb.ssd.census.gov/relatedparty/, accessed on March 27, 2017).
Notes: Growth rates in Figure 4 are decomposed into the four effects above. For each year, the sum of the quantity effect, price effect, and entry effect minus exit effect is 1.

and recovered by 0.6 percent in 2010. Thus, although the intrafirm trade between Korea and the US dropped deeper than the arm's length trade during the GTC, intrafirm trade also strongly recovered in the subsequent years. The pattern of deeper drop and faster recovery is found in the aggregate export flows during the GTC, and it could be the case that large firms, which are the majority of the exports, are involved in the intrafirm trade. Due to the lack of related party trade data in 2015, I cannot compare the patterns of intrafirm and arm's length trade in the 2015 trade drop, but this could be done in the near future when the data is available.

Figure 5 shows the decomposition of the growth rate into quantity, price, entry, and exit effects. I do not run OLS regressions for intrafirm trade between Korea and the US because there is only one observation (country) in each year. The decomposition results show that the high related-party group stayed stable in price, entry, and exit effects throughout the years. The quantity effect of high related party exports fell by 49.8 percent in 2009, reflecting the huge drop of intrafirm exports in 2009. But the price effect of the high related-party group fell by only 6.7 percent in 2009, showing that the trade drop of 2009 was mostly due to the quantity effect. The pattern is similar in low related-party trade. In later years, when trade slowdown has continued, all four effects of the high related-party stay more stable than the low-related party. In 2012, when the low related-party's quantity effect jumped and its price effect dropped, the four effects of the aggregate export from Korea to the US showed the same patterns. Thus, it seems that, unlike the total export fluctuations in quantity and price effects, intrafirm trade, at least with the US, stayed more stable and resilient during the period of slowdown.

6 Conclusion and policy implications

Observing the unusual trade trends of the world and Korea in the last decade, I investigate detailed features of the trade collapse and slowdown at both aggregate and disaggregated

levels. I show that Korea's recent export drop in 2015 is apparently accompanied with low oil prices. Thus it seems natural that exports in the near future will show positive growth if oil prices continue their recovery. There is evidence, however, that points to the structural changes of exports. The long-run trade-income elasticity has shrunken after the global financial crisis, and Korea's bilateral trade barriers with most of its important trading partners have tightened since 2011.

I also present evidence regarding the heterogeneities in disaggregated trade flows. Overall, the exports of large corporations are more resilient than that of medium and small enterprises during the trade collapse and slowdown, but small firms fared better during the trade slowdown than the trade collapse. I provide rare evidence regarding Korean intrafirm exports' stability during the period of trade slowdown. In the long run, analyzing value-added exports would be helpful to understand the current slowdown of the international trade, when the value-added data for the current years are available in the future.[12]

The results of this paper offer various policy implications. First, to lower the adverse effect of oil price fluctuations on export growth, it is important to diversify the export products. Korea's export prices are strongly affected by oil prices since Korea completely depends on foreign sources when it comes to its oil supplies. But there is a way to mitigate the negative effect of oil prices fluctuations. Haddad et al. (2010) point out that, in the US during the global financial crisis, the prices of homogenous goods plunged but the prices of differentiated goods stayed stable. The situation was similar in Korea during the trade slowdown period. According to the Bank of Korea, between 2012-2016, export prices of chemical, primary metal, and coals and petroleum products fell most while the export prices of transport equipments and general machineries hardly changed. Thus, diversifying the export products to include more differentiated products would lower the temporary price effects due to oil price fluctuations.

Second, considering the fact that the long-run trade-income elasticity of the world has

[12]Since the export value-added database from the World Bank or the OECD does not cover 2015-16, as of now it is difficult to measure how value-added exports changed during the trade drop periods.

shrunken, it is likely that future export growth will be modest unlike before the mid-2000s. China's average growth rate in 2002-11 was 10.6, but was 7.4 in 2012-15 according to the IMF. As China is transforming itself from "the factory of the world" into a domestic-consumption-centered economy, the international trade through global value chains will likely continue to be slow. It is important for policy-makers to have a long-run perspective and be ready to navigate the age of slow trade to maximize the benefits from international trade.

Third, while bilateral trade barriers between Korea and its important trading partners are universally increasing, the trade barriers of Vietnam have continuously lowered since 2000. The diminishing trend of the trade barriers between Korea and Vietnam has been intact during the period of the trade collapse and slowdown. It seems, therefore, likely that the trend will continue in the future, and such trend may apply to the trade barriers between Korea and other ASEAN countries. Korea has free trade agreements in effect with both Vietnam and ASEAN, but the utilization rates of the two FTAs are low at 36.0 percent and 52.3 percent as of 2016. Therefore, it will be beneficial to enhance the utilization rates through economic cooperations with Vietnam and other ASEAN countries.

Lastly, at a disaggregated level, export flows show heterogenous patterns depending on firm sizes, product categories, destination countries, and organization mode of exports. The results in section 5 identify robust export flows during the recent slowdown and drop, on which policy makers can focus attention and encourage these sectors to become main export industries in the age of slow trade. The share of exports by small firms has been rising during the slowdown period according to the Korea International Trade Association, which is encouraging. Thus, policy makers may further support small firms by helping them to transform their manufacturing facilities into smart factories to boost productivity and by effectively operating export finances, which Korean small firms request most as export policies. Also, as emerging countries are expected to continue their slow growth in the near future, exports, especially consumption goods, to advanced countries will be promising. Given the mild price effects in the growth of intrafirm exports, it is worth noting that FDI-induced

exports may contribute to the stabilization of export flows.

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Appendix

A List of advanced and emerging countries

1 Advanced countries

Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong (Special Administrative Region of China), Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Macao (Special Administrative Region of China), Malta, Netherlands, New Zealand, Norway, Portugal, Puerto Rico, San Marino, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Taiwan (Republic of China), United Kingdom, United States Minor Outlying Islands, United States of America

2 Emerging countries

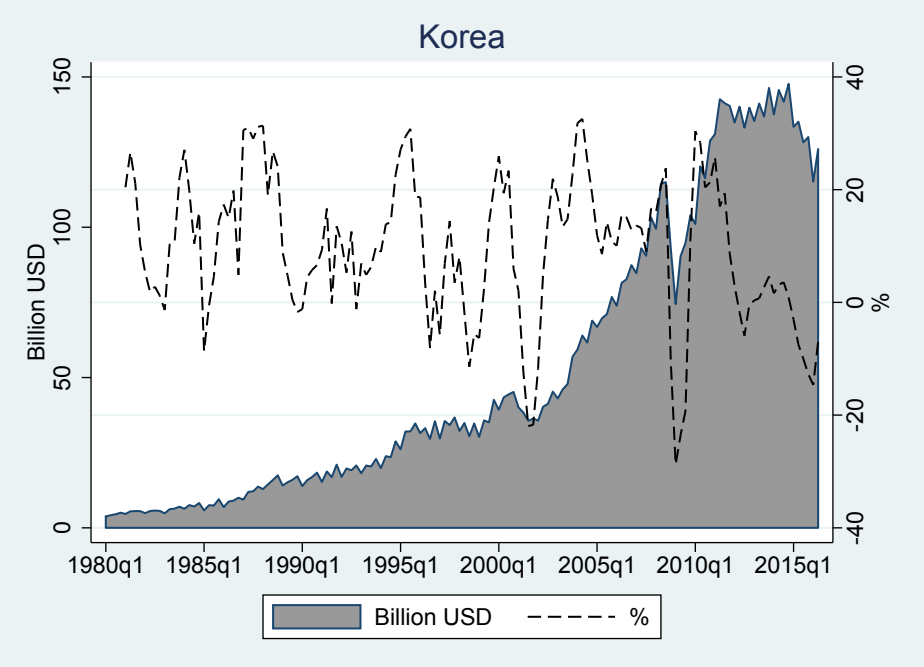
Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Darussalam, Bulgaria, Burkina Faso, Burundi, Cote d'Ivoire, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo (Brazzaville), Democratic Republic of the Congo, Costa Rica, Croatia, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Islamic Republic of Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao PDR, Lebanon, Lesotho, Liberia, Libya, Republic of Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali Marshall Islands, Mauritania, Mauritius, Mexico, Federated States of Micronesia, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Islands, South Africa, South Sudan, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic (Syria), Tajikistan,

Tanzania, United Republic of Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Yemen, Zambia, Zimbabwe

B Historic trend of Korean exports

Korean exports have monotonically increased from before 1980s until the financial crisis in 2008, although there were ups and downs in smaller scales. There was a period of time, between 1995 and 1999, when the level of trade plateaued as was between 2012 and 2015. But the main difference between the two plateaus is that the first plateau in the 1990s was Korea specific: the world trade was still increasing in the period.

Figure A1: Historic trend of Korean exports



Sources: IMF DOT (http://www.imf.org/en/Data, accessed on January 1, 2017).
Note: Own calculation of the author. The left axis is the level of exports in USD, and the right axis is the quarter-on-quarter growth rate of exports.

C Data sources of goods part GDP

Table A1: Data sources of goods part GDP

Country	Source
Republic of Korea	Bank of Korea
China	National Bureau of Statistics of China
US	Bureau of Economic Analysis
Japan	Federal Reserve Economic Data
Vietnam	General Statistics Office of Vietnam
Hong Kong	Census and Statistics Department of Hong Kong
Taiwan	Directorate General of Budget Accounting and Statistics
Singapare	Statistics Singapore
Australia	Australian Bureau of Statistics
Germany	Eurostat
Saudi Arabia	Saudi Arabian Central Department of Statistics

Generally (in the case of Korea, Saudi Arabia, Vietnam, Australia, Taiwan, and USA), the goods part of GDP includes primary industries (agriculture, forestry, and fishing), mining, and manufacturing. China's goods part of GDP includes primary and secondary industries. Chinese value added by industry data are classified by total primary, secondary, and tertiary. China's secondary industry includes manufacturing, mining, production and supply of electricity, steam, gas and water, and construction. So China's goods part of GDP include wider range of industries than other countries. The goods part of GDP of Japan, Hong Kong, and Germany include primary and manufacturing industries, and Singapore's include manufacturing only. All goods part GDP statistics are nominal millions of USD.

Japan's statistics agency does not offer value added by industry but GDP. So I use OECD Value added by activity data to calculate the share of primary industry and manufacturing out of Japan's GDP from 2000 to 2014 and multiply the share by GDP to get the goods part of GDP. I use 2014 value to proxy the share of primary and manufacturing industry in 2015 and 2016. Australia and Hong Kong offer value added by industry in real term only. So I calculate the share of primary, mining, and manufacturing industries out of GDP using real value added statistics, and then multiply with the nominal GDP to calculate the aggregate goods production.

Since the goods part GDP statistics are originally in local currency, I convert them to millions of US dollars using the quarterly average exchange rate from Bank of Korea for Korea, China, Japan, Singapore, and Vietnam, Bloomberg for Australia, Germany, Hong Kong, Saudi Arabia, and Central Bank of Republic of China (Taiwan) for Taiwan.

The ratio of gross output and value added for the total economy information is from the OECD Structural Analysis (STAN) database for USA, Germany, Korea, and Japan between 2000 and 2011. The OECD STAN offers the information about Australia for manufacturing industry only between 1990 and 1999, which is 3.23 on average. The goods part GDP includes primary and mining industries as well, and Arvis et al. (2016) report that the gross output and value added ratio for agriculture ranges between 1.74 and 1.93. So I use the weighted average of the two industries, which is 2.90, as a proxy for the ratio for Australia. I use the latest value available as a proxy of the ratio for the recent years. The ratio of gross output and value added used for China is 2.85, which is an average value of the ratio between 1987-2008 according to Wu (2012). For Vietnam, Hong Kong, Singapore, Taiwan, and Saudi Arabia, I use the yearly average of other Asian developing countries, Korea and China.