A multilevel analysis of FDI impacts: The role of big world players (China, East Asia, EU28, Japan, U.S.) in production networks and final markets

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Abstract

This paper analyzes the interplay of Chinese FDI inflows with the presence of Asian production networks by means of a Computable General Equilibrium (CGE) model. Despite the fact that East Asia is by far the main supplier of Chinese imported intermediates, the former experiences the largest GDP fall across all the regions considered. East Asia GDP structure relies heavily on the sectors in which China receives more FDI and the losses of East Asian exports, due to the fierce Chinese competition, result in production and GDP reductions. The rest of regions Japan, EU28 and the U.S., undergo similar crowding out effect in exports and GDP reductions, but because they are less specialized than East Asian in the sectors in which China becomes most competitive, they are less harmed. Only ROW gains because it is protected from Chinese competition and specialized in sectors in which China demands more.

Key words: Vertical specialization; Fragmentation; Intermediate; Computable general equilibrium

JEL: C68, F15, F17

1. Introduction

The emergence of China on the world stage poses important questions about its economic consequences for that and other regions of the world and demands powerful methodologies able to quantify its challenges and opportunities.

Somehow, Chinese geographical frontiers become "blurred" in this process. On the one hand, China has been escalating positions as a favorable Foreign Direct Investment (FDI) destination, ranking now 2nd among top hosts of FDI inflows in the world (UNCTAD, 2013). This implies that FDI must play an important role in Chinese GDP growth (e.g., Kym et al., 2003) and foreign trade (e.g., Dean et al., 2009). Some authors have pointed out that in the absence of FDI flows, the Chinese high rates of GDP growth and exports would be in danger (Whalley and Xin, 2010; Zhang, 2013).On the other hand, a significant part of what is produced in (and later exported from) China relies heavily on foreign imported intermediates. What does, then, the "made in China" really mean?

Imported intermediate inputs embodied in exports have raised close attention to what the literature calls: vertical specialization, global production sharing, networks, supply-chain trade or value-added trade. Input-Output (IO) analysis is a dominant methodology in this research. Koopman et al. (2008) disentangle the imported intermediate inputs from domestic ones in Chinese exports. They obtain that only 40-50% of the value added is created in China, the rest being imported mainly from Japan, Korea, Taiwan, Hong Kong and the U.S. Dean et al. (2011), following Koopman et al. (2008) methodology to split the Chinese IO tables, find that there is a significant Asian-supplier network, with Japan and the Four Tigers accounting for more than half of Chinese imported inputs in 1997 and 2002. Baldwin and Lopez-Gonzalez (2013), based on two data sets (the World IO Database and the Trade in Value Added Database), suggest that supply-chain trade has shifted heavily towards "Factory Asia" and away from "Factory North America" and "Factory Europe".

In this paper, we study the interplay of FDI accruing to China with the presence of Asian networks. The regions considered are China, East Asia, Japan, EU28, the U.S. and the rest of the world (ROW) and, the Chinese sectors receiving FDI, Electronics, Machinery, Chemicals and Textiles. We pay particular attention to the role of these sectors along several levels of analysis, such as their weight in GDP, imports and exports in the world, in China and in the rest of regions. Our approach incorporates the real numbers of costs, export orientation and import reliance of production in the different sectors across all regions, which underlie the results at the macroeconomic levels (such as GDP growth, wages, aggregate foreign trade and welfare). We use a Computable General Equilibrium (CGE) model. This methodology allows capturing the complex geographical and sectoral relationships of domestic and imported intermediates. Further, CGEs rely on a well-grounded theoretical framework in order to derive the consistent micro and macroeconomic results. They also combine both the demand and supply side of the economy, as well as, product and labor markets across regions (Markusen, 2002).

The model, thus, captures the presence of Asian networks and production chains, together with the main destinations of final and intermediate goods produced by China. However, we go beyond the data describing the presence of networks and markets and try to quantify the consequences of the particular linkages of each region with the Chinese economy. In theory, FDI inflows may have multiple effects. They affect factors remunerations, investment, GDP growth, technological transfers and productivity, the climate of competition among firms, foreign trade, and so on (see Lipsey, 2002, Barba Navaretti and Venables, 2004 or Latorre, 2010, for theoretical reviews of the literature). A small handful of big multinationals may transform the production landscape of entire countries. However, comprehensive studies of their impact, such as CGE analyses of FDI, are rather

scarce (Latorre, 2009). We, thus, aim at applying this methodology to the consequences of the complex globalization of China.

The rest of the paper is organized as follows. Section 2 fully describes the weight of sectors in the world and across regions. Section 3 describes the model and simulations. The aggregate and sectoral results are analyzed in section 4. Section 5 concludes.

2. Data section

Table 1 offers the definition of sectors and their relative importance in each region's GDP, exports and imports. The GDP structure reflects the level of development of the different regions. Agriculture and Mining are very important in China and ROW. Services are less important by contrast in these two regions compared with the rest. The four sectors, to which FDI accrues (Textiles, Chemicals, Electronics and Machinery) appear in bold. They account for 9.2% of Chinese GDP. In East Asia, whose GDP structure in manufacturing is very similar to that of China, their weight is 13.3% of GDP. The shares in Japan and Europe are similar and around 10%. The areas in which they are less relevant are the U.S. (7.5%) and ROW (6.4%).

The four sectors receiving the shock are vital for the exports of China (64%), East Asia (54.6%) and Japan (53.4%), while being less important in the other regions. There is a strong network between China and East Asia, in which Japan also participates although it is less integrated than the previous two areas. We summarize this in Figure 1. There we can see that East Asia provides the vast majority of total Chinese imports ranging from 70.4% in Electronics to 46.8% in Chemicals, with the smallest share in Machinery of 36.5%. The next most important supplier for China is Japan, which accounts for around 15% of Chinese imports, with the exception of Machinery where it provides 36.5%.Taking into account that 86.3%, 96.9%, 84.5% and 68% of total Chinese imports are of intermediates in Textiles, Chemicals, Electronics and Machinery, respectively, this must be a strong network by which East Asia and, to a lesser extent Japan, provide intermediates to be further processed in China.

Figure 1 also shows that Chinese export structure contrasts drastically with that of the imports. To the U.S., EU and ROW go between 70% and 76% of total Chinese exports. Imports from EAS, which is Chinese next important destination (after the U.S., EU and ROW) are mostly intermediates. This suggests that most of the Chinese final goods go to the U.S., EU and ROW, although there may be also intermediates in those Chinese exports to be further processed in those areas of the world[1].

In the U.S. services account for the bigger share in exports (Table 1). Exports of Motor vehicles are very important for Japan, while ROW depends heavily on its Mining exports. Textiles exports are very important in China and less important in the rest of regions.

The fours sectors experiencing FDI increases account for 53.5% of overall Chinese imports and 43.2% in East Asia exhibits a closer import pattern while their weight in imports from the rest of regions is smaller.

[1] In Zhou and Latorre (2013a; 2013b) we analyze more deeply the amount of imports and their use (i.e., whether they are for Private or Public consumption, Gross capital formation, Intermediates). We do it, however, for Textiles, Electronics and Machinery and for four regions.

Table 2 gives an outline (GDP, exports and imports) of the values and regions' shares in the world[2]. Europe is the largest economy (31% of world GDP), ranking first also in world trade (about 40%). The U.S. and ROW come next in their GDP shares (both around 25%) but they are very different in their trade openness. The US is a quite close economy, so is Japan, although less intensively. China and East Asia, by contrast, are more open since their weight in world trade surpasses their 6.3% and 5.2% shares in GDP, respectively.

Table 3 presents each region's weight in world GDP, exports and imports focusing on the sectors where the FDI shock takes place in China. The brackets of the columns labeled "World" further offer the importance of the sector in the world GDP, exports and imports. Even though China has a small weight in total world GDP (6.3 %), it generates important shares of global value added in these four sectors, particularly, in Textiles (16.7%) and Electronics (14.3%). Further, its contribution to world exports in these two latter sectors is of remarkable importance, 30.7% and 22.1%, respectively. China, Japan and East Asia nearly account for half of world exports of Electronics and Textiles. The three regions share a trade pattern by which their role in exports tends to surpass by far their role in imports (i.e., they constitute the "trade surplus" areas). The contrary applies to the U.S., and to a lesser extent, ROW and Europe (i.e., the "trade deficit" areas). Europe is the main single region in the creation of world value added, exports and imports in the four sectors considered. It stands out, however, in its importance in value added in Chemicals and Machinery and, even more, in exports from these two sectors. ROW is relatively important in the production and trade of Textiles but clearly less important in exports from the other three sectors. Note that Textiles, in turn, accounts for a very small share in world GDP (1.5%) and in world exports which, necessary coincide with world imports (both accounting for 4.6% in the total)[3]. Machinery is the most important sector in terms of world trade (13.7%), followed by Chemicals with 11.3% and Electronics with 8.4% shares.

To sum up, in 2007 China accounts for rather reduced shares in world GDP, exports and imports. In the sectors receiving the FDI shock, however, China is considerably more important than on average in the world. The U.S., EU and ROW are not important supplier of intermediates but play more the role of markets for China. The EU is by far the region with highest weights in GDP, exports and imports in the world. Our data point to a strong integration of China with East Asia and to less intensively with Japan. Both areas do supply most of the intermediates that are further processed in China.

3. The model and simulation

We use a multilevel model that combines the technology of production of firms (their cost structures and output levels) together with the demand side of the economies (how much production of each sector is demanded internally or exported), and the presence of factor markets (labor and capital demanded for production and their corresponding remunerations). This methodology which is technically called a CGE model, tries to grasp how shocks (e.g., the arrival of new multinationals

[2] The values for GDP and their shares in the world resemble well the ones from the World Bank "World Development Indicators" in current $ of 2007, which is the source used by GTAP for macroeconomic variables (Hussein and Aguiar, 2012). For trade data issues like re-exports are dealt carefully by the GTAP team, which use as a base United Nations COMTRADE for their calculations (Gehlhar, Wang and Yao, 2010).
[3] Both the exports and the imports are calculated at FOB value. We have also compared the exports and imports at CIF value with the ones at FOB value. The differences are very small and do not affect our results.

to a particular sector) occurring in one part of the economy are spread to the rest. It seeks to offer results at the microeconomic level (production, exports, imports…) in different sectors and also at the macroeconomic level (GDP, welfare, aggregate trade flows, wages…) for all the regions considered within the same model. It quantifies those shocks occurring at the different levels. Our model is the GAMS (General Algebraic Modeling System) version (Rutherford, 2005) of the Global Trade Analysis Project (GTAP) model (Hertel, 1997). It is explained technically in Zhou and Latorre (2013b). Note, however, that in the present version we use a multilevel analysis with different factors, regions and sectors compared to our previous studies.

Since we want to explore the role of FDI, we simulate the shock of capital stock changes brought about by FDI inflows. It consists of a simultaneous increase in the capital stock of the Chinese sectors of Textiles, Chemicals, Electronics and Machinery. Based on the data from NBSC (various years), the accumulated FDI inflow, proxied by fixed asset investment funded by foreign capital, in Electronics has nearly doubled during the period of 2004—2011, the increase was around 50% in Machinery, and 30% in Chemicals and 27% in Textiles. Thus, we simulate a shock corresponding to those sectoral capital stock increases simultaneously, keeping the capital stock in rest sectors and regions fixed.

Capital is assumed to be firm-type and sector specific, i.e., the capital used in, say, chemicals will be different to the one used in other sectors. This assumption of specific capital also implies that capital is fixed and cannot move across sectors. As a consequence, our results should be interpreted as the short run outcome, i.e., the impact after two or three years. The assumption of specific capital also involves that its remuneration will differ across sectors. Labor, by contrast, is fully mobile within regions and its endowments are fixed. Therefore the wage will be the same within each of the regions considered in the model.

The macroeconomic outcomes, arise from the aggregation of all sectoral results. Additionally, the resulting aggregates have to fulfill equations reflecting the national accounts identities. These latter equations reproduce the circular flow of the economy: production, income distribution, and (domestic and foreign) demand. After the simulation, factor remunerations in the sectors receiving a shock will be changed (i.e., the rental rate of capital and the overall wage will vary). As a consequence, those sectors will readjust their factor demands, intermediate inputs, prices, production, exports and imports. The rest of sectors respond to the shock as well, changing their inputs, production and price. Due to the change of capital stock and the overall wage, national income changes. Domestic demand for private consumption and intermediates adjust to national income and output changes, respectively.

However, the export orientation, domestic/imported intermediate intensity, private consumption orientation and trade relationship vary largely in the four sectors studied. Given the division and collaboration through production networks and other trade patterns, the rest of regions respond to the changes of Chinese trade. As a result, they will also adjust production, imports, and exports.

4. Results

4.1. Sectoral results

Table 4 presents the percentage change in output and the differences with respect to the benchmark of the value of exports and imports across all regions and sectors.

Chinese production in the sectors receiving FDI will expand heavily. The larger the FDI increase, the higher the output goes up. Therefore, the biggest increase takes place in Electronics (30.3%) and the smallest in Textiles (1.2%). The arrival of FDI will decrease the price of goods, enhancing the competitiveness in exports with the only exception of Textiles[4]. Chinese exports increase dramatically, crowding out exports from the rest of regions in Electronics, Machinery and Chemicals, which explains their respective reductions in production in those sectors. This will bring about a mild fall in overall production across regions, which contrasts with the Chinese output expansion (see row "Total" at the bottom of Table 4).

Chinese exports in the sectors receiving FDI crowd out all exports across *all* the rest of regions. Only one exception to this general trend arises in Chemicals, in which Europe and Japan escape from the reductions in exports. The world predominance of Europe in foreign trade of Chemicals is clear in Table 3 above. Besides, Europe is a very important provider of Chemicals for ROW and will not be displaced by Chinese exports in this area. Japan accounts for higher Chinese import shares in this sector and will benefit from the increase in Chinese production sufficiently enough so as to compensate the exports lost in the rest of regions[5].

China will export less in several sectors, especially in Metals and Services, which will turn out to be supplied by the rest of regions excluding ROW. In the case of Metals, the overall increase in Chinese production brings about a higher demand for this product in order to be used as an intermediate. Regarding Services, the expansion of national income, stemming from FDI inflows, explains the rising demand for this private consumption oriented sector. The increase in Chinese output and lower exports in Food and Beverages is also related to higher national income. Exports from Textiles do not follow the general pattern of sectors receiving FDI, because they will be more demanded with higher private consumption. Therefore, the amount of Textiles exports from China will shrink.

Chinese aggregate exports increase and so do those of the other regions with the exception of ROW. Aggregate imports accruing to China go up as well. This is because more intermediates are needed for higher levels of production and for the rising Chinese private consumption. By contrast, overall imports in other regions will be reduced. As we shall see shortly, national income decreases (so does production) in them (again with the exception of ROW).

Looking at the absolute values of exports and imports, we find that the largest adjustments (in real value) occur in Electronics, Chemicals, Metals and Services. Interestingly, the exports of Services and Metals counteract to some extent the evolution of foreign trade in the sectors where the shock in FDI takes place in China. Chinese competitiveness does crowd out exports in the other regions, but those regions still manage to compensate that phenomenon by increasing their exports in the sectors in which China is now exporting less. This is illustrated in Figure 2 by the percentage changes in the four main sectors, which are calculated as the change in absolute values reflected in Table 4, with respect to the value of exports in each sector and region in the benchmark. Looking at China and its exports of Electronics and Machinery we find the important increases it experiences (29.6% and 16.2%, respectively) after the FDI shock. Its overall imports of Machinery will go down (-2.8%) because it will substitute imported Machinery by the cheaper Machinery it now produces. Imports of Electronics in China rise by (10.1%), since this production, in contrast with Machinery, relies very heavily on imported intermediates.

[4] The causation chain of more FDI producing more exports is analyzed in detail in Zhou and Latorre (2013a; 2013b).

[5] Figures describing these bilateral trade patterns are available from the authors upon request.

China will however, export considerably less of Metals (-19.2%) and services (-21.6%) of which it will import more (15.3% and 18.1%, respectively). This will expand heavily the exports of the rest of regions in these two sectors, which will go mainly to satisfy Chinese rising appetite from them, reducing the amount exported to other destinations.

All in all, Figure 2 shows that while exports of most regions in Electronics and Machinery fall there is a compensating force in the increase of exports from Services and Metals. We also find that overall imports and exports in the world increase after the shock across the four sectors considered.

Let us turn to analyze the evolution of East Asia, which is so heavily integrated with Chinese production. Table 4 shows that East Asia reduces total exports in the sectors in which Chinese export competition becomes more aggressive, despite its role as Chinese intermediate supplier in the Asian networks. It exports more to China but it is displaced by China in the other markets. We will briefly illustrate this point by showing the bilateral import and export trade in Electronics, where the largest volumes of trade are affected.

Figure 3 shows the bilateral trade changes (in billions of dollars) of Electronics after the shock. One of the axis shows the 'Exporter' and the other one the 'Importer'. Take 'China' in the 'Exporter' axis and the 'EU' in the 'Importer' axis as an example —the pink cone of Figure 3, the bilateral change of 20.9 means that the Electronics exports from China to Europe increase in 20.9 billions or the imports of Europe from China go up by that amount. 'Total imports' in the 'Exporter' axis, shows the overall import change of importers shown in the 'Importer' Axis. For instance, the navy blue cone, whose dimensions are 'Total imports' in 'Exporter' axis and 'CHN' in 'Importer' axis, means that the overall imports of China increase by 19.1 billions (which coincides with overall Chinese imports in Electronics in Table 4). Similarly the light yellow cone, with dimension of 'China' in the 'Exporter' axis and 'total exports' in the 'Importer axis', means that the overall exports of China go up by 81.3 billions (as shown in Table 4).

Chinese exports mainly go to the U.S., Europe and ROW, which are the biggest markets for its exports (Figure 1). Overall exports across all regions are heavily crowded out, even though they all increase the exports going to China. East Asia experiences the highest increases in exports going to China but it faces the fierce competition of Chinese exports in the rest of markets. This latter effect predominates and its overall exports go down. This leads us to say that being integrated in Chinese production networks as an intermediate supplier does not guarantee profits.

4.2. Aggregate results

Table 5 presents the percentage change of the overall wage, the rental rate of capital, national income which is a proxy for welfare, the capital stock, aggregate imports and exports, as well as, GDP.

FDI accruing to China will increase its capital stock by 7.36%. This will improve labor productivity and therefore wages by 0.42%. An accumulation of capital causes a reduction in its remuneration of 1.99%. The increase in wages, together with a higher capital stock, leads to a strong expansion of national income and welfare (11.54%)[6]. As a result, aggregate imports rise heavily (7.84%), propelled by higher demand and production, while exports also rise although less intensively by

[6] See Latorre et al. (2009) or Latorre (2010) for a full explanation about why national income can be used as a proxy for welfare in the GTAP model.

2.90%. Recall the sectors receiving the FDI increase heavily their exports but due to the rise of national income and production, exports in other sectors will be reduced. Finally, all these forces drive up GDP in China by 2.68%. These findings are in accordance with our previous studies on the impact of FDI on host economies (Gómez-Plana and Latorre, 2014; Latorre 2012, 2013).

The adjustments are logically of smaller magnitude for the rest of regions. Because production shrinks slightly in all of them (Table 4), wages, and often the rental rate of capital, will diminish. The decrease is most intense in East Asia, Japan and Europe. In these regions, the weight in GDP of the three sectors where Chinese exports increase most (Electronics, Machinery and Chemical) is the highest (Table 1). Chinese competition crowds out exports of the rest of regions in these sectors, thus, reducing their output. As shown in Table 1, East Asia is the region in which these sectors account for a higher GDP (13.3%). Accordingly, wages and the rental rate of capital experience the largest decrease in East Asia. In the opposite extreme, ROW and the U.S. exhibit the lowest weight of GDP in these three sectors (5.3% and 6.6%, respectively). This explains why the fall in wages is the smallest in these two regions and the capital rental even increases. This evolution of factor's remunerations lies behind the outcomes on national income and GDP. The latter decrease most in East Asia, followed by Japan and Europe. The U.S. also undergoes a reduction in national income and GDP, while ROW, whose capital rental increases heavily, exhibits rises in both national income and GDP. Recall the GDP structure in ROW is quite protected from Chinese competition, since it heavily relies on Mining, Agriculture and Services in which Chinese exports are going down.

The fall in national income, which drives down private consumption across all regions, explains the reduction in aggregate imports (except in China and ROW). Aggregate exports, by contrast, rise slightly due to the higher exports in the sectors in which China competes less.

All in all, China benefits from FDI inflows. ROW also benefits because its economic structure differs the one in China. The contrary applies to East Asia, whose GDP manufacturing structure closely follows that of the Asiatic giant. As a result, East Asia is heavily crowed out in important sectors that coincide with the ones in which China becomes very aggressive. Japan and Europe are intermediate cases in the sense that they are crowded out in some sectors but are able to compensate that by exporting more in others. Finally, the U.S. benefits mainly due to its low exposure to Chinese competition.

5. Conclusions

By 2007 China accounted for a relatively small share in World GDP (6.3%), exports (8.3%) and imports (6.4%). This was far from the weights of regions like Europe (31%, 39.7% and 40.8%, respectively) or the U.S. (25.2%, 9.2% and 14.5%, respectively). However, the arrival of FDI inflows to Chinese manufacturing seems to have produced negative effects in many regions of the world. When Chinese exports increase, due to FDI, exports and production shrink in the sectors that compete with them across the rest of regions. The latter experience an overall reduction in production which drives down wages and the capital rent, thus, reducing their national income and GDP.

We simulate the real FDI increases that have taken place in Chinese Electronics, Machinery, Chemicals and Textiles. These four sectors account for 64.5% and 53.5% of Chinese overall exports and imports, respectively, while their weight is of 38.1% in total world exports (or imports).

China benefits from the FDI inflows, since there is a rise in wages (0.42%), GDP (2.68%) and national income (11.54%). Chinese export competitiveness increases very heavily in Electronics, Machinery and Chemicals. East Asia is the region that is most negatively affected, even though it has strong connections through production networks with China. It will export more in those sectors in which China compete less after the FDI increase. Further, it will, generally, supply important intermediates for the sectors in which China increases production, but it will be displaced by China in the rest of markets. The main negative outcomes for East Asia arise from its decrease in production in the sectors in which China is more aggressive (Electronics, Machinery and Chemicals). These three sectors explain 13.3% of GDP in East Asia, the highest share among all the regions considered. As a consequence, its fall in GDP is the largest across all regions (-0.4%, approximately).

In Japan and Europe the weight in GDP of Electronics, Machinery and Chemicals is 8.6% and 9.1%, respectively. Their Chemicals sectors are the only case of survival to Chinese competition in sectors that have received the FDI. Indeed, except in these latter cases, China crowds out exports across all regions when it becomes more competitive due to FDI. Despite this virtuous evolution of Chemicals, overall production still shrinks in Japan and Europe, driving their GDP down by 0.26% in both areas. In the U.S., the weight in GDP of the three sectors, in which Chinese competition rises strongly, is lower than the three previous regions. This, together with its smaller openness to trade and big importance in services (in which China export less), considerably reduces its negative outcomes in GDP (-0.10%).

The Rest of the world (ROW) is the only region that we have analyzed that is positively affected by the Chinese booming economy. ROW is protected from Chinese competition because in its GDP sectors like Mining and Agriculture account for the biggest shares. In fact, ROW's exports from these sectors are primarily going to satisfy Chinese rising demand for Agricultural products and Mining resources.

In the light of the literature on vertical specialization, this paper finds that engaging in networks in China does not guarantee profitable outcomes. Our general equilibrium analysis allows to further analyze the role of regions as final markets. We could a priori expect that consumers would benefit from cheaper Chinese imports. This does not seem to be the case, either. Europe, the U.S. and ROW are the main destinations of Chinese exports. These may become cheaper, but the point is that Europe, the U.S. and ROW are also important producers in the world.

Our analysis reveals that the forces from the production side of the economy are more important than the ones from the consumption side. As we have said, this benefits ROW but will harm Europe and the U.S. in a different magnitude.

All in all, our paper suggests that the best industrial policies outside China should further strengthen the comparative advantage in the sectors in which China competes less.

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Table 1: Definition of sectors and their relative importance in each region's GDP, Exports and Imports (2007)

Sector/Goods Definition	GDP (%)						Exports (%)						Imports (%)					
	CHN	JPN	EAS	US	EU	ROW	CHN	JPN	EAS	US	EU	ROW	CHN	JPN	EAS	US	EU	ROW
01-14 Agriculture	11.0	1.2	5.5	1.0	1.7	6.6	0.9	0.1	0.8	3.8	1.6	3.8	2.7	2.5	2.0	1.3	2.2	2.6
15-18 Mining	4.0	0.1	3.7	1.2	0.7	11.0	0.5	0.1	3.4	1.1	1.1	32.6	13.9	23.3	12.7	12.6	6.9	7.3
19-26 Food & Beverages	3.2	3.3	3.5	2.2	4.1	4.5	2.0	0.4	3.4	3.1	5.2	4.9	1.8	5.2	3.3	2.9	4.8	4.8
27-29 Textiles	**4.1**	**0.6**	**2.0**	**0.8**	**1.7**	**1.6**	**17.2**	**1.1**	**5.2**	**1.4**	**3.5**	**3.9**	**2.7**	**5.1**	**3.3**	**5.8**	**4.8**	**4.6**
30-31 Woods & Paper	2.1	1.8	1.6	2.4	2.3	1.5	4.2	0.7	2.3	2.7	4.0	2.6	1.9	2.7	1.7	3.6	3.7	3.0
32 Petroleum	0.6	2.6	2.3	0.5	2.1	1.3	1.8	1.5	3.9	4.1	2.2	6.3	2.4	3.8	4.3	3.5	3.0	4.4
33 Chemicals	**5.7**	**2.5**	**4.0**	**2.6**	**3.6**	**2.4**	**7.4**	**12.2**	**10.8**	**13.3**	**15.3**	**6.0**	**12.5**	**7.8**	**10.5**	**8.4**	**13.0**	**10.9**
34-37 Metals	7.4	3.0	3.7	2.2	3.7	3.5	9.8	9.2	6.5	6.1	9.5	10.2	8.4	6.8	10.0	6.7	9.5	9.8
38-39 Motor Vehicles	2.5	2.6	2.8	1.9	2.7	2.0	3.3	24.1	6.1	14.5	13.0	5.9	4.2	4.3	4.5	12.5	11.1	12.4
40 Electronics	**3.0**	**2.8**	**4.6**	**0.6**	**1.0**	**0.8**	**22.5**	**13.5**	**25.3**	**6.8**	**4.5**	**2.3**	**20.2**	**9.0**	**15.4**	**11.0**	**5.7**	**5.4**
41 Machinery	**6.5**	**3.2**	**4.8**	**3.5**	**4.4**	**2.1**	**17.4**	**26.6**	**13.3**	**16.5**	**16.5**	**5.2**	**18.2**	**10.5**	**14.0**	**13.5**	**12.5**	**15.3**
42 Other manufacturing	2.5	0.6	0.6	0.4	1.0	0.8	6.2	1.0	1.2	1.4	1.4	1.3	0.4	1.6	1.2	3.4	1.7	1.5
43-45 Electricity & Gas & Water	3.4	1.9	2.3	2.1	2.3	3.0	0.1	0.0	0.1	0.2	0.6	0.9	0.1	0.1	0.3	0.2	0.7	0.5
46 Construction	6.3	6.4	5.7	6.3	7.1	6.7	0.4	1.3	0.8	0.5	0.7	0.4	0.4	1.3	0.5	0.1	0.6	0.9
47-57 Services	37.9	67.4	52.8	72.5	61.5	52.2	6.2	8.2	16.8	24.5	21.1	13.8	10.3	16.0	16.2	14.3	19.8	16.5
Whole economy	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Authors' calculation based on GTAP 8 Data Base (Narayanan et al. 2012).

Note: The definition of sectors follows the ISIC Rev 3 Classification. CHN, JPN, EAS, US, EU and ROW stand for China, Japan, East Asia, United States, Europe and Rest of the world, respectively. East Asia is constituted by Republic of Korea, Taipei China, Hong Kong China, and ASEAN countries (Singapore, Cambodia, Indonesia, Republic Lao, Malaysia, Philippine, Thailand and Vietnam).

Table 2: Each region's GDP, exports and imports and their weight in the world (2007)

Region	GDP (Billions $)	GDP (%)	Exports (Billions $)	Exports (%)	Imports (Billions $)	Imports (%)
China	3494.1	6.3	1222.8	8.3	941.0	6.4
Japan	4377.9	7.8	742.1	5.0	670.2	4.5
East Asia	2917.8	5.2	1666.5	11.3	1435.6	9.7
United States	14061.8	25.2	1366.2	9.2	2139.5	14.5
Europe	17327.1	31.0	5867.3	39.7	6031.4	40.8
Rest of the world	13652.6	24.5	3914.2	26.5	3561.4	24.1
World	55831.3	100	14779.2	100	14779.2	100

Source: Authors' calculation based on GTAP 8 Data Base (Narayanan et al. 2012).

Table 3: Each region's weight in world GDP, exports and imports of Textiles, Chemicals, Electronics and Machinery (2007)

Sector	Regional % in world sectoral GDP						World	Regional % in world sectoral exports						World	Regional % in world sectoral imports						World
	CHN	JPN	EAS	US	EU	ROW		CHN	JPN	EAS	US	EU	ROW		CHN	JPN	EAS	US	EU	ROW	
Textiles	16.7	3.2	7.0	13.6	34.4	25.1	100 (1.5)	30.7	1.2	12.7	2.7	30.3	22.4	100 (4.6)	3.7	5.0	7.0	18.3	41.6	24.4	100 (4.6)
Chemicals	11.3	6.4	6.6	20.7	35.9	19.0	100 (3.1)	5.4	5.4	10.7	10.8	53.6	14.0	100 (11.3)	7.3	3.1	9.2	10.8	46.0	23.6	100 (11.3)
Electronics	14.3	16.9	18.6	10.8	24.3	15.2	100 (1.3)	22.1	8.1	34.0	7.5	21.1	7.2	100 (8.4)	15.3	4.9	17.8	19.0	27.7	15.4	100 (8.4)
Machinery	11.0	6.9	6.8	24.0	37.4	14.0	100 (3.7)	10.5	9.7	11.0	11.1	47.6	10.1	100 (13.7)	8.5	3.5	9.9	14.4	36.8	27.0	100 (13.7)

Source: Authors' calculation based on GTAP 8 Data Base (Narayanan et al. 2012).
Note: see Table 1

Table 4: Impact on output (% change), exports (change in billions $) and imports (change in billions $)

Sectors	Output (% change)						Exports (change in billions $)							Imports (change in billions $)						
	CHN	JPN	EAS	US	EU	ROW	CHN	JPN	EAS	US	EU	ROW	World	CHN	JPN	EAS	US	EU	ROW	World
Agriculture	2.0	0.3	0.3	0.4	0.3	0.2	-3.3	0.0	0.5	1.7	1.6	3.4	3.8	5.9	-0.3	-0.2	-0.1	-1.5	0.1	3.8
Mining	-0.3	0.8	0.1	0.2	0.3	0.1	-0.5	0.0	0.6	0.6	0.6	4.9	6.2	7.6	0.1	0.5	-2.0	-1.2	1.2	6.2
Food & Beverages	3.2	0.0	0.1	0.1	-0.0	0.2	-6.9	0.2	1.2	1.4	4.3	-0.1	0.1	4.4	-1.3	-0.5	-0.9	-2.7	1.1	0.1
Textiles	1.2	1.6	0.7	1.1	1.1	0.0	-9.7	0.5	1.0	0.7	5.1	-1.2	-3.6	1.6	-0.6	-0.2	-1.8	-3.1	0.4	-3.6
Woods & Paper	-2.5	0.6	0.7	0.6	0.7	0.1	-8.8	0.4	0.7	1.3	4.9	0.5	-0.9	2.3	-0.4	-0.1	-2.1	-0.9	0.4	-0.9
Petroleum	3.1	-0.2	-0.1	-0.6	-0.5	-0.2	-1.1	0.2	0.6	0.1	-0.2	0.0	-0.4	1.5	-0.1	-0.2	-0.4	-1.0	-0.2	-0.4
Chemicals	6.9	-0.1	-0.7	-0.1	0.1	-0.8	7.0	0.2	-1.2	-0.2	2.0	-4.4	3.5	2.1	0.2	0.1	0.1	-1.2	2.2	3.5
Metals	-0.2	1.4	0.8	0.8	1.2	-0.0	-23.0	4.2	2.5	3.9	15.3	1.7	4.7	12.0	-0.8	-0.8	-3.3	-1.5	-1.0	4.7
Motor Vehicles	-1.2	1.1	0.0	0.4	0.4	-0.5	-5.9	3.0	-0.1	2.1	6.3	-2.6	2.9	3.8	-0.2	-0.1	-0.7	-1.8	1.9	2.9
Electronics	30.3	-2.9	-2.0	-5.8	-4.6	-4.2	81.3	-5.2	-7.6	-8.6	-15.1	-6.7	38.0	19.1	3.4	0.0	10.8	0.8	3.8	38.0
Machinery	8.5	-0.9	-1.6	-1.0	-0.9	-2.2	34.6	-2.1	-4.2	-5.8	-11.8	-8.1	2.6	-4.7	0.8	-0.1	3.2	-0.4	3.9	2.6
Other manufacturing	-2.0	0.9	0.7	1.8	1.0	0.2	-8.1	0.4	0.3	0.7	3.2	0.1	-3.5	0.4	-0.4	-0.2	-1.5	-2.0	0.2	-3.5
Electricity & Gas & Water	3.6	-0.1	-0.1	-0.0	-0.0	-0.1	-0.4	0.0	0.0	0.1	0.5	-0.7	-0.4	0.2	-0.0	-0.1	-0.1	-0.5	0.1	-0.4
Construction	0.1	0.0	-0.0	-0.0	0.0	-0.0	-0.7	0.2	-0.0	0.1	0.8	-0.2	0.1	0.3	-0.1	-0.0	-0.0	-0.3	0.2	0.1
Services	2.9	0.0	0.2	0.0	-0.0	0.1	-16.3	2.2	5.6	4.7	18.7	-6.5	8.5	17.5	-1.6	-1.6	-1.8	-9.5	5.5	8.5
Total	3.8	-0.0	-0.1	-0.1	-0.0	-0.1	38.2	4.3	0.0	2.7	36.3	-19.7	61.8	73.9	-1.2	-3.5	-0.8	-26.5	19.9	61.8

Source: Authors' simulation based on GTAP 8 Data Base (Narayanan et al. 2012).

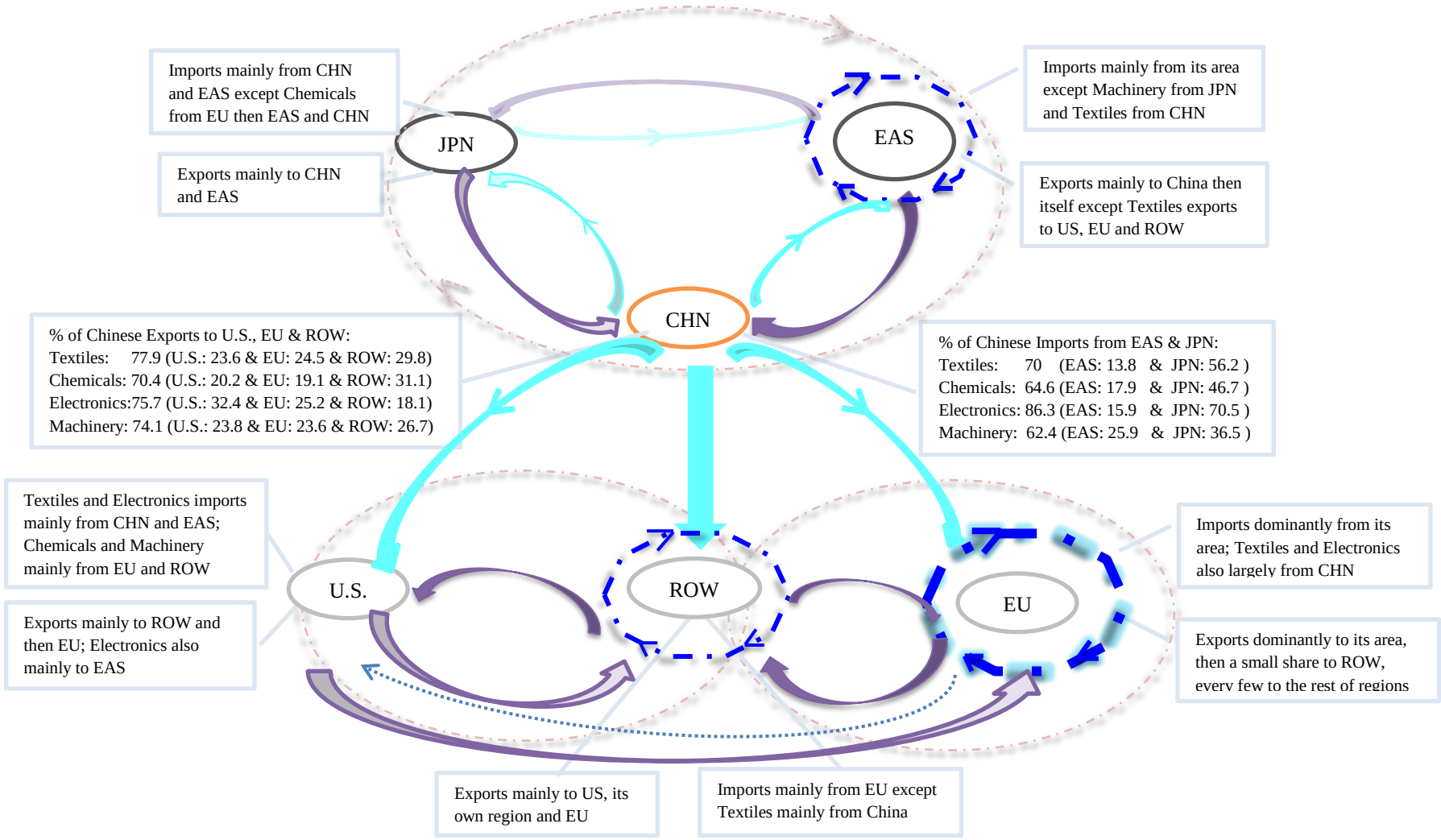
Note: See Table 1.

Table 5: Impact on aggregate variables (% change)

Aggregate variables	China	Japan	East Asia	United States	Europe	Rest of the world
Wage	0.42	-0.36	-0.58	-0.18	-0.33	-0.22
Rental rate of Capital	-1.99	-0.32	-0.31	0.06	-0.22	0.48
National income (Welfare)	11.54	-0.32	-0.41	-0.07	-0.81	0.51
Capital stock	7.36	0.00	0.00	0.00	0.00	0.00
Imports	7.86	-0.19	-0.25	-0.04	-0.44	0.56
Exports	2.90	0.60	0.02	0.25	0.63	-0.47
GDP	2.68	-0.26	-0.40	-0.10	-0.26	0.18

Source: Authors' simulation based on GTAP 8 Data Base (Narayanan et al. 2012).

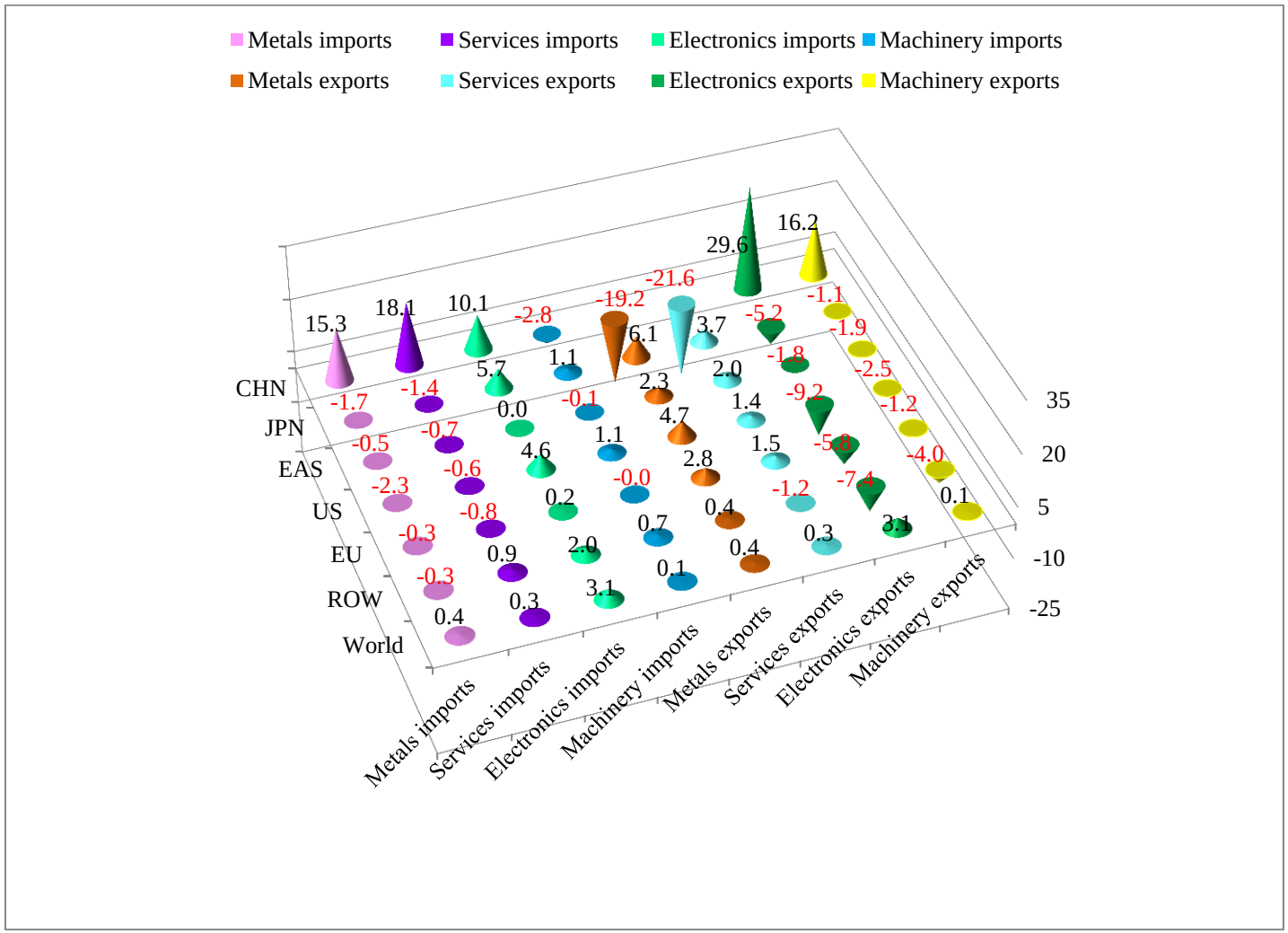
Figure 1: Main trade relationships of Textiles, Chemicals, Electronics and Machinery among regions



Source: Authors' caculation based on GTAP 8 Data Base (Narayanan *et al.* 2012)

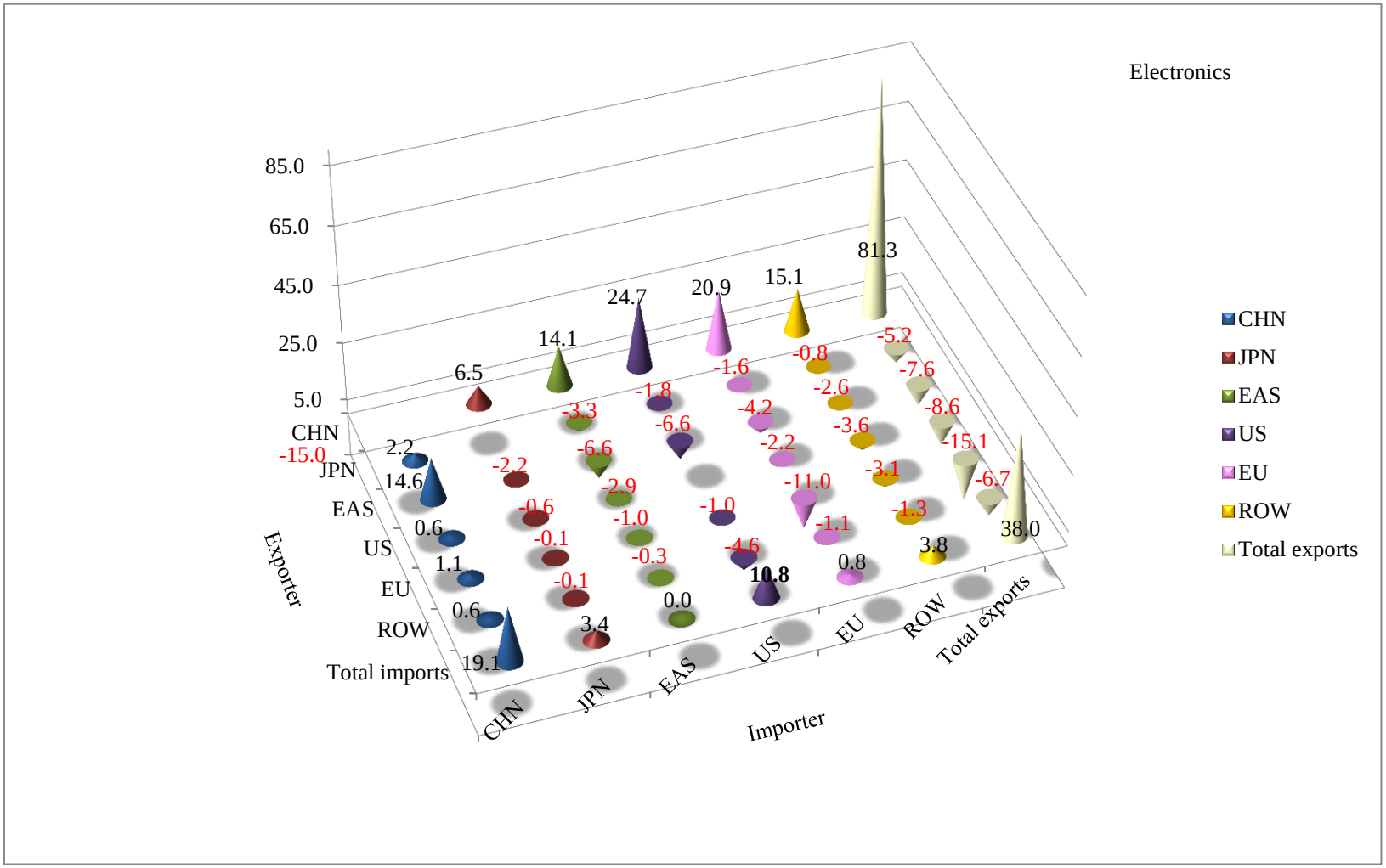
Note: see Table 1.

Figure 2: Impact on exports and imports of Metals, Services, Electronics and Machinery across regions (% change)



Source: Authors' calculation based on GTAP 8 Data Base (Narayanan et al. 2012)
Note: See Table 1.

Figure 3: Impact on Electronics bilateral trade (change in Billions $)



Source: Authors' calculation based on GTAP 8 Data Base (Narayanan et al. 2012).
Note: See Table 1.