FDI in China and global production networks: Assessing the role of and impact on big world players (East Asia, Japan, EU28 and U.S.)

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FDI in China and global production networks: Assessing the role of and impact on big world players (East Asia, Japan, EU28 and U.S.)

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ABSTRACT

This paper analyzes several effects of FDI accruing to Textiles, Chemicals, Electronics and Machinery in China. Though the four sectors have contrasting production technologies and vary largely in trade patterns, the related Chinese exports and imports still follow a general trend: East Asia and Japan are the main intermediate suppliers while the rest of regions play more the role of final markets. The paper describes the networks among big regions, providing their relative importance across different levels (local industry, global industry, host economy and world economy). It also estimates a rich set of regional impacts after the rising FDI inflows.

Key words: Multilevel analysis, Globalization, Industrial Organization, MNEs and Economic Growth in Emerging Markets

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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 second among top hosts of FDI inflows in the world (UNCTAD, 2013). FDI seems to play an important role in Chinese GDP growth (e.g., Kim, Lyn & Zychowicz, 2003) and foreign trade (e.g., Dean, Lovely, & Mora, 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 & Xin, 2010; Zhang, 2014).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? What can other regions expect from it? In this paper, we try to reply to these questions. To that aim, we use a multilevel analysis which considers the interplay of six regions in which the world economy has been split.

In the study of international business, as well as in other areas, there has been an increasing interest in multilevel methodologies (Agarwal & Hoetker, 2007; Klein, Tosi & Cannella, 1999). A multilevel approach allows combining several levels of analysis to illuminate the multiple causes or consequences of behaviors at and across those levels. For example, different aspects of foreign direct investment (FDI) can be studied, such as its differential impact across networks, sectors, countries or regions, depending on technologies of production, export orientation, import reliance, among other factors. It seems intuitive that there must be some relationships between these higher and lower levels, even though the literature strands analyzing them tend to be disconnected.

The present study adds to the multilevel literature by means of a bottom-up methodology. In other words, our approach incorporates the real data on total costs and production in the different sectors of the regions

we consider, and their multiple foreign trade connections through networks, which underlie their corresponding results at higher levels (such as GDP growth, aggregate foreign trade and welfare). We thus try to shed some light on the policies each country might take to get better off after the growing importance of Multinational Enterprises (MNEs) in China, considering the complexity associated in global networks and the co-evolution of FDI and trade (Cantwell, Dunning & Lundan, 2010).

Imported intermediate inputs embodied in exports have raised close attention to production networks. Koopman, Wang & Wei (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, Fung & Wang (2011) 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 & Lopez-Gonzalez (2013) suggest that trade related to production networks has shifted heavily towards "Factory Asia" and away from "Factory North America" and "Factory Europe".

We analyze the interplay of FDI accruing to China with the presence of global production networks. The regions considered are China, East Asia, Japan, EU28, the U.S. and the rest of the world (ROW). The Chinese sectors receiving FDI are Electronics, Machinery, Chemicals and Textiles, which constitute 62.6% and 52.8% of its overall exports and imports in 2007, respectively. 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. The multilevel methodology relies on a well-grounded quantitative framework in order to derive the consistent micro and macroeconomic results. It also combines both the demand and supply side of the economy, as well as, product and labor markets across regions (Latorre, 2010, Chapter 1). Buckley (2007) has pointed out that globalization has different speeds in markets of goods than in labor markets. Both types of markets will be accounted for in this analysis.

The model, thus, captures the presence of Asian production networks, 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 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 Meyer, 2008; Caves, 2007; Barba Navaretti & Venables, 2004; Lipsey, 2002, for reviews of the literature). A small handful of big MNEs may transform the production landscape of entire countries. However, comprehensive studies of their impact are rather scarce (Latorre, 2009).

The literature on FDI or networks in China often offers studies which are descriptive and lack methodological rigor as pointed out in the review of Zhao, Flynn, & Roth, (2007) and also by Lyles, Flynn, & Frohlich (2008). Other studies employ robust methodologies but focus on particular aspects, such as, Tian (2007) and Meyer & Sinanis (2009), which analyze spillover effects of FDI; or Chen & Chen (1998), which delve into the relationship between networks and FDI in Taiwanese firms investing in China and other regions. This latter study illustrates how networks can facilitate entering a market, such as the Chinese one, in which institutions facilitating internalization may not work well. It could be seen as a particular specification of the broader theory of the "Liability of outsidership" (Johanson & Vahlne, 2009), which develops that idea that "insidership in relevant network(s) is necessary for successful internationalization" (Johanson & Vahlne, 2009: 1411). One of the innovations of our analysis lies in the fact that we synthesize FDI, trade effects and global production networks, as suggested by Itaki (1991), in a framework considering economy-wide effects across countries and regions. We thus try to address some of the pending areas that according to Meyer (2004) exist in the research agenda on MNEs in emerging economies. Meyer (2004: 260-1) points out that "international business research has been largely looking into the MNE, rather than 'looking out' from MNEs to the societies in which they are operating" and that "One of the challenges is to tie the partial views discussed in different literatures together to allow comprehensive assessments" (Meyer, 2004: 261). In sum, we try to offer a holistic view of the consequences of the complex globalization of China.

The rest of the paper is organized as follows. Section 2 fully describes the role of the different regions as production centers, intermediate suppliers and final markets. Section 3 describes the multilevel model and simulations. The results are analyzed in section 4, while section 5 concludes.

DATA

Our model relies on the real data for the world economy provided by the GTAP8 Data Base (Nayaranan, Aguiar & McDougall, 2012), which we split in six regions and fifteen sectors. Figure 1 reflects the different levels of data. Beginning from the top, the model incorporates the weight of the six regions in the world economy (China, Japan, East Asia[1], U.S., EU28 and the rest of the world, ROW). These regions, in turn, have 15 sectors (13 manufactures, agriculture and services), for which there is a complete set of real values about their total costs (bottom level of Figure 1). We can see that these costs include capital and labor remunerations, as well as domestic and imported intermediates. Labor costs have been rising in the last years in China. But MNEs want to lower *total* costs, which is what we include in our analysis. On the other hand, data on imported intermediates is of upmost importance for the analysis of global production networks. The more foreign investors source internationally, the lower the opportunities for local firms will be. This would moderate the positive impact on the host economy.

Figure 1 gives an outline (GDP, exports and imports) of regions' shares in the world[2]. The information refers to the year 2007. 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.

(Figure 1 AROUND HERE)

Table 1 offers the definition of the 15 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%).

(Table 1 AROUND HERE)

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 rest of regions. There is a strong network between China and East Asia, in which Japan also participates although it is less integrated than the two previous areas. We summarize this in Figure 2. There we can see that East Asia provides the vast majority of total Chinese imports ranging from 70.5% 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 25.9%.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, there must be a strong network by which East Asia and, to a lesser extent Japan, provide intermediates to be further processed in China.

(Figure 2 AROUND HERE)

Figure 2 also shows that Chinese export structure contrasts drastically with that of the imports. More than 70% of total Chinese exports go to the U.S., EU and ROW. 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[3].

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 four sectors experiencing FDI increases account for 53.5% of overall Chinese imports and 43.2% in overall East Asian imports, while their weight in imports from the rest of regions is smaller.

Table 2 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 labelled "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 %) in 2007, it still 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 in the world). The contrary applies to the U.S., and to a lesser extent, ROW and Europe (i.e., the "trade deficit" areas). Europe is the largest 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)[4]. 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.

(Table 2 AROUND HERE)

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 data we have analyzed point to the existence of a strong integration of China with East Asia and to a less intense one of China with Japan. Both areas do supply most of the intermediates that are further processed in China. 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.

THE MODEL AND SIMULATION

We use a multilevel model that combines the technology of production of firms (their overall cost structures and output levels) together with the demand side of the economies (e.g., 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 Computable General Equilibrium (CGE) model, tries to grasp how shocks (e.g., the arrival of new multinationals to a particular sector) occurring in one part of the economy are spread to the rest. It seeks to offer results at lower levels (such as production, labor demand, prices, costs) in different sectors and also at the higher levels (GDP, welfare, aggregate trade flows and wages) for all the regions considered within the same model. Interestingly 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 & Latorre (2014a). Note, however, that in the present version we reinvigorate the analysis with different factors, regions and sectors compared to our previous studies.

Since we want to explore the role of FDI, we simulate a shock of changes in the capital stock 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 both Chemicals and Textiles. Thus, we simulate a shock corresponding to those sectoral capital stock

increases simultaneously, keeping the capital stock in rest sectors and regions fixed. Of course, this evolution of FDI flows is one of the outcomes of the complex process giving rise to foreign MNEs, as developed in the OLI paradigm (e.g., Dunning, 1980, 1988, 2000; Dunning and Lundan, 2008). In our approach we do not delve into the determinants of FDI accruing to China but rather try to estimate the impact of the actual flows that have taken place.

One important point about our modeling strategy is that we isolate the impact of FDI in the adjustment of the model. This contrasts with other techniques, such as econometrics, which looks for causality in data that are the result of a complex interplay of different forces. Our initial dataset is also the result of complex economic forces across regions. However, once it is in place, we *only* introduce in the model a shock that changes capital stocks in the sector to which FDI accrues. This implies that the subsequent adjustments only respond to the change in levels of FDI. By comparing percent changes across variables of the model with respect to the initial dataset we have isolated the impact of FDI.

Note that FDI (and its related capital) goes to different sectors which use different technologies. This means that "the same amount of FDI flows" will have a distinct impact depending on the particular sector involved in the shock. Indeed, in the model capital is assumed to be sector specific, i.e., the capital used in, say, chemicals will be different to the one used in other sectors. It is true that MNEs carry with them a rich set of tangible and intangible assets whose effects can hardly be proxied by data on capital stocks. Decades ago Hymer (1976) and Dunning (1977) draw attention to the peculiarities of the multinational firm and, somehow, turn the analysis of FDI from capital moving across countries into an analysis of special firms (MNEs). However, trying to model and quantify that process seems an effort in which the profession is still struggling. Interestingly, Tian (2007) finds that it is foreign firms' capital in China which has positive effect of technology spillovers on the productivity of domestic firms, rather than their foreign products or employment which are insignificant in his analysis. Tian even identifies that "the positive effect of FDI technology spillovers through capital comes mainly from foreign participation in tangible assets rather than from foreign participation in intangible assets" (Tian, 2007: 153). Furthermore,

among developing countries FDI taking the form of greenfield investment is more common than in developed economies. In particular, foreign mergers and acquisitions in China account for 7.3% in the period 1990-2010, compared to a world average of 38.9% (Liu, Lu & Zhang, 2015). Therefore, capital is an important element of MNEs' effects.

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. Further, 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 upper-level results, or 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. National income changes due to the change of capital stock and its remuneration and also due to the adjustment of the overall wage. Domestic demand for private consumption and intermediates adjust to national income and output changes, respectively.

However, the export orientation, domestic/imported intermediate intensity and private consumption orientation vary largely in the four sectors studied. We have analyzed this in detail in Zhou& Latorre (2014a; 2014b) and Latorre et al. (2009). Given the division and collaboration through production networks and other trade patterns, the rest of regions respond differently to the changes of Chinese trade. As a result, they will also adjust production, imports, and exports, as well as other variables.

RESULTS

Sectoral results

Table 3 presents the percentage change in output and the differences with respect to the initial dataset of the value of exports and imports across all regions and sectors.

(Table 3 AROUND HERE)

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[5]. 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 3).

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 2 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[6].

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 3 by the percentage changes in the four main sectors, which are calculated as the change in absolute values reflected in Table 3, with respect to the value of exports in each sector and region in the initial dataset. 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.

(Figure 3 AROUND HERE)

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 3 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 3 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 4 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 4, 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 3). 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 3).

(Figure 4 AROUND HERE)

Chinese exports of Electronics mainly go to the U.S., Europe and ROW, which are the biggest markets for its exports (Figure 2). 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 (14.6 billions) but it faces the fierce competition of Chinese exports in the rest of markets. This latter effect predominates and its overall exports go down (-7.6 billions). This leads us to say that being integrated in Chinese production networks as an intermediate supplier does not guarantee profits.

Aggregate results

Table 4 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 across regions.

(Table 4 AROUND HERE)

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%)[7]. As a result, aggregate imports rise heavily (7.84%), propelled by higher demand and production, while exports also rise although less intensively by 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). They are also consistent with the overall positive outcomes expected by Meyer (2004: 273): "I share the view of most observers that in most cases, MNEs play a positive role". They also make sense in the context of Chinese level of development, as recently analyzed by Meyer & Sinani (2009), using a very different methodology.

The adjustments are logically of smaller magnitude for the rest of regions. Because production shrinks slightly in all of them (Table 3), 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. GDP, indeed, decreases 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 from 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. is less harmed than Japan or Europe due to its low exposure to Chinese competition.

Sensitivity Analysis

We carry out an Unconditional Systematic Sensitivity Analysis (Harrison, Jones, Kimbell & Wigle, 1993), in which we change two critical elasticities: 1) The Amington elasticity (substitution between imports and domestic production and 2) The elasticity of substitution between labor and capital. We halve and double their values in all the sectors and regions while keeping the rest of elasticities at their initial value.

Table 5 offers the percentage changes of the aggregate variables with the new elasticities. The row labeled "bench" repeats, for the sake of comparison, the results obtained with the original elasticities, i.e., the ones from Table 4. Percentages adjustments in GDP are negligible across regions, even though for China the higher the elasticities the slightly higher the GDP turns. This implies that more flexible technologies facilitate a more efficient use of resources leading to more growth. Across the rest of variables changes are very small with the different elasticities. The causation chain behind the results which has already been explained clearly remains applicable. ROW and China would be the only regions that win after the shock.

With the higher ("double") elasticity of substitution between imports and domestic production, production in the sectors receiving FDI increases more than in the benchmark case. Aggregate imports and exports will be somewhat higher because more imported intermediates will be used for production and higher production will lead to more exports in these sectors. In order to produce more in the FDI receiving sectors a higher amount of labor needs to be reallocated to them. This will raise the wage and bring about a lower rental rate of capital. The latter effect prevails reducing national income, always compared to the central case we had already analyzed.

With a lower ("half") elasticity of substitution between labor and capital production in the sectors receiving FDI is also larger than in the central scenario. Because more labor needs to go to those sectors the wage will be higher, but the rental rate of capital will be smaller leading to lower national income. Production in the FDI sectors is higher, which brings about higher aggregate imports of Chinese

intermediates. However, their higher production does not translate in overall higher Chinese exports because other sectors are exporting less.

But note that the key for the adjustment in the rest of regions would be the weight in their GDP of the sectors involved in the FDI shock. We get a more negative outcome in East Asia because in that region the weight in GDP of Electronics, Machinery and Chemical is the highest across regions. GDP is also slightly worse in Japan and the EU and slightly better in ROW with the half value of this elasticity. These trends should be familiar to us since they again reflect that the higher the increase in production in the FDI receiving sectors in China the more harmful their effects for the rest of regions are with the exception of ROW.

CONCLUSIONS

By 2007 China accounted for a relatively small share in World GDP (6.3%), exports (8.3%) and imports (6.5%). 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. Interestingly, our approach allows isolating the impact of FDI from other economic sources. The 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 FDI and global production networks, this paper finds that engaging in networks in China does not guarantee profitable outcomes. Our multilevel model allows analyzing 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 and the outcomes show that workers suffer from losses in wages. 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. although in a different magnitude.

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

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[1] East Asia is constituted by Republic of Korea, Taipei China, Hong Kong China, and ASEAN countries (Singapore, Cambodia, Indonesia, Republic Lao, Malaysia, Philippines, Thailand and Vietnam).

[2] The values for GDP (which are not reproduced in Figure 1) and their shares in the world resemble well the ones from the World Bank "World Development Indicators" in current dollars of 2007, which is the source used by GTAP for macroeconomic variables (Hussein & 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 & Yao, 2010).

[3] In Zhou and Latorre (2014a; 2014b) 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 less sectors than the ones considered in this paper, namely, Textiles, Electronics and Machinery and in a context of four regions (China, East Asia, U.S. and ROW).

[4] 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.

[5] The causation chain of more FDI producing more exports is analyzed in detail Zhou and Latorre (2014a; 2014b).

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

[7] 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.

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 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 3 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 4 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).

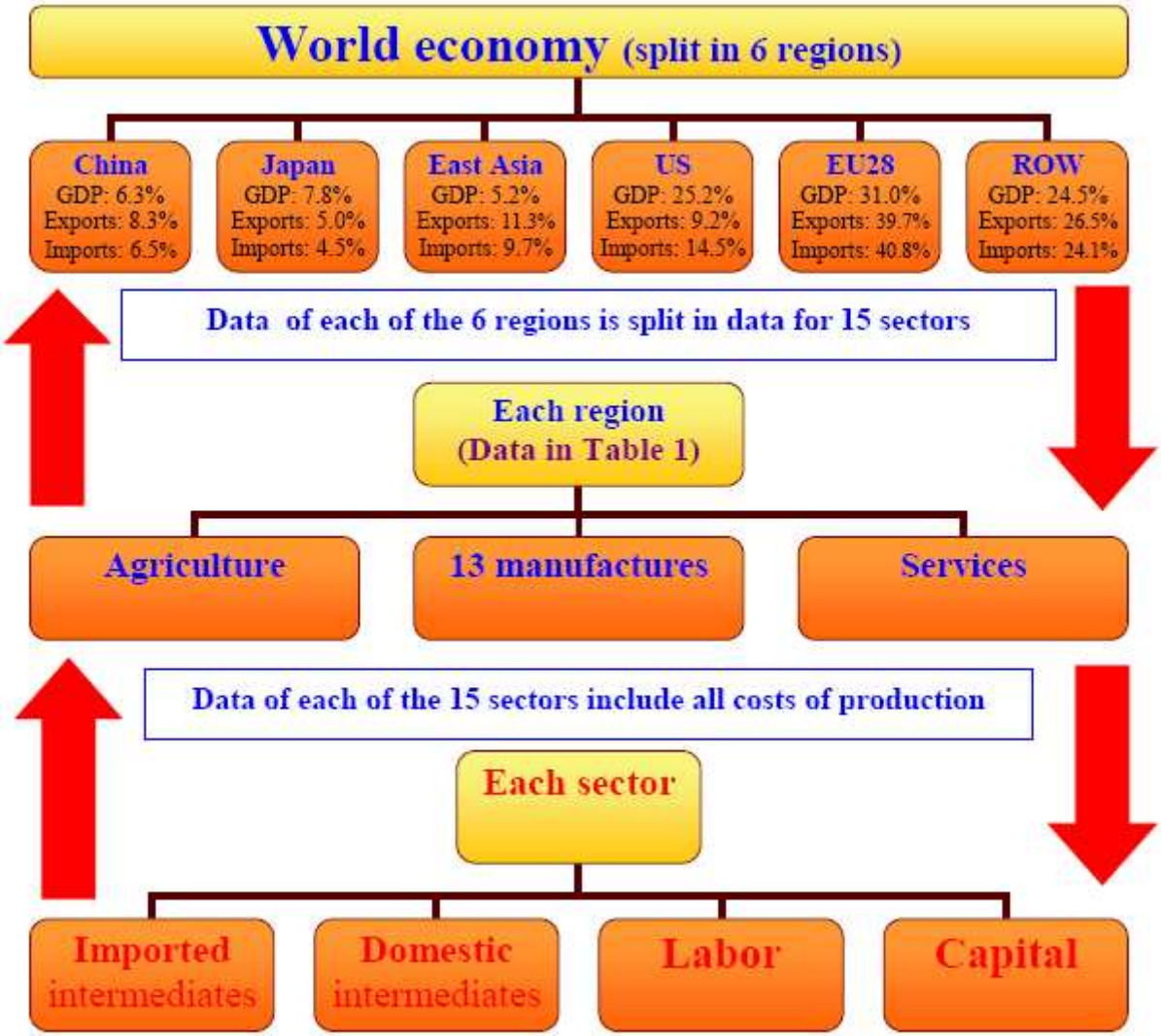
Table 5 Sensitivity analysis—impacts on aggregate variables (% change)

FDI shock		GDP						Imports						Exports					
		CHN	JAP	EAS	USA	EU	ROW	CHN	JAP	EAS	USA	EU	ROW	CHN	JAP	EAS	USA	EU	ROW
	Bench	2.7	-0.3	-0.4	-0.1	-0.3	0.2	7.9	-0.2	-0.2	-0.0	-0.4	0.6	2.9	0.6	0.0	0.2	0.6	-0.5
Elasticity of substitution between imports and domestic production	Half	2.6	-0.3	-0.4	-0.1	-0.3	0.2	7.3	-0.2	-0.2	-0.1	-0.3	0.3	2.0	0.6	0.0	0.2	0.8	-0.7
	Double	2.8	-0.3	-0.4	-0.1	-0.2	0.2	8.5	-0.1	-0.2	0.2	-0.6	0.9	3.9	0.6	0.1	0.5	0.4	-0.1
Elasticity of substitution between labor and capital	Half	2.3	-0.3	-0.6	-0.1	-0.3	0.2	9.6	-0.3	-0.3	-0.0	-0.6	0.7	2.7	0.7	0.1	0.3	0.9	-0.6
	Double	3.0	-0.2	-0.2	-0.1	-0.2	0.1	6.3	-0.1	-0.2	-0.0	-0.3	0.4	3.0	0.5	-0.0	0.2	0.4	-0.3
FDI shock		Wage						Rental rate of capital						National income					
		CHN	JAP	EAS	USA	EU	ROW	CHN	JAP	EAS	USA	EU	ROW	CHN	JAP	EAS	USA	EU	ROW
	Bench	0.4	-0.4	-0.6	-0.2	-0.3	-0.2	-2.0	-0.3	-0.3	0.1	-0.2	0.5	11.5	-0.3	-0.4	-0.1	-0.8	0.5
Elasticity of substitution between imports and domestic production	Half	0.2	-0.3	-0.6	-0.2	-0.3	-0.2	-1.9	-0.3	-0.3	0.0	-0.2	0.5	11.8	-0.3	-0.4	-0.1	-0.9	0.5
	Double	0.7	-0.4	-0.6	-0.2	-0.3	-0.3	-2.1	-0.3	-0.3	0.1	-0.2	0.5	11.1	-0.3	-0.4	-0.1	-0.7	0.5
Elasticity of substitution between labor and capital	Half	1.4	-0.5	-0.8	-0.2	-0.4	-0.3	-3.4	-0.4	-0.5	0.1	-0.3	0.6	12.2	-0.4	-0.6	-0.1	-1.1	0.6
	Double	-0.0	-0.2	-0.4	-0.1	-0.2	-0.2	-1.2	-0.2	-0.2	0.0	-0.2	0.4	10.9	-0.2	-0.2	-0.1	-0.5	0.4

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

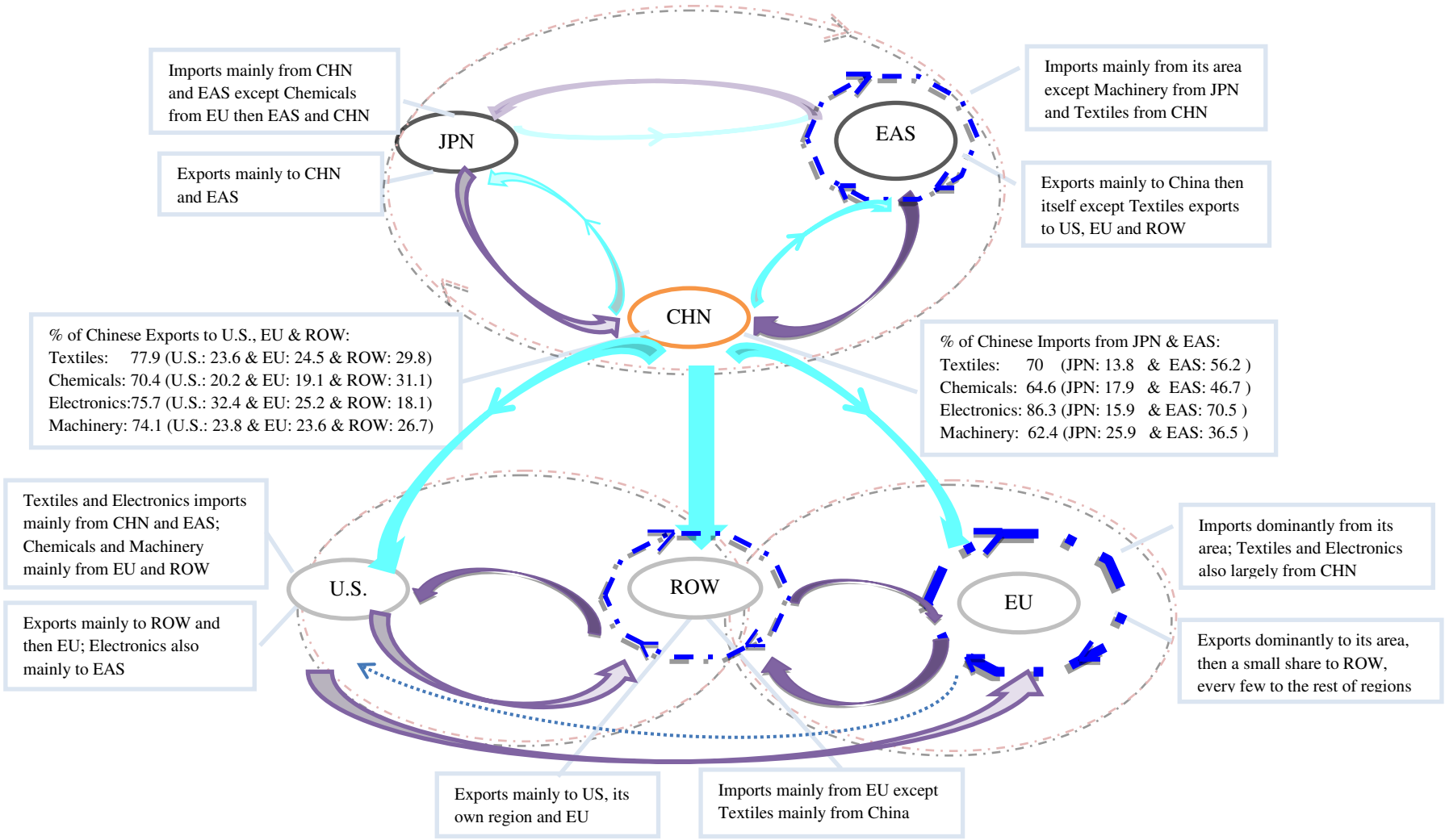
Note: See Table 1.

Figure 1 Multilevel data in the model (2007)



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

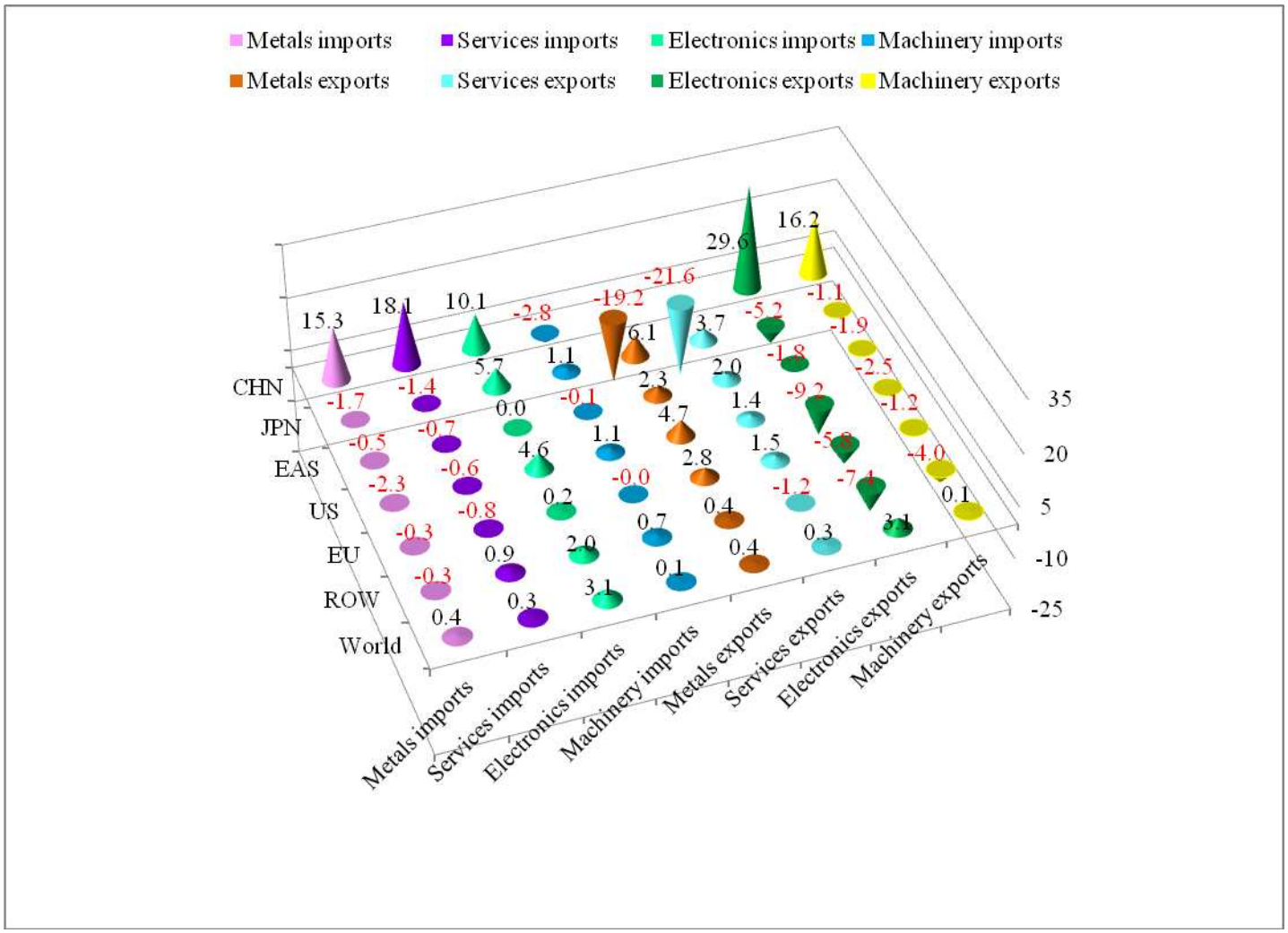
Figure 2 Main trade relationships in Textiles, Chemicals, Electronics and Machinery among regions



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

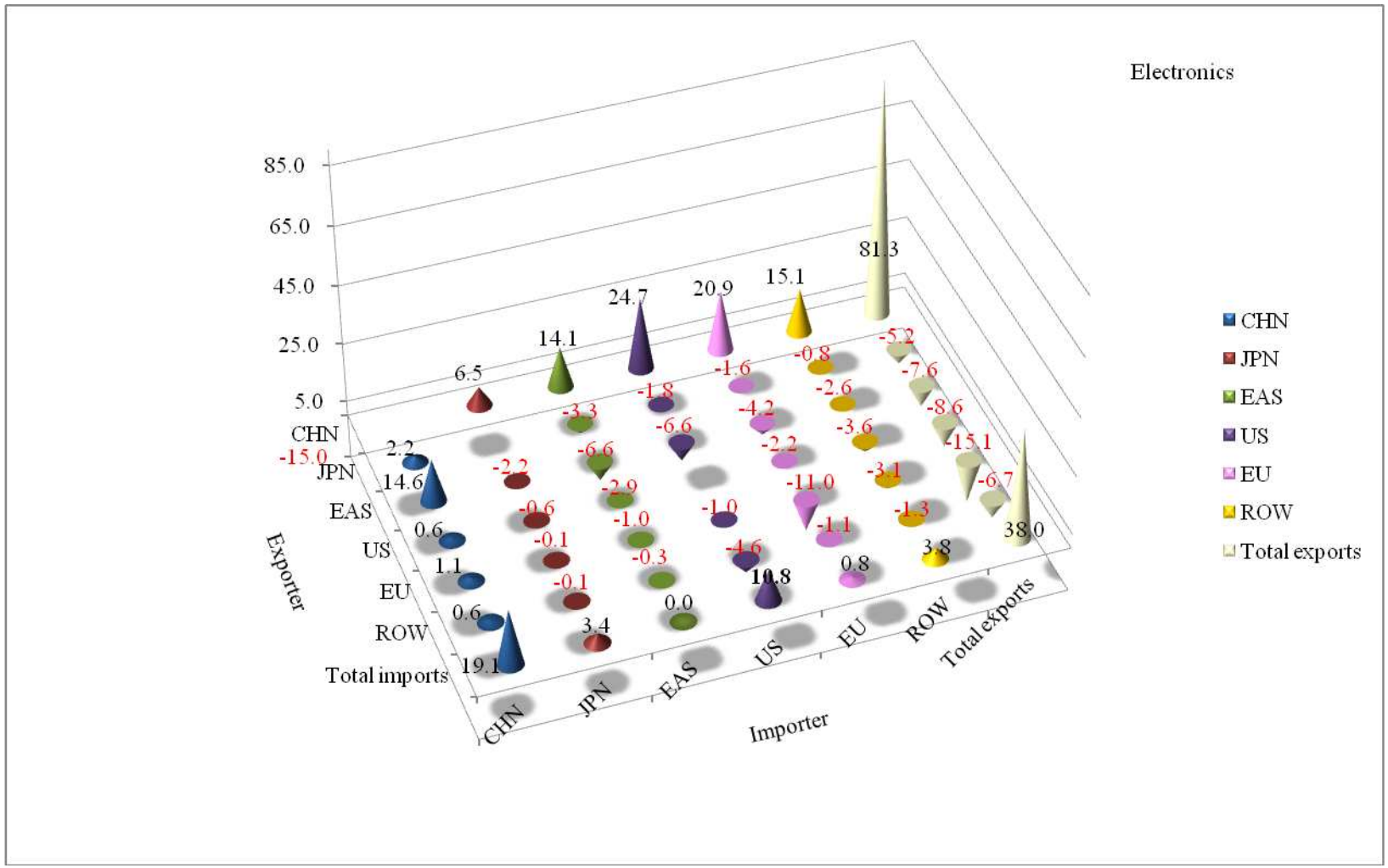
Note: see Table 1.

Figure 3 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 4 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.