The impact of FDI on the production networks between China and East Asia and the role of the U.S. and ROW as final markets

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Abstract:

This paper uses a 3 factor – 4 region – 15 sector computable general equilibrium model to study the impact of FDI accruing to China. We focus on the sectors of Electronics, Machinery and Textiles which account for 55.4% and 40% of Chinese overall exports and imports, respectively. Our data seem to confirm the existing empirical knowledge on the production networks between China and East Asia, and the role that the U.S. and ROW play as final markets for Chinese exports. Based on these differentiated geographical roles and on the contrasting production technologies of the three sectors, we offer an in-depth analysis of the effect of FDI inflows on production, prices and bilateral trade across China, East Asia, the U.S. and ROW. The magnitude of FDI inflows brings about proportional impacts on the increase in production and the fall in prices across the three sectors considered. However, the subsequent adjustment in bilateral trade differs. On the one hand, FDI leads to an increase of Chinese exports of Electronics and Machinery, crowding out production and exports in the rest of regions. On the other hand, the increase in FDI in Textiles still brings about increase in production which does not result in higher exports. The private consumption orientation of Textiles explains its contrasting trade pattern with respect to Electronics and Machinery. The fall in Chinese exports of Textiles in China underlies the increase on exports of Textiles across the rest of regions. However, world trade flows in Textiles are of smaller volume than the one in Electronics and Machinery. Therefore, the increase in Textiles of exports of the rest of regions does not compensate their big losses of exports in Machinery and Electronics.

Key words: Computable General Equilibirium; Intermediates; Multinationals; Triangular trade pattern; Production fragmentation; Value chains.

JEL codes: C68, F14, F15, F17.

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1. Introduction

Through Foreign Direct Investment (FDI) and trade, China has become increasingly integrated into the global production Chain. It is the largest recipient of FDI among all developing economies. Its share of the world inward FDI flows rose from 2.8% in 1991 to 8.1% in 2011(UNCTAD, various years). FDI inflows have substantially contributed to its capital formation process.

East Asian economies, out of the geographic proximity and cultural links, provide 63% of cumulative FDI in China from 1985 to 2008 (Xing, 2010). As empirically tested by (Fukao *et al.*, 2003) with data from the electrical machinery industry, FDI plays a significant role in the rapid increase in vertical intra-industry trade in East Asia in recent years.

The exports and imports between China and East Asia have nearly quadrupled from 2000 to 2009 (OECD, various years). In fact, more than 70% of intraregional trade in East Asia is in parts and components that will be further assembled and exported to other region (ADB, 2007). Trade of intermediate goods has largely driven the rapid growth of intra-Asian trade (Athukorala, 2008; Brooks and Hua, 2009). Dean *et al.* (2008), using two Chinese benchmark input-output tables and a detailed trade dataset which distinguishes processing trade from other forms of trade, shows strong evidence of an Asian network of intermediate supplies to China. Xing (2011) points out that most of the processing imports from East Asian economies are used as intermediate inputs for finished products targeting third markets and that China has primarily functioned as a big assembling factory for MNEs from East Asian economies. The U.S. is the largest single market for processing exports of China, based on panel data of 51 trading partners of China from 1993–2008.

The emergence of China has intensified the production fragmentation within Asia (Gaulier *et al.*, 2007a) and led to a triangular trade pattern among China (the export base), advanced Asian economies (component suppliers), the U.S. and Europe (markets) (Gaulier *et al.*, 2007b). Triangular trade through China is thought to form the principal mechanism of shock transmission in the Asia-Pacific region under the Crisis based on international Input-Output analysis (Inomata and Uchida, 2009).

The close ties among Asian economies can be explained by the increased production fragmentation and the rise in intra-industry trade. Production fragmentation (Deardorff, 1998) is a production process during which final product is split into two or more steps and each production step is undertaken in different locations across national boundaries. Various terms have been used to describe this phenomenon including production networks (Henderson *et al.*, 2002; Ernst and Kim, 2002; Sturgeon, 2002), slicing the value chain (Krugman, 2005), vertical specialization (Hummels *et al.*, 2001), international production sharing (Ng and Yeats, 1999) and outsourcing (Feenstra and Hanson, 1999). Xing and

Detert (2010) give iphone as an example of the global production networks and highly specialized production processes in which China is mainly devoted to the assembly phase.

Koopman *et al.* (2008) develop a general formula for computing domestic and foreign contents, and reveal that the share of foreign content in exports from Chinese electronic devices is particularly high (about 80%). Wang *et al.* (2009), using an international input-output table, disclose the heterogeneity in the value chain across sectors: the Electronics industry has the most integrated global production network, with value shares becoming more evenly distributed among East Asian economies from 1990 to 2000. In contrast, Wearing apparel is more concentrated in Asian developing countries, with a shift in value-added away from industrialized Asian countries and the rest of the world. Decomposing Chinese real export growth of over 500 percent since 1992, China's export structure changed dramatically, with growing export shares in Electronics and Machinery and a decline in Agriculture and Apparel. These results match the evidence derived in this paper. The strongest overall export growth has been in Machinery, and within this broad category, particularly in Telecoms, Electrical Machinery (Amiti and Freund, 2008).

Specialization allows the production to be distributed efficiently across the regions, based on their comparative advantage, like wage differentials. Multinational enterprises (MNEs) in advanced Asian economies specialize in production of intermediate goods and they further export intermediates to their affiliates in China for assembly and re-export (Haltmaier *et al.*, 2007). Production networks centered on China have contributed significantly to growth in East Asia (Haddad, 2007).

In summary, the empirical literature points to the existence of different geographical roles in the production process worldwide. In particular, it suggests that the emergence of China has intensified integration in Asia through production networks. China works closely with other Asian economies through processing trade and its growth further reinforces the production networks within the region. China plays an important role as a production center and export base, relying heavily on the intermediates from more advanced Asian economies (Japan, Korea, Taiwan, Hong Kong, Singapore). FDI inflows in China, as well as, trade have largely induced the development of this production network, which in turn, has consequences for the trade patterns within and outside the region. The U.S. and ROW, by contrast, are the main final markets for East Asian exports.

However, the above refereed literature, often lacks a general equilibrium perspective which would allow analyzing the micro and macroeconomic impact, as well as, the demand and supply sides of this phenomenon, in a manner consistent with trade patterns. Further, the CGE analyses that include FDI are rather scarce (Latorre, 2009). This is the gap that we aim to cover with this study of the impact of inward FDI in Electronics, Machinery and Textiles sectors of the Chinese economy. We focus on the effects on the Chinese trade pattern in these sectors which constitute 55.4% and 40% of its overall exports and imports,

respectively. We pay particular attention to the role that the different geographical areas play in their associated production networks and in their final demand. In particular, we analyze the evolution of East Asian production networks and its final markets – the U.S. and the Rest of the World (ROW).

This paper is organized as follows. Section 2 describes the model that we use. The benchmark data and simulation scenario are discussed in section 3. The results are analyzed both at the aggregate and sectoral level, as well as, from the demand and supply side in section 4. Section 5 concludes.

2. Data

In our model there are three factors of production (capital, unskilled and skilled labor), four regions (China, East Asia[1], the U.S. and ROW) and fifteen sectors. The Manufacturing sector is disaggregated into thirteen sub-sectors which are presented in Table 1. The other two sectors are Agriculture and Services. We model capital and skilled labor as sector-specific, while unskilled labor is fully mobile within but not across regions. This assumption allows us to capture the medium term impact of the simulated FDI shock.

Table 1 displays the whole structure of the Chinese economy. In the first two columns, it presents the names of the sectors and their correspondences with the original GTAP sectors. The percentage calculations of the table are based on the latest GTAP8 database (Narayanan *et al.*, 2012), which is the one used in our model. The information refers to the year 2007.

2.1. Comparing the three sectors' importance in Chinese economy

As shown in column 3 of Table 1, Electronics, Textiles and Machinery are the most export oriented sectors in the Chinese economy: 56% of Electronics production, 36% of Textiles and 25% of Machinery are exported. Combining their exports together, they account for 55.5% of Chinese overall exports (column 5). According to their weights in the production and value added (GDP), Machinery is a bit larger, followed by Textiles and Electronics (columns 8 and 9). Moreover, MNEs are highly involved in the production of these sectors, since they contribute to more than 80% of Electronics output, 24% and 27% in Textiles and Machinery, respectively[2].

[1] After the close observation of the FDI sources and main trade partners of China, we finally aggregate Japan and new industrialized economies (Republic of Korea, Taiwan China, Hong Kong China and Singapore) as East Asia.

[2] 中国工业经济统计年鉴 2008 (China Industry Economy Statistical Yearbook 2008).

On the other hand, the three sectors vary largely in the aspects mentioned below. As shown in column 4, imports play a much smaller role for domestic consumption of Textiles (6.8%), contrasting with 48.2% of Electronics and 23.8% Machinery. Column 7 shows that Textiles outweighs the sum of Electronics and Machinery in Private consumption. From the production side, Textiles is unskilled labor intensive compared with Electronics and Machinery (column 11). The Machinery sector is logically most capital intensive (column 12).

2.2. Comparing the role of the four regions in the world commodity market

2.2.1 Role in Electronics

Table 2 shows the different roles that the four regions play in Electronics. The left side of Part 1 of this table displays the demand structure (private consumption, government consumption, gross capital formation and intermediate inputs) of imported Electronics in each region. China and East Asia lie ahead of the U.S. and ROW with respect to their high weight of intermediate inputs in imports. The U.S., ROW and, to a lesser extent, East Asia distinguish themselves from China due to their high private consumption weight (20%, 14% and 11.5%, respectively) and high capital formation weight (26.2%, 31.5% and 22.2%, respectively). These tendencies underlie the geographical shares of world Electronics imports by demand (left side of Part 2 of Table 2). Note first, that the U.S. and ROW together account for 69.4% (18.8% + 50.5%) in world Electronics imports[3]. However, their weights are higher in world private consumption (81.6% = 28.3% + 53.3%), public consumption (99.8%) and capital formation (80.5% = 19.1% + 61.4%), exhibiting a smaller importance in intermediates (61.7% = 16.8% + 44.9%). East Asia and China together, play a more important role in intermediate imports of Electronics (38.3%= 21.5% + 16.8%) than in the rest of components of demand. Imports for private demand in China are the lowest in the world.

Now let us analyze the roles played by the different regions in production. The right side of Part 1 reflects the allocation of domestic Electronics goods (production[4]). China, East Asia and ROW share similarities in devoting most of their output to exports and intermediates, while the U.S. devotes domestic goods intensively to capital formation and intermediates, with a rather small share going to private consumption. China exhibits the lowest of production devoted to private consumption across regions. The low private consumption weight in production and imports of the Chinese economy will soon become familiar to us. These patterns in production also have a reflection in world patterns. This can be seen in

[3] Imports include the value of physical imports, transport margins and import tariffs.

[4] The right side of Tables 2, 3 and 4 display the demand allocation of "domestic goods". Strictly speaking, domestic goods (commodities) in a social accounting matrix (SAM) table are the sum of production (output) and total export tariffs. Production takes up 96.1%, 98.4% and 99.2% of domestic goods in Textiles, Electronics, and Machinery, respectively. Therefore, we will use the terms production or output to refer to domestic commodities, hereafter.

the right side of Part 2, which shows us the geographical shares of world production of Electronics, further specifying the shares in each demand component. Nearly half of world production of Electronics (46.4% = 18.9% + 27.5%) is concentrated in China and East Asia, which also contribute to 51% (22.1% + 28.8%) of world exports and employ 35.7% (23.9% + 11.8%) of world domestic intermediates. Private consumption, public consumption and Investment in the U.S. and ROW contribute to 81.7%, 99.4% and 77.2 % of world levels, respectively.

To sum up, in relative terms, imports and production of Electronics are more related to intermediates and exports in China and East Asia. Most of Chinese imports are of intermediates, mainly from East Asia due to the existing production networks[5] between the two regions. They together serve as the biggest world production and export base for Electronics. By contrast, in the U.S. and ROW, Electronics seem more related to final domestic demand (i.e., private consumption, public consumption and investment). This underlies a triangular trade pattern among these regions that has been pointed out by some authors (Gaulier *et al.*, 2007b; Inomata and Uchida, 2009), by which East-Asia provides intermediates to be further processed in China, while the latter exports them to the U.S. which is the main (single-country) final market. A pattern which is consistent with the literature review presented in the Introduction.

2.2.2 Role in Machinery

Table 3 shows the different roles that the four regions play in Machinery in a manner analogous to Table 2. Therefore, the left side of Part 1 of this table exhibits the allocation structure of imported goods in each region. The imports are largely used for intermediates but this tendency is more intense in China and East Asia. As befits the nature of the Machinery sector, an important part of imports is also devoted to investment. Imports for private consumption are more important in the U.S. and ROW. China exhibits the lowest import tendency for private consumption and the highest for intermediates. The left side of Part 2 shows the geographical shares of world Machinery imports by demand. Following the above explained patterns, East Asia and China account for 22% (11.4% + 10.6%) of world intermediate inputs and 18.5% (8.8% + 9.7%) of world capital formation but their shares are very low in world private consumption. The U.S. and ROW take up 90% (23.2% + 66.4%) of world private consumption of imported goods.

The right side of Part 1 displays how each region allocates their domestic output. Private consumption of Machinery goods is pretty low across regions, though more important in the U.S. and ROW. Production for investment is important across all regions. China

[5] In Part 1 of Table 2 we see that 84.5% of Chinese imports are of intermediates. We will see later (in Part 3 of Table 7) that 60% of total Chinese imports of Electronics come from East Asia. It seems logical to assume that most of the Chinese imports are intermediates from East Asia. The literature review from the introduction also points clearly in this direction.

devotes most of its production (49.3%) to intermediates, followed by exports (24.7%). By contrast, East Asia and ROW, devote nearly half of their outputs for exports, next in importance come intermediates. The resulting world output patterns are in the right side of Part 2, which displays the geographical share of each demand component of world Machinery production. Domestic intermediate input in China ranks high in the world. East Asia shows a large share in the world exports, though ROW, as a combination of rest of the regions has a much higher weight. China and East Asia provide 30.4% (16.5% + 13.9%) of world production of Machinery and 28.3% (10.5% + 17.8%) of world exports. The U.S. and ROW contribute 87.5% to the world private consumption, and around two thirds to the world capital formation and intermediates.

These patterns suggest that, in relative terms, China and East Asia play more the role of producers than the role of final markets, the latter being more important in the U.S. and ROW. To put it simpler, from a world perspective the U.S. and ROW play a more important role as final markets, while China and East Asia are more specialized in producing intermediate goods and export goods. Thus, we again find a similar pattern to the one described above for Electronics, especially in the flows of Chinese intermediate imports coming from East Asia (Part 1 of Table 3 and Part 3 of table 8 below). But because the Machinery production depends less on imported intermediates (and more on domestic ones) than Electronics does (Figure 1), the production networks between China and East Asia is not as strong as in Electronics. In addition, the higher importance of Machinery in investment across all geographical areas, makes its pattern somewhat different to the one of Electronics.

2.2.3 Role in Textiles

Table 4 repeats the structure of Tables 2 and 3, now including information for Textiles. The left side of Part 1 reveals how each region allocates the imported Textile goods. According to the nature of the product, Textiles is quite different from Electronics and Machinery in its small importance for capital formation. In China 86.3% of the imports are intermediates. As happened in Electronics and Machinery, China exhibits the smallest share of imports used for private consumption across all regions. However, it is important to note that in the case of textiles 13.7% of all Chinese imports go to private consumption, while in Electronics and Machinery the shares were much lower (4.5% and 2.7%, respectively). In East Asia, the U.S. and ROW, by contrast, more than 59% of imports are for private consumption, especially high is the case of the U.S., with 72.7% of imports going to private consumption. The rest of imports are mainly used for intermediates in these regions. The left side of Part 2 shows the geographical shares of world Textiles imports by demand type. In contrast with Electronics and Machinery, Textiles imports from China and East Asia account for a much reduced share (12.7% = 3.7%+9%) of world imports. These two regions hold similar weights (around 8% each) in world intermediates imports but differ in final demand due to China's extremely low private consumption (less than 1%) and negligible

investment in the world. Private households from the U.S. explain 22.7% of world imports. ROW, being a region comprised of a mixture of many countries, shows a pretty high weight in the world imports of Textiles in every component of final and intermediate demand.

The right side of Part 1 shows how each region allocates its domestic output. As happened in Machinery, Textiles output in China is largely used as intermediates (54.5%) and exports (34.4%), while again only small quantities are devoted to private consumption. With a high share of private demand (46.4%) and very low exports (7.5%), the U.S. pattern contrasts with the Chinese one. East Asia devotes a higher share than usual to private consumption (32.9%), but devotes more to intermediates (35.9%). ROW exhibits a rather similar pattern to the one of East Asia but the latter is slightly more specialized in intermediates' production and ROW in production for private consumption. The right side of Part 2 reflects the geographical shares of world production of Textiles. China takes up 10% of world production for private consumption, while the U.S. accounts for 17.6%. China again shows nearly zero world production devoted to investment, while the U.S. and ROW lie ahead, taking up 37.1% and 40.1%, respectively. In terms of the weights of exports and intermediates in the world, China exhibits the highest importance if we do not consider ROW. Looking at Part 2 as a whole, China takes up only 3.7% of world textile imports but 27.9% of world output as shown in the last column of this part. This means that domestic demand for textiles in China is mostly satisfied by national production (93.2%)[6]. The imported goods mainly serve as intermediates in China in contrast to their use as private consumption in the rest of regions considered.

Overall, China accounts for 28% of world output and 30.7% of world exports in Textiles. These percentages are higher than the ones exhibited in Electronics and Machinery. As in the two former sectors, China still relies on the imported intermediates coming mainly from East Asia (again we find evidence for production networks), while the U.S. and ROW are its main export markets (Part 3 of Table 9).

3. The model and simulationd

Mathiesen (1985) has expressed an Arrow-Debreu general equilibrium model in a compact and efficient way. Equilibrium is defined by three types of equations: market clearance (i.e., supply equals demand for all goods and factors), income balance (i.e., net income equals net expenditure) and zero profits (i.e., cost of inputs equals the value of outputs). Rutherford (2005) uses Mathiesen's approach for the setup of the GTAPinGAMS model. It is the version in the software GAMS of the well-known GTAP model created by Hertel

[6] This can also be seen in the column of "Import percentage of domestic consumption" in Table 1, with 6.8% in Textiles.

(1997). The GTAP model is able to reflect the world economy using input-output information, detailed foreign trade data, as well as, a rich set of data from national accounts of the different regions. All data are homogenized in the GTAP database (Narayanan et al., 2012). Latorre (2010, Chapter 3) offers a very detailed explanation of the GAMS version, while a more succinct one is available in Latorre et al. (2009).

In the mathematical form, Rutherford's model is derived from maximizing a series of nonlinear equations using a dual approach (Dixit and Norman, 1980). Thus, microeconomic optimization reflects the adjustments to the shocks introduced in the model. The adjustment is also consistent with the macroeconomic framework embedded in the national accounts identities present in the model. The whole set of equations of the model appear in appendix 1, which includes illustrative figures of the trees with their mathematical functional forms.

The shock we run consists of a simultaneous increase in the capital stock of the Chinese sectors of Electronics, Machinery and Textiles. According to the National Bureau of Statistics of China (various years), the accumulated FDI inflow in Electronics has more than doubled during the period of 2004—2011[7], the increase was of 50% in Machinery and of 30% in Textiles. Thus, we simulate a shock of the corresponding capital stock increases in the three sectors simultaneously, meanwhile the capital stock in rest sectors and regions remains fixed. We are interested in how the accumulation of FDI reshapes the trade divisions within East Asia, as well as, the impacts for the U.S. and ROW.

After the shock, factor remunerations will be changed. Then the sectors will readjust their factor inputs, intermediate inputs, prices and production. This further has an impact on the regional income, domestic consumption and exports in the host country. Through the trade links and production networks, this shock is transmitted to rest of regions. As a result, they will change the production, imports, and exports. According to the above analyzed contrasting characteristics of these three sectors, we expect that their subsequent adjustments will differ.

4. Results

4.1. Aggregate results

As shown in Table 5, after the simulation China has benefited from the FDI inflows according to the rise of GDP (2.1%) and national income and welfare (9.6%)[8], which are

[7] The exact source is the 'Investment in Fixed Assets in Urban Area By Sector, Jurisdiction of Management and Registration Status' from National Bureau of China Statistics (various years). Due to the lack of detailed FDI stock data and FDI flows across sectors, we take the "fixed assets investment funded by foreign capitals" as a proxy for the foreign fixed assets. The latter takes into account the capital invested in China by all foreign firms across the world, including firms from Hong Kong, Taiwan, and Macao.

[8] Note that in GTAPinGAMS the increase in national income is equal to the increase in real private consumption, which, in turn, can be used as a proxy for the variation of the country's welfare. For more details on this see Hertel (1997, chapter 1) or Latorre (2010, chapter 3).

mainly related to the increase of the capital stock. The aggregate skilled wages are pushed up by 1.9%. By contrast, the unskilled wages and capital rents are pulled down in China, 0.7% and 1.6%, respectively, resulting from the shrink of labor input and the large decrease of capital rent in the sectors receiving FDI. Note that these evolutions of factors remunerations are intuitive since one would expect a higher complementarity between foreign capital and skilled labor so that the entry of capital raises skilled labor remuneration. On the other hand, the fall in the wage of unskilled labor would match its smaller complementarity with capital. Further, capital accumulation pushes down its rent and this is also consistent with an increase in the competition climate brought about by the increase in FDI.

The impact of this shock, initially involving only three sectors, is negligible in the rest of regions at this aggregate level. However, East Asia seems slightly more affected, experiencing a very small contraction.

4.2. Sectoral output, prices and specific factor prices

FDI inflows in China will result in a decrease of capital and skilled labor remunerations in the sectors directly involved in the shock, which, in turn, will push down their prices and increase their production (Table 6). The scope of the reductions in skilled labor and capital remunerations, as well as, the subsequent reductions in prices and output increases follow the relative importance of the amount of FDI inflows received. Recall that FDI inflows are much higher in Electronics (100%) than in Machinery (50%), followed by Textiles (30%). Besides, there is a substitution effect between new foreign capital and unskilled labor, so that capital crowds out unskilled labor in Textiles, Machinery and Electronics. Unskilled labor is then reallocated throughout the rest of sectors in the economy. Those sectors (not receiving FDI) that increase production do so because they employ more unskilled labor, since capital and skilled labor are sector specific. When more unskilled labor is accumulated, skilled labor and capital become relatively less abundant in the sectors (not receiving FDI) that produce more, thus increasing their productivity and remuneration.

The outputs of Electronics and Machinery in the rest of regions are crowded out by their large expansion in China and the much cheaper Chinese prices. As a result, output has contracted noticeably for Electronics (ranging from 2.8% fall in East Asia to a 5.3% decrease in the U.S.) and moderately in Machinery (with around 1% to 1.5% reductions). By contrast, the output of Textiles remains unchanged since the shock on Textiles in China is weak to affect the rest of regions. Further, Textiles is much more oriented to private consumption than Electronics or Machinery. Therefore, following a drastic increase in national income and demand of 9.6% (Table 5), Textiles production will tend to satisfy this prevailing force. Returns on capital and skilled wages are affected negatively in Electronics and Machinery for East Asia, the U.S and ROW, while they go up in the case of Textiles.

This seems to be the result from the reduction (increase) of output in the first two sectors (Textiles) which carries a reduction of (an increase in) the demand for factor inputs.

4.3. Comparing the evolution of trade patterns

Tables 6, 7 and 8 offer a broad panorama about the main geographical partners in bilateral trade of each of the four regions in the sectors of Electronics, Machinery and Textiles, respectively. In particular, they present detailed information on bilateral exports (in Parts 1 and 2), imports (Part 3), as well as, import prices (Part 4). This is a valuable complement to the Tables 2, 3 and 4, which provide information on each region's production and imports putting them in relationship with macroeconomic variables from the demand side of the economy (private and public consumption, Investment, intermediates and exports.).

4.3.1. Chinese exports

Chinese exports of Electronics have increased by 29.4% after the FDI inflow (Part 1 of Table 7). This figure is very close to the expansion rate of output (30.2%). Given that Electronics is very export oriented, the increase in output will be primarily allocated to exports. The difference of exports between the simulation and the benchmark (labeled as "difference" in Part 1 of Table 7), shows that the U.S. and ROW absorb the majority of the increase in Chinese exports. Indeed they are the main markets of China (Part 2 of Table 7), accounting for 81% (32.4% + 48.7%) of its exports in the benchmark. Chinese exports crowd out other suppliers and gain substantially in the world export market as a big source of Electronics. As reflected in Part 3 of Table 7, it raises the share in its trade partners' import structures and crowds out other suppliers' shares. An important force contributing to the heavy increase in exports is the large fall in the price of Chinese Electronics goods (Part 4 of Table 7).

After the shock, the Machinery sector in China expands its overall exports by 19.6% (Part 1 of Table 8), exceeding by far the expansion rate (9.6%) of output. Machinery allocates more output to exports than Electronics because the Machinery intermediates are extensively used across sectors rather than intensively for its own production as Electronics does (Figure 1)[9]. As a consequence, the extra intermediate demand caused by the increase in its own output is smaller in Machinery than in Electronics, so more production is exported in Machinery. As happened in Electronics, the U.S. and ROW are the biggest markets of China (together they explain 79.6% (23.8% + 55.8%) of overall exports in the benchmark. That is why they absorb the majority of the increased exports of China after the shock (see the "difference" in absolute value terms). And again, similarly to the Electronics case, though less intensively, output and exports in the rest of regions are crowded out (Part 3 of Table 8). Machinery goods also experience an important fall in prices in China, thus

[9] Figure 1 presents the input-output structure of Machinery, Electronics and Textiles in China.

enhancing its competitiveness, even though the fall is less pronounced than in Electronics (Part 4 of Table 8).

Textiles is distinct from the two other sectors because it is more private-consumption oriented. Because FDI inflows increase national income and demand in China, Textiles exports go down by 1.2% (Part 1, Table 9) despite of its production expansion (2.4%). Part 3 also reflects the fall in the weight of China in the import structure of the rest of regions. On the other hand, the fall in the output price of Chinese Textiles is milder than in the case of Electronics or Machinery (Part 4, Table 9).

Looking at the export structure of China across Part 2 of Tables 7, 8 and 9, we find that it basically remains stable, especially in Textiles. China expands the exports to all the partners relative to their weight in its exports, largely revealing the underlying collaboration and division in production and demand among them. In short, in Electronics and Machinery exports are enlarged while Textiles exports are reduced when the three sectors receive FDI flows and expand their output.

4.3.2. Chinese imports

We reorganize the same information on exports that appears Tables 7, 8, and 9 in a different manner with the purpose of making easier the analysis of imports. Table 10 displays imports values in the benchmark and simulation, as well as, the percentage and value (in billions of dollars) change after the shock. This calculation is based on the absolute numbers shown in Part 1 of Tables 7, 8 and 9. Therefore, the overall Electronics imports of China are the sum of the Electronics exports from the rest of regions to China.

Chinese overall imports of Electronics increase by 9.9% (Table 10). As a destination of Electronics exports from other regions, China becomes more important, since its domestic consumption of Electronics —private consumption, capital formation and intermediates, relies heavily (48.2% in Table 1) on imports. In particular, the intermediate demand for Electronics imports has largely pushed up the overall import demand. Indeed, intermediates account for 84.5% of overall imports and they are very intensively used in Electronics production, which expands after the FDI inflow[10]. The biggest increase of Chinese imports comes from East Asia. This region, which is highly integrated with China in the Electronics production networks, provides 60% of Chinese overall imports (Part 3, Table 7). Thus, after the shock East Asia strengthens its export ties with China as an important intermediate

[10] The intense use of imported intermediates in the production of Electronics, which is higher than their use in Machinery or Textiles, can be well related to the more important presence of multinationals in the former sector. This finding is common to other previous studies (e.g., Latorre, 2012; Latorre, 2013).

supplier. One interesting phenomenon is that even though domestic output price is cheaper than imported ones (Part 4 of Table 7), China still enlarges the imports from other regions.

Unlike the increase of Electronics imports, overall imports of Machinery shrink by 4% (Table 10). The overall import demand is mainly pulled down by the decreasing investment demand. As mentioned above, Machinery relies less on its own imported intermediates in its production process than Electronics does (Figure 1). Therefore, the increase in production in Machinery does result in a relatively smaller increase in demand for imported Machinery intermediates compared to the case of Electronics. Further, domestic output price is much cheaper than the imported one (Part 4 of Table 8) and all the sectors substitute imports with domestic production. East Asia suffers the biggest decrease of Chinese imports, in absolute value, because it supplies 59.2% for Chinese imports and serves as an import intermediate supplier. Nevertheless, comparing the import structure of China before and after shock, East Asian weight grows up a bit due to the overall reduction of Chinese Machinery imports.

More surprisingly, China enlarges its overall Textiles imports by 4.4% from the rest of regions (Table 10). This is twice the increase experienced in the production of Textiles after the FDI shock. This means that the big increase of national income (9.6%) further pushes up private consumption of Textiles which, in turn, increases the demand for their imports. East Asia, as the biggest supplier (60.4%) of Chinese imports, experiences the biggest increase of exports to China, in absolute value; while ROW, due to a smaller benchmark value, undergoes the biggest percent increase of exports to China.

Looking at the import structures of China (Part 3 of Table 7, 8, and 9), as happened with the Chinese export structure, they basically do not change. The main collaboration and division trends with the rest of regions remain. East Asia is the main provider of Chinese imports before and after the shock. It accounts for around 60-65% of them.

4.3.3. Exports of the rest of regions

Let us analyze the differences between the benchmark value of exports and their simulation values (Part 1, Tables 7, 8 and 9). If we want to compare the impact on exports across regions, we should compare the evolution of the difference between the simulation and benchmark values (not the percentages changes). In this sense, East Asia loses, decreasing its exports of Electronics (-11.6 billion of dollars, Part 1 of Table 7) and Machinery (-5.7 billion, Part 1 of Table 8). Even though East Asia exports a bit more of Textiles, the impact is very small, compared to the falls experienced in Machinery and Electronics. The U.S. loses more in its Electronics exports (-7.8 billion of dollars compared to -5.5 billion in Machinery). For both East Asia and the U.S. the most important cause of losses is the fall in exports to ROW. However, their losses are more important in Electronics than in Machinery because Chinese exports are more competitive in the former

sector. In the case of ROW, by contrast, the largest falls in exports arise in the Machinery sector. ROW exports more volume of Machinery than Electronics and the associated losses are larger.

Even though all the rest of regions, apart from China, increase their exports of Textiles, the values involved are so small that they do not make up for the above commented losses that all of them experience in Electronics or Machinery.

4.3.4. Imports of the rest of regions

In Electronics, total imports of all regions increase after the shock, as reflected in Table 10. China and East Asia become more integrated since the Electronics imports from China (probably more of the intermediates) increase. Imports of the U.S. and ROW also increase. In the latter case, probably the exports are mainly final goods[11].

A similar pattern arises in Machinery. The U.S. and ROW increase their imports. East Asia also increases its imports although less intensively. Note that the U.S., both in Electronics and Machinery, increase its overall imports more intensively than ROW. This may come as a surprise given that ROW is by far a more important trade partner for both China and East Asia. It seems that even through China increases its exports more heavily to ROW (Part 1 in Table 7 and 8, Table 10), there is a substitution effect in the interregional trade flows in the regions of ROW, so that previous imports among ROW regions are now displaced by Chinese exports, resulting in a reduction of imports within the ROW region. Total trade within that region is reduced. These results would therefore support the triangular trade pattern between China, East Asia and the U.S. (Gaulier *et al.*, 2007a; Inomata and Uchida, 2009).

Again the Textiles pattern differs drastically from the two previous ones. Due to the reduction of Chinese exports after the shock, the rest of regions increase their exports, we now also see that they reduce their imports. Only China, which experiences an important increase in private consumption, increases its imports demand for Textiles.

5. Sensitivity analysis

To examine the robustness of the results, we change the values of two crucial elasticities in the model: 1) the elasticity of substitution between imports and domestic production (i.e.

[11] Part 3 of Tables 7, 8 and 9 reflect that for the U.S. and ROW, China is not the main provider of imports. Indeed, it is ROW the region that weights more as an import source both for the U.S. and ROW. This contrasts with the importance of the U.S. and ROW as markets for the Chinese economy (Part 2 of Tables 7, 8 and 9). The two former regions account for around 80% of total Chinese exports in the 3 sectors considered. China is, however, more integrated with East Asia if we look at the data from the point of view of East Asia. China, indeed, exhibits a much higher weight in East Asian geographical structure than it does in the ones from the U.S. and ROW.

the Armington elasticity); 2) the elasticity of substitution between labor and capital. We carry out an Unconditional Systematic Sensitivity Analysis (Harrison et al. 1993), in which we halve and double each one of the two types of elasticities in all of the fifteen sectors in China, while keeping the rest of elasticities at their benchmark value. Then we compare the results for the aggregate and sectoral variables which have been analyzed above.

Table 11 shows the results of the aggregate variables, in a structure analogous to that of Table 5. The columns of "double" and "half" list the results obtained when each of the elasticities are multiplied or divided by two, respectively. There are not significant differences in the aggregate variables compared to our previous results. Slightly bigger differences occur in the percent change of capital rent and skilled wage in China in the case of changing the elasticity of substitution between labor and capital. A bigger elasticity of substitution among factors conveys a more flexible production technology. This implies that the adjustments in factors remunerations are milder (more intense) with higher (lower) elasticities of substitution among factors. In general, the more elastic the substitution, the bigger the increase of GDP, since factors and goods can be more easily reallocated across sectors which helps the economy to become more efficient.

Table 12 shows us the Chinese trade patterns in the simulation previously run and those obtained with the new values of the elasticities. We omit the trade patterns for the rest of regions, due to the very small changes found after the sensitivity test. The overall trade pattern in China remains unchanged. East Asia is still the main supplier of Chinese imports while the U.S. and ROW are the biggest markets for Chinese exports. The different values of the elasticities have a small impact on Chinese exports. The less elastic the substitution elasticities, the higher the Chinese exports. In the case of lower elasticity of substitution among factors of production, the less flexible technology results in a larger amount of unskilled labor being employed in the sectors receiving the FDI shock. As a consequence, their production will be larger and their prices lower. Therefore, Chinese exports become more competitive and expand more in the world market. In the case of lower substitution between imported and domestic goods, there is higher rigidity in the domestic demand for final consumption even though the domestic price is relatively cheaper. Thus, more domestic goods will be exported after the output expansion.

All in all, we find that our results are robust, since the causation chain found remains unchanged.

6. Conclusions

This paper analyzes how FDI accruing to Electronics, Machinery and Textiles in China affects the bilateral trade patterns among China itself, East Asia, the U.S. and ROW. We use a (3-factor 4-region 15-sector) CGE model that allows us to capture the demand and

production side, as well as, the production networks and final demand roles of the different geographical areas.

Though we focus only on Electronics, Machinery and Textiles, we are, in fact, analyzing 55.4% and 40% of overall Chinese exports and imports, respectively, and 13.6% of Chinese GDP. We find that China has benefited from the FDI inflow according to the rise of GDP (2.1%) and welfare (9.6%, proxied by national income). The scope of the reductions in skilled labor and capital remunerations, as well as, the subsequent reductions in prices and output increases follow the magnitude of FDI inflows each sector has received. Because Electronics is the main recipient of FDI inflows it experiences the most intense fall in prices and increase in production. Next in importance come the adjustments in prices and production in Machinery. Finally, Textiles exhibits the most moderate price decreases and output expansion.

There are 3 characteristics of Chinese trade that stand out from the data. We summarize them as follows:

1. Around 80% of Chinese exports are directed to the U.S. and ROW. ROW is the more important destination accounting for 50% to 60% of total Chinese exports while the U.S. weights around 25% to 30%. Thus, only around 20% of Chinese exports go to East Asia. Note that imports from East Asia are mostly intermediates with a rather low weight of private consumption, particularly in Machinery goods. This implies that most of the Chinese exports of final goods are directed to the U.S. and ROW. Therefore, the latter constitute the main final markets of Chinese exports.

2. Chinese imports are mostly intermediates ranging from 68% (in Machinery) to around 85% (in Electronics and Textiles). One of the main challenges of trade statistics nowadays is to combine the dimension of type of good traded and country of origin. While that information might exist for some isolated countries, they are rather uncommon and not available across groups of countries. The information from the GTAP database used in this paper, however, provides us with important clues in this regard, as will be seen in the third characteristic,

3. Around 60% of total Chinese imports come from East Asia. As noted above, our data (to the best of our knowledge, no existing data) do not allow knowing simultaneously the country of origin (whether it is East Asia or not) and the type of good from that country of origin (whether it is an intermediate or a final good). But with 80% intermediate imports and 60% being provided by East Asia, it seems reasonable to assume that East Asia is heavily integrated in the Chinese production networks, providing an important amount of intermediates.

The Chinese trade patterns brought about by more FDI and the trade patterns in the rest of regions differ in the three sectors considered. Figure 2 shows a diagram summarizing our main findings. Let us point out here the essence behind them.

After FDI inflows, Chinese exports of Electronics and Machinery increase, while exports of Textiles go down. The U.S. and ROW absorb the majority of the increase in Chinese exports. The contrasting pattern in Textiles seems related to its importance in Chinese private consumption. With higher FDI inflows, household income and national demand in China increase. More Textiles will be demanded domestically and less will be exported.

On the other hand, after the increase in exports of Electronics and Machinery, production and exports from the rest of regions are crowded out. The important fall in export prices makes Chinese exports very competitive. However, note that China will import more Electronics and less Machinery from the rest of regions after the shock. This contrast arises from the fact that Electronics imports are heavily used for Electronics production which goes up after FDI inflows. In Machinery, though, imported intermediates are used less intensively in production which also expands after the FDI inflows. Finally, the fall in Chinese exports of Textiles results in an increase of Textiles exports across the rest of regions. However, exports of Textiles are smaller in world trade flows than the ones from Machinery and Electronics. Therefore, the increase in Textiles exports falls short to compensate the reduction in exports of Machinery and Electronics that the rest of regions experience.

This analysis confirms and expands the main outcomes from the empirical literature summarized in the introduction using a general equilibrium perspective. There are tight production networks between China and East Asia, while the U.S. and ROW are their main final markets. Taking those geographical patterns into account together with the particular production technologies (e.g., the intensity of the use of imported intermediate in production) and the demand orientation (e.g., the private consumption orientation of Textiles) helps to trace the impact FDI on trade.

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Appendix

Apart from some new parameters, we basically keep the GTAP's notation. Sets *i* and *j* define sectors and commodities; *r* and *s* refer to regions; and *f* denotes factors of production, i.e., unskilled labor, skilled labor and capital. The new parameters are *h* (host economy), which belongs to *r*; *l* (sectors receiving the FDI shock), which is a subset of *i*; and FDI(f, j, r), which is the new overall capital stock index.

Model equations:

Production

$$cf_{jr} = \left(\sum_{f} \theta_{fjr} \left(\overline{p}^{f}_{jr} \right)^{\left(1-\sigma_j^{Lsf}\right)} \right)^{1/\left(1-\sigma_j^{Lsf}\right)} \tag{1}$$

$$ci_{ijr} = \left[\left(\theta_{dijr} \left(\overline{p}^{d}_{ijr} \right)^{\left(1-\sigma_i^{A}\right)} \right) + \left(\left(1-\theta_{dijr}\right) \left(\overline{p}^{m}_{ijr} \right)^{\left(1-\sigma_i^{A}\right)} \right) \right]^{1/\left(1-\sigma_i^{A}\right)} \tag{2}$$

$$c^{y}_{jr} = \left(\sum_{i} \theta_{ijr} ci_{ijr} \right) + \left(\theta^{f}_{jr} cf_{jr} \right) \tag{3}$$

$$c^{y}_{jr} = p^{y}_{jr} (1 - t^{y}_{jr}) \tag{4}$$

$$ddfm_{ijr} = vdfm_{ijr}\, Y_{jr} \left(ci_{ijr} \Big/ \overline{p}^{d}_{ijr} \right)^{\sigma_i^{A}} \tag{5}$$

$$difm_{ijr} = vifm_{ijr}\, Y_{jr} \left(ci_{ijr} \Big/ \overline{p}^{m}_{ijr} \right)^{\sigma_i^{A}} \tag{6}$$

$$dfm_{fjr} = vfm_{fjr}\, Y_{jr} \left(cf_{jr} \Big/ \overline{p}^{f}_{jr} \right)^{\sigma_i^{LK}} \tag{7}$$

Remuneration of capital and skilled labor as specific factors

$$p^{sf}_{r} = \left(\sum_{j} \theta^{sf}_{jr} \left(p^{sf}_{jr} \right)^{(1+\eta)} \right)^{1/(1+\eta)} \tag{8}$$

Public consumption

$$p^{g}_{ir} = \left[\left(\theta^{dg}_{ir} \left(\overline{p}^{dg}_{ir} \right)^{\left(1-\sigma_i^{A}\right)} \right) + \left(\left(1-\theta^{dg}_{ir}\right) \left(\overline{p}^{mg}_{ir} \right)^{\left(1-\sigma_i^{A}\right)} \right) \right]^{1/\left(1-\sigma_i^{A}\right)} \tag{9}$$

$$\sum_{i} \left(\theta^{g}_{ir}\ p^{g}_{ir} \right) = p^{G}_{r} \tag{10}$$

$$ddgm_{ir} = vdgm_{ir}\ G_r\left(p^g_{ir} \Big/ \overline{p}^{dg}_{ir}\right)^{\sigma^A_i} \tag{11}$$

$$digm_{ir} = vigm_{ir}\ G_r\left(p^g_{ir} \Big/ \overline{p}^{mg}_{ir}\right)^{\sigma^A_i} \tag{12}$$

Private consumption

$$p^c_{ir} = \left[\left(\theta^{dc}_{ir}\left(\overline{p}^{dc}_{ir}\right)^{\left(1-\sigma^A_i\right)}\right) + \left(\left(1-\theta^{dc}_{ir}\right)\left(\overline{p}^{mc}_{ir}\right)^{\left(1-\sigma^A_i\right)}\right)\right]^{1/\left(1-\sigma^A_i\right)} \tag{13}$$

$$\prod_i \left(p^c_{ir}\right)^{\theta^p_{ir}} = p^C_r \tag{14}$$

$$ddpm_{ir} = vdpm_{ir}\ C_r\left(p^c_{ir} \Big/ \overline{p}^{dc}_{ir}\right)^{\sigma^A_i}\left(p^C \Big/ p^c_{ir}\right) \tag{15}$$

$$dipm_{ir} = vipm_{ir}\ C_r\left(p^c_{ir} \Big/ \overline{p}^{mc}_{ir}\right)^{\sigma^A_i}\left(p^C \Big/ p^c_{ir}\right) \tag{16}$$

Imports

$$pm_{isr} = \theta^{ym}_{isr}.\overline{py}^m_{isr} + \sum_j \theta^{tm}_{jisr}\overline{p}\overline{t}^m_{jisr} \tag{17}$$

$$p^M_{ir} = \left(\sum_s \theta^M_{isr}\, pm_{isr}^{\left(1-\sigma^M_i\right)}\right)^{1/\left(1-\sigma^M_i\right)} \tag{18}$$

$$dxmd_{isr} = vxmd_{isr} \times M_{ir} \tag{19}$$

$$dtwr_{jisr} = vtwr_{jisr} \times M_{ir} \tag{20}$$

Transport services

$$\prod_r \left(p^Y_{ir}\right)^{\theta^t_{ir}} = p^T_i$$

$$dst_{jr} = vst_{jr} \times yt_j \times \left(pt_j \Big/ py_{jr}\right) \tag{21}$$

Income balance condition

$$\begin{aligned} raInc_r = vb_r - \left(p^G_r\ \overline{vg}\overline{m}_r\right) - \sum_i \left(p^Y_{ir}\ \overline{I}_{ir}\right) + \sum_f \left(p^f_r\ evom_{fr}\right) + revt^y_r + revt^L_r + revt^K_r \\ + revt^{fd}_r + revt^{fm}_r + revt^{pd}_r + revt^{pm}_r + revt^{gd}_r + revt^{gm}_r + revt^{xs}_r + revt^{ms}_r \end{aligned} \tag{22}$$

Market clearance equations

$$raInc_r = C_r\ vpm_r\ p^C_r \tag{23}$$

$$G_r = 1 \tag{24}$$

$$Y_{ir}\ vom_{ir} = \sum_j ddfm_{ijr} + ddpm_{ir} + ddgm_{ir} + dxmd_{irs} + dst_{ir} + \bar{I}_{ir} \tag{25}$$

$$M_{ir}\ vim_{ir} = \sum_j difm_{ijr} + dipm_{ir} + digm_{ir} \tag{26}$$

$$YT_j\ vtw_j = \sum_i \sum_s \sum_r dtwr_{jisr} \tag{27}$$

$$evom_{Lr} = \sum_i dfm_{Lir} \tag{28}$$

$$NEWevom_{Kr} = evom_{Kr}\ FT_{Kr} \tag{29*}$$

$$vfm_{Kjr}\ FDI_{Kjr}\left(p^K_{jr} \Big/ p^K_r\right)^{\eta} = dfm_{Kjr} \tag{30*}$$

Endogenous variables:

Production

$difm_{ijr}$	Total demand for the imported intermediate *i* in sector *j* in region *r*
$ddfm_{ijr}$	Total demand for domestic purchases of intermediate *i* in sector *j* in region *r*
dfm_{fir}	Total demand for primary factor *f* in sector *i* in region *r*
$NEWevom_{Kr}$	Value of the capital stock after FDI inflows in region *r*
FT_{Kr}	One plus the percentage change in the capital stock in region *r*
$\overline{p}^f_{jr}$	Tax-inclusive price of factor *f* used in sector *j* in region *r*
$\overline{p}^L_r$	Tax-inclusive wage in region *r*
$\overline{p}^K_{jr}$	Tax-inclusive price of capital in sector *j* in region *r*
$\overline{p}^d_{ijr}$	Tax-inclusive price of the domestically purchased intermediate *i* to be used in sector *j* in region *r*
$\overline{p}^m_{ijr}$	Tax-inclusive price of the imported intermediate *i* to be used in sector *j* in region *r*
p^K_{jr}	Price of capital in sector *j* in region *r*

p_r^K Price of capital, excluding taxes or subsidies, in region *r*

p_{jr}^Y Price of good *j* before taxes

Y_{jr} One plus the percentage change in total gross output in sector *j* in region *r*

Public consumption

$ddgm_{ir}$ Demand for domestic purchases of good *i* for public consumption in region *r*

$digm_{ir}$ Demand for imports of good *i* for public consumption in region *r*

G_r One plus the percentage change in national public consumption in region *r*

$\overline{p}_{ir}^{dg}$ Tax-inclusive price of public consumption of the domestic good *i* in region *r*

$\overline{p}_{ir}^{mg}$ Tax-inclusive price of public consumption of the imported good *i* in region *r*

p_{ir}^g Tax-inclusive price of good *i* for public consumption in region *r*

p_r^G Aggregate price of public consumption in region *r*

Private consumption

$ddpm_{ir}$ Demand for domestic good *i* for private consumption in region *r*

$dipm_{ir}$ Demand for imports of good *i* for private consumption in region *r*

$raInc_r$ Budget available for private consumption of the representative household in region *r*

C_r One plus the percentage change in national private consumption in region *r*

$\overline{p}_{ir}^{dc}$ Tax-inclusive price of private consumption of domestic good *i* in region *r*

$\overline{p}_{ir}^{mc}$ Tax-inclusive price of private consumption of imported good *i* in region *r*

p_{ir}^c Tax-inclusive price of good *i* for private consumption in region *r*

p_r^C Aggregate price of private consumption in region *r*

Imports and transport services

$dxmd_{isr}$ Demand for physical units of imports of good *i* in region *r* coming from region *s*

$dtwr_{jisr}$ Demand for the transport service *j* needed for transport of good *i* from region *s* to region *r*

dst_{ir} Production of good *i* used as a transport service in region *r*

M_{ir} One plus the percentage increase in imports of good *i* in region *r*

pm_{isr} Bilateral import price of region *r* for good *i* from *s*, including transport-service cost

p_{ir}^{M} Price of imports of good *i*, including transport services, in region *r*

$\overline{py}_{isr}^{m}$ Import price in region *r* of physical good *i* coming from region *s*, including export subsidy of region *s*, import tariff of region *r*

$\overline{pt}_{jisr}^{m}$ Price of the transport service *j* for moving good *i* from *s* to *r,* including import tariffs of region *r*

p_{i}^{T} Price of the transportation service *i*

YT_{j} One plus the percentage change in the world production of the international transport service *j*

Taxes and subsidies

$revt_{r}^{y}$ Total payments of subsidies on output in region *r*

$revt_{r}^{f}$ Total income from taxes on primary factors in region *r*

$revt_{r}^{fd}$ Total income from taxes on domestic intermediates in region *r*

$revt_{r}^{fm}$ Total income from taxes on imported intermediates in region *r*

$revt_{r}^{pd}$ Total income from taxes on private consumption of domestic goods in region *r*

$revt_{r}^{pm}$ Total income from taxes on private consumption of imported goods in region *r*

$revt_{r}^{gd}$ Total income from taxes on public consumption of domestic goods in region *r*

$revt_{r}^{gm}$ Total income from taxes on public consumption of imported goods in region *r*

$revt_{r}^{xs}$ Total payments of subsidies on exports in region *r*

$revt_{r}^{ms}$ Total income from tariffs on imports in region *r*

Exogenous variables and parameters:

Production

$evom_{fr}$ Total endowment of factor *f* in region *r*

θ_{fjr} Share of the factor *f* in value in sector *j* in region *r*

θ_{dijr} Share of the domestic intermediate input *i* in its total use in sector *j* in region *r*

θ_{ijr} Share of the intermediate input *i* (domestic plus imported) in gross production in sector *j*

θ_{jr}^{f} Share of value added in gross production in sector *j* in region *r*

θ_{jr}^{sf} Share of specific factor *sf* (skilled labor; capital) employed in sector *j* in region *r*

$vdfm_{ijr}$ Benchmark value of the domestic purchases of intermediate *i,* used in sector *j* in region *r*

vfm_{fir} Benchmark value of the demand for the primary factor *f* in sector *j* in region *r*

$vifm_{ijr}$ Benchmark value of the demand for the imported intermediate *i* to be used in sector *j* in region *r*

vom_{ir} Benchmark value of the sectoral gross production in region *r*

Demand

$\bar{I}_{ir}$ Fixed investment expenditure in sector *i* in region *r*

Public consumption

θ_{ir}^{dg} Share of the domestic good *i* in public consumption in region *r*

θ_{ir}^{g} Share of the good *i* in total public consumption in region *r*

$vdgm_{ir}$ Benchmark value of the domestic purchases of good *i* for public consumption in region *r*

$vigm_{ir}$ Benchmark value of the imports of good *i* for public consumption in region *r*

$\overline{vgm}_{r}$ Benchmark value of total (imported plus domestic) national public consumption in region *r*

Private consumption

θ_{ir}^{dc} Share of the domestic good *i* in private consumption in region *r*

θ_{ir}^{p} Share of the good *i* in total private consumption in region *r*

$vdpm_{ir}$ Benchmark value of the domestic purchases of good *i* for private consumption in region *r*

$vipm_{ir}$ Benchmark value of the imports of good *i* for private consumption in region *r*

vpm_{r} Benchmark value of total national private consumption in region *r*

Foreign sector

vb_{r} Current account balance of region *r* in the benchmark

vim_{ir} Benchmark physical volume of imports in sector *i* in region *r*

θ^{m}_{isr} Bilateral import value share (the weight of region *s* in total imported good *i* of region *r*)

Transport services

θ^{ym}_{isr} Share of the amount of physical units of goods (excluding transport services) in imports of region *r*

θ^{tm}_{jisr} Share of the amount of transport service *j* used in imports of good *i* in region *r*

θ^{t}_{ir} Share of the part of production of good *i* devoted to transport services in region *r* in the part of world production of good *i* devoted to transport services

$vxmd_{isr}$ Benchmark amount of physical units of imports of the good *i* in region *r* coming from region *s*

$vtwr_{jisr}$ Benchmark amount of the transport service *j* needed for transport of good *i* from region *s* to region *r*

vst_{jr} Benchmark production of good *j* used as a transport service in region *r*

vtw_{j} Benchmark aggregate of international transport services in sector *j* in the world

Taxes

t^{fd}_{ijr} Tax rate of the domestic intermediates from sector *i* to be used in sector *j* in region *r*

t^{fm}_{ijr} Tax rate of the imported intermediates from sector *i* to be used in sector *j* in region *r*

t^{f}_{jr} Tax rate on the factor *f* used in sector *j* in region *r*

t^{y}_{jr} Output subsidy rate in sector *j* in region *r*

t^{gd}_{ir} Tax rate on the domestic public good *i* purchased domestically in region *r*

t^{gm}_{ir} Tax rate on the imported public good *i* in region *r*

t_{ir}^{pd} Tax rate on the domestic private good *i* purchased domestically in region *r*

t_{ir}^{pm} Tax rate on the imported private good *i* in region *r*

t_{isr}^{ms} Import tariff rate on the good *i* exported from *s* to *r*

t_{isr}^{xs} Export subsidy rate on the good *i* exported from *s* to *r*

Elasticities

σ_i^A Elasticity of substitution between imports and domestic production in sector *i* (Armington elasticity)

σ_i^M Intra-import elasticity of substitution

σ_i^{Lsf} Elasticity of substitution between labor and specific factors in sector *i*

η_{sf} Elasticity of transformation of specific factors across sectors

Simulation parameters

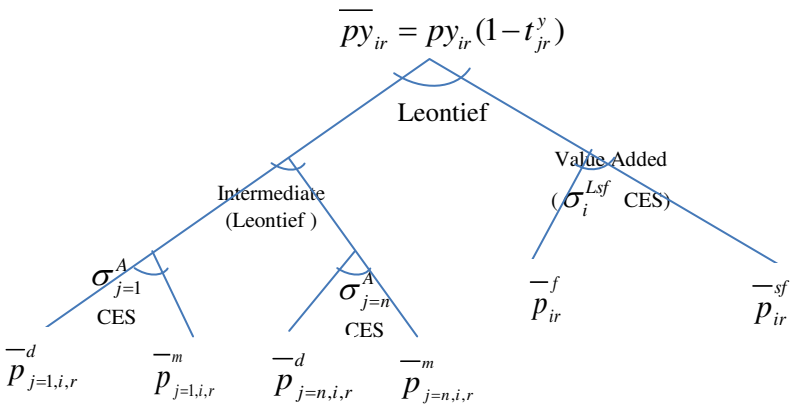
FDI_{Kjr} One plus the percentage increase in the total stock of capital of sector *j* in region *r*

Figures

1. Production

As shown in Figure 1, on the top layer, the production is carried out under a Leontief technology combining a composite of intermediate goods and a composite of primary factors. On the second layer, the composite of intermediate inputs is a Leontief combination of n inputs. In turn, each of these n inputs are a constant elasticity substitution (CES) bundle of domestic and import intermediates. The composite of primary factors is also a CES nesting of sluggish capital, sluggish skilled labor and mobile unskilled labor.

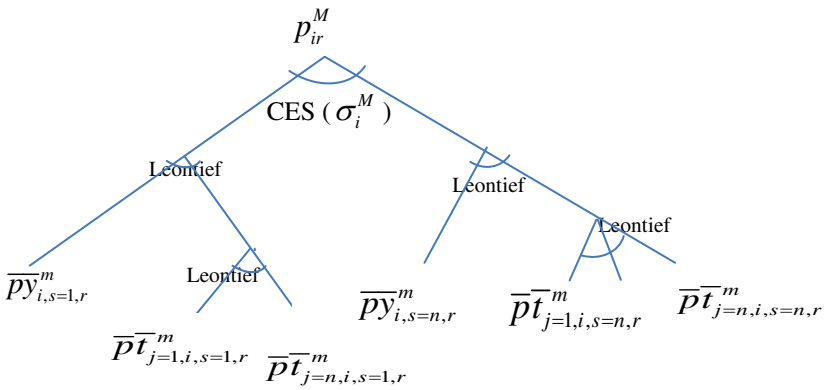
Figure 1 Production function: $Y_{ir} = F_{ir}(ddfm, difm, dfm)$



2. Imports

As can be seen at the top of Figure 2, imports of a particular good *i* are the nested CES aggregation of bundles of imported goods and associated transportation services coming from different regions. At the second layer, transportation services and imports for each regions are combined proportionally (i.e., using a Leontief technology). Trade flows embody export subsidies, paid by government in the exporting region, and import tariffs, collected by government in the importing region.

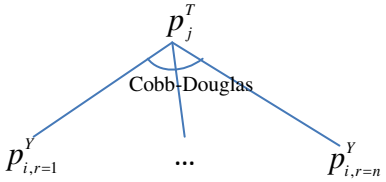
Figure 2 Armington aggregation of imports: $A_{ir}(dxmd, dtwr) = M_{ir}$



3. International transportation services

International transportation is a Cobb-Douglas combination of transport services across the different regions in the world, as shown in figure 3.

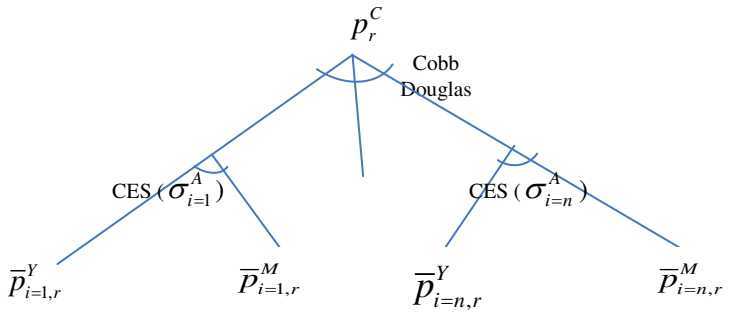
Figure 3: International Transportation Services: $YT_j = T_j(dst)$



4. Private consumption

Private consumption is a Cobb-Douglas function of *i* (*i* =1, …, n) composite goods . Each of those goods are, in turn, Armington composites of its domestic and imported varieties. As shown in figure 4 below.

Figure 4: private consumption $H_r(ddpm, dipm) = C_{ir}$



5. Public consumption

Public consumption is a Leontief combination of i (i =1, …, n) composite goods, where each composite is an Armington composites of its domestic and imported varieties.

Figure 5: Public consumption $G_r = G_r\left(ddgm_{ir}, digm_{ir}\right)$

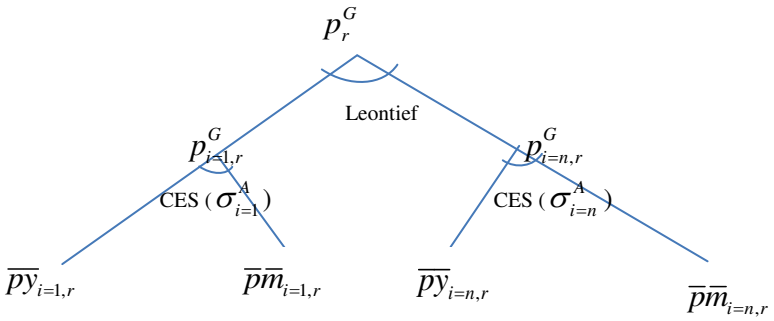


Table 1: Definition of sectors and their relative importance in China

Sector/Goods Definition		Export % of domestic production	Imports % in domestic consumption	Commodity % in:			Production side (%)				
				Trade		Domestic Demand	% of Production	V.A. % in GDP	% of skilled Labor	% of unskilled Labor	% of capital
				Exports	Imports	Private consumption					
Agriculture	01~14 Agriculture, hunting and fishing	1.9	5.1	0.9	3.0	12.5	6.4	11.0	0.5	19.7	10.3
Mining	15~18 Mining and quarrying	2.4	34.9	0.5	15.0	0.2	2.9	4.0	1.5	3.4	5.7
Food and Beverage	19~26 Food, beverages and tobacco	5.2	4.7	2.0	1.9	17.6	4.9	3.2	1.8	3.1	2.6
Textiles	**27~29 Textiles, wearing apparel, leather, footwear**	**35.8**	**6.8**	**16.7**	**2.7**	**6.0**	**6.1**	**4.1**	**2.3**	**4.8**	**2.8**
Woods and Paper	30~31 wood without furniture, paper, publishing, media	17.1	7.4	4.1	2.0	0.6	3.1	2.1	1.3	2.7	2.0
Petroleum	32 Petroleum	7.9	9.5	1.7	2.4	2.6	2.8	0.6	0.3	0.5	0.5
Chemicals	33~34 Chemicals, rubber and plastic products	12.9	22.8	7.2	12.8	2.5	7.2	5.7	2.7	4.3	4.8
Metals	34~37 Mineral products nec, Ferrous metals, metals nec, metal products	9.9	7.3	9.5	8.3	0.6	12.5	7.4	4.5	8.2	8.2
Motor Vehicles	38~39 Motor vehicles and parts, transport equipment nec	11.4	13.4	3.2	4.1	2.4	3.7	2.5	1.5	2.7	1.6
Electronics	**40 Electronic equipment**	**56.3**	**48.2**	**21.8**	**19.4**	**1.9**	**5.0**	**3.0**	**1.7**	**2.7**	**2.5**
Machinery	**41 Machinery and equipment nec**	**24.9**	**23.8**	**16.9**	**17.9**	**2.1**	**8.9**	**6.5**	**3.9**	**6.1**	**5.3**
Other Manufacturing	42 Manufactures nec	39.0	3.9	6.0	0.4	1.4	2.0	2.5	0.6	1.5	4.0
Electricity, Gas and Water	43~45 Electricity; Gas manufacture and distribution; Water	0.6	0.3	0.1	0.1	3.3	2.8	3.4	3.5	2.1	4.5
Construction	46 Construction	0.7	0.5	0.4	0.3	0.9	8.2	6.3	5.2	9.2	4.4
Services	47~57 Services	4.9	4.4	8.9	9.8	45.6	23.5	37.9	68.7	29.0	40.7
Total		13.0	11.5	100	100	100	100	100	100	100	100

Source: Authors' calculations based on Narayanan *et al.* (2012).

Table 2: Benchmark allocation of production and imports of Electronics (% shares)

Part 1	Total Electronics' imports of each region by demand type (%)					Demand use of production in Electronics in each region (%)					
	Private Consumption	Public Consumption	Investment	Inter-mediate	Total	Private Consumption	Public Consumption	Investment	Inter-mediate	Export	Total
CHN	4.5	0.0	11.0	84.5	100.0	2.3	0.0	5.6	36.7	55.4	100.0
EAS	11.5	0.0	22.2	66.3	100.0	10.2	0.0	13.3	26.9	49.6	100.0
U.S.	20.0	0.0	26.2	53.7	100.0	5.5	0.0	23.8	52.2	18.5	100.0
ROW	14.0	0.9	31.5	53.6	100.0	8.1	0.3	12.2	22.3	57.1	100.0
Part 2	Geographical share of world Electronics imports by demand type (%)					Geographical share of world production of Electronics by demand type (%)					
	Private Consumption	Public Consumption	Investment	Inter-mediate	World Imports	Private Consumption	Public Consumption	Investment	Inter-mediate	Export	World output
CHN	5.2	0.0	6.5	21.5	15.3	6.1	0.0	7.8	23.9	22.1	18.9
EAS	13.2	0.2	13.1	16.8	15.3	39.6	1.8	27.1	11.8	28.8	27.5
U.S.	28.3	0.0	19.1	16.8	18.8	15.0	0.0	34.0	20.6	7.5	19.2
ROW	53.3	99.8	61.4	44.9	50.6	39.3	98.2	31.0	43.7	41.5	34.4
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations based on Narayanan *et al.* (2012).

Note: CHN represents China; EAS stands for East Asia; ROW is Rest of the world.

Table 3: Benchmark allocation of production and imports of Machinery (% shares)

Part 1	Total Machinery' imports of each region by demand type (%)					Demand use of production in Machinery in each region (%)					
	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	Total	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	Export	Total
CHN	2.7	0.0	29.3	68.0	100.0	2.2	0.0	23.9	49.3	24.7	100.0
EAS	7.4	0.0	35.1	57.5	100.0	2.1	0.0	19.6	28.8	49.5	100.0
U.S.	15.0	0.0	40.3	44.8	100.0	9.3	0.0	31.8	36.5	22.4	100.0
ROW	9.0	0.4	39.1	51.5	100.0	5.5	0.1	18.6	29.4	46.4	100.0
Part 2	Geographical share of world Machinery imports by demand type (%)					Geographical share of world production of Machinery by demand type (%)					
	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	World Imports	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	Export	World output
CHN	2.6	0.0	6.8	11.4	8.8	6.9	0.0	17.8	23.9	10.5	16.5
EAS	7.9	0.0	8.9	10.6	9.7	5.5	0.7	12.3	11.8	17.8	13.9
U.S.	23.2	0.0	14.9	12.0	14.1	34.3	0.0	27.6	20.6	11.1	19.2
ROW	66.4	100.0	69.3	66.0	67.4	53.2	99.3	42.4	43.7	60.6	50.4
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations based on Narayanan *et al.* (2012).

Table 4: Benchmark allocation of production and imports of Textiles (% shares)

Part 1	Total Textiles' imports of each region by demand type (%)					Demand use of production in Textiles in each region (%)					
	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	Total	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	Export	Total
CHN	13.7	0.0	0.0	86.3	100.0	11.1	0.0	0.0	54.5	34.4	100.0
EAS	60.2	0.0	0.9	38.9	100.0	32.9	0.0	1.6	35.9	29.7	100.0
U.S.	72.7	0.0	0.5	26.8	100.0	46.4	0.0	1.6	44.5	7.5	100.0
ROW	59.0	0.2	0.3	40.5	100.0	36.0	0.2	0.4	28.4	35.0	100.0
Part 2	Geographical share of world Textiles imports by demand type (%)					Geographical share of world production of Textiles by demand type (%)					
	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	World Imports	Private Consumption	Public Consumption	Investment Demand	Inter-mediate	Export	World output
CHN	0.8	0.0	0.0	8.1	3.7	10.4	0.0	0.0	40.0	30.7	27.9
EAS	9.0	0.0	21.2	8.9	9.0	7.9	0.6	22.8	6.8	6.9	7.2
U.S.	22.7	0.0	25.9	12.7	18.7	17.6	0.0	37.1	13.3	2.7	11.4
ROW	67.5	100.0	53.0	70.3	68.6	64.1	99.4	40.1	39.8	59.7	53.4
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations based on Narayanan *et al* .(2012).

Table 5: Impact on aggregate variables (% change)

Macro indices	China	East Asia	U.S.	Rest of the World
Wage of skilled workers	1.89	-0.43	-0.17	-0.29
Wage of unskilled workers	-0.72	-0.43	-0.13	-0.28
Capital rent	-1.65	-0.41	0.04	0.13
National income (Welfare)	9.62	-0.45	-0.00	-0.19
Capital stock	6.00	0.00	0.00	0.00
GDP	2.07	-0.34	-0.08	-0.06

Source: Authors' simulations.

Table 6: Impact on output, prices and specific factors' remunerations (% change)

% change	Output				Price				Sectoral skilled labor price				Sectoral capital remuneration			
	CHN	EAS	U.S.	ROW	CHN	EAS	U.S.	ROW	CHN	EAS	USA	ROW	CHN	EAS	USA	ROW
Agriculture	0.8	0.2	0.2	0.2	3.7	0.7	0.9	0.4	17.5	1.6	2.6	1.3	17.5	1.6	2.6	1.3
Mining	0.0	0.2	0.1	0.1	-2.5	2.1	1.8	1.8	1.5	5.3	3.7	3.4	1.5	5.3	3.7	3.4
Food and Beverage	1.8	-0.1	0.0	0.1	2.3	0.3	0.2	0.1	10.3	-0.7	-0.0	0.1	10.3	-0.7	-0.0	0.1
Textiles	**2.4**	**0.5**	**0.2**	**0.1**	**-4.3**	**0.2**	**0.1**	**-0.0**	**-7.2**	**0.0**	**0.0**	**-0.1**	**-24.7**	**0.0**	**0.0**	**-0.1**
Woods & Paper	-2.9	0.6	0.4	0.5	-0.9	0.4	0.2	0.2	0.6	0.6	0.5	0.8	0.6	0.6	0.5	0.8
Petroleum	1.7	0.1	-0.4	-0.2	-2.1	1.7	1.6	1.4	8.6	-0.3	-1.2	-1.0	8.6	-0.3	-1.2	-1.0
Chemicals	-1.9	0.9	0.4	0.5	-1.5	0.9	0.5	0.4	1.4	1.6	1.0	1.0	1.4	1.6	1.0	1.0
Metals	0.1	1.0	0.6	0.6	-1.0	0.8	0.2	0.4	5.5	1.4	0.8	1.0	5.5	1.4	0.8	1.0
Motor Vehicles	-1.3	0.6	0.3	0.2	-2.2	0.1	-0.0	-0.1	3.3	0.5	0.4	0.2	3.3	0.5	0.4	0.2
Electronics	**30.2**	**-2.8**	**-5.3**	**-3.6**	**-10.5**	**-2.0**	**-2.0**	**-2.6**	**-14.6**	**-6.9**	**-11.2**	**-8.3**	**-50.7**	**-6.9**	**-11.2**	**-8.3**
Machinery	**9.6**	**-1.4**	**-1.0**	**-1.5**	**-7.8**	**-0.8**	**-0.7**	**-0.8**	**-16.0**	**-3.3**	**-2.0**	**-2.9**	**-39.1**	**-3.3**	**-2.0**	**-2.9**
Other manufacturing	-2.0	0.9	1.2	0.6	-2.6	0.4	0.3	0.2	-0.8	0.9	1.4	0.8	-0.8	0.9	1.4	0.8
Electricity, Gas and Water	2.1	-0.0	-0.0	-0.0	0.2	0.3	0.2	0.2	13.1	-0.9	-0.2	-0.2	13.1	-0.9	-0.2	-0.2
Construction	0.1	0.0	-0.0	0.0	-0.7	0.0	-0.0	-0.0	4.8	-0.4	-0.1	-0.1	4.8	-0.4	-0.1	-0.1
Services	2.4	0.1	0.0	0.0	0.3	-0.1	-0.1	-0.1	10.4	-0.3	-0.0	-0.0	10.4	-0.3	-0.0	-0.0

Source: Authors' simulations.

Table 7: Impact on bilateral trade in Electronics (absolute values and % change)

Part 1. Export Quantity (benchmark values, simulations values, difference between simulation and benchmark values and % change)																		
Exports	Exports from China to:				Exports from East Asia to:					Exports from the U.S. to:				Exports from ROW to:				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	50.5	86.5	130.1	267.1	114.9	71.6	48.0	123.4	357.9	10.7	20.3	62.0	92.9	64.3	46.5	97.5	306.8	515.0
Simulation	65.8	110.3	169.6	345.6	125.3	65.4	42.9	112.7	346.3	11.4	18.1	55.5	85.1	71.8	43.5	89.1	287.4	491.9
Difference	15.3	23.7	39.5	78.5	10.4	-6.2	-5.1	-10.7	-11.6	0.7	-2.1	-6.4	-7.8	7.6	-3.0	-8.4	-19.3	-23.1
% change	30.3	27.4	30.3	29.4	9.1	-8.7	-10.7	-8.7	-3.2	7.0	-10.5	-10.4	-8.4	11.8	-6.5	-8.6	-6.3	-4.5
Part 2. Regions' shares in exports at FOB price in the benchmark, in the simulation and the difference in % points																		
Regions' shares in Exports	Exports from China to:				Exports from East Asia to:					Exports from the U.S. to:				Exports from ROW to:				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	18.9	32.4	48.7	100.0	32.0	20.0	13.4	34.6	100.0	11.5	21.8	66.7	100.0	12.5	9.1	19.1	59.4	100.0
Simulation	19.0	31.9	49.1	100.0	36.1	18.8	12.4	32.6	100.0	13.4	21.3	65.2	100.0	14.6	8.9	18.2	58.3	100.0
Difference	0.1	-0.5	0.4	0.0	4.1	-1.1	-1.0	-1.9	0.0	1.9	-0.5	-1.4	0.0	2.1	-0.2	-0.8	-1.1	0.0
Part 3. Regions' shares in imports at CIF price in the benchmark, in the simulation and the difference in % points																		
Regions' shares in Imports	Imports of China by source				Imports of East Asia by source					Imports of the U.S. by source				Imports of ROW by source				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	60.4	5.7	33.9	100.0	27.4	37.5	10.7	24.5	100.0	38.0	20.4	41.6	100.0	21.5	19.7	9.9	48.8	100.0
Simulation	60.0	5.5	34.4	100.0	34.0	33.9	9.5	22.6	100.0	45.3	17.7	37.0	100.0	27.0	18.1	9.0	45.9	100.0
Difference	-0.4	-0.1	0.5	0.0	6.6	-3.6	-1.2	-1.9	-0.0	7.3	-2.6	-4.7	0.0	5.6	-1.6	-1.0	-3.0	0.0
Part 4. % change of bilateral import price (PM) and output price of Electronics (PY)																		
Prices	bilateral PM of China, from			PY_	bilateral PM of East Asia, from				PY_	bilateral PM of U.S., from			PY_	bilateral PM of ROW, from				PY_
	EAS	U.S.	ROW	CHN	CHN	EAS	U.S.	ROW	EAS	CHN	EAS	ROW	U.S.	CHN	EAS	U.S.	ROW	ROW
% change	-5.9	-6.0	-6.1	-10.5	-6.7	-2.0	-2.1	-2.3	-2.0	-6.5	-1.8	-2.1	-2.0	-6.9	-2.3	-2.4	-2.5	-2.6

Source: Authors' simulations

Note: The export quantity is in billions of dollars. It does not include any subsidy on the exports neither the transport margin.

Table 8: Impact on bilateral trade in Machinery (absolute values and % change)

Part 1. Export Quantity (benchmark values, simulations values, difference between simulation and benchmark values and % change)																		
Exports	Exports from China to:				Exports from East Asia to:					Exports from the U.S. to:				Exports from ROW to:				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	42.2	49.0	115.0	206.2	101.6	52.6	59.9	146.6	360.7	15.8	35.8	173.5	225.0	53.8	64.1	178.0	931.0	1227.0
Simulation	49.4	58.5	138.7	246.5	98.3	50.9	59.2	146.6	355.0	15.0	34.1	170.5	219.5	51.0	60.8	172.7	912.8	1197.3
Difference	7.2	9.5	23.7	40.3	-3.3	-1.7	-0.6	-0.1	-5.7	-0.8	-1.7	-3.0	-5.5	-2.8	-3.3	-5.4	-18.2	-29.7
% change	17.0	19.4	20.6	19.6	-3.3	-3.2	-1.0	-0.0	-1.6	-5.0	-4.9	-1.7	-2.4	-5.2	-5.2	-3.0	-2.0	-2.4
Part 2. Regions' shares in exports at FOB price in the benchmark, in the simulation and the difference in % points																		
Regions' shares in Exports	Exports from China to:				Exports from East Asia to:					Exports from the U.S. to:				Exports from ROW to:				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	20.3	23.8	55.8	100.0	28.1	14.6	16.6	40.7	100.0	7.0	15.9	77.1	100.0	4.4	5.3	14.6	75.7	100.0
Simulation	19.9	23.8	56.3	100.0	27.6	14.3	16.7	41.4	100.0	6.8	15.5	77.6	100.0	4.3	5.1	14.6	76.0	100.0
Difference	-0.4	-0.0	0.5	0.0	-0.5	-0.2	0.1	0.6	0.0	-0.2	-0.4	0.6	0.0	-0.1	-0.1	-0.1	0.4	0.0
Part 3. Regions' shares in imports at CIF price in the benchmark, in the simulation and the difference in % points																		
Regions' shares in Imports	Imports of China by source				Imports of East Asia by source					Imports of the U.S. by source				Imports of ROW by source				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	59.2	9.2	31.5	100.0	22.3	26.7	18.2	32.7	100.0	17.7	20.6	61.6	100.0	8.8	10.8	12.7	67.7	100.0
Simulation	59.6	9.2	31.2	100.0	25.6	25.9	17.4	31.1	100.0	20.4	20.2	59.3	100.0	10.4	10.7	12.5	66.4	100.0
Difference	0.4	-0.1	-0.3	0.0	3.2	-0.8	-0.8	-1.6	0.0	2.7	-0.4	-2.3	0.0	1.6	-0.0	-0.2	-1.3	0
Part 4. % change of bilateral import price (PM) and output price of Machinery (PY)																		
Prices	bilateral PM of China, from			PY_	bilateral PM of East Asia, from				PY_	bilateral PM of the U.S., from			PY_	bilateral PM of ROW, from				PY_
	EAS	U.S.	ROW	CHN	CHN	EAS	U.S.	ROW	EAS	CHN	EAS	ROW	U.S.	CHN	EAS	U.S.	ROW	ROW
% change	-5.5	-5.3	-5.2	-7.8	-3.0	-0.7	-0.5	-0.5	-0.8	-3.2	-0.9	-0.6	-0.7	-3.3	-1.0	-0.8	-0.8	-0.8

Source: Authors' simulations

Note: The export quantity is in billions of dollars. It does not include any subsidy on the exports neither the transport margin.

Table 9: Impact on bilateral trade in Textiles (absolute values and % change)

Part 1. Export Quantity (benchmark values, simulations values, difference between simulation and benchmark values and % change)																		
Exports	Exports from China to:				Exports from East Asia to:					Exports from the U.S. to:				Exports from ROW to:				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	37.7	36.8	111.9	186.4	16.3	4.4	6.5	19.7	46.9	1.2	1.5	16.0	18.7	7.6	16.1	68.4	315.8	408.0
Simulation	37.3	36.4	110.5	184.2	17.1	4.5	6.5	19.8	47.8	1.2	1.5	16.0	18.8	8.0	16.2	68.6	316.4	409.2
Difference	-0.4	-0.4	-1.4	-2.2	0.7	0.0	0.0	0.0	0.8	0.0	0.0	0.1	0.1	0.3	0.1	0.2	0.6	1.2
% change	-1.1	-1.1	-1.3	-1.2	4.5	0.4	0.4	0.3	1.8	4.6	0.5	0.3	0.6	4.4	0.3	0.3	0.2	0.3
Part 2. Regions' shares in exports at FOB price in the benchmark, in the simulation and the difference in % points																		
Regions' shares in Exports	Exports from China to:				Exports from East Asia to:					Exports from the U.S. to:				Exports from ROW to:				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	18.6	23.6	57.8	100.0	34.6	9.4	13.7	42.2	100.0	6.3	7.9	85.9	100.0	1.9	4.0	16.9	77.2	100.0
Simulation	18.6	23.6	57.8	100.0	35.6	9.3	13.5	41.6	100.0	6.5	7.9	85.6	100.0	2.0	4.0	16.9	77.1	100.0
Difference	0.0	0.0	-0.0	0.0	0.9	-0.1	-0.2	-0.6	0.0	0.2	-0.0	-0.2	0.0	0.1	0.0	0.0	-0.1	0.0
Part 3. Regions' shares in imports at CIF price in the benchmark, in the simulation and the difference in % points																		
Regions' shares in Imports	Imports of China by source				Imports of East Asia by source					Imports of the U.S. by source				Imports of ROW by source				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	64.9	4.6	30.5	100.0	64.0	7.3	2.4	26.3	100.0	40.0	5.2	54.8	100.0	26.0	4.3	3.4	66.3	100.0
Simulation	64.9	4.6	30.4	100.0	63.7	7.3	2.4	26.5	100.0	39.7	5.2	55.1	100.0	25.8	4.3	3.4	66.5	100.0
Difference	0.0	0.0	-0.0	0.0	-0.3	0.1	0.0	0.2	0.0	-0.3	0.0	0.3	0.0	-0.2	0.0	0.0	0.2	0.0
Part 4. % change of bilateral import price (PM) and output price of Textiles (PY)																		
Prices	bilateral PM of China, from			PY_	bilateral PM of East Asia, from				PY_	bilateral PM of the U.S., from			PY_	bilateral PM of ROW, from				PY_
	EAS	U.S.	ROW	CHN	CHN	EAS	U.S.	ROW	EAS	CHN	EAS	ROW	U.S.	CHN	EAS	U.S.	ROW	ROW
% change	-4.5	-4.5	-4.5	-4.3	0.5	0.3	0.2	0.3	0.2	0.3	0.1	0.1	0.1	0.2	-0.0	-0.0	-0.0	-0.0

Source: Authors' simulations

Note: The export quantity is in billions of dollars. It does not include any subsidy on the exports neither the transport margin.

Table 10: Impact on bilateral imports in Electronics, Machinery and Textiles (absolute values and % change)

Electronics	Imports of China from:				Imports of East Asia from:					Imports of the U.S. from:				Imports of ROW from				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	114.9	10.7	64.3	189.8	50.5	71.6	20.3	46.5	188.9	86.5	71.6	97.5	255.6	130.1	123.4	62.0	306.8	622.3
Simulation	125.3	11.4	71.8	208.6	65.8	65.4	18.1	43.5	192.7	110.3	65.4	89.1	264.8	169.6	112.7	55.5	287.4	625.3
Difference	10.4	0.7	7.6	18.8	15.3	-6.2	-2.1	-3.0	3.9	23.7	-6.2	-8.4	9.1	39.5	-10.7	-6.4	-19.3	3.0
% change	9.1	7.0	11.8	9.9	30.3	-8.7	-10.5	-6.5	2.0	27.4	-8.7	-8.6	3.6	30.3	-8.7	-10.4	-6.3	0.5
Machinery	Imports of China from:				Imports of East Asia from:					Imports of the U.S. from:				Imports of ROW from				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	101.6	15.8	53.8	171.2	42.2	52.6	35.8	64.1	194.7	49.0	52.6	178.0	279.6	115.0	146.6	173.5	931.0	1366.1
Simulation	98.3	15.0	51.0	164.3	49.4	50.9	34.1	60.8	195.2	58.5	50.9	172.7	282.0	138.7	146.6	170.5	912.8	1368.5
Difference	-3.3	-0.8	-2.8	-6.9	7.2	-1.7	-1.7	-3.3	0.4	9.5	-1.7	-5.4	2.4	23.7	-0.1	-3.0	-18.2	2.4
% change	-3.3	-5.0	-5.2	-4.0	17.0	-3.2	-4.9	-5.2	0.2	19.4	-3.2	-3.0	0.9	20.6	-0.0	-1.7	-2.0	0.2
Textiles	Imports of China from:				Imports of East Asia from:					Imports of the U.S. from:				Imports of ROW from				
	EAS	U.S.	ROW	Total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Benchmark	16.3	1.2	7.6	25.1	37.7	4.4	1.5	16.1	59.8	36.8	4.4	68.4	109.6	111.9	19.7	16.0	315.8	463.4
Simulation	17.1	1.2	8.0	26.2	37.3	4.5	1.5	16.2	59.5	36.4	4.5	68.6	109.4	110.5	19.8	16.0	316.4	462.7
Difference	0.7	0.1	0.3	1.1	-0.4	0.0	0.0	0.1	-0.3	-0.4	0.0	0.2	-0.2	-1.4	0.0	0.1	0.6	-0.7
% change	4.5	4.6	4.4	4.4	-1.1	0.4	0.5	0.3	-0.5	-1.1	0.4	0.3	-0.2	-1.3	0.3	0.3	0.2	-0.2

Source: Authors' simulations

Note: The import quantity is derived from the bilateral export quantity, that means one country's physical export good is exactly the physical import good of its trade partner. It is in billions of dollars, without any export subsidy neither the transport margin nor the import tax.

Table 11: Sensitivity analysis—effects on aggregate variables of changes in elasticities (% change)

	A) Elasticity of substitution between imports and domestic production								B) Elasticity of substitution between labor and capital							
	Half				Double				Half				Double			
	CHN	EAS	USA	ROW	CHN	EAS	USA	ROW	CHN	EAS	USA	ROW	CHN	EAS	USA	ROW
Wage (skilled)	1.9	-0.4	-0.2	-0.3	1.9	-0.4	-0.2	-0.3	3.6	-0.5	-0.2	-0.3	0.8	-0.4	-0.1	-0.2
Wage (unskilled)	-0.9	-0.4	-0.1	-0.3	-0.4	-0.5	-0.1	-0.3	-0.3	-0.5	-0.1	-0.3	-0.6	-0.4	-0.1	-0.2
Capital Rent	-1.6	-0.4	0.0	0.1	-1.7	-0.4	0.1	0.2	-2.8	-0.4	0.1	0.1	-1.0	-0.3	0.0	0.1
National income	9.8	-0.4	-0.0	-0.2	9.4	-0.5	0.0	-0.1	10.2	-0.5	0.0	-0.3	9.0	-0.4	-0.0	-0.1
GDP	2.0	-0.3	-0.1	-0.1	2.2	-0.4	-0.1	-0.1	1.8	-0.4	-0.1	-0.1	2.3	-0.3	-0.1	-0.0

Source: Authors' simulations

Table 12: Sensitivity analysis –Trade Patterns for China (absolute values and percentages)

Electronics	Electronics X from CHN to:				CHN Export structure, by destination %				CHN Import structure, by source %			
	EAS	U.S.	ROW	Total	EAS	U.S.	ROW	total	EAS	U.S.	ROW	total
Bench	50.5	86.5	130.1	267.1	18.9	32.4	48.7	100	60.4	5.7	33.9	100
Simulation	65.8	110.3	169.6	345.6	19.0	31.9	49.1	100	60.0	5.5	34.4	100
Sensitivity 1	67.2	112.0	172.8	352.0	19.1	31.8	49.1	100	59.9	5.6	34.5	100
Sensitivity 2	63.5	107.6	164.6	335.7	18.9	32.1	49.0	100	60.3	5.5	34.2	100
Sensitivity 3	69.0	115.3	178.1	362.4	19.0	31.8	49.1	100	59.9	5.5	34.5	100
Sensitivity 4	62.3	104.9	160.6	327.8	19.0	32.0	49.0	100	60.1	5.6	34.3	100
Machinery	Machinery X from CHN to:				CHN Export structure, by destination				CHN Import structure, by source			
	EAS	U.S.	ROW	Total	EAS	U.S.	ROW	total	EAS	U.S.	ROW	total
Bench	42.2	49.0	115.0	206.2	20.5	23.8	55.8	100	59.2	9.2	31.5	100
Simulation	49.4	58.5	138.7	246.5	20.0	23.7	56.3	100	59.6	9.2	31.2	100
Sensitivity 1	50.4	59.6	141.4	251.4	20.1	23.7	56.2	100	59.5	9.2	31.3	100
Sensitivity 2	48.4	57.5	136.2	242.0	20.0	23.7	56.3	100	59.9	9.1	31.0	100
Sensitivity 3	52.9	63.0	150.1	266.0	19.9	23.7	56.4	100	59.7	9.1	31.1	100
Sensitivity 4	46.6	54.9	129.6	231.1	20.2	23.7	56.1	100	59.5	9.2	31.3	100
Textiles	Textiles X from CHN to:				CHN Export structure, by destination				CHN Import structure, by source			
	EAS	U.S.	ROW	Total	EAS	U.S.	ROW	total	EAS	U.S.	ROW	total
Bench	37.7	36.8	111.9	186.4	20.2	19.7	60.0	100	64.9	4.6	30.5	100
Simulation	37.3	36.4	110.5	184.2	20.3	19.8	60.0	100	64.9	4.6	30.4	100
Sensitivity 1	37.6	36.7	111.6	185.9	20.2	19.8	60.0	100	64.9	4.7	30.5	100
Sensitivity 2	37.6	36.7	111.6	185.9	20.2	19.8	60.0	100	65.0	4.6	30.4	100
Sensitivity 3	39.0	38.7	117.9	195.6	20.0	19.8	60.3	100	64.9	4.6	30.5	100
Sensitivity 4	36.3	35.0	106.2	177.5	20.5	19.7	59.8	100	64.9	4.6	30.4	100

Note: See note on Table 7.

Simulation: results after FDI shock and before sensitivity test
Sensitivity 1: results after FDI shock and **halving** the elasticity of substitution **between imports and domestic production**
Sensitivity 2: results after FDI shock and **doubling** the elasticity of substitution between **imports and domestic production**
Sensitivity 3: results after FDI shock, and **halving** the elasticity of substitution between **labor and capital**
Sensitivity 4: results after FDI shock, and **doubling** the elasticity of substitution between **labor and capital**

Figure 1: Input-Output structure of Machinery, Electronics and Textiles in China

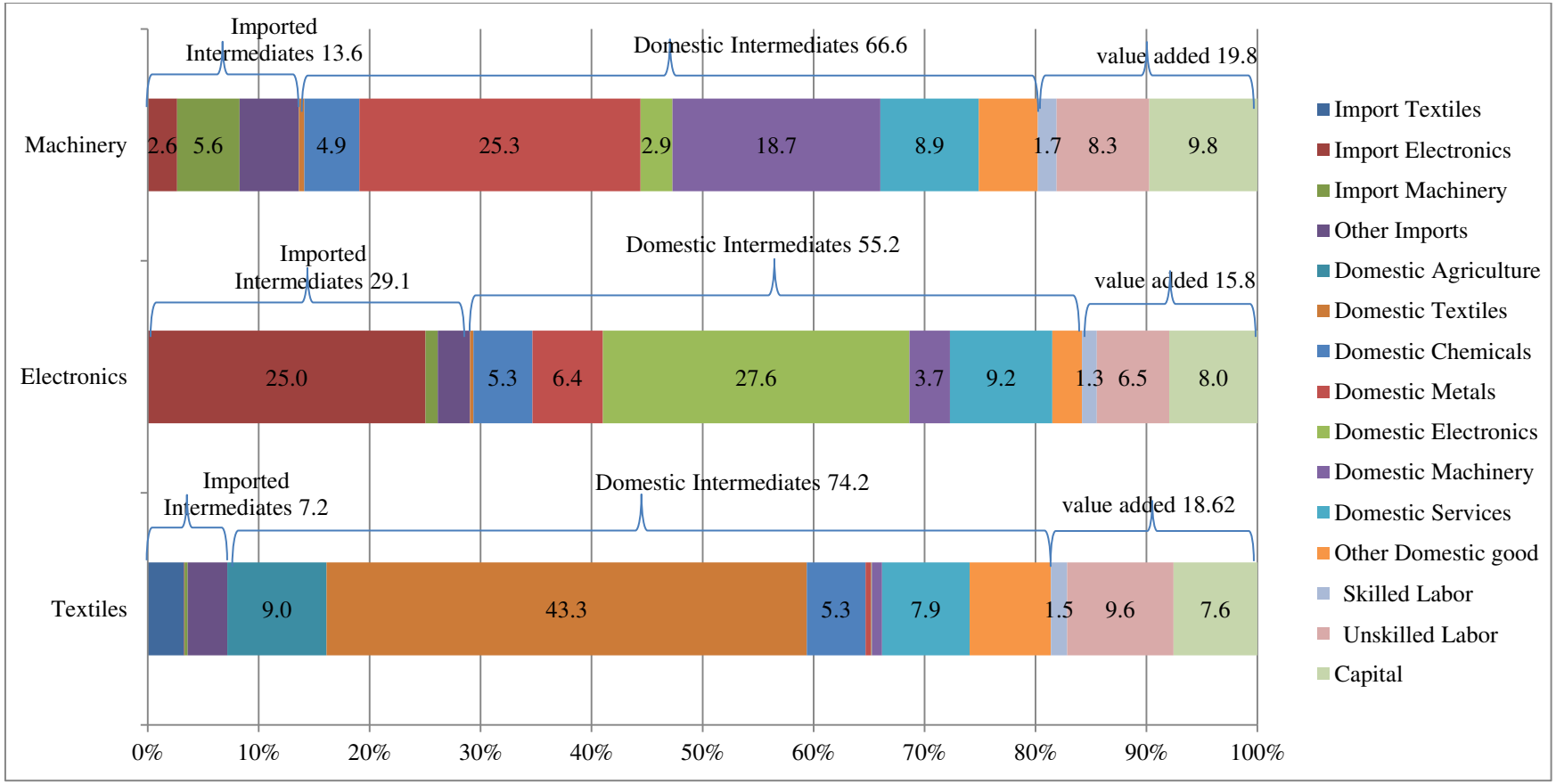
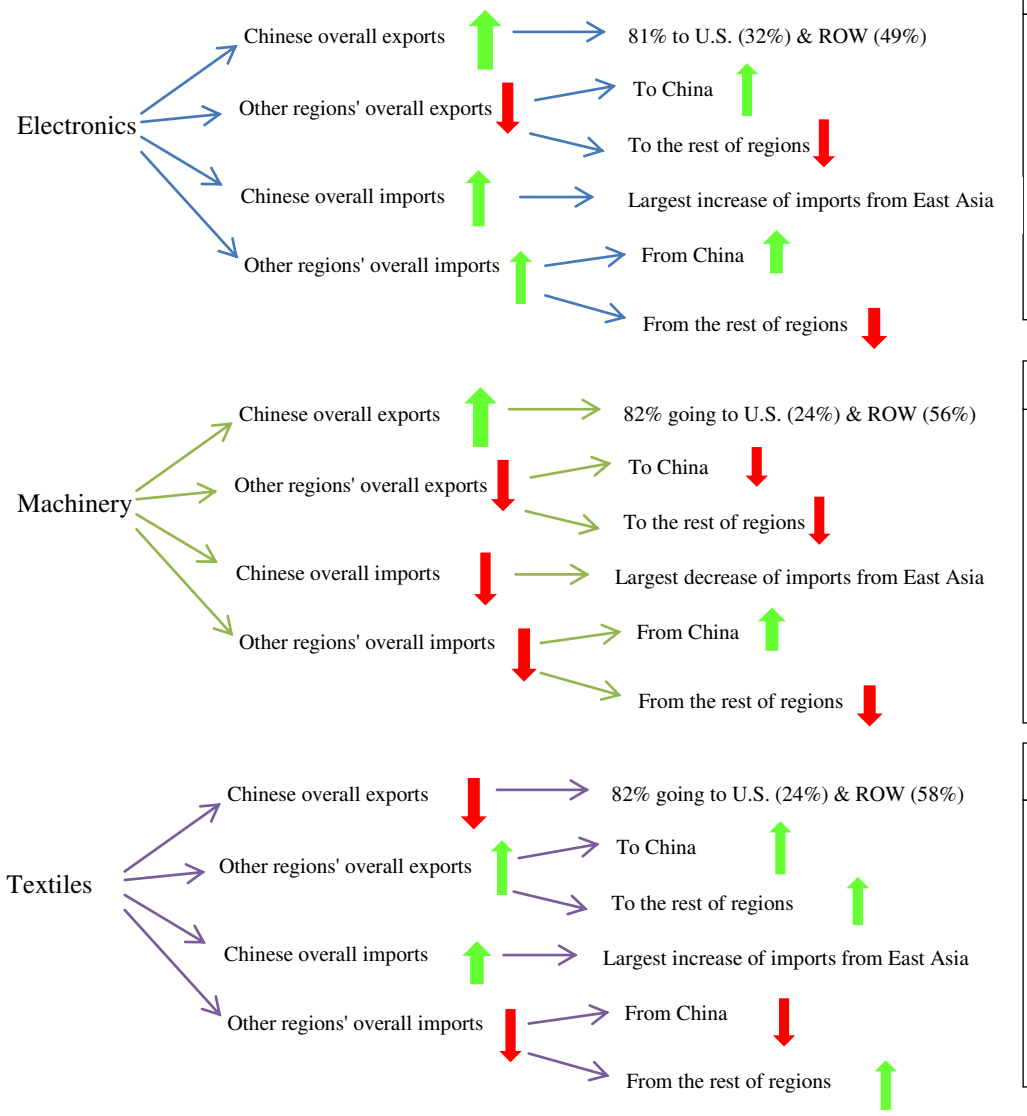


Figure 2: Diagrammatic illustration of the evolution of bilateral trade patterns after the FDI shock



Explanation

- ❖ 85% of Chinese imports are intermediates
- ❖ 60% of Chinese imports are from East Asia
- ❖ Electronics production relies heavily on imported Electronic intermediates
- ❖ Big fall in the price of Chinese Electronics

Explanation

- 68% of Chinese imports are intermediates
- 59% of Chinese imports are from East Asia
- Imported intermediates are not so intensively used in Machinery production (compared to Electronics)
- Machinery production in China relies more on domestic Machinery intermediates
- Substitution effects due to cheaper domestic prices than imported ones

Explanation

- ➢ 86% of Chinese imports are intermediates
- ➢ 65% of Chinese imports are from East Asia
- ➢ Textiles production in China relies heavily on domestic Textile intermediates
- ➢ Large increase of private consumption in China
- ➢ Exports lack price competitiveness in comparison with Electronics and Machinery

The small increase in Textiles exports that all regions except China achieve cannot compensate to the big fall in exports in Electronics and Machinery.