Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

How FDI influences the triangular trade pattern among China, East Asia and the U.S.?
A CGE analysis of the sector of Electronics in China

Jing Zhou[1] and María C. Latorre[2]

(Preliminary version, April 2013)

Abstract:

This paper uses a computable general equilibrium model to simulate the FDI inflow in the Electronics sector in China. Our aim is to capture how the causation chain works through production networks and triangular trade pattern. The results reveal that China is a production base and export center for Electronics, with a heavy dependence on East Asian Electronics supply. Meanwhile, the U.S. and Rest of world are important markets for Electronics exports. China collaborates with East Asia in the production networks but competes with East Asia on the exports to the U.S. and ROW. The shock of FDI reinforces the pivotal role of China and intensifies its exports without any remarkable change on the pattern of the geographical destiny of its Electronics exports. The Chinese trade links and production division remain unchanged. However, China takes up more of the world market share released by their competitors. In this sense, after the shock, the shares in imports of Electronics of rest of regions, thus, have changed noticeably.

Key words: Triangular Trade Pattern; Production Networks; CGE Model; FDI;

JEL Classification: F14, F15, F17

[1] YunNan University of Finance and Economics; Ph.D candidate of Universidad Complutense Madrid, jzhou01@ucm.es. The helpful comments from Professor Maroto, as well as the funding from Chinese Social funds (No. 12CJL047) are greatly acknowledged.
[2] Universidad Complutense Madrid

1. Introduction

The impact of triangular trade among China, East Asia and the U.S. has raised much interest. Particular attention has been devoted to the pattern of collaboration (Haddad, 2007) or competition (Gaulier *et al.*, 2007) through FDI (foreign direct investment) or trade. Some authors have focused on free trade agreements and trade policy to explain the regional integration. One important conclusion is that trade liberalization policy has accelerated the transition of East Asia (Kitwiwattanachai *et al.*, 2010; Kawai *et al.*, 2010).

Other studies have paid attention to production networks, as well as processing trade, vertical specialization, domestic export content, triangular trade and production networks among China, East Asia itself and the U.S. (Wang *et al.*, 2009; Ma and van Assche, 2010; Xing and Detert, 2010; Koopman *et al.*, 2010). Indeed, there is considerable evidence that East Asia imports from the U.S. high-tech parts, which are converted into key intermediates and latter exported to China, while China processes and finally exports the finished goods to the U.S. The U.S., indeed, is the main export market for Asian finished goods and has been playing a significant role in this network (Xing, 2011; Amiti and Freund, 2008).

In the literature, however, not much attention has been paid to the role of FDI in these processes, particularly using a CGE framework. We try to bridge this gap by analyzing the impact on the triangular trade pattern of the FDI accruing to China. China, as an emerging and transition economy, is abundant in cheap labor supply and unique in its FDI and export encouraging policies, continuous high economic growth and potential market size. These factors together have been important for attracting huge FDI from rest of the world. Especially, the neighboring East Asian economies, due to the geographic proximity and cultural links, have provided 63% of cumulative FDI in China from 1985 to 2008 (Xing,

2010). An important part of the triangular trade, then, develops when the multinationals from advanced Asian economies set up fragmentation production branches and import intermediates from their parent firms. Thus, there seems to be a strong relationship between FDI, networks and trade.

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

2. The model

Our model is the GAMS (General Algebraic Modeling System) version (Rutherford, 2005) of the Global Trade Analysis (GTAP) model (Hertel, 1997). The core GTAP model is a static computable general equilibrium model of the world, which makes viable evaluating the medium term impacts of different shocks. In the current aggregation of the model, we use a 4-region, 2-factor and 15-sector version.

To be more precise, the CGE model we apply in this paper is the GTAP6inGAMs model developed by Rutherford (2005). The GTAP6inGAMs is a traditional static Arrow–Debreu general equilibrium model in which the equilibrium is defined by zero profit and market clearance conditions. Most of the model specifications are the same as in Hertel (1997), which uses GEMPACK, with only two differences. First, the GEMPACK version is based on a constant difference elasticity demand system, while the GAMs model uses Cobb–Douglas preferences. Second, in GEMPACK global capital is endogenously allocated by

regional rates of return. By contrast, for simplicity, the GTAP6inGAMS model exogenously fixes the global capital flows at base year levels.

In the model there are four economic agents: producers, private consumers, government and trading partners, all of them maximizing their own profit or welfare. Mathematically it is a system derived from a series of non-linear equations determined by each agent's optimization, as well as, national account identities.

Hertel (1997) offers a complete explanation of the model and the GTAP database. The equations appear in a 'linearized' form, as is standard in GEMPACK. Rutherford (2005) explains the whole set of equations, parameters and variables in a friendly algebraic format. Further details on the model can be found in Rutherford's paper.

3. Data and simulations

As mentioned before, there are two factors of production (labor and capital), four regions (China; East Asia[3]; the U.S. and Rest of World) and fifteen sectors. The Manufacturing sector is disaggregated into thirteen sub-sectors. The other two sectors are Agriculture and Services. We model capital as sector-specific and labor as fully mobile within but not across regions. This implies that our results grasp the medium term impact of the shock analyzed.

Table 1, offers the whole sectoral picture of the Chinese economy. In the first two columns, it presents the complete sectoral names, as well as, the shorter name after aggregation that will be used, henceforth. 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

[3] 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.

information refers to the Year 2007. The exports of Electronics account for 22% of total Chinese exports while the imports of Electronics take up 20% of all the imports in China. By contrast, sectoral output and value added of Electronics only account for 5% and 3% of total production and aggregate GDP, respectively. Similarly, the amount of labor and capital used in Electronics is for both only 2.5% of the total amount of factors available in China. This rather small sector has a high dependency on the world market, as 56.33% of its production goes to exports and 48.17% of the domestic demand for Electronics relies on the imports.

Apart from Electronics, Textiles and Machinery also show a high dependence on the export markets, contributing to 16.7% and 16.9% of total Chinese exports. As happened with Electronics, the two sectors are smaller in terms of value added, production, use of capital and labor. However, their foreign trade links are very important in Chinese total trade. Table 1 also shows that other sectors are more oriented to private consumption. This is the case of Agriculture, Food and Beverages, as well as, the Services sectors, which account for 12.5%, 17.5% and 45.5% of total private consumption in China. We will see that the export or private consumption orientation of the sectors will be important for their outcomes of production and labor demand after the shock.

China, out of its abundant labor and market potential, has attracted huge FDI flows in its most export-oriented sector— Electronics. MNEs account for 80% of total Electronics production and contribute to more than 70% of Electronics exports[4]. We are interested in how the evolution of FDI reshapes the East Asian economy and how the effects are magnified through production networks and trade linkages of Electronics. Thus, our

[4] 中国工业经济统计年鉴.Translated as “China Industry Economy Statistical Yearbook” 刘富江 (2008) .

simulation consists of a realistic shock about the evolution of the capital stock of Electronics in China. 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[5]. Thus, we simulate a 100% increase of capital stock in Electronics in China, meanwhile the capital stock in rest sectors and regions remains fixed.

4. Empirical Results

4.1. Aggregate results

Table 2 presents the macroeconomic impacts across regions of the FDI shock in Electronics in China. It provides the percentage change in real terms with respect to the benchmark value of aggregate variables: the wage, the capital rent, GDP from the income side, national income[6], the CPI and the overall increase of capital stock.

Since capital input of the Electronics sector only accounts for 2.48% of total capital stock in China (Table 2), the 100% increase of capital stock in it results in a 2.48% increase of total capital stock. The rest of the regions keep their capital stock stable. Capital accumulation leads to a fall in the rental rate of capital. The abundant labor supply and the flexible substitution between labor and capital in manufacturing ensure that the wage in China rises by 0.22%. The fall in the rental rate of capital and the increase in wages, following an increase in the capital stock, have been generally obtained in previous CGEs (e.g., Latorre

[5] 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 take into account the capital invested in China by all foreign firms across the world, including firms from Hong Kong, Taiwan, and Macao.

[6] Due to the fact that private consumption is calculated using a Cobb-Douglas form, percentage variations in private consumption coincide with changes in households' income. The change of households' consumption or income can be considered as a welfare change. Hertel (1997, Chapter 1) notes that percentage changes in real private consumption, when investment and public consumption are fixed in real terms, is the case in GTAP6inGAMS.

et al., 2009; Latorre, in press), as well as in broader reviews of the literature using other methodologies (e.g.,Rama, 2003). It is also the expected outcome in a capital specific setting, as the theory of trade models with specific capital shows (e.g., Jones, 2000; 2002). Higher wages and, more importantly, a bigger capital stock lead to a 3.82% and 0.99% increase in national income and GDP, respectively. Macroeconomic results across the rest of regions remain the same.

The CPI[7] in China has risen up around 2%. The higher domestic prices of Services, Agriculture, as well as Food and Beverage have mainly lead to the higher CPI. This upward pressure is only partially offset by the fall in Electronic prices, due to the small weight (1.9%) of this sector in total private consumption. Across the rest of regions variations in the CPI are small. The CPI is derived from the weight of import and domestic prices in the consumption structure.

4.2. Sectoral results

4.2.1. Production, prices and labor demand

In China, the evolution of exports and private consumption are the key to the changes in output across sectors. Those sectors that are more export oriented—devoting a large part of its production to exports, as shown in Table 1, will diminish their production (Table 3). The reason for this is that the increase in the Chinese prices (as reflected in the higher CPI) are bigger than in the rest of regions, so China loses competitiveness (except in Electronics).

[7] As a CGE model describes only relative prices, we choose CPI as the model's numeraire, a benchmark of value against which the changes in all other prices can be measured. CPI is the weighted sum of initial consumer prices, where the weights are each good's base budget share in the consumption bundle. The GTAP6inGAMS by default takes a different variable as the numeraire. That is the dispensable budget for private consumption in ROW (RA_{row}), in order to compare the change of rest of regions' budget for private consumption. We choose CPI, and hope to find the relative price change based on it. Except CPI itself, all the value terms will be discounted by it.

Production falls because these sectors export less. The sectors experiencing increases in output are the ones whose production is more devoted to private consumption. Private consumption increases due to the higher national income in China, pushing up the production of the sectors more responsive to its tendency.

The biggest changes in output take place in the Electronic sectors itself. Following the arrival of new capital, output increases strongly in this sector in China. The important increase of Chinese exports to the rest of regions will crowd out the output of electronics in East Asia, the U.S. and ROW (Table 3). In East Asia production has contracted by 3.76%. Reductions are more sizeable in the U.S. (-6.89%) and ROW (-4.61%). This is due to the role of East Asia as a provider of intermediates of Electronics to China. This will be analyzed more deeply when dealing with exports.

Labor demand follows the evolution of production. In this capital specific setting, sectors that increase production do so by employing more labor. The only exception is Electronics. Since its capital rent in China is nearly half of the former price after the shock, while the labor price goes up slightly, this sector replaces labor with capital.

4.2.2. Intermediate input of the Electronics sector

Table 4 shows the demand for total, imported and domestic intermediates to be used in the Electronics sector across regions. The final three columns show the change in total intermediates. Looking at Electronics intermediates, we find that the demand for them follows the production change in Electronics production (shown in Table 3). This is due to the Leontief function of the upper nest in the production tree of GTAP6inGAMS.

Except for Electronics intermediates themselves, the Electronics sectors in East Asia, the U.S. and ROW rely more on domestic intermediates than on imported ones. In China the

tendency is reversed. This difference arises from the fact that domestic intermediate prices are cheaper than imported ones in East Asia, the U.S. and ROW, but are more expensive than imported ones in China (see Part 2 of table 4).

Focusing on Electronics intermediates, the Electronics sectors in East Asia, the U.S. and ROW reduce more domestic inputs than imported ones when they cut down their output, as the imported inputs are cheaper than domestic ones. This sector in China, however, uses 47.55% more of domestic intermediates and 20% more of imported ones. The production of domestic intermediates to be used in Electronics increases much more than does that of imported intermediates. However, due to the limited substitution between domestic and imported intermediates, imports of irreplaceable parts and components also increase after the shock.

Based on the analysis of intermediate inputs, it seems that the Electronics goods used as intermediates are standardized and can be substituted by imported ones to a certain extent based on their elasticity of substitution (4.4). The substitution effect is limited because there are some irreplaceable key component and parts in the production.

4.2.3. Bilateral exports of electronics

4.2.3.1. Allocation structure of imported and domestic Electronics

Table 5 shows the different roles that the four regions considered play in Electronics. Let us look first at the use of imports in this sector. The left side of Part 1 of the table displays private consumption, government consumption, gross capital formation and intermediates. China and East Asia stand out in the weight of imports that are intermediate goods, i.e., goods that will be further processed, with a weight of around 80% and 66%, respectively.

By contrast, in the U.S. and ROW the weight of intermediates of Electronics falls to around the half of imports. This reflects the idea that China and East Asia have an important role as "factories of Electronics" in the world.

The right side of Part 1 of Table 5 shows a complementary picture. It displays the destiny of domestic Electronics in the four regions. In particular, it shows the percentage of domestic goods that satisfies private and government consumption, gross capital formation, intermediates and exports. This information further confirms the role of China as a factory of Electronics in the world. 55% of its production is exported and 36% is of intermediates. In China only 2.5% of production goes to private consumption and only 6% is for gross capital formation, while government consumption is negligible. In East Asia about 75% of the output is devoted to either exports (50%) or intermediates production (26%). However, the weight of private consumption and gross capital formation is higher than in China (10.5% and 13.3%, respectively). East Asia is a region which gathers developed Asian economies therefore it devotes a higher share than China to the consumption of finished Electronics goods. It also reveals that East Asia plays a role as an export base for Electronics as China does, though less intensively, according to their export ratio of production. Thus, there are some similarities in the weight of export and intermediate ratio relative to production in China and East Asia.

The ROW region exhibits a similar pattern to the one of East Asia, since it also devotes an important part of its production to exports and intermediates (57% and 20.6%). However, in ROW the production of intermediates is smaller than in East Asia, suggesting a smaller role as a factory of Electronics compared to East Asia. Finally the U.S. devotes nearly half of its

production to intermediates which are mainly consumed domestically as the low weight of exports suggests.

The left side of Part 2 of Table 5 displays the geographical share of total imports of Electronics across the world, by demand component (i.e., classified as intermediate inputs, private consumption, public demand and investment demand). It unfolds the truth that the U.S. and ROW are the biggest markets for Electronics goods, according to their weight in private consumption and investment demand. By contract, China and East Asia account for rather small share in private consumption (18%), public demand (0.17%) and investment demand (21%). Instead, they account for 38% of world imports of Electronics intermediates. The U.S. and ROW account for a much smaller share in intermediate imports of Electronics.

The right side of Part 2 of Table 5 shows us the geographical shares of total domestic Electronics by demand component. Looking at the geographical shares of intermediates, 44% of them are concentrated in China and East Asia (with 21.6% and 23%, respectively). The table does not exhibit any absolute numbers. However, taking into account absolute numbers behind the imports of intermediates of China and East Asia (21.4% and 16.7% at the left of the table) together with absolute numbers of domestic intermediates of them, the whole East Asia overtakes ROW as the center of intermediates processing. This enables us to interpret China and East Asia as the main factory of Electronics in the world. This is further confirmed by looking at their share in total domestic supply of Electronics in the world (right side of Part 2 of Table 5). China and East Asia together account for more than 46% of total world production of Electronics.

These data suggest that the regions considered play a different role in the "triangular trade pattern". China stands out as a factory, East Asia follows that same trend although less

intensively. The U.S. and ROW are biggest markets for the Electronics finished goods of the world.

4.2.3.2. Evolution of bilateral trade in Electronics.

The main outcomes for the evolution of trade appear in Table 6. The Part 1 of that Table presents the benchmark real values of exports of Electronics, as well as, the values after the simulation and the corresponding percentage changes. Note that the values of imports can be inferred from the exports values.

After the arrival of FDI to China its exports increase heavily and by a rather similar percentage (around 34%[8]) to the rest of regions. This implies that China strongly intensifies its exports without any marked change on the pattern of the geographical destiny of those exports. The trade links and the production division remain unchanged. The absolute values show that for China's exports, the U.S and ROW are the most important markets. This is also confirmed by the percentage weight in total Chinese exports reported in the second part of Table 6. It can be seen that the U.S. and ROW account for 32.4% and 48.7% of Chinese exports in the benchmark. Note the contrast with the pattern of the East Asia region. For East Asia the biggest market is China (32.04% of East Asian exports), while the U.S. and ROW are of less important than for China (accounting for 13.44% and 34.57% of East Asian exports, respectively). The East Asian region is also a rather important market for itself, bigger than the U.S., since it takes up nearly 20% of exports from East Asia compared to the U.S. which accounts for 13.44%.

As a result of the shock, all the rest of regions intensify their exports to China, while diminishing exports to other destinies. We have seen that most of the exports accruing to

[8] Note that the increase experienced in the production of Electronics after the shock is of 34% (Table 3).

China are of intermediates (Table 5 Part 1). More imports of intermediates are necessary given that Chinese production is increasing very heavily. The ROW region exhibits the biggest increase of exports to China (10.9%). However, in absolute values the increase is smaller than the exports of East Asia to China. The percentage is bigger just because the level of ROW's initial exports is much smaller than the one from East-Asia to China. Indeed, East-Asia provides many more exports to China (in absolute terms, before and after the shock). This means that there are important production networks between East Asia and China. East Asia is more a partner in the production networks for China than a market like the U.S. or ROW.

Indeed, Table 6 confirms that the nature of the ties of Electronics' trade between China and East Asia is different from the ones between China, the U.S. and ROW. The Part 3 of that Table shows the geographical import structure. Nearly two thirds of Electronics imports of China come from East Asia while two thirds of the imports of East Asia come from itself and China. The adjustment after the shock is quite different when we look at its import side. China, without changing its geographical destinies, and due to its lower prices is crowding out other providers of Electronics.

The last row of Table 6 shows import prices and domestic output prices. Imports coming from China exhibit the biggest fall in prices in East-Asia (-5.85%), the U.S. (-5.90%) and ROW (-6.00%). Clearly the price competitiveness of China has become very challenging. Particularly when we compared the import prices with the domestic output prices in Electronics. As a result, China gains in the import share of all regions: from 27.38% to 35.16% of total imports of Electronics in East Asia; from 38.01% to 46.54% in the U.S. and from 21.50% to 28.08% in ROW. By contrast, the shares of the imports provided by East

Asia, U.S. and ROW are always reduced in the bilateral transactions among them. These sizeable changes in the import structure contrast with the small changes in the export structure after the shock. The absolute values behind the import structure by source country can be inferred from the values of exports at top of Table 6. We can see that the highest increases in Chinese exports across regions are concentrated in its main markets, ROW and the U.S.

5. Conclusions

This paper has examined the trade patterns of Electronics among China, East Asia, the U.S. and ROW. In particular, it has analyzed how the evolution of production and sourcing of intermediate inputs affect foreign trade. As other authors have pointed out (e.g. Kawai 2004), we also find that FDI plays a vital role in shaping Asian regional Electronics production networks.

We replicate the real increase in FDI stock experienced in Electronics in China, which has doubled in the period 2004-2011. The simulations from our CGE model indicate that China has benefited from the FDI inflow. Its GDP increases by 1% and welfare, represented by private consumption, rises by 3.8%. Besides, the pivotal role of China in the production network of Electronics has been strengthened by intensifying its exports to all the trade partners. However, the increase in Electronics exports occurs without any remarkable change in the pattern of its previous geographical destinies. In other words, Chinese trade links and production division remain unchanged. By contrast, the geographical import structure of the regions considered in the model changes considerably. The large increase of Chinese exports, following a big fall in their export prices, crowds out other competitors across the world.

China plays a central role as a production center and export base for Electronics in the world. Its main export markets are the U.S. and ROW. East Asia is the main input provider of Chinese Electronics. The increase in the production of Electronics in China is more important for the larger exports of electronics from East Asia than for the U.S. and ROW, due to the production networks that exist between China and East Asia. China collaborates with East Asia in the production of electronics but competes with that region in the U.S and ROW markets. After the shock, East Asia increases exports to China but reduces exports to the rest of regions. Even though East Asia loses ground in the world market, it still gains through the exports to China.

All in all, the FDI shock in Electronics sector in China has deepened the trend of regional integration of East Asia. It has further strengthened the role of China as a production center and export base and its close collaboration with other East Asian economies.

Table 1: Definition of sectors, commodity shares, import reliance and export tendency and production structure of China

Sector/Goods Definition (based on GATPAgg)		Commodity % in:			Import % of domestic consumption	Export % of domestic production	Production side (%)			
		Domestic Demand[9]	Trade				% of Production Value	secotral V.A. % in GDP	% of K input	% of L input
		Private consumption	Imports	Exports						
Agriculture	01~14 Agriculture, hunting and fishing	12.49	2.97	0.91	5.05	1.85	6.40	11.04	10.33	15.05
Mining	15~18 Mining and quarrying	0.2	15.04	0.53	34.93	2.39	2.89	3.95	5.74	2.97
Food and Beverage	19~26 Food, beverages and tobacco	17.56	1.91	1.95	4.69	5.15	4.92	3.21	2.58	2.80
Textiles	27~29 Textiles, wearing apparel, leather, footwear	5.99	2.7	16.7	6.83	35.81	6.06	4.07	2.84	4.18
Woods and Paper	30~31 wood without furniture, paper, publishing, media	0.62	1.98	4.08	7.37	17.05	3.11	2.06	1.95	2.33
Petroleum	32 Petroleum	2.58	2.36	1.72	9.46	7.85	2.84	0.60	0.49	0.45
Chemicals	33~34 Chemicals, rubber and plastic products	2.51	12.81	7.15	22.82	12.88	7.21	5.67	4.75	3.86
Metals	34~37 Mineral products nec, Ferrous metals, metals nec, metal products	0.63	8.27	9.51	7.25	9.88	12.49	7.41	8.23	7.30
Motor Vehicles	38~39 Motor vehicles and parts, transport equipment nec	2.36	4.07	3.24	13.35	11.42	3.69	2.46	1.63	2.44
Electronics	40 Electronic equipment	1.89	19.44	21.84	48.17	56.33	5.03	2.95	2.48	2.47
Machinery	41 Machinery and equipment nec	2.07	17.85	16.93	23.78	24.85	8.85	6.45	5.34	5.56
Other Manufacturing	42 Manufactures nec	1.42	0.42	6.01	3.9	38.97	2.00	2.48	3.99	1.24
Electricity, Gas and Water	43~45 Electricity; Gas manufacture and distribution; Water	3.28	0.08	0.12	0.31	0.56	2.84	3.36	4.53	2.48
Construction	46 Construction	0.85	0.34	0.42	0.48	0.67	8.18	6.34	4.39	8.26
Services	47~57 Services	45.55	9.76	8.89	4.44	4.92	23.50	37.94	40.73	38.62
Total		100	100	100	11.53	12.99	100	100	100	100

Source: Narayanan *et al.* (2012).

[9] Due to space limitation, we only list private consumption share, and omit the intermediate demand, public consumption and investment demand in the domestic demand.

Table 2: Impact on aggregate variables (% change)

Macro indices	CHN	EAS	USA	ROW
Wage	0.22	-0.14	-0.03	-0.08
Capital rent	-0.71	-0.17	0.02	0.02
National income	3.82	-0.16	0.02	-0.09
GDP	0.99	-0.12	-0.02	-0.03
CPI	2.06	-0.08	-0.01	0.09
Kstock	2.48	0.00	0.00	0.00

Note: CHN represents China, EAS stands for East Asia, and ROW for Rest of world

Table 3: Impact on sectoral output and labor input (% change)

% change	Output				Labor input			
	CHN	EAS	U.S.	ROW	CHN	EAS	U.S.	ROW
Agriculture	0.38	0.09	0.09	0.06	0.64	0.21	0.25	0.11
Mining	-0.22	0.13	0.06	0.03	-0.65	0.44	0.25	0.2
Food & Beverage	0.94	-0.02	0.03	0.01	1.82	-0.05	0.05	0.03
Textiles	-2.72	1.41	1.04	0.87	-4.55	2.05	1.3	1.43
Woods and Paper	-1.19	0.30	0.19	0.22	-2.18	0.49	0.26	0.36
Petroleum	0.61	0.11	-0.13	-0.06	1.29	0.32	-0.25	-0.21
Chemicals	-0.68	0.6	0.3	0.23	-1.52	1.19	0.5	0.46
Metals	-0.54	0.55	0.22	0.25	-1.15	0.97	0.28	0.45
Motor Vehicles	-0.97	0.53	0.23	0.01	-1.62	0.80	0.28	0.02
Electronics	34.18	-3.76	-6.89	-4.61	-13.68	-7.05	-9.56	-9.10
Machinery	-1.55	0.76	0.42	0.25	-3.03	1.23	0.53	0.37
Other manufacturing	-0.94	0.45	0.65	0.19	-3.94	0.70	0.77	0.31
Electricity, Gas and Water	0.6	-0.01	-0.02	0	1.7	-0.06	-0.04	0
Construction	0.03	0.02	-0.02	0	0.04	0.03	-0.03	0
Services	1.00	0.04	-0.02	-0.01	2.07	0.07	-0.02	-0.01

Table 4: Impact on intermediate demands and prices of the Electronics sector (% change)

Part 1: Intermediate demand of the Electronics sector												
	domestic intermediate demand				Imported intermediate demand				total intermediate demand			
	CHN	EAS	U.S.	ROW	CHN	EAS	US	ROW	CHN	EAS	U.S.	ROW
Agriculture	26.08	-3.67	-6.95	-4.57	34.18	-4.63	-6.86	-4.73	34.18	-3.76	-6.89	-4.61
Mining	33.89	-4.05	-6.81	-4.67	35.15	-3.73	-6.94	-4.50	34.19	-3.77	-6.89	-4.61
Food and Beverage	33.95	-3.76	-6.89	-4.59	42.23	-4.81	-7.28	-4.70	34.18	-3.76	-6.89	-4.61
Textiles	33.8	-3.39	-6.76	-4.26	39.93	-5.94	-8.76	-5.25	34.18	-3.76	-6.89	-4.61
Woods and Paper	33.6	-3.70	-6.85	-4.56	39.81	-4.82	-8.00	-4.82	34.18	-3.76	-6.89	-4.61
Petroleum	34.07	-3.76	-6.89	-4.61	35.28	-3.79	-6.87	-4.60	34.18	-3.76	-6.89	-4.61
Chemicals	32.94	-3.66	-6.79	-4.54	38.43	-4.04	-7.36	-4.68	34.18	-3.76	-6.89	-4.61
Metals	33.68	-3.56	-6.72	-4.51	39.32	-4.26	-7.68	-4.75	34.18	-3.76	-6.89	-4.61
Motor Vehicles	33.47	-3.59	-6.82	-4.60	38.75	-4.14	-7.04	-4.62	34.18	-3.76	-6.89	-4.61
Electronics	47.55	-6.72	-10.09	-7.21	19.76	-0.46	0.34	-3.28	34.34	-3.75	-6.86	-4.6
Machinery	33.1	-3.41	-6.60	-4.49	37.76	-4.11	-7.41	-4.72	34.18	-3.76	-6.89	-4.61
Other manufacturing	34.05	-3.19	-6.52	-4.48	37.38	-4.34	-7.70	-4.89	34.18	-3.76	-6.89	-4.61
Electricity, Gas and Water	34.16	-3.76	-6.89	-4.61	41.55	-4.77	-7.24	-4.66	34.18	-3.76	-6.89	-4.61
Construction	34.16	-3.76	-6.89	-4.60	38.33	-4.12	-7.15	-4.70	34.18	-3.76	-6.89	-4.61
Services	33.82	-3.70	-6.88	-4.60	40.18	-4.33	-7.07	-4.65	34.18	-3.76	-6.89	-4.61
Part 2: Intermediate input prices												
	domestic intermediate input price				import intermediate input price				composite intermediate input price			
	CHN	EAS	U.S.	ROW	CHN	EAS	US	ROW	CHN	EAS	U.S.	ROW
Agriculture	0.83	0.28	0.33	0.13	-1.79	0.71	0.29	0.2	-1.79	0.32	0.3	0.15
Mining	-1.26	0.77	0.63	0.58	-1.42	0.71	0.65	0.55	-1.29	0.71	0.64	0.57
Food and Beverage	0.5	0.12	0.09	0.03	-1.91	0.56	0.26	0.07	0.43	0.12	0.09	0.03
Textiles	-0.56	0.38	0.18	0.24	-1.73	1.09	0.76	0.52	-0.64	0.48	0.22	0.34
Woods and Paper	-0.48	0.09	0.06	0.05	-1.92	0.47	0.46	0.13	-0.62	0.11	0.08	0.06
Petroleum	-1.08	0.63	0.57	0.46	-1.5	0.65	0.55	0.46	-1.12	0.63	0.56	0.46
Chemicals	-0.6	0.32	0.15	0.12	-1.81	0.44	0.33	0.16	-0.88	0.35	0.18	0.14
Metals	-0.65	0.26	0.07	0.11	-1.84	0.48	0.37	0.18	-0.75	0.32	0.12	0.14
Motor Vehicles	-0.78	0.04	-0.01	-0.03	-2	0.22	0.07	-0.02	-0.95	0.09	0.02	-0.03
Electronics	-7.93	-1.33	-0.99	-1.8	-3.46	-2.77	-3.43	-2.72	-5.92	-2.03	-1.77	-2.42
Machinery	-1.14	0.11	-0.01	-0.03	-1.98	0.30	0.20	0.03	-1.34	0.21	0.06	0
Other manufacturing	-1.29	0.09	0.03	0.05	-1.94	0.41	0.38	0.17	-1.32	0.25	0.14	0.09
Electricity, Gas and Water	0.01	0.15	0.06	0.08	-1.89	0.53	0.20	0.10	0.01	0.15	0.07	0.08
Construction	-0.39	0.02	0	-0.01	-1.98	0.22	0.15	0.05	-0.40	0.02	0	-0.01
Services	0.37	-0.05	-0.03	-0.05	-2.06	0.29	0.08	-0.02	0.23	-0.02	-0.02	-0.05

Table 5: Imported and domestic Electronics allocation in the benchmark (absolute values and % change)

Part 1	Total Electronics import of each region by demand type (%)					Total domestic Electronics of each region by demand type (%)					
	Private Consumption	Public Demand	Investment Demand	Interm-ediate	Total	Private Consumption	Public Demand	Investment Demand	Export	Interm-ediate	Total
CHN	6.05	0.00	14.56	79.38	100	2.45	0.00	5.89	55.16	36.51	100
EAS	11.71	0.01	22.36	65.93	100	10.57	0.01	13.34	49.32	26.76	100
U.S.	21.14	0.00	26.10	52.75	100	5.92	0.00	23.88	18.38	51.81	100
ROW	16.17	0.89	31.31	51.62	100	9.46	0.33	12.46	55.96	21.80	100
Part 2	**Geographical share of world Electronics imports by demand type (%)**					**Geographical share of domestic Electronics in the world by demand type (%)**					
	Private Consumption	Public Demand	Investment Demand	Interm-ediate	Total	Private Consumption	Public Demand	Investment Demand	Export	Interm-ediate	Total
CHN	6.44	0.00	8.71	21.47	15.78	5.91	0.00	8.10	22.13	21.65	18.78
EAS	11.73	0.17	12.60	16.80	14.87	37.19	1.78	26.70	28.80	23.09	27.33
U.S.	26.47	0.01	18.38	16.79	18.57	14.60	0.01	33.51	7.53	31.35	19.16
ROW	55.37	99.82	60.30	44.94	50.78	42.29	98.21	31.69	41.54	23.91	34.74
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Narayanan *et al.* (2012)

Table 6: Impact on bilateral trade in Electronics (absolute values and % change)

Part 1. Export Quantity (bench and % change)																		
Exports	Electronics X from CHN to:				Electronics X from EAS to:					Electronics X from U.S. to:				Electronics X from ROW to:				
	EAS	U.S.	ROW	total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	total	CHN	EAS	U.S.	ROW	Total
Bench	50.48	86.53	130.08	267.09	114.87	71.64	47.99	123.43	357.94	10.70	20.26	61.97	92.94	64.26	46.50	97.47	306.77	515.00
Simulate	68.43	114.61	176.92	359.96	124.01	64.20	42.05	111.01	341.26	11.14	17.51	53.78	82.43	71.29	42.79	87.68	283.70	485.46
% change	35.58	32.45	36.00	34.77	7.95	-10.39	-12.38	-10.07	-4.66	4.13	-13.58	-13.22	-11.30	10.94	-7.97	-10.04	-7.52	-5.74
Part 2. Weight of destiny in electronics exports at FOB price (%)																		
Destiny weight of Exports	Electronics X from CHN to:				Electronics X from EAS to:					Electronics X from U.S. to:				Electronics X from ROW to:				
	EAS	U.S.	ROW	total	CHN	EAS	U.S.	ROW	Total	CHN	EAS	ROW	Total	CHN	EAS	U.S.	ROW	Total
Bench	18.86	32.42	48.71	100	32.04	19.96	13.44	34.57	100	11.51	21.81	66.68	100	12.48	9.05	19.05	59.42	100
Simulate	18.97	31.87	49.16	100	36.28	18.76	12.35	32.61	100	13.51	21.25	65.24	100	14.69	8.84	18.18	58.29	100
change	0.11	-0.56	0.45	0	4.24	-1.20	-1.09	-1.96	0	2.00	-0.56	-1.44	0	2.21	-0.21	-0.87	-1.13	0
Part 3. Weight of source in imported electronics at CIF price (%)																		
Source weight of Imports	Electronics M of CHN by source				Electronics M of EAS by source					Electronics M of U.S. by source				Electronics M 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
Bench	60.43	5.67	33.91	100	27.38	37.45	10.69	24.48	100	38.01	20.38	41.61	100	21.50	19.72	9.93	48.85	100
Simulate	60.04	5.45	34.51	100	35.16	33.33	9.21	22.30	100	46.54	17.30	36.16	100	28.08	17.86	8.71	45.34	100
change	-0.39	-0.22	0.60	0	7.78	-4.12	-1.48	-2.18	0	8.53	-3.08	-5.45	0	6.59	-1.86	-1.22	-3.51	0
Part 4. % change of Real bilateral import price (PM) and real output price of Electronics (PY)																		
Prices	bilateral PM of China, from			PY_ CHN	bilateral PM of EAS, from				PY_ EAS	bilateral PM of U.S., from			PY_ U.S.	bilateral PM of ROW, from				PY_ ROW
	EAS	U.S.	ROW		CHN	EAS	U.S.	ROW		CHN	EAS	ROW		CHN	EAS	U.S.	ROW	
% change	-3.38	-2.98	-3.68	-7.93	-5.85	-1.31	-0.90	-1.61	-1.33	-5.90	-1.38	-1.67	-0.99	-6.00	-1.47	-1.07	-1.78	-1.80

Note: The export quantity is in billions of unit, it doesn't include any subsidy on the exports nor the transport margin.

References

Amiti, M. and Freund, C. (2008), "The anatomy of China's export growth", *Policy Research Working Paper Series 4628, The World Bank.*

Gaulier, G., Lemoine, F. and Ünal-Kesenci, D. (2007), "China's Integration in East Asia:Production Sharing, FDI & High-Tech Trade", *Economic Change and Restructuring*, Vol. 40 1-2, pp. 27–63.

Hertel, T.W. (Ed.) (1997), *Global trade analysis. Modelling and applications*, Cambridge University Press, Cambridge.

Jones, R.W. (2000), *Globalization and the theory of input trade*, MIT Press, Cambridge, Mass.

Jones, R.W. (2002), "Trade theory and factor intensities: an interpretative essay", *Review of International Economics*, Vol. 10, pp. 581–603.

Kawai, M., Lee, J.-W. and Petri, P.A. (Eds.) (2010), *Asian Regionalism in the World Economy: Engine for Dynamism and Stability*, UK: Edward Elgar, Cheltenham.

Kitwiwattanachai, A., Nelson, D. and Reed, G. (2010), "Quantitative impacts of alternative East Asia Free Trade Areas: A Computable General Equilibrium (CGE) assessment", *Journal of Policy Modeling*, Vol. 32 No. 2, pp. 286–301.

Koopman, R., Powers, W., Wang, Z. and Wei, S.-J. (2010), "Give credit where credit is due: Tracing value added in global production chains", *NBER Working Paper No. 16426*.

Latorre, M.C. (in press), "On the differential behaviour of national and multinational firms: A within and across sectors approach", *The World Economy*.

Latorre, M.C., Bajo-Rubio, O. and Gómez-Plana, A.G. (2009), "The effects of multinationals on host economies: A CGE approach", *Economic Modelling*, Vol. 26 No. 5, pp. 851–864.

Ma, A.C. and van Assche, A. (2010), "The role of trade costs in global production networks. Evidence from China's processing trade regime", *World Bank, Policy Research Working Paper No. 5490*.

Narayanan, B., Aguiar, A. and McDougall, R. (Eds.) (2012), *Global Trade, Assistance, and Production: The GTAP 8 Data Base*, Center for Global Trade Analysis, Purdue University.

National Bureau of Statistics of China, "Investment in Fixed Assets in Urban Area by Sector, Jurisdiction of Management and 5-14 Investment in Fixed Assets in Urban Area by Sector, Jurisdiction of Management and Registration Status (2007)", available at: http://www.stats.gov.cn/tjsj/ndsj/2008/indexeh.htm.

Rama, M. (2003), *Globalization and workers in developing countries*, World Bank, Development Research Group, Public Services, Washington, D.C.

Rutherford, T.F. (2005), *GTAP6inGAMS: The dataset and static model*, prepared for the workshop "Applied general equilibrium modeling for trade policy analysis in Russia and the CIS" Moscow, December 1-9.

Wang, Z., Powers, W. and Wei, S.-J. (2009), "Value Chains in East Asian Production Networks--An International Input-Output Model Based Analysis", *Office of Economics Working Paper, U.S. International Trade Commission 2009-10-C*.

Xing, Y. (2010), “Facts About and Impacts of FDI on China and the World Economy”, *China: An International Journal*, Vol. 8 No. 2, pp. 309–327.

Xing, Y. (2011), “Processing trade, exchange rates, and the People's Republic of China's bilateral trade balances”, *ADBI Working Paper Series*, No. 270.

Xing, Y. and Detert, N. (2010), “How the iphone widens the United States trade deficit with the People's Republic of China”, *ADBI Working Paper Series* No. 257.

刘富江 (2008), *中国工业经济统计年鉴*. *Translated as "China Industry Economy Statistical Yearbook"*, 中国统计出版社 (China Statistics Press).