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# How much can foreign multinationals affect the Chinese economy? A dynamic general equilibrium analysis of Japanese FDI

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# How much can foreign multinationals affect the Chinese economy?
## A dynamic general equilibrium analysis of Japanese FDI

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September 17, 2014

## Abstract

We analyze the impacts of a sharp fall of Japanese foreign direct investment (FDI) to China that occurred after the worldwide financial crisis in 2009. The study is conducted by means of a three-region (Japan, China, and the rest of the world (ROW)) recursive dynamic computable general equilibrium (CGE) model with multinational enterprises (MNEs) driven by FDI. Our simulation experiment showed that the FDI fall would cause price rises of Japanese affiliates' goods and a depreciation of the renminbi. These two forces with the FDI fall would heavily reduce exports and production of Japanese MNE affiliates, while increasing those in Chinese manufacturing. This, however, does not mean that China would be a gainer, because it would experience a contraction in its service sector. Its losses in its service sector would exceed the gains in the manufacturing sectors. Therefore, overall China would lose due to the FDI fall.

JEL classification codes: C68, F21, F23, F17

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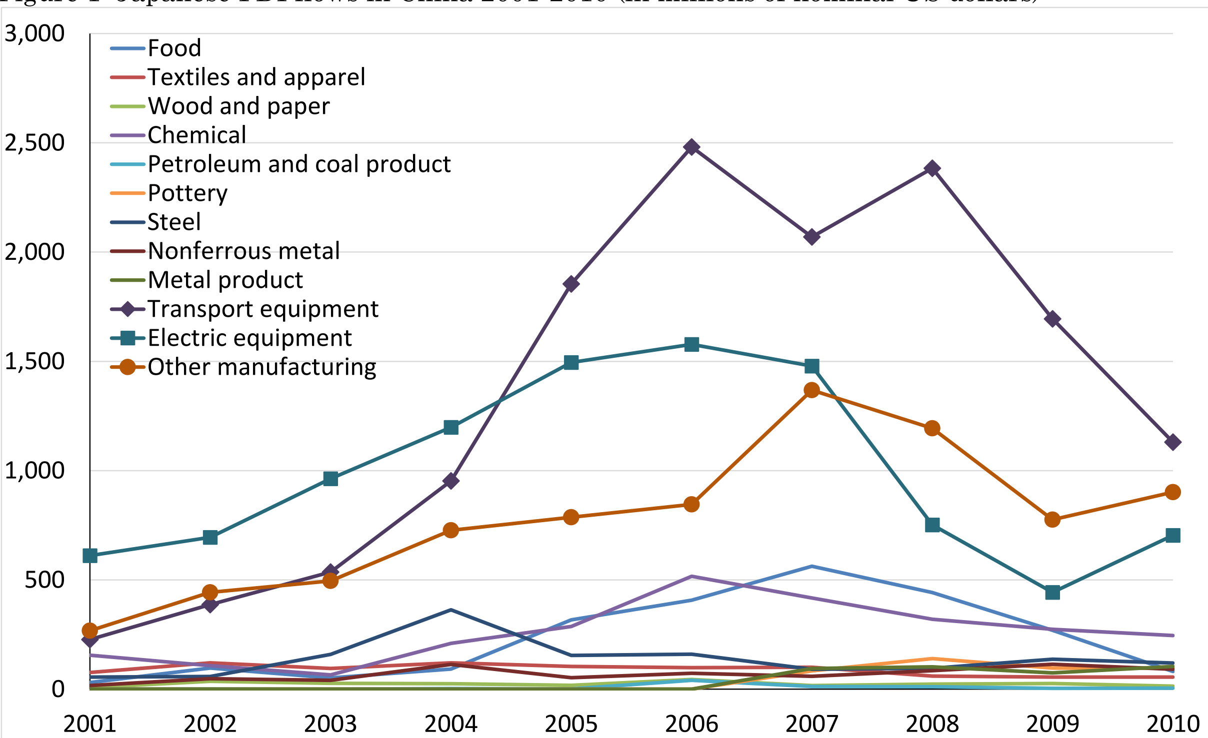
# 1. Introduction

In the *World Investment Prospect Survey* by UNCTAD (2012), China always appeared as the world's most attractive destination of foreign direct investment (FDI) in 2008-2012.[1] Among many countries, Japan is the largest economy investing in China, accounting for 7.3% of the total cumulative FDI flows, preceding the US (5.8%) and several major European countries (e.g., Germany, the UK and France together account for 4.1%).[2] This large FDI has been a powerful engine accelerating the Chinese economy (Dean et al., 2009; Kim et al., 2003). However, after the worldwide financial crisis in 2009, the FDI inflow fell sharply (Figure 1).

Figure 1: Japanese FDI flows in China 2001-2010 (in millions of nominal US dollars)




Source: Compiled by the authors based on METI data.

The mechanism boosting Chinese GDP and exports was anticipated to work oppositely in

[1] "China" refers to mainland China unless otherwise specified.

[2] A large part of cumulative FDI inflows to China stems from Hong Kong (35%) and "other (undefined)" (33.5%) (Xing, 2010). Although Hong Kong appears as the largest FDI donor to China, most of its FDI originally comes from different countries. Thus, it is hard to know who the ultimate investor is (Ramstetter, 2011).

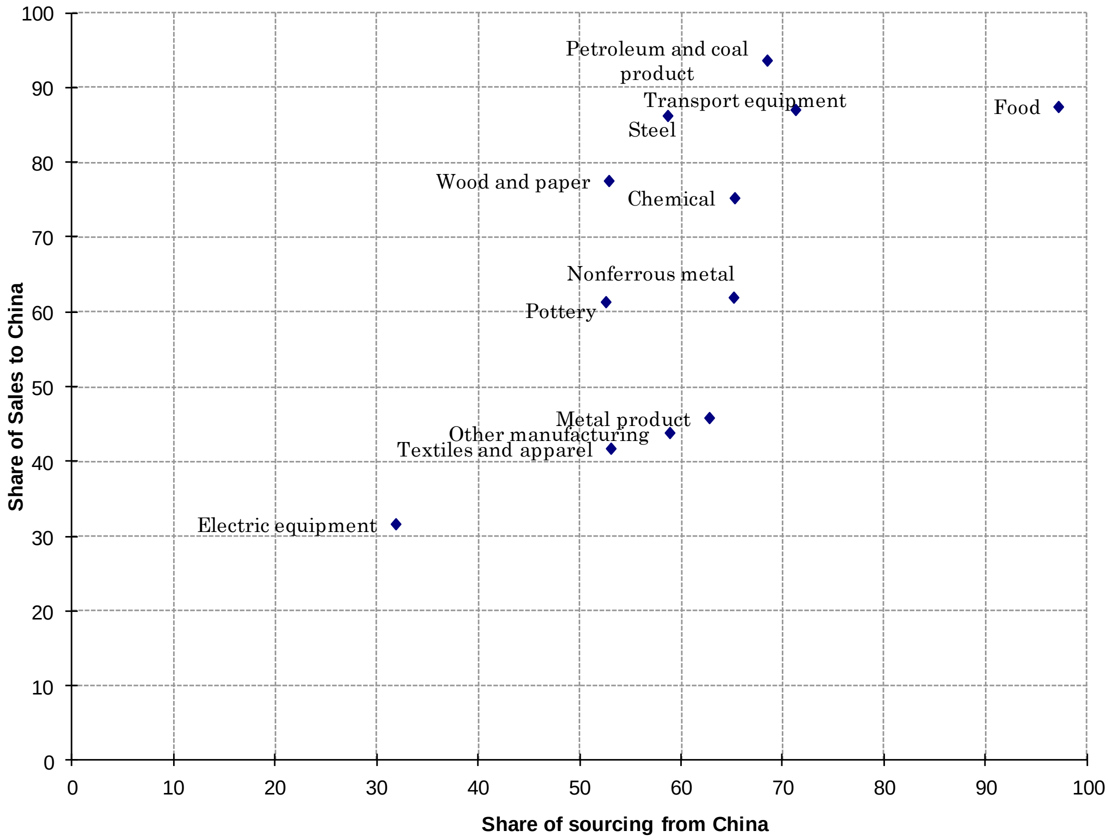
turn and to affect its macroeconomy adversely. This concern is often raised (e.g., Whalley & Xin, 2010; Zhang, 2013), but only a few studies have measured the magnitude of the negative impacts on the macroeconomy and output of industries that have committed to accepting FDI to a large extent.

Japanese multinational enterprises (MNEs) in China are predominant in manufacturing sectors (Dean et al., 2009; Greaney & Li, 2009). FDI is especially concentrated in three sectors: transport equipment, electric equipment, and other manufacturing (Figure 1). It steadily increased before the crisis and then decreased sharply. The sharp FDI fall especially affected these major FDI host sectors. Its negative impact can affect various activities of these sectors in terms of production, employment and foreign trade (Markusen, 2002).

Moreover, the impact of the FDI fall did not affect the Chinese economy alone. A tight linkage between China and Japan has rapidly developed because of the steadily growing FDI from Japan. MNE affiliates and local firms compete with and/or depend on each other in input markets (material, cheap labor, and capital goods) and output markets (domestic sales and exports). Baldwin-Okubo (2013) diagrams visualize their unique patterns by sector (Figures 2 and 3). For example, the position of food in Figure 2 (at the top right corner) indicates typical horizontal FDI with heavy dependence on the host economy for input sourcing and output sales. In contrast, the position of the electric equipment sector (close to the lower left corner) indicates export-platform FDI, where input is sourced mostly abroad and output is also sold mostly abroad. Japanese MNE affiliates work as a part of global supply chains. The position of the transport equipment sector in Figure 2 also indicates horizontal FDI, where the majority of input is sourced locally and output is mostly sold in the Chinese local market.

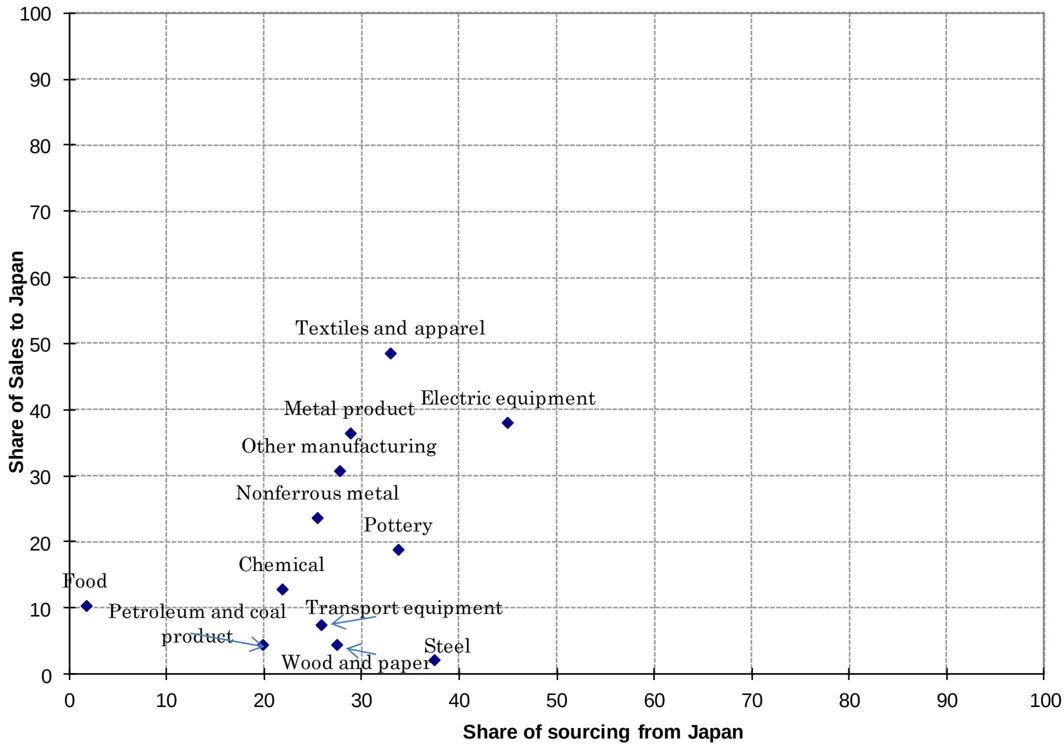
In these diagrams, many sectors are located in the center. Their patterns of competition and interdependence between the host and donor countries are not as clear as what the simple dichotomy of, say, vertical vs. horizontal FDI tells us. The impact of the FDI fall can be propagated in a complex manner between China and Japan and among sectors. Therefore, we need to employ a framework that can distinguish and describe different technologies and activities of MNE affiliates and local firms, and to quantify the ultimate impacts of the FDI fall on the macroeconomy.

Figure 2: Sales/Sourcing Patterns of Japanese MNE Affiliates to/from China




Source: Compiled by the authors based on METI data.

Figure 3: Sales/Sourcing Patterns of Japanese MNE Affiliates to/from Japan




Source: Compiled by the authors based on METI data.

While the fall of FDI inflow in China is marked (Figure 1) and the potential effects of the decrease in FDI could be very vast (Barba Navaretti &Venables, 2004; Latorre, 2009; Lipsey, 2002), the impact of the decrease has not been examined well either empirically or quantitatively considering both macro and microeconomic impacts comprehensively. This is partly because the literature of FDI has concentrated on the causes and consequences of its expansion, which has been prominent in the last decade in Asia. Armstrong (2009) studied determinants of Japanese FDI in China but not its impact on the Chinese economy. Xing (2006) found that the devaluation of the renminbi (RMB) substantially increased Japanese FDI to China. Locational attractiveness for Japanese FDI has been examined in many studies (e.g., Blaise, 2005; Cassidy Andreosso-O'Callaghan, 2006; Cheng, 2007; Kawai, 2009). Tanaka and Hashiguchi (2012) used firm-level data and measured technological spillovers from MNE affiliates to their nearby local firms in China. From a macroeconomic perspective, Whalley and Xin (2010) decomposed the GDP growth of China and found a substantial contribution of FDI inflow to the growth. Hosoe (2014) analyzed the impact of a power crisis in Japan on its FDI to China with a dynamic world trade CGE model and found that FDI would be intensified in power-consuming sectors. Gómez Plana and Latorre (2014) studied impacts of disinvestment in Spain with a static single country CGE model with FDI. However, given the unique pattern of FDI in Asia, as pointed by Baldwin and Okubo (2013) and Petri (2012), we cannot directly apply the findings of that Spanish case to this Chinese case.

In this study, we tried to answer the following two questions. The first one is how the fall of FDI from Japan to China has transformed the respective domestic economies in terms of, especially, industrial composition and competition between local firms and MNE affiliates. The second question is how much the evolution of FDI has changed the comparative advantages of their industries and the resulting trade patterns between them. The effects of the reduction of Japanese FDI flows into China have been studied with a world trade and recursive dynamic CGE model, calibrated to the GTAP database version 8 (Hertel, 1997). The presence and activities of Japanese MNE affiliates in China, in terms of sourcing of input and sales of output, is described with their rich and detailed survey dataset by METI, which is used complementarily to model MNEs in our CGE model. With a numerical experiment, we found the FDI fall would directly cause a contraction of Japanese MNE affiliates' output and that Chinese local firms would take over their role in manufacturing. This, however, does not mean China would gain, inasmuch as its service sector would be adversely affected. In contrast, Japanese manufacturing would reduce output of its MNE affiliates in China and that of its local firms in Japan but increase service output to finally gain in GDP.

The rest of the paper is organized as follows. The next section explains the model used in our analysis. Section 3 describes the data and the simulation scenario. The main results are discussed in Section 4, followed by the concluding Section 5.

## 2. Model

We develop a world trade CGE model with recursive dynamics that covers 20 sectors (Table 1) and 3 regions: Japan, China and the rest of the world (ROW). This sectoral aggregation pattern is chosen to describe the maximum details of the above-documented concentration of Japanese FDI in Chinese manufacturing by combining METI data with the GTAP database.

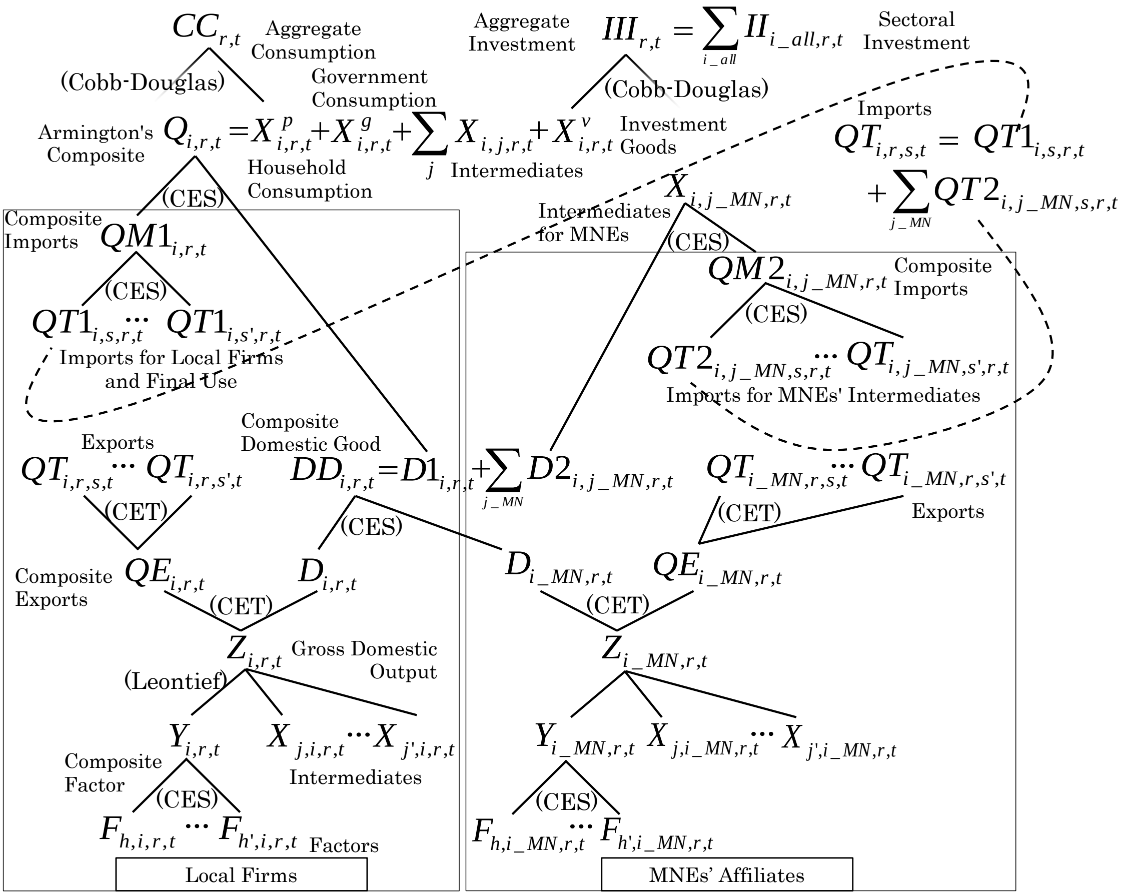
Table 1: Sectoral Aggregation

| Abbreviation | Sector |
|---|---|
| AGR | Agriculture |
| COA | Coal (mining) |
| OIL | Oil (mining) |
| GAS | Gas (mining) |
| FOD, FOD2* | Food |
| TXA, TXA2* | Textiles and apparel |
| WPP, WPP2* | Wood and paper |
| CHM, CHM2* | Chemical |
| PTC, PTC2* | Petroleum and coal product |
| POT, POT2* | Pottery |
| STL, STL2* | Steel |
| NFM, NFM2* | Nonferrous metal |
| MET, MET2* | Metal product |
| TEQ, TEQ2* | Transport equipment |
| EEQ, EEQ2* | Electric equipment |
| MAN, MAN2* | Other manufacturing |
| ELY | Electricity (energy) |
| TWG | Town gas (energy) |
| TRS | Transportation |
| SRV | Service |

*Note.* Asterisks denote sectors hosting Japanese MNE affiliates in China.

This model follows the line of the CGE model by Hosoe (2014) with nested constant elasticity of substitution (CES)/transformation (CET) structure, and distinction of MNE affiliates from local firms in 12 Chinese manufacturing sectors (Figure 4). No MNE affiliates are, however, assumed to operate in either Japan or the ROW; only China hosts MNE affiliates established with Japanese FDI.

Figure 4: Structure of the CGE Model for FDI Analysis (within a period)




Source: Adopted and modified from Hosoe (2014)

For this study, we made two modifications in his original model. While Hosoe (2014) assumed that both FDI and local investment were endogenously determined according to the sectoral mass and the rate of returns, we exogenize the FDI so that we can manipulate it to examine hypothetical changes in our counter-factual simulation. Second, we simplify the model by omitting the substitability among various energy inputs.

The input pattern (domestic vs. imported) and thus the cost structure of MNE affiliates and local firms are separately estimated using the METI data (Table 2). That is, Chinese local firms exhibit different costs compared to the Japanese MNE affiliates operating in the same sector. This feature was absent in many earlier CGE models with MNEs, as Latorre (2009) noted. Furthermore, by assuming two separate Armington (1969) CES/CET structures for local firms and

MNE affiliates as shown in the left and right panels in Figure 4, respectively, we can assume different import-domestic demand ratios and export-domestic supply ratios between these two subsectors (i.e., that with Chinese local firms and that with Japanese MNE affiliates) to reflect their import sourcing/export sales patterns. The output of these two subsectors (i.e., the domestic good produced by the local firms, $D_{i,CHN,t}$, and that of the MNE affiliates, $D_{i\_MN,CHN,t}$) are combined into a composite domestic good $DD_{i,CHN,t}$ using a CES aggregation function. This structure depicts competition between MNE affiliates and local firms. For this CES function, we use the elasticity of substitution often assumed for that between imports and domestic goods provided by the GTAP database, following Latorre et al. (2009).

Table 2: Sectoral Sales, Exports, and Imports of Japanese MNE Affiliates and their Share

| Sector | Sales [mil. USD] | Share [%] | Exports [mil. USD] | Share [%] | Imports [mil. USD] | Share [%] |
|---|---|---|---|---|---|---|
| Food | 4,809 | 1.0 | 600 | 2.5 | 95 | 0.1 |
| Textiles and apparel | 3,132 | 0.7 | 1,821 | 1.1 | 1,114 | 0.6 |
| Wood and paper | 598 | 0.2 | 138 | 0.3 | 182 | 0.1 |
| Chemical | 6,470 | 0.9 | 1,598 | 7.4 | 1,541 | 0.8 |
| Petroleum and coal product | 270 | 0.1 | 17 | 0.0 | 71 | 0.0 |
| Pottery | 1,063 | 0.3 | 410 | 1.6 | 311 | 0.0 |
| Steel | 5,145 | 1.1 | 704 | 1.9 | 1,847 | 0.9 |
| Nonferrous metal | 1,630 | 0.7 | 619 | 3.8 | 441 | 0.1 |
| Metal product | 1,460 | 0.7 | 790 | 1.8 | 343 | 0.4 |
| Transport equipment | 45,333 | 12.7 | 5,839 | 14.3 | 10,042 | 4.4 |
| Electric equipment | 30,306 | 6.2 | 20,710 | 7.5 | 16,081 | 1.2 |
| Other manufacturing | 37,474 | 3.2 | 21,064 | 6.2 | 11,422 | 1.0 |

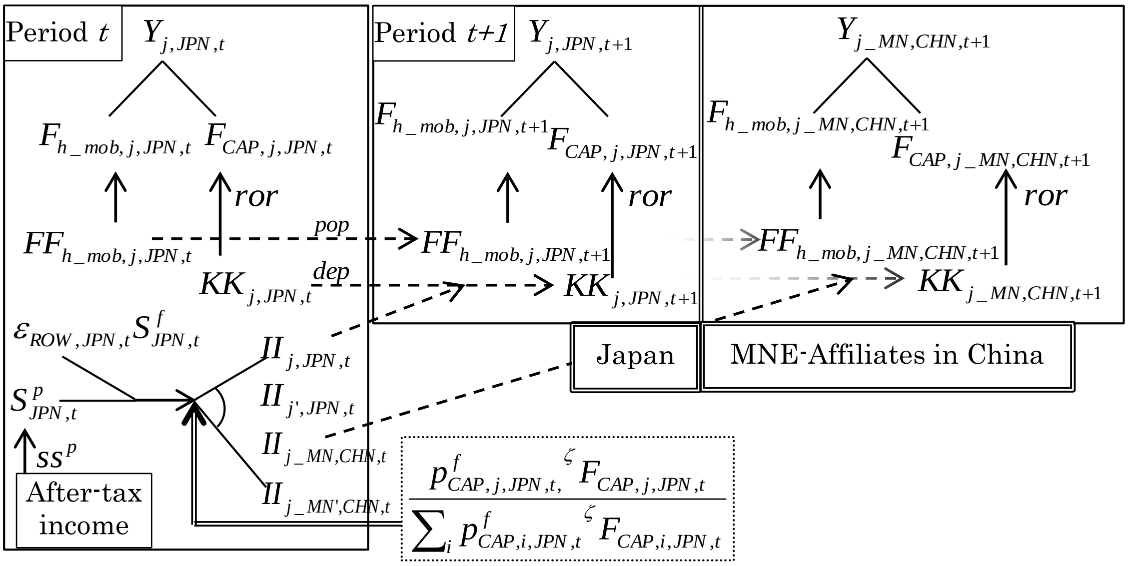
Source: compiled by the authors with METI data for sales, exports and imports and with the GTAP database for sectoral total sales, exports and imports.

Dynamics are intrinsically driven by savings with a constant propensity to save (Figure 5). The savings are allocated among sectoral investment for domestic firms, $II_{j,r,t}$, and the MNE affiliates in China, $II_{j\_MN,CHN,t}$. The domestic sectoral investment $II_{j,r,t}$ is determined by the share of their sectoral operating surplus $p^{f}_{CAP,j,r,t}{}^{\zeta} F_{CAP,j,r,t}$.[3] In contrast, the FDI $II_{j\_MN,CHN,t}$ is set to be exogenous for our counter-factual simulation as discussed above. This investment (or new capital) is added to the original putty-clay type capital stocks for the next period. Feeding a

[3] By manipulating the parameter $\zeta$, we can change the adjustment speed of capital stock through the installation of new capital in reaction to yield gaps among sectors. In this study, we assume $\zeta$ =1.

population growth rate $pop$, which drives the labor endowment $FF_{h\_mob,r,t}$, a depreciation rate $dep$, and a rate of returns of capital $ror$, the model generates a constantly growing path.

Figure 5: Dynamic Model Structure for the *j*-th Sector in Japan




Source: Adopted and modified from Hosoe (2014)

## 3. Data and Simulation Scenario

We use the GTAP database version 8 for the year 2007 (Hertel, 1997). As mentioned above, one of the strengths of our simulations lies in the use of a detailed dataset describing Japanese subsidiaries in China and their FDI evolution. We compute the share of Japanese affiliates in all the Chinese manufacturing industries by using data from the *Survey of Overseas Business Activities* by METI for 2007 and the annual average foreign exchange rate (117.754 JPY/USD) reported in *International Financial Statistics* by the IMF for 2007. Table 2 shows that the share of Japanese MNE affiliates in their sectoral sales in China is sizable in such sectors as transport equipment (12.7%), electronic equipment (6.2%) and other manufacturing (3.2%).[4] These sectors have been major FDI recipients in the recent evolution of these inward flows to China (Figure 1). Table 2 shows that the presence of Japanese MNE affiliates is often larger in exports than that in output, but smaller in imports. This relatively low dependence on imported intermediates implies a relatively weak backward linkage with their Japanese headquarters.

[4] Sectoral sales are used to separate input and output of Japanese MNE affiliates from those of Chinese local firms, following a common practice used in CGE models with MNEs (e.g., Lakatos & Fukui, 2013).

We assume a business-as-usual (BAU) path that is constantly growing at the rate of 2% per annum as the base of our comparative dynamics and run this recursive dynamic model for five periods to measure the short-run impact of the FDI fall.[5] In our counter-factual scenario, FDI flows are assumed to fall by a magnitude as large as its average decline during 2007-2010 (Table 3). Across all manufacturing sectors, FDI flows declined by 34% in these five years on average. Behind this general reduction, there were a few sectors that experienced a positive FDI change.

Table 3: Average Growth Rate of FDI Inflows in 2007-2010 (%)

| Host Sector in China | FDI Growth Rate |
|---|---|
| Food | -85 |
| Textiles and apparel | -44 |
| Wood and paper | -16 |
| Chemical | -40 |
| Petroleum and coal product | -59 |
| Pottery | 15 |
| Steel | 32 |
| Nonferrous metal | 57 |
| Metal product | 12 |
| Transport equipment | -45 |
| Electric equipment | -51 |
| Other manufacturing | -33 |
| Total | -34 |

Source: Computed by the authors based on the METI data.

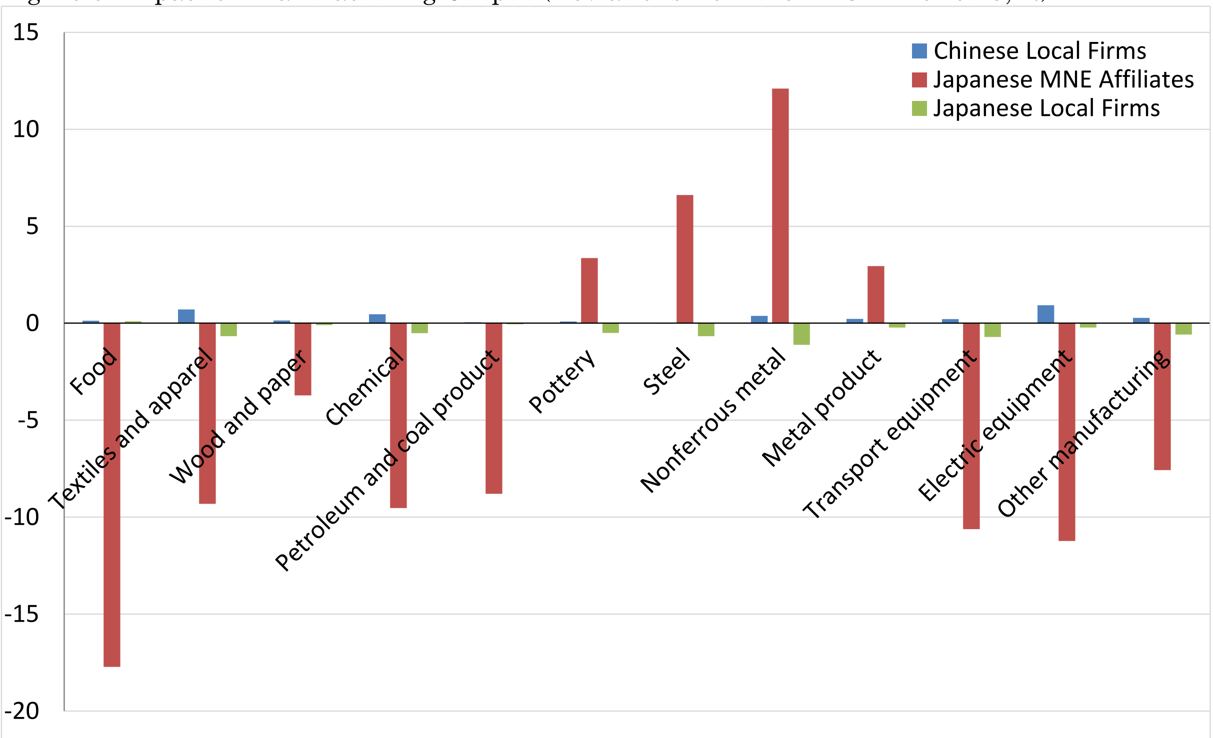
# 4. Simulation Results

## 4.1 Sectoral Impact

Results of the simulation indicated that the output of Japanese MNE affiliates in China would fall in general. Among the 12 manufacturing sectors, the food sector would experience the largest decrease of output (18%) while the nonferrous metals sector would show the largest increase, 12% (Figure 6). This is because we assumed that the former experienced the largest reduction of FDI by 85% and that the latter underwent the largest increase of FDI (57%). Comparing the assumed magnitude of FDI changes with that of the resulting output changes of MNE affiliates, the ratio is 4-5:1 in all sectors but the petroleum and coal product sector. That is, about 20-25% of the original magnitude of FDI changes would be transmitted to the output changes.

[5] The direction of the impacts does not change even when we extend the time horizon of our experiment.

Figure 6: Impact on Manufacturing Output (Deviations from the BAU in Period 5, %)



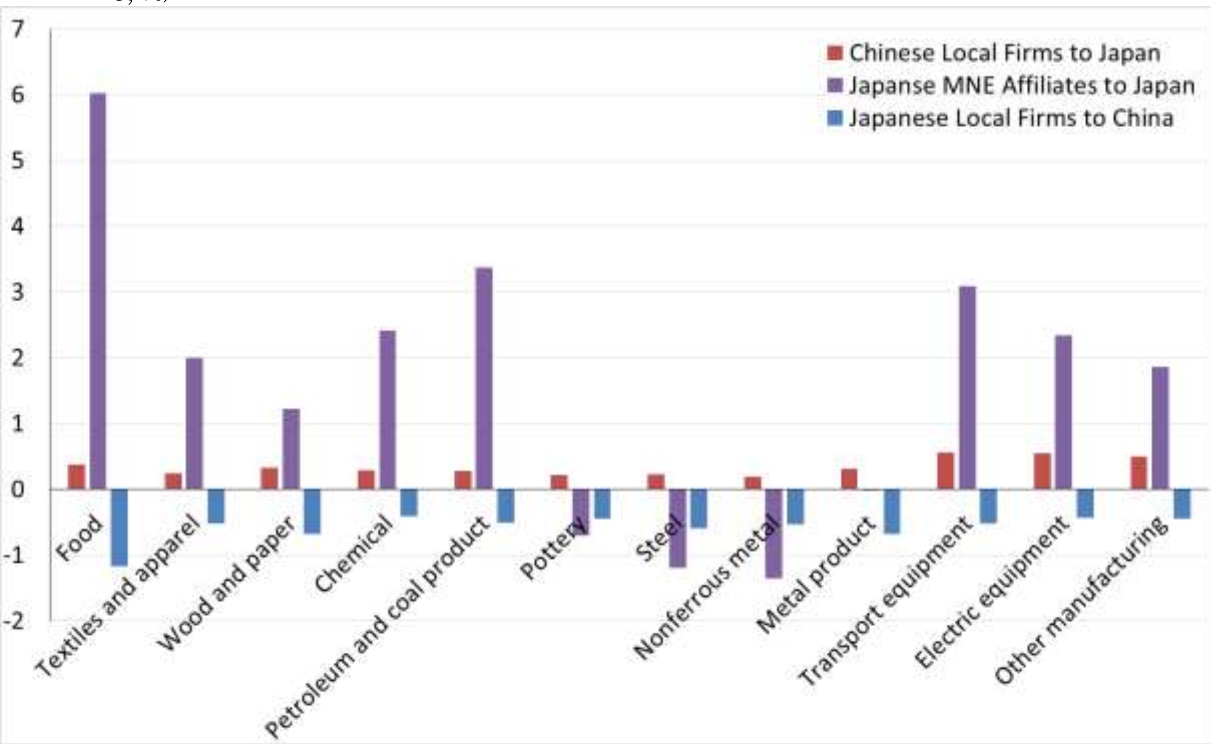

Source: Simulation results

The impact of FDI changes on output of local firms in China and Japan would be relatively small. This is because the output of Japanese MNE affiliates does not have significant market share in China (Table 2). However, a deeper analysis of their changes can provide greater insight. In China, the electric equipment sector would gain most, followed by the textiles and apparel sector. Japanese MNE affiliates in these two sectors are located in the upper right area among these 12 sectors in the Baldwin-Okubo (2013) diagram (Figure 3). That is, the MNE affiliates in these two sectors among the 12 sectors are most (but not fully) dependent on Japan both in sourcing and sales. In their absence due to their FDI fall, Chinese local firms would take over the role that Japanese MNE affiliates played and increase their output. Many other Chinese local manufacturing sectors would gain. The larger contraction the rival MNE affiliates show, the larger the Chinese local firms would gain.

In Japan, all sectors but food would reduce their output although we often expect that a FDI fall could lead to a return of investment to the domestic sectors and thus an increase of their output in Japan. This puzzling result is caused partly because the contraction of MNE affiliates in China would reduce demand for intermediates supplied by Japanese local firms. However, as many of the Japanese MNE affiliates are not so much dependent on intermediates imported from Japan (Figure 3), this would not be the decisive reason. The key driver of this phenomenon is rather the foreign exchange rate.

The patterns of FDI flows would not only affect production of Japanese MNE affiliates but also their prices. A lower level of capital accumulation from FDI would result in higher capital remunerations and thus higher product prices and their export prices of MNE affiliates (Figure 7)[6]. This export price rise would make the MNE affiliates' exports less competitive and thus cause a decline in their volume (Figure 8). The bilateral trade between China and Japan would contract (by 1.0% for the Chinese exports and by 2.5% for the Japanese exports) (Table 4). At the same time, the FDI fall would directly reduce demand of the RMB for investing in China. They would jointly make the RMB depreciate by 0.8% vis-à-vis the Japanese yen (JPY) and less (around 0.3%) against the US dollar (USD). This RMB depreciation would cause a decrease of Japanese exports and output.

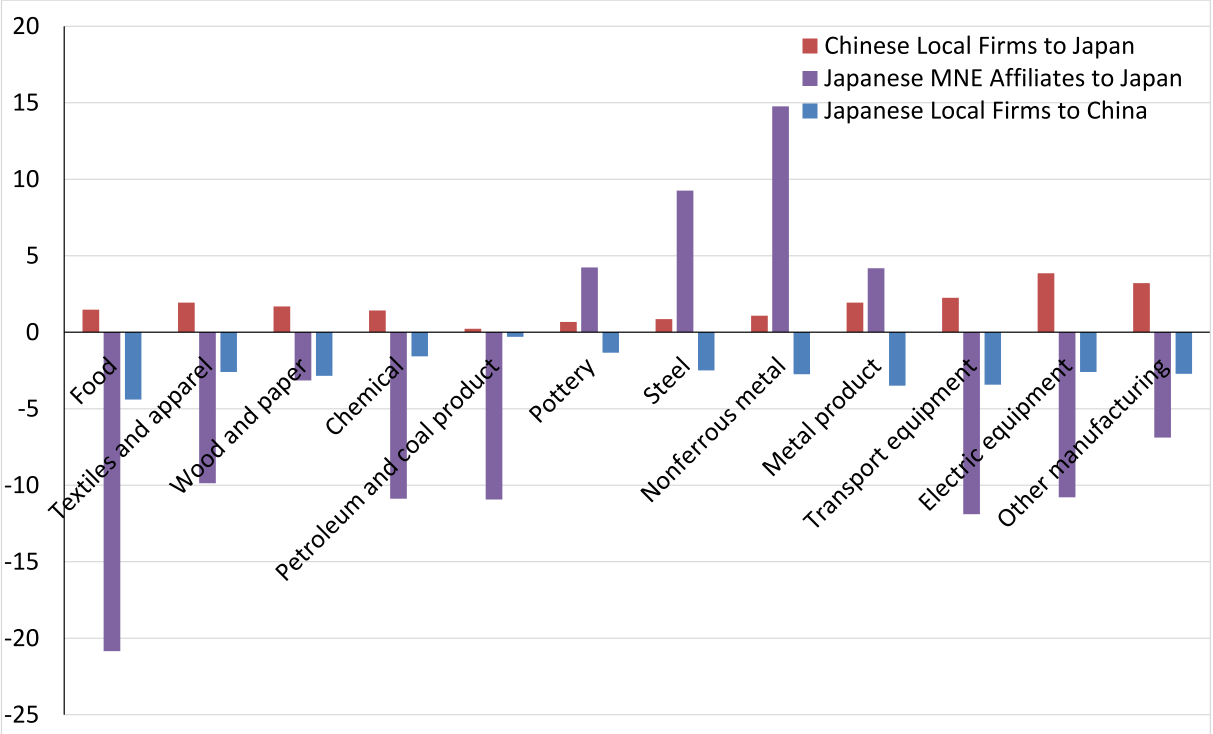
Figure 7: Impact on Prices of Bilateral Manufacturing Exports (Deviations from the BAU in Period 5, %)




Source: Simulation results

[6] The export prices are measured relative to a numeraire price (index of Armington's composite good prices).

Figure 8: Impact on Bilateral Manufacturing Exports (Deviations from the BAU in Period 5, %)




Source: Simulation results

Table 4: Impact on Total Output and Exports of the 12 Manufacturing Sectors (Deviations from the BAU in Period 5, %)

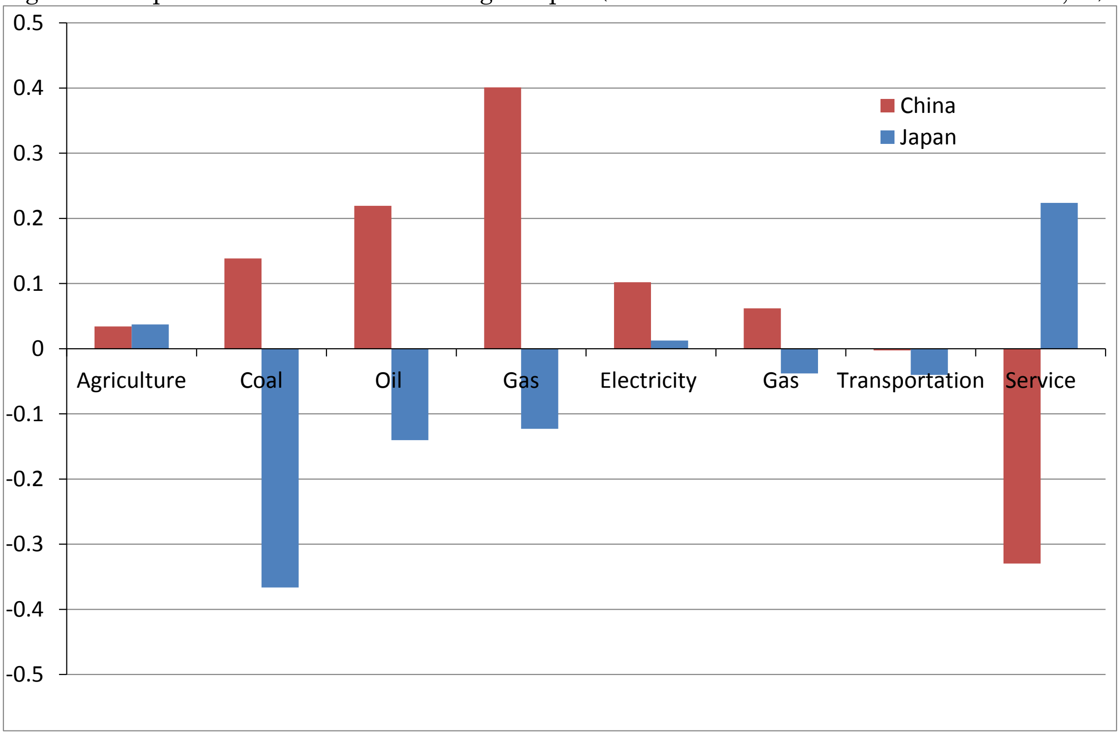
| | | Output | Exports | | | |
|---|---|---|---|---|---|---|
| | | Total | Total | o/w *to China* | *to Japan* | *to the ROW* |
| China | Total | 0.1 | 0.5 | - | *-1.0* | *0.7* |
| | o/w *Chinese local firms* | *0.3* | *1.0* | - | *2.3* | *0.9* |
| | *Japanese MNE affiliates* | *-8.9* | *-9.2* | - | *-8.8* | *-10.2* |
| Japan | | -0.4 | -1.5 | *-2.5* | - | *-1.3* |
| the ROW | | 0.0 | 0.0 | *-0.5* | *1.2* | *0.0* |

Note: Laspeyres quantity indexes are computed on the basis of simulation results.

## 4.2 Aggregate Impact

Just because the total manufacturing output would increase in China and decrease in Japan, can we conclude that China would gain and that Japan would lose? To answer this question, we need to examine the impacts on the non-manufacturing sectors. This RMB depreciation would discourage exports and production of tradable sectors (i.e., manufacturing) in Japan and thus make investment in these sectors less profitable. Finally, resources would move into the service sector and thereby increase its output by 0.2% (Figure 9). In contrast, Chinese manufacturing sectors would expand while its service sector would contract by 0.3%.

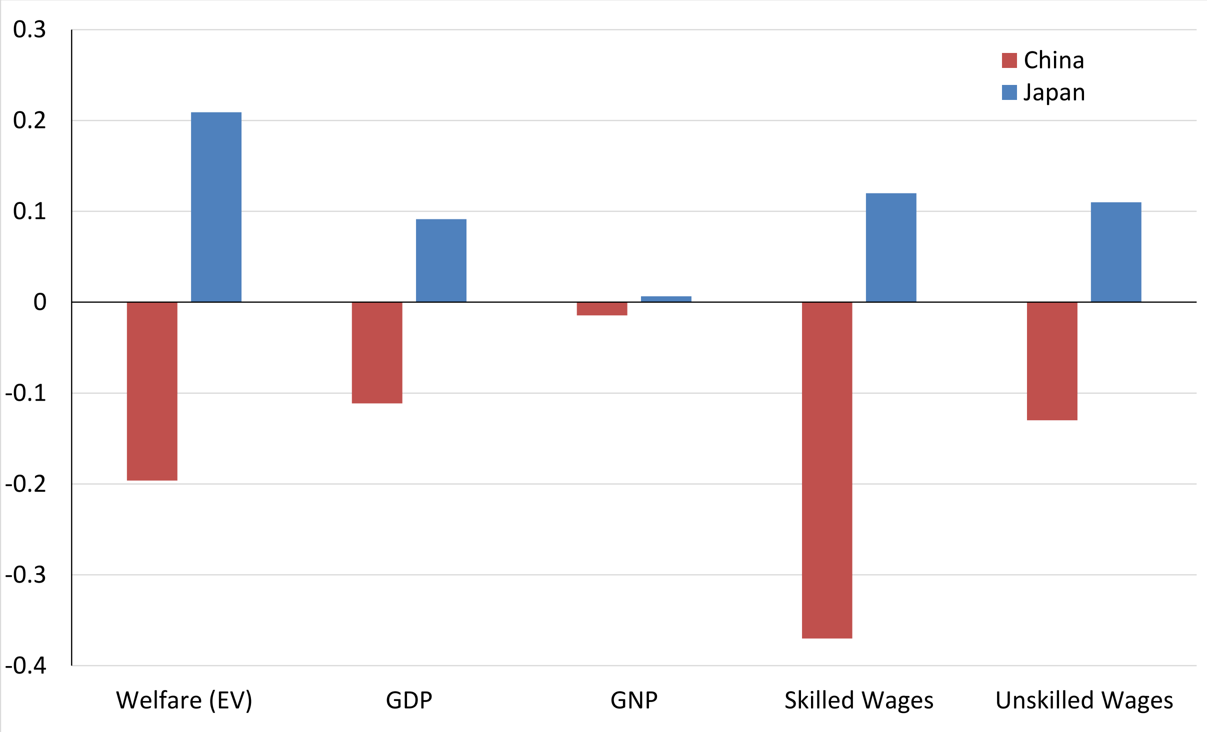
Figure 9: Impact on Non-manufacturing Output (Deviations from the BAU in Period 5, %)




Source: Simulation results

As no direct shock is assumed in the non-manufacturing sectors, their output changes would be small across sectors and regions. On the other hand, the services sector is very large among these non-manufacturing sectors, accounting for 28% and 58% of overall production in China and Japan, respectively. Even a small output change in this sector would have a large significance. Combining the gains in manufacturing with the losses in service, we find that China would lose in terms of its GDP/GNP and equivalent variations (EVs) (Figure 10). By the same logic, Japan would gain overall. The nationality of capital stocks is not changed in our simulation but only the location where capital stocks are installed is changed (i.e., FDI vs. domestic investment). Therefore, GNP would not be affected so significantly; the change of GDP would be larger. The wage rate of skilled labor would fall larger than that of unskilled labor. As the service sector in China employs more skilled labor than unskilled labor, its contraction would affect skilled labor more severely.

Figure 10: Impact on Welfare (EV, % of the BAU GDP), GDP, GNP, and Wages (Deviations from the BAU in Period 5, %)




Source: Simulation results

## 5. Conclusions

Japan is the largest single country investing in China in the form of FDI. FDI is often fickle and volatile in response to various news and shocks. While Japan had long committed to the Chinese economy with FDI, we learned after the financial crisis that this trend would no longer be sure and could reverse suddenly. We simulated the sharp FDI fall that we observed after the financial crisis with a dynamic CGE model and quantified its impact not only on the Chinese economy but also on the Japanese economy.

While the contraction of Japanese FDI would benefit many Chinese manufacturing sectors, especially textiles and apparel, and electric equipment, it would cause a depreciation of the RMB that would accelerate manufacturing exports. The aggregate results show that the FDI fall would not be good news for China since it would lead to lower welfare, GDP, and wages, which would originate mostly from a contraction of its service sector. In contrast, Japan would benefit from this FDI fall despite declines of manufacturing output and exports. This implication is derived by using a comprehensive macroeconomic framework with microeconomic details describing production, trade, and investment by sector.

Economies are becoming more globalized and integrated. With negative news, FDI can move back to Japan as quickly as it moved out to China for a small profit margin. Eventually, a nation-wide riot hitting many Japanese MNE affiliates in China in 2012 made Japanese companies hesitate to invest in China further. While we simulated the FDI fall after the financial crisis in 2009, our quantitative result provides insight into the impact of another possible negative shock on Japanese FDI. These days, Japanese MNE affiliates are accelerating FDI to countries other than China. We can elaborate our CGE model framework by incorporating FDI to third parties and the impact of switching FDI destinations from China to other countries in the context of globalizing Asian economies.

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## Appendix: Sensitivity analysis

In order to check the robustness of the model we rerun the same simulation as before just modifying the values of the elasticities in the model. In Figure A, we show the macroeconomic impacts in period 5 with the standard elasticities (whose results had been presented in Figure 10) and with other values for three parameters. First we change the value of $\zeta$ , i.e., the parameter that grasps the speed in installing new capital stock in reaction to yield gaps among sectors. In the standard model, it takes a value of 1, which implies that the new capital will follow the mass of previous capital taking into account both the capital service price and the capital input. We rerun the model giving it a value of 2. In this latter case, investors regard the capital service price more important in their adjustment decisions than the mass of capital, which accelerates the convergence of capital service prices among sectors. As shown in Figure A, this change would not imply any significant difference compared to the standard case. We also used alternative values for the (top-level) Armington elasticity and the (bottom-level) elasticity of substitution among different origins of imports and found that the predicted macro indicators differ only in magnitude, but not in sign.

Figure A: Results of the Sensitivity Analysis in GDP (Deviations from the BAU in Period 5, %) and Welfare (EV, % of the BAU GDP)