Quantifying the Economic Impact of U.S. Offshoring Activities in China and Mexico

—— a GTAP-FDI Model Perspective

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Introduction

U.S. offshoring activities in emerging market economies, such as China and Mexico, have raised much interest. Particular attention has been paid to U.S. offshoring activities in some specific sectors, for instance, to Mexico's transportation equipment sector and to China's electronics sector. For example, McCalman and Spearot (2013) use an econometrics analysis to see how complexity, variety vintage[1] and production scales affect the share of U.S. motor vehicle production offshored to Mexico, and find that U.S. offshored varieties to Mexico in the motor vehicle sector tend to be of older design vintage, less complex, and lower scale. McCalman and Spearot (2015) use a difference-in-difference methodology to analyze how the Corporate Average Fuel Standards (CAFE) rule[2] affects U.S. offshoring of motor vehicle production to Mexico before and after NAFTA, and find that when NAFTA relaxed the CAFE rule for Mexican production, it provided an additional reduction in the cost of offshoring vehicles to Mexico for those varieties regulated by CAFE. Zhou and Latorre (2014) study the influence of foreign direct investment (FDI) received by the electronics sector in China on production and trade among China, the United States, and East Asian trading partners, using a computable general equilibrium (CGE) model. The policy shock is an exogenous 100 percent increase in the capital stock in the electronics sector in China. The authors find that the increase in capital stock results in exports of electronics from China to the United States increasing by 32.5 percent, while Chinese domestic production of electronics would increase by 34.2 percent. Furthermore, the authors show that exports of electronics from the other three regions to each other decline by at least 7.5 percent, while exports of electronics from the United States to China would increase by 4.1 percent. The authors note that this pattern reflects the large amount of electronics China imports as intermediate goods.

Meanwhile, there are very few literature comparing the different patterns of U.S. offshoring activities in China and Mexico, and its likely impact on output, trade, investment and employment, particularly using a computable general equilibrium (CGE) model framework. This paper tries to bridge this gap by comparing how U.S. offshoring activities in China and Mexico would change if the two U.S. main trading partners adopt similar investment policies towards the United States. A CGE model incorporates real production, consumption and international trade and investment data of the economies into a rigorous theoretical framework. The modelling framework allows comparison of different economies in two environments: one in which the base values of policy instruments such as tariffs and investment

[1] The variety vintage is the proxy for the quantity of human capital in production.

[2] The regulatory CAFE standards were distinct for U.S. domestically produced vehicles and imported production. Before NAFTA was implemented, U.S. firms need to meet separate standards for their U.S. and Mexican production. Mexican light-truck exports to the United States are treated as imported commodities, and therefore were subject to distinct rules under CAFE from U.S. domestic light-truck production. After NAFTA however, Mexican production was treated the same as domestic production, and so trucks produced in Mexico were required only to meet the same regulatory standards as trucks produced in the United States and of the same class.

restrictions are unchanged, and one in which these measures are changed, or “shocked”, to reflect the policies that are being studies (USITC, 2016).

The CGE model framework used in this paper is the Global Trade Analysis Project (GTAP)-FDI model first developed by Lakatos and Fukui (2014), which incorporates FDI stock and foreign affiliate sales data into the standard GTAP model framework. This paper further improves the Lakatos and Fukui(2014) version of the GTAP-FDI model by incorporating the linkage between exports and FDI into the model.

The paper is organized as follows. Section 2 describes the current pattern of U.S. offshoring activities in China and Mexico. Section 3 describes the framework of the GTAP-FDI model, explains the linkage between exports and FDI that is built into the model, as well as the data and simulation scenarios. Section 4 presents the simulation results both at the aggregate and sectoral levels. Section 5 concludes.

U.S. Offshoring Activities in China and Mexico

U.S. offshoring activities in China continue to grow in the past couple of years. Total U.S. foreign affiliate sales (FAS) in China increased from $143.7 billion in 2009 to $341.2 billion in 2014.[3] According to the 2014 U.S. FAS data in China, U.S. offshoring activities mainly go to China’s manufacturing sector — U.S. FAS in China’s manufacturing sector totaled $204.3 billion in 2014, which accounts for 59.9 percent of total U.S. FAS in China in 2014. Meanwhile, U.S. FAS in China’s services sector reached $132.0 billion in 2014, accounting for 38.7 percent of total U.S. FAS in China. Table 1 reports U.S. FAS in China in 2014, by sector.

Table 1: U.S. Foreign Affiliate Sales in China, 2014, in million dollars		Share of Total
agriculture, forestry, fishing and hunting	173	0.1%
mining, other	1979	0.6%
oil and gas extraction	2703	0.8%
food manufacturing	10917	3.2%
beverages and tobacco products	2024	0.6%
textiles, apparel and leather products	2265	0.7%
wood products	35	0.0%
paper and printing and related support activities	3505	1.0%
petroleum and coal products	49	0.0%
chemicals, plastics and rubber products	48773	14.3%
nonmetallic mineral products	1926	0.6%
primary metals	4295	1.3%
fabricated metal products	3802	1.1%
transportation equipment manufacturing	21666	6.3%
computer and electronic products	65463	19.2%
machinery, electrical equipment, appliances and components	24718	7.2%

[3] The data includes total FAS from U.S. majority-owned foreign affiliates operated in China, and is from the U.S. Bureau of Economic Analysis (BEA).

miscellaneous manufacturing and furniture and related products	14889	4.4%
utilities	0	0.0%
construction	498	0.1%
wholesale and retail trade, and accommodation and food services	106629	31.2%
wholesale trade	78818	23.1%
retail trade	17711	5.2%
accommodation and food services	10100	3.0%
transportation and warehousing services	4481	1.3%
Information services	3975	1.2%
banking and other finance	3388	1.0%
insurance credits and other activities	474	0.1%
real estate and renting and leasing	933	0.3%
other services	11662	3.4%
Total	**341222**	**100.0%**

Baseline Data from the GTAP-Foreign Direct Investment (FDI) model, pulled from the U.S. Bureau of Economic Analysis

As is illustrated from table 1 above, among China's manufacturing sector, the computer and electronic products sector has the highest amount of U.S. FAS, totaling $65.5 billion, followed by the chemical, rubber and plastic products ($48.8 billion), and machinery and electrical equipment ($24.7 billion). Within China's services sector, wholesale trade has the highest amount of U.S. FAS, totaling $78.8 billion, followed by retail trade ($17.7 billion) and accommodation and food services ($10.1 billion).

Compared to U.S. offshoring activities in China, U.S. offshoring activities in Mexico demonstrate very different patterns — Mexico has a much higher U.S. FAS in its transportation equipment manufacturing, retail trade, as well as banking and other financial services sectors than China does (table 2). Meanwhile, Mexico also has a much lower U.S. FAS in its computer and electronic products, machinery and other electrical appliances, as well as the wholesale trade sector, compared to China.

Table 2: U.S. Foreign Affiliate Sales in Mexico, 2014, in million dollars		**Share of Total**
agriculture, forestry, fishing and hunting	1350	0.5%
other mining	5816	2.3%
oil and gas extraction	346	0.1%
food manufacturing	13280	5.2%
beverages and tobacco products	2814	1.1%
textiles, apparel and leather products	1025	0.4%
wood products	1	0.0%
paper and printing and related support activities	262	0.1%
petroleum and coal products	521	0.2%
chemicals, plastics and rubber products	23156	9.1%
nonmetallic mineral products	1219	0.5%
primary metals	2583	1.0%
fabricated metal products	1602	0.6%

transportation equipment	66413	26.2%
computer and electronic products	6592	2.6%
machinery, electrical equipment, appliances and components	12009	4.7%
miscellaneous manufacturing and furniture and related products	4488	1.8%
utilities	487	0.2%
construction	2114	0.8%
wholesale and retail trade, and accommodation and food services	70589	27.9%
wholesale trade	32761	12.9%
retail trade	37059	14.6%
accommodation and food services	769	0.3%
transportation and warehousing	4698	1.9%
Information services	3126	1.2%
banking and other finance	19926	7.9%
insurance credits and other activities	687	0.3%
real estate and renting and leasing	1455	0.6%
other services	6840	2.7%
Total	**253399**	100.0%

Baseline Data from the GTAP-Foreign Direct Investment (FDI) model, pulled from the U.S. Bureau of Economic Analysis

As is illustrated in table 2 above, within Mexico's manufacturing sectors, transportation equipment has the highest amount of U.S. FAS, totaling $66.4 billion, followed by chemical, rubber and plastic products ($23.2 billion) and food manufacturing ($13.3 billion). When it comes to the services sector, the retail trade sector in Mexico has a much higher U.S. FAS in 2014 compared to that of China's retail trade sector – Mexico's retail trade has the highest amount of U.S. FAS in 2014, reaching $37.1 billion, followed by wholesale trade ($32.8 billion) and banking and other financial services ($19.9 billion).

Model and Simulation Scenarios

Structure of the GTAP-FDI Model

The GTAP-FDI model is a CGE model which incorporates FDI stock and FAS data. It is a comparative static, multi–regional and multi–sector CGE model which differentiates between domestic and foreign firms both on the demand and supply side (Lakatos and Fukui, 2014). As an extension of the standard GTAP model, the major difference between the Lakatos and Fukui (2014) model with FDI and the standard GTAP model is that the former incorporates an additional level of nesting representing the region of ownership— Using Mexico's transportation equipment sector as an example -- in the first stage, consumers allocate expenditure between domestically produced and imported transportation equipment. Then, in the second stage, there is an additional nesting in the sense that Mexico's domestically produced motor vehicles are further divided by either produced by Mexican domestic firms or foreign firms. Meanwhile, expenditure on imported motor vehicles is allocated across different importing regions, and finally allocated across ownership categories to various multinational companies in these importing regions, respectively.

On the supply side, compared to the standard GTAP model, the Lakatos and Fukui (2014) model with FDI differentiates between domestic firms and foreign-owned affiliates of multinational companies. Using Mexico's domestic supply of transportation equipment as an example -- it is composed of output of both domestic automobile firms and foreign-owned automobile firms located in Mexico. Foreign-owned firms are then further differentiated by country of ownership. Furthermore, each of these firms combines value-added and intermediate inputs using a Leontief technology to produce final goods, which implies that intermediate inputs are differentiated by not only the regions of firm location, but by the region of firm ownership as well (Lakatos and Fukui, 2014). Therefore, the model represents heterogeneous production technologies for firms differentiated by the region of ownership as well as location.

Implementation of Exports-FDI Linkage into the GTAP-FDI Model

In the Lakatos and Fukui (2014)'s FDI model, capital stock is assumed to be fixed at the national level and can only move across sectors, barring the establishment of a linkage between trade flows and FDI. However, there are abundant empirical evidences supporting the hypothesis that there is a close linkage between the reduction of trade costs and FDI flows. For instance, using a gravity model with panel dataset from 1990 to 2000 among 17 OECD countries, Bergstrand and Egger (2007) found that free trade agreements (FTAs) between two countries are associated with a lower level of bilateral investment. Using U.S. outbound FDI for the years 2005 to 2015 and applying the same gravity model of FDI as in Bergstrand and Egger (2007), USITC (2016) also found that U.S. bilateral and regional trade agreements had a significant negative effect on U.S. outbound FDI in manufacturing industries.

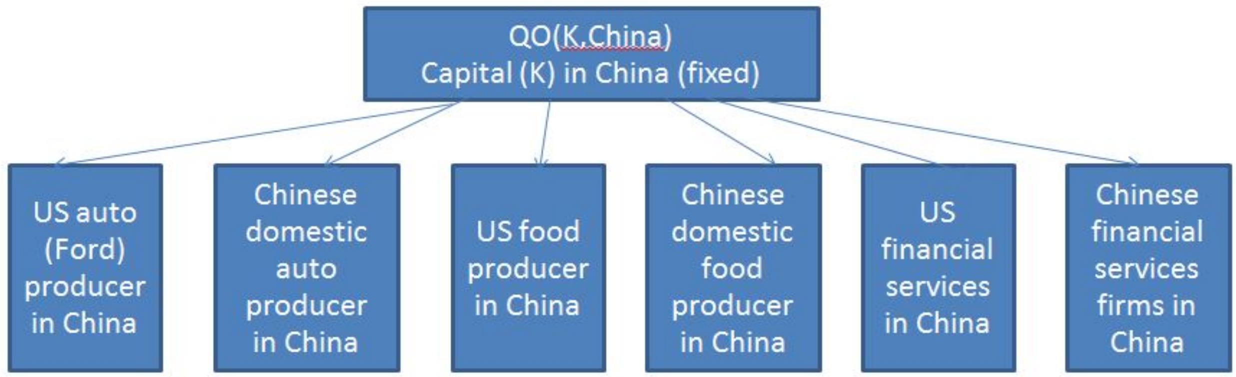
There are also econometric studies that have tested and confirmed that the aforementioned inter-modal switching between exports and FDI happened not only in merchandise trade and FDI, but also in the services sector. Riker (2015) uses U.S. foreign affiliate sales data from 2009 to 2012 to analyze how mode 1 and mode 3 barriers affect foreign affiliate sales. The econometric results indicate that eliminating restrictions on mode 1 cross-border exports of services would reduce foreign affiliate sales by 24.2 percent on average.

Given the ample empirical evidence of the aforementioned relationship between bilateral trade and FDI, this paper improved the Lakatos and Fukui (2014) version of the GTAP-FDI model by building the linkage of bilateral trade and FDI into the model. In this section, we explicitly demonstrate how to bring the abovementioned theory into the GEMPACK programming language of the model by offering code snippets where applicable.

Capital (K) Movement in Lakatos and Fukui (2014) FDI Model

In Lakatos and Fukui (2014) version of the FDI model, capital is used as an input for production, and total capital used in each country is fixed. As an input, capital is then allocated across different sectors and could move across sectors in each country. However, capital could not move across borders. Using capital used in China as an example: Total capital used in China is fixed, and it could be used by Chinese domestic firms and foreign affiliates located in China in different sectors (see figure 1 below):

Figure 1:



The capital movement assumption in Lakatos and Fukui (2014) version of the FDI model is implemented in the code as:

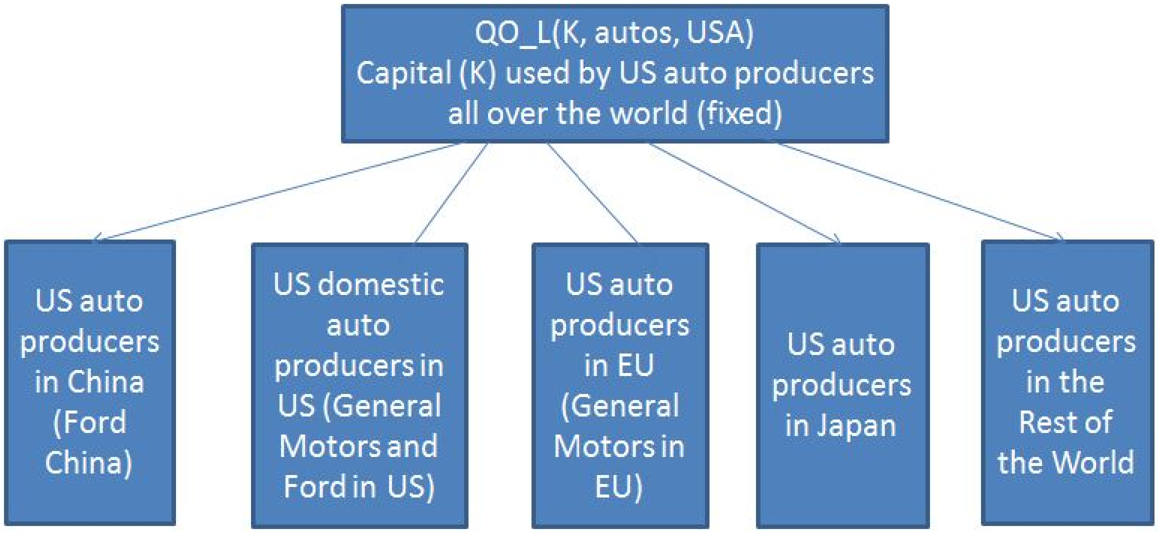
```
Equation ENDW_SUPPLY
# eq'n distributes the sluggish endowments across sectors (HT 51) #
(all,i,ENDWS_COMM)(all,j,TRAD_COMM)(all,l,LOC)(all,o,OWN)
   qoes_mnc(i,j,l,o) = qo(i,l) - endwslack_mnc(i,l,o)
                    + ETRAE(i) * [pm(i,l) - pmes_mnc(i,j,l,o)];
```

Where qoes_mnc(i,j,l,o) is capital input i used in industry j in region l owned by parent companies in region o. qo(i,l), which is the total capital input used in region l, is fixed, and is in large part determined by the price of the capital input used in region l, which is pm(i,l) in the equation.

Capital Movement which Builds a Linkage between Exports and FDI

In order to establish a linkage between exports and FDI, this paper revised the assumption of capital movement in Lakatos and Fukui (2014) version of the model and in turn assumes that capital could move across borders but is sector specific. Using capital used by U.S. motor vehicle producers as an example: this paper assumes that capital, as an input, used by U.S. motor vehicle producers all over the world is fixed, and this fixed amount of capital is allocated among U.S. domestic motor vehicle producers, and U.S. motor vehicle foreign affiliates located all over the world (see figure 2 below):

Figure 2:



The capital movement assumption in our model is implemented in the code as:

```
Equation ENDW_SUPPLY
# eq'n distributes the sluggish endowments across sectors (HT 51) #
(all,i,ENDWS_COMM)(all,j,TRAD_COMM)(all,l,LOC)(all,o,OWN)
   qoes_mnc(i,j,l,o) = qo_l(i,j,o) - endwslack_mnc(i,j,o)
                     + ETRAE(i) * [pm_l(i,j,o) - pmes_mnc(i,j,l,o)];
```

Again qoes_mnc(i,j,l,o) is the capital input i used in industry j in region l owned by parent companies in region o. The major difference, compared to the Lakatos and Fukui (2014) version of the FDI model, is that in our version of the model, qo_l(i,j,o), which is capital i used in industry j all over the world, owned by parent companies in region o is fixed, thus allowing sector-specific capital to move across borders. In the next section, we would illustrate how this change to the model would be able to account for the linkage between exports and FDI.

We calibrate the model to GTAP 9 Data Base (Aguiar, Narayanan and McDougall, 2016) for 2011, with foreign affiliate sales and FDI stock data incorporated (Lakatos and Fukui, 2014). In order to capture the most current economic situation in the world, we also updated the total exports and imports of all major regions, U.S. sectoral trade flows with China and Mexico, as well as U.S. GDP and output data in the model to 2016. U.S. FAS data to China and Mexico was updated to 2014.[4] We aggregate the data base to 8 regions: USA, China, Mexico, Canada, Hong kong, Britain, rest of 27 EU member countries, and the rest of the world; and 26 sectors.

We also change the fixed labor supply assumption into a flexible labor supply in our model specification. Under the fixed labor supply assumption, the aggregate labor supply in each country remains unchanged, which implies that workers do not work more (either by working longer hours or by joining the labor force) in response to an increase in wages. However, a reduction of tariff and/or investment barriers in one country is expected to affect aggregate labor supply in that country accordingly as increases in real

[4] This is the most recent data available from the U.S. Bureau of Economic Analaysis.

wages would attract more workers to join the labor force. In order to accurately measure the employment effects, this paper therefore alters the aggregate labor supply elasticity in the models to reflect the flexible labor supply assumption. Under the flexible labor supply assumption, the aggregate labor supply elasticity is greater than zero, which implies that the labor supply will expand in response to a rise in wages. A labor supply elasticity of 0.4 was used for advanced economies and 0.44 for developing countries in the model (USITC, 2016).[5] This elasticity implies that, for every 1 percent rise in wages in the United States, workers in the United States will increase their supply of labor by 0.4 percent.

Table 3 offers the details about the sectoral output in the United States, China and Mexico used in our model. The first four columns present their full name and the output level of different sectors in the United States, China and Mexico, respectively (in billion dollars). The next columns offer their weight in total output in each of the three countries.

Table 3: Output of the United States, China and Mexico

Full name of sectors	United States	China	Mexico	Share of Total		
agriculture, forestry, fishing and hunting	421.5	1157.3	48.7	1.5%	5.7%	2.4%
mining, other	105.9	422.9	25.3	0.4%	2.1%	1.2%
oil and gas extraction	249.0	114.0	40.7	0.9%	0.6%	2.0%
food manufacturing	762.3	834.6	117.1	2.7%	4.1%	5.8%
beverages and tobacco products	187.1	188.9	25.4	0.7%	0.9%	1.3%
textiles, apparel and leather products	86.2	1019.9	28.7	0.3%	5.0%	1.4%
wood products	101.5	232.2	16.3	0.4%	1.1%	0.8%
paper and printing and related support activities	268.9	321.6	17.7	0.9%	1.6%	0.9%
petroleum and coal products	438.4	547.8	45.7	1.5%	2.7%	2.3%
chemicals, plastics and rubber products	1068.5	1564.3	81.7	3.7%	7.6%	4.0%
nonmetallic mineral products	118.9	704.8	24.9	0.4%	3.4%	1.2%
primary metals	212.0	1387.6	57.3	0.7%	6.8%	2.8%
Fabricated metal products	380.2	440.6	20.0	1.3%	2.2%	1.0%
transportation equipment	1034.4	892.4	152.3	3.6%	4.4%	7.5%
computer and electronic products	399.6	1056.7	72.8	1.4%	5.2%	3.6%
machinery, electrical equipment, appliances and components	482.4	1971.6	104.3	1.7%	9.6%	5.2%
miscellaneous manufacturing and furniture and related products	240.2	355.2	12.3	0.8%	1.7%	0.6%
utilities	390.8	327.3	37.6	1.4%	1.6%	1.9%
construction	1433.0	1791.4	151.9	5.0%	8.8%	7.5%
wholesale and retail trade, and accommodation and food services	4236.9	936.7	219.0	14.8%	4.6%	10.8%
transportation and warehousing	1078.0	917.7	122.5	3.8%	4.5%	6.1%
Information Services	1613.9	225.6	40.5	5.6%	1.1%	2.0%

[5] This paper uses the same labor supply elasticity as was used in U.S. International Trade Commission's 2016 report on Trans-Pacific Partnership Agreement (TPP). See USITC, 2016, Trans-Pacific Partnership Agreement: Likely Impact on the U.S. Economy and on Specific Industry Sectors, Publication Number: 4607.

banking and other finance	1443.8	415.8	39.1	5.1%	2.0%	1.9%
insurance credits and other activities	931.5	109.0	15.2	3.3%	0.5%	0.8%
real estate and renting and leasing	3473.4	715.5	134.5	12.1%	3.5%	6.6%
other services	7430.9	1818.5	372.2	26.0%	8.9%	18.4%
Total	28589.3	20469.6	2023.7	100.0%	100.0%	100.0%

Source: Authors' calculation based on GTAP 9 Database, and the Update of U.S. Output based on BEA Data; Output in billion dollars

As can be seen from table 3 above, the output structure of the three countries differ considerably: agriculture and manufacturing are more important in China than in the United States and Mexico, while services are less important in China than in the rest. Services sectors account for a bigger share in total output in the United States than in China and Mexico, with wholesale and retail trade (14.8 percent), real estate, renting and leasing services (12.1 percent), as well as information (5.6 percent) and banking and other financial services (5.1 percent) being the major sectors contributing to total U.S. output. By contrast, manufacturing sector account for a bigger share in total output in China compared to the United States, with machinery and electrical equipment (9.6 percent), chemicals, plastic and rubber products (7.6 percent); primary metals (6.8 percent) and computer and electronic products (5.2 percent) being the main sectors contributing to total Chinese output. Regarding Mexico, certain manufacturing and services sectors are the main sectors contributing to total Mexico output – for instance, transportation equipment manufacturing (7.5 percent), food manufacturing (5.8 percent), wholesale and retail trade (10.8 percent), construction (7.5 percent) and real estate services (6.6 percent).

Moreover, the Mexican economy is much more reliant upon U.S. FDI compared to China: the share of total U.S. foreign affiliate sales over total output in Mexico and China was 12.5 percent for Mexico and 1.7 percent for China (table 1, 2, and 3).

Simulation Scenarios

According to data from the World Bank, the net FDI inflows into China increased by more than threefold from 2001 to 2016, partly due to Chinese government's policy to attract FDI in certain sectors. The net FDI inflows into Mexico remained largely unchanged from 2001 to 2016. In order to compare different patterns of U.S. offshoring activities in China and Mexico, this paper simulates the following stylized scenarios in sectors where there is a large presence of U.S. foreign affiliates in China and Mexico:

1) China unilaterally loosens its investment regulations in its computer and electronic products sector, so that the returns to capital by U.S investors in China's computer and electronic products sector increases by 20 percent;
2) Mexico unilaterally loosens its investment regulations in its computer and electronic products sector, so that the returns to capital by U.S investors in Mexico's computer and electronic products sector increases by 20 percent;
3) China unilaterally loosens its investment regulations in its transportation equipment sector, so that the returns to capital by U.S investors in China's transportation equipment sector increases by 20 percent;

4) Mexico unilaterally loosens its investment regulations in its transportation equipment sector, so that the returns to capital by U.S investors in Mexico's transportation equipment sector increases by 20 percent;
5) China unilaterally loosens its investment regulations in its wholesale and retail trade sector, so that the returns to capital by U.S investors in China's wholesale and retail trade sector increases by 20 percent;
6) Mexico unilaterally loosens its investment regulations in its wholesale and retail trade sector, so that the returns to capital by U.S investors in Mexico's wholesale and retail trade sector increases by 20 percent;

Empirical Results

Table 4 presents the results on China and Mexico's GDP, U.S. foreign affiliate sales, production and trade, in aggregate level and by sector, after the shock. It provides the percentage change in real terms with respect to the benchmark value for the following variables: U.S. FAS in China and Mexico in the computer and electronics, transportation equipment and wholesale and retail trade sectors; China and Mexico's output in the aforementioned liberalized sectors; as well as U.S. output, exports and imports in these liberalized sectors.

Table 4: Impact on GDP, foreign affiliate sales, production and trade (in percent)

	China simulations				Mexico simulations		
	Electronics	Transport. Equipment	Retail, wholesale services		Electronics	Transport. Equipment	Retail, wholesale services
US foreign affiliate sales in China in liberalized sectors	12.13	8.29	9.30	USA foreign affiliate sales in Mexico in liberalized sectors	15.00	7.78	6.27
China output in liberalized sector	0.58	0.13	0.29	Mexico output in liberalized sector	1.29	3.26	1.36
China's real GDP	0.03	0.01	0.12	Mexico's real GDP	0.04	0.24	0.51
US exports by sector				US exports by sector			
Transport. Equipment	0.05	-0.12	-0.01	Transport. Equipment	0.00	-0.49	-0.09
Electronics	-0.59	0.07	0.01	Electronics	-0.03	0.16	-0.13
Retail, wholesale services	0.05	0.03	-0.30	Retail, wholesale services	0.01	0.16	-0.36
US imports by sector				US imports by sector			
Transport. Equipment	-0.03	-0.01	-0.06	Transport. Equipment	-0.01	0.42	0.04
Electronics	0.13	-0.03	-0.09	Electronics	0.06	-0.08	0.02

Retail, wholesale services	-0.04	-0.02	0.09	Retail, wholesale services	0.00	-0.07	0.12
US output by sector				US output by sector			
Transport. Equipment	0.01	-0.10	-0.05	Transport. Equipment	0.00	-0.59	-0.06
Electronics	-0.57	0.03	-0.02	Electronics	-0.11	0.06	-0.09
Retail, wholesale services	-0.01	-0.01	-0.07	Retail, wholesale services	0.00	-0.02	-0.04

Authors' calculations

As can be seen from table 4 above, when China and Mexico adopts similar investment policy changes towards the United States, change in U.S. foreign affiliate sales has a much larger impact on the Mexican economy than on the Chinese economy, as the percentage change in real GDP and in output are higher in Mexico than in China. This is because the overall size of the Chinese economy is much bigger than the Mexican economy: overall output level in China is 10 times larger than in Mexico (see table 3). Moreover, the Mexican economy is more dependent upon U.S. FDI compared to China, as was mentioned in the previous section. Therefore, the same FDI shock from the United States (in percentage change terms) has a larger impact over the Mexican economy.

Among Mexico's manufacturing sectors, transportation equipment sector has the highest level of U.S. FAS. Hence, taking simulation 4) as an example, as can be illustrated in table 4 above, when the returns to capital by U.S. investors in Mexico's transportation equipment sector increases by 20 percent, capital flows from the United States into Mexico's transportation equipment sector. As a result, U.S. FAS in Mexico's transportation equipment sector increases by 7.8 percent. Following the increase of the output level of U.S. foreign affiliates in Mexico's motor vehicle sector, overall output in Mexico's transportation equipment sector also expands by 3.3 percent ($4.96 billion). A bigger capital stock in Mexico's motor vehicle sector also leads to an increase in Mexico's real GDP (by 0.2 percent).

As was discussed in the previous section, we improved the GTAP_FDI model by allowing sector-specific capital to move across borders. Therefore, overall output level in U.S. domestic transportation sector declines by 0.6 percent as more capital flows out of the U.S. motor vehicle sector into Mexico's transportation equipment sector. Declining U.S. domestic production renders a decrease in U.S. exports of motor vehicles (by 0.5 percent) to the world. Meanwhile, U.S. imports of motor vehicles from the world increases by 0.4 percent, which is driven mainly by an increase in U.S. imports of motor vehicles from Mexican-based U.S. foreign affiliates (by 7.9 percent or $2.42 billion).

In China's case, computer and electronics sector has the highest level of U.S. FAS among different Chinese manufacturing sectors. Results from simulation 1) shows that when the returns to capital by U.S investors in China's computer and electronic products sector increases by 20 percent, U.S. FAS in China's computer and electronics sector rises by 12.1 percent with the arrival of new U.S. capital. The rising output level of U.S. affiliates also result in an overall expansion of China's computer and electronics sector – the overall output level of China's computer and electronics sector increases by 0.6 percent ($6.09 billion). The arrival of U.S. capital also leads to a slight increase in China's real GDP (by 0.03 percent). With capital flowing out of the United States into China's computer and electronics sector, U.S. domestic production and exports of computer and electronics products both decline by around 0.6 percent. Meanwhile, U.S. imports of computer and electronic products from the world increases by 0.13 percent, mainly driven by an increase in U.S. imports of such products from Chinese-based U.S. foreign affiliates (by 12.1 percent or $994.2 million).

The increase in Chinese production and exports of electronic products also crowds out the production of other main regions, including 27 EU member countries (with output level in computer and electronics declining by 0.45 percent), Canada (declining by 0.07 percent), Mexico (declining by 0.23 percent) and the rest of the world (declining by 0.11 percent). However, output level in Hong kong's computer and electronics product sector increases by 0.03 percent (or by $13.6 million). Moreover, Hong kong's exports of computer and electronics products to China also increases by $ 33.2 million. This is probably due to the role of Hong kong as an entrepôt economy and as a provider of intermediates of computer and electronics to China. Therefore, following the increase in Chinese production of computer and electronic products, Hong kong exports more intermediates to China.

Concluding Remarks

This paper examines the U.S. offshoring activities in China and Mexico, and examines how U.S. offshoring activities in China and Mexico would change if the two U.S. main trading partners adopt similar investment policies towards the United States, in three different sectors: computer and electronic products; transportation equipment and wholesale and retail trade. The simulations from our CGE model indicate that both China and Mexico have benefited from the U.S. FDI inflow, though the impact is bigger over the Mexican economy than the Chinese economy. For China's computer and electronic products sector in particular, the simulation results indicate that China plays a role as a production base and export center for computer and electronic products to the United States. The inflow of U.S. capital into China's computer and electronic products sector expands the production of U.S. foreign affiliates in China, and in turn drives up these foreign affiliates' exports back to the United States. Meanwhile, change in output and trade flows in Hongkong indicates that Hongkong is an important input provider for the production of computer and electronic products in China.

The analysis in this paper can be extended in several ways. Transportation equipment sector could be further split into motor vehicles as finished products and motor vehicle parts as intermediate goods. The simulation results from the liberalization in Mexico's transportation equipment sector indicate that the inflow of U.S. capital into Mexico's motor vehicle sector would expand the production of U.S. foreign affiliates and in turn their exports back to the United States. However, the current version of the model could not differentiate between U.S. trade flows with Mexico of motor vehicles as finished products and motor vehicle parts as intermediate goods. Splitting the sector will further illustrate how the regional value chain of motor vehicle production in North America would change following a possible liberalization in Mexico's transportation equipment sector. The number of regions can also be increased. Finally, regarding model assumptions, changing the comparative static model into a dynamic one would be of interest.

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