When Multinational Companies Come – a CGE Analysis on the Impact of Growing Inward FDI on the Indian Economy

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ECONOMICS WORKING PAPER SERIES

Working Paper 2022–11–B

U.S. INTERNATIONAL TRADE COMMISSION

500 E Street SW

Washington, DC 20436

November 2022

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Office of Economics Working Paper 2022–11–B
November 2022

Abstract

India is rapidly emerging as an attractive destination for foreign direct investments (FDI), and FDI inflows to India increased significantly — India's inward FDI stock increased from $312.9 billion in 2014 to $572.9 billion in 2020. We use a novel computable general equilibrium (CGE) model to simulate the growth of inward FDI in different sectors in India and analyze how increasing inward FDI affects the country's overall economy, trade patterns and production. Most CGE models do not model capital in a way that accounts for the international mobility of capital. In a standard CGE model, capital is assumed to be fixed at the national level and can only move across sectors, barring the possibility of establishing a linkage between international trade, FDI and foreign affiliate sales (FAS). This is at odds with the recent theoretical and empirical FDI literature, which focuses on modeling capital to explain the linkage between international trade and FDI (Bergstrand and Egger, 2007, 2010, 2013a, 2013b). We bridge this gap by developing a CGE model which incorporates internationally mobile capital and use this model to analyze the impact of the recent growth in inward FDI on the Indian economy. Our simulation results show that a larger sized easing of FDI restrictions increases the overall amount of capital in the Indian economy, as well as the country's nominal and real GDP. It also drives up the overall labor wages and household income. At the sectoral level, increasing inward FDI has, on average, a larger impact on sectoral production in India's manufacturing sectors compared to services sectors, since foreign affiliates has a larger presence in the Indian manufacturing sectors. Our simulation results also indicate that due to foreign affiliates' expanding their production in India and their reallocation of capital globally, Indian imports declines in some sectors. The sectors where Indian imports decline the most are different manufacturing sectors, including pharmaceutical products manufacturing, paper and paper products, and computer and electronic products, while Indian imports in most services sectors increase slightly. As the Indian manufacturing sector is more dependent upon international trade compared to its services sector, the effect of inter-modal switching between trade and FDI dominates the changes in imports in Indian manufacturing sectors. By contrast, the "income effect" dominates the changes in imports in Indian services sectors.

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Introduction

India is rapidly emerging as an attractive destination for foreign direct investments (FDI), largely due to the Indian government's economic reforms and growingly favorable investment climate. After coming into office in 2014, the Modi government took many measures to reduce/remove FDI barriers. From 2014 to 2017, the Modi government executed 37 reforms relaxing FDI rules in different sectors, far outpacing the number of sectoral relaxations in the entire six-year when Indian Prime Minister Atal Bihari Vajpayee was in office (29 changes), and equal to the number of sectoral relaxations in the entire 10-year period when Prime Minister Manmohan Singh was in office (Rossow, 2017, 2022). Among the 37 relaxations of FDI rules, some of them are quite significant: For instance, in August 2014, the Modi government announced that inward FDI in India's railway transport sector is allowed up to 100 percent. In December 2014, the Modi government announced the removal/relaxation of the once onerous rules around inward FDI in India's construction services sector.[1] As a result, FDI inflows to India increased significantly — India's inward FDI stock increased from $312.9 billion in 2014 to $572.9 billion in 2020, an increase of 83.1 percent (IMF, 2021). From 2018 to 2020, Modi government's pace of FDI reform became more moderate, and there were few steps to further relax FDI regulations (Rossow, 2022).

In this paper, we apply a computable general equilibrium (CGE) framework simulating the growth of inward FDI in different sectors in India and analyze how increasing inward FDI affects the country's overall economy, trade patterns and production. CGE models have been used to analyze economy-wide and sectoral effects as a result of changes in international trade and FDI. In a standard CGE model, capital is assumed to be fixed at the national level and can only move across sectors, barring the possibility of establishing a linkage between international trade, foreign direct investment (FDI) and foreign affiliate sales (FAS). This is at odds with the recent theoretical and empirical FDI literature, which focuses on modeling physical capital to explain the linkage between international trade and FDI (Bergstrand and Egger, 2007, 2010, 2013a, 2013b). We bridge this gap by developing a CGE model framework which incorporates internationally mobile capital, and using this model to analyze the impact of the recent growth in inward FDI on the Indian economy.

The modern general equilibrium theories of FDI and multinational enterprises (MNEs) dates back to the Markusen-Venables-Maskus *Knowledge-Capital* model (1998, 2000, 2002), which is a two-country, two-factor (skilled and unskilled labor) and two goods model that explains the production and trade of multinational firms. However, there is a puzzle in this 2*2*2 model framework: When two countries have identical absolute as well as relative factor-endowments, horizontal MNEs' FAS displaces completely national firms and trade between the two countries, whereas in reality, FAS and national firms' exports coexist.[2] To resolve this

[1] See Press Note 8 and Press Note 10, 2014.

[2] In the Knowledge-Capital model, since the setup of firms and plants both require human capital (skilled labor), the intuition is that if trade costs between two countries are sufficiently high, then the relative cost for country i of

puzzle, Bergstrand and Egger (2007) introduces physical capital into the Markusen (2002)'s *Knowledge-Capital* model as the third primary factor of production, as well as introducing a third region (rest of the world). In Bergstrand and Egger (2007)*'s Knowledge-and-Physical-Capital* model, physical capital is internationally mobile in the sense that MNEs will endogenously choose the optimal allocation of their physical capital between home and foreign locations to maximize profits. The introduction of physical capital into the 2*2*2 model explains the coexistence of FAS and international trade for two identically-sized economies, due to the endogeneity of the relative price of human-to-physical capital.[3] Bergstrand and Egger (2007) also introduces a bilateral free trade agreement (FTA) between countries i and j into their *Knowledge-and-Physical-Capital* model. The model calibration indicates that a reduction in trade costs makes bilateral investment less economical, and therefore should tend to reduce bilateral FDI. Finally, the two authors adopt gravity equations using pooled cross-section time-series empirical data for bilateral trade and FDI flows among 17 OECD countries for 11 years (1990–2000) to empirically test their model, and the empirical results is consistent with the theory that shows a substitutability between trade and FDI— a reduction in "trade costs" (in the form of the presence of an FTA) is correlated with a higher level of bilateral trade, but a lower level of bilateral investment — between a pair of countries. Bergstrand and Egger (2010, 2013b) further introduce intermediate goods production as well as relative factor endowment into their *Knowledge-and-Physical-Capital* model, and show that the predictions from their model explains very well the empirical data.

The recent theorical and empirical FDI literature demonstrates the importance of modeling capital to explain the relationship between international trade and bilateral FDI/FAS. Meanwhile, in the field of CGE literature, there have recently been some important efforts to incorporate FDI and FAS into global CGE modeling (Petri, 1997; Hanslow, 2000; Lakatos and Fukui, 2014). However, less attention has been given to incorporating capital which is internationally mobile into a CGE model framework. Our paper addresses this gap by incorporating capital which is internationally mobile into a GTAP model framework, calibrating it to the GTAP 10 Data Base, with a 2014 baseline to analyze how the recent growth of inward FDI in different sectors in India affects the Indian economy.

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supplying a foreign market j with goods from foreign affiliates of i's horizontal multinational enterprises (HMNEs) is low relative to exporting from i. As country j's GDP size gets bigger and closer to country i, this would unambiguously increase the price of skilled (relative to unskilled) labor, displacing completely national firms in i.

[3] In the *Knowledge-and-Physical-Capital* model, as the two countries' GDP size gets closer, it becomes more profitable for country I to serve country j's market using HMNEs to avoid trade costs. Therefore, FDI – physical capital – moves from country I to country j, raising the relative price of physical capital in i, and lowers the relative price of human capital in i. A higher price of physical capital in i (as i and j converge in size) raises the relative price of multi-plant HMNE firm setups, reducing the displacement of single-plant national firms (which serve markets via exports instead) and helping secure their coexistence with HMNEs. Moreover, a lower price of human capital in i lowers the price of HMNE and national export firm setups, also helps to secure the coexistence of both types of firms.

The rest of the paper is organized as follows. Section 2 gives an overview of Indian government's effort of easing FDI restrictions and global inflows of FDI into India. Section 3 provides a literature review of CGE model frameworks which incorporates FDI. It also introduces FDI literature which observes empirically the substitutability between trade and FDI, and details how we incorporate the modeling of internationally-mobile capital into a GTAP model framework. Section 4 outlines the simulation scenarios and discusses simulation results both at the aggregate and sectoral levels. Section 5 concludes.

Global Inflows of FDI into India

From 2014 to 2017, the Modi government has taken a lot of effort to liberalize India's FDI regime. The Indian government takes two different approaches to notify the public of changes in its FDI rules, either through Press Notes or through legislative changes (Rossow, 2017). For most of the FDI regulation changes, the government notifies the public through a Press Note issued by the Indian Department of Industrial Policy and Promotion (DIPP), while a small minority of FDI changes are implemented through legislative action (Rossow, 2017).[4] Table 1 lists measures the Modi government has taken to ease the country's FDI restrictions in various sectors.

Table 1: Measures Taken by the Modi Government to Ease FDI Restrictions in Various Sectors in India

Defense Sector	Cap on FDI raised from 26 percent to 49 percent (Press Note 7, 2014)
Railway Sector	100 percent FDI allowed under automatic route in the construction, operation, and maintenance of specific rail infrastructure projects (Press Note 8, 2014)
Construction Sector	FDI rules relaxed, including reducing minimum capitalization (Press Note 10, 2014)
Pharmaceuticals	FDI up to 74 percent allowed under automatic route; FDI beyond the threshold of 74 percent allowed through the government approval route.
Medical Devices	100 percent FDI allowed under automatic route (Press Note 2, 2015)
Coal Mining Sector	100 percent FDI allowed under automatic route for sales of coal and for coal mining activities (including associated processing infrastructure), (Special Provisions Bill, 2015)
Insurance and Pension Sector	Increased FDI cap for insurance and pension firms to 49 percent (Amendment Bill, 2015); allows FDI above 26 percent in insurance and pension via automatic route (Press Note 1 and 2, 2016).
E-Commerce Sector	FDI in marketplace e-commerce authorized at 100 percent with conditions (Press Note 3, 2016)
Multiple Sectors	100 percent FDI allowed under automatic route in various broadcasting sectors, including teleports, Direct-to-Home (DTH), Mobile TV, Cable Network, etc; in the

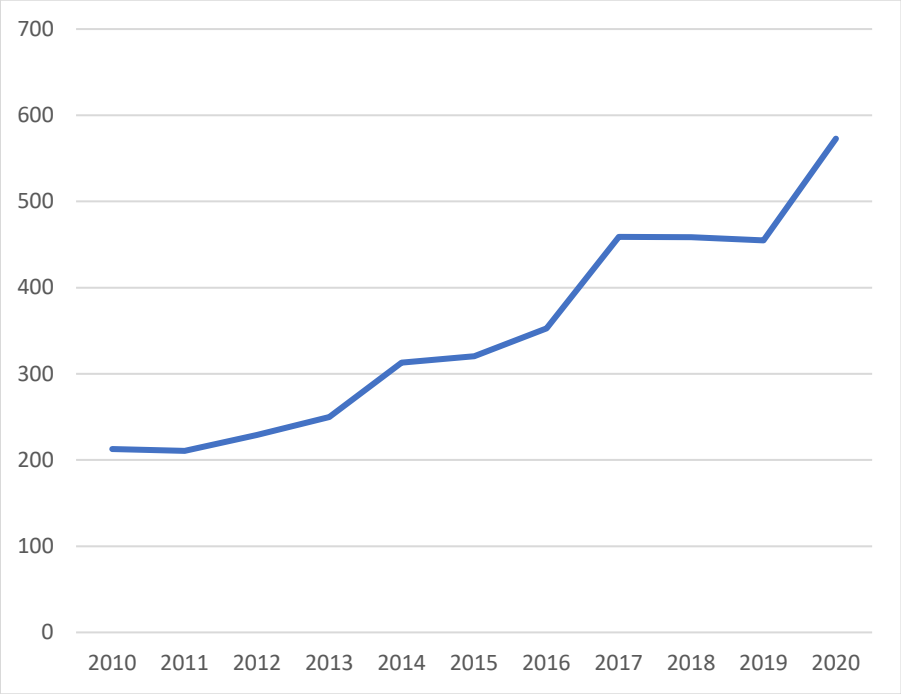
[4] According to Rossow (2017), this channel only applies to 1) the investment caps in the Insurance and pension sectors, which were established by the legislation; 2) the coal sector, where legislative changes is required to allow foreign-owned firms to set up commercial coal operations in India.

	civil aviation sector, foreign equity cap in non-scheduled air transport services increased from 74 percent to 100 percent under the automatic route, and 100 percent FDI allowed under automatic route in greenfield airport projects; in single brand retailing, FDI up to 100 percent allowed under automatic route (Press Note 5, 2016)
Stock Exchanges	Removed 5 percent holding for non-residents (Press Note 1, 2017)

Source: Department for Promotion of Industry and Internal Trade, Government of India, January 2021; Rossow, 2017.

Partly due to the Indian government's policies in reducing investment barriers, India's inward FDI stock grew rapidly from 2014 to 2020. India's inward FDI stock totaled $572.9 billion in 2020, an 83.1 percent increase from $312.9 billion in 2014 (IMF 2021, see figure 1). In 2020, the United States, Mauritius[5], several European countries (Britain, Germany, and the Netherlands), Japan and Singapore were the largest sourcing countries of FDI into India, jointly accounting for 87.0 percent of total inward FDI positions in India (see figure 2).

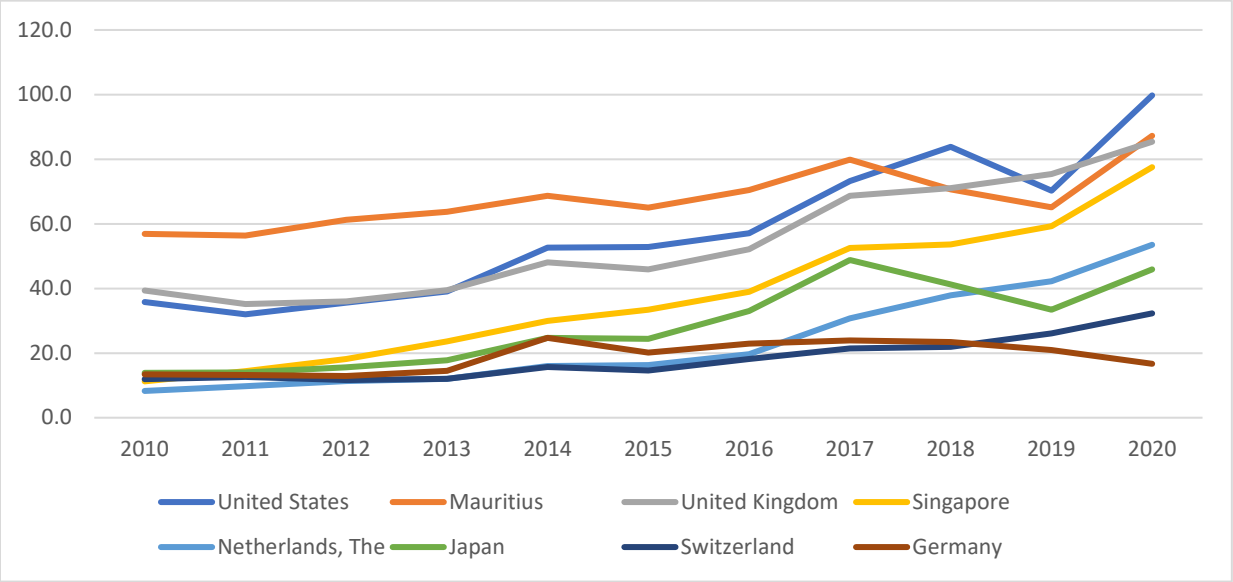
Figure 1: Indian Inward Foreign Direct Investment (FDI) Positions, 2010–20, in billion dollars



Source: International Monetary Fund (IMF), Coordinated Direct Investment Survey (CDIS), December 8, 2021.

[5] It is worth pointing out that project-level greenfield FDI data from FDIMarkets, as well as project-level mergers and acquisitions (M&A) data from Zephyr shows that India's inward FDI from Mauritius is most likely FDI coming from a third-party country (such as China) which is routed through Mauritius. Mauritius has "historically been a significant offshore center, serving as a major route for foreign investors to access India." (USITC, 2020). Damgaard et al. (2019) notes that Mauritius ranks as one of the lowest countries around the world in terms of its estimated real FDI as a share of reported total FDI. It is estimated that only around 4 percent of the inward FDI remains in Mauritius as real FDI, while the majority of inward FDI into Mauritius is re-directed to other third-party countries.

Figure 2: Indian Inward Foreign Direct Investment (FDI) Positions, By Leading Source Countries, 2010–20, in billion dollars



Source: International Monetary Fund (IMF), Coordinated Direct Investment Survey (CDIS), December 8, 2021.

Official government data on inward FDI into India by sector and by source country is scarce. In the absence of official data, we rely on commercial databases that provide data on individual greenfield FDI projects[6]. Table 2 lists the number of worldwide greenfield FDI projects in India during 2014–21. It shows that global investors invested in a total of 5,098 greenfield FDI projects in India from 2014 to 2021. Among them, global investors focused on software and IT services, business services, industrial equipment, communications, financial services, as well as automobile and parts manufacturing when investing in greenfield FDI projects in India.

Table 2 Worldwide greenfield FDI projects in India, by number of projects and percent, 2014–21

Project Sector	**Number of Projects**	**% of Total**
Software & IT services	1214	23.8%
Business services	507	9.9%
Industrial equipment	394	7.7%
Communications	350	6.9%
Financial services	344	6.7%
Automobile and Parts Manufacturing	291	5.7%
Chemicals	187	3.7%
Transportation & Warehousing	187	3.7%
Electronic components	169	3.3%

[6] *Financial Times,* fDi Markets database (accessed August 2, 2022). Greenfield FDI projects are defined as new investments by foreign investors, as opposed to acquisitions of existing companies or equity investments in the latter.

Food & Beverages	159	3.1%
Real estate	141	2.8%
Consumer products	140	2.7%
Renewable energy	99	1.9%
Plastics	89	1.7%
Metals	87	1.7%
Hotels & tourism	71	1.4%
Aerospace	67	1.3%
Non-automotive transport OEM	56	1.1%
Other	546	10.7%
Grand Total	5098	100.0%

Source: Financial Times, fDi Markets database (accessed August 2, 2022).

It is worth pointing out that the pattern of greenfield FDI into India is pretty different among the leading source countries. For instance, the United States invested a total of 1,732 greenfield FDI projects in India from 2014 to 2021. Among them, the leading sectors in terms of the number of projects are software and IT services (732), business services (192), communications (110), consumer products (91), financial services (69) and industrial equipment (69). By contrast, Germany invested a total of 436 greenfield FDI projects in India from 2014 to 2021, and the leading sectors in terms of the number of projects are automobile and parts manufacturing (87), industrial equipment (61), software and IT services (46), transportation and warehousing (46), chemicals (33) and business services (25) (FDIMarkets, 2022). The project-level greenfield FDI data shows that the United States is a leading investor in India mainly in services sectors, such as software and IT and business services, while Germany is a leading investor mainly in manufacturing sectors, such as automobile and parts manufacturing and industrial equipment manufacturing.

A Summary of Literature and Model Framework

Literature Review of CGE Model Frameworks with FDI Incorporated

The Petri (1997) model was the first CGE model that considers foreign commercial presence. The model uses the Armington assumption of national product differentiation and distinguishes among different products by both firm location and firm ownership. In Petri (1997)'s model, consumers and firms choose first between goods produced by firms with ownership in different regions, and then between goods produced in different areas. Another example of a CGE model that incorporates FDI is FTAP (Hanslow, Phamduc & Verikios, 2000). The FTAP model is a version of the standard GTAP model that incorporates FDI using Petri's assumption. The major difference between the FTAP model and Petri's model is that the FTAP model assumes that consumers and firms first choose between goods produced in different origin regions, and then between goods produced by firms with ownership in different regions. Lakatos and Fukui (2014)'s model follows the FTAP approach, and incorporates the FDI and FAS by source country, destination country and by sector into the model. The two authors use this model to analyze the reduction of investment barriers in India's retail services sector. Lakatos and Fukui (2014)'s

model is also used in USITC (2014) to analyze the impact of India's investment policies on the U.S. economy and on different sectors.

Tsigas and Yuan (2018) develop an extension of the Lakatos and Fukui model which allows sector/country-specific capital to be reallocated across economies. The authors use this model to analyze how U.S. outward FDI would change if destination economies liberalize their FDI regimes. This is the model we employ in this paper. Latorre, Olekseyuk and Yonezawa (2020) develops a CGE model with monopolistic competition and FDI in services to look at the role of services multinational companies (MNEs) in international trade and impact on the economy and uses the model to analyze specifically the effect of Brexit.

A GTAP Model with Internationally-Mobile Capital

The standard GTAP model is a comparative static, multi–region and multi–sector CGE model. On the supply side, land and capital stock are assumed to be fixed at the national level. Firms are assumed to substitute between capital and labor according to a constant elasticity of substitution (CES) function, while using intermediate inputs in fixed proportions to the value–added composite. Imported products from different regions are assumed to be imperfect substitutes, and so do the domestically produced and imported commodities in each country/region. Firms then allocate expenditure between domestically produced and imported commodities. On the demand side, a representative regional household receives all income generated in the region and allocates it among private consumption, government consumption, and savings. The model uses data from national statistical accounts that capture a snapshot of economic conditions in each country at a specific point in time. The model is typically used in forward-looking counterfactual analysis of proposed or potential trade and investment changes and compare the current global situation to one in which policy instruments are changed, or "shocked," to proposed values.

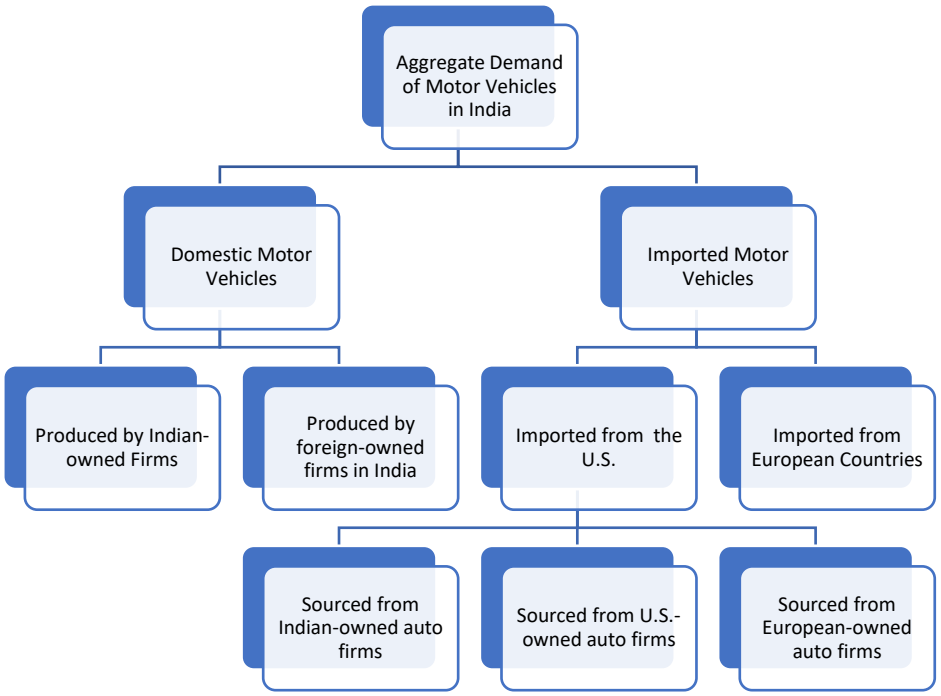
The model we developed extends the standard GTAP model framework in the following ways: On the demand side, supply side and on capital mobility[7].

Demand Side

Figure 3 sketches production linkages in our model using India's transportation equipment sector as an example. In the first stage, aggregate supply of motor vehicles in India consists of domestically produced and imported motor vehicles. In the second stage, India's domestically produced motor vehicles are the aggregate produced by Indian-owned firms or foreign-owned firms in India. Expenditures on imported motor vehicles are allocated across different sources, and finally allocated across ownership categories to various multinational companies in economies exporting motor vehicles to India.

[7] The model we developed follows Lakatos and Fukui (2014)'s approach on the demand and supply side. In addition to that, we introduced the capital mobility concept and allows capital to be internationally mobile in our model.

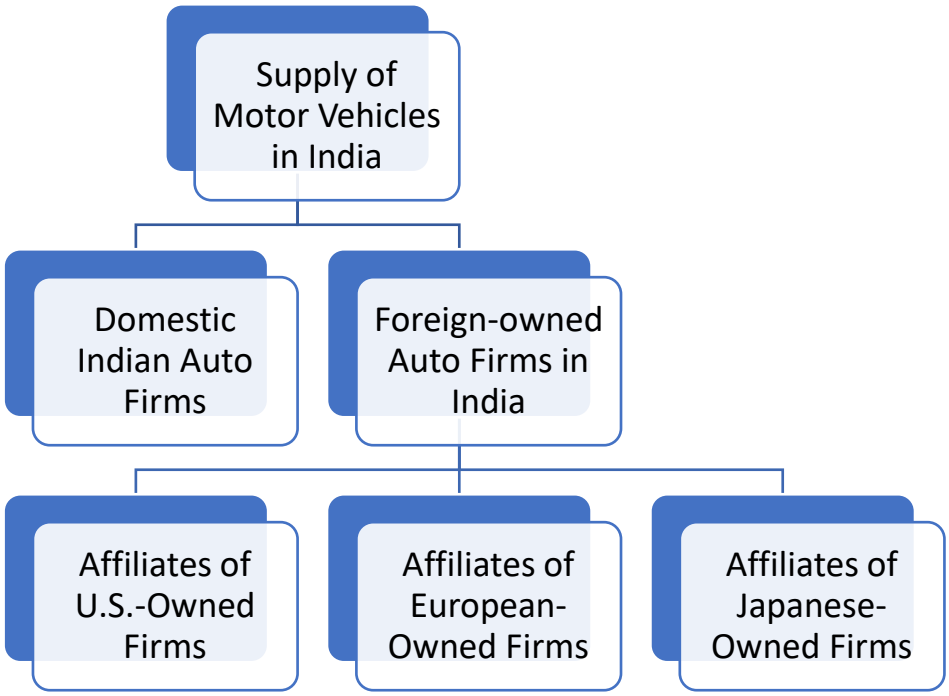
Figure 3: Illustrative Production Linkages in the GTAP Model with Internationally-Mobile Capital Incorporated: Domestic Production and Imports



Supply Side

On the supply side, FDI differentiates between domestic firms and foreign-owned affiliates of multinational companies. Figure 4 illustrates the linkages among motor vehicle firms operating in India. Domestic supply of motor vehicles is composed of output of both domestic automobile firms and foreign-owned automobile firms located in India. Foreign-owned firms are then further differentiated by country of ownership. The domestic and foreign-owned firms are differentiated by ownership through the differences in labor-capital ratio (value-added inputs). 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. Therefore, the model represents heterogeneous production technologies for firms differentiated by the region of ownership as well as location.

Figure 4: Illustrative Production Linkages in the GTAP Model with Internationally-Mobile Capital Incorporated: Domestically-owned Firms and Foreign Affiliates



International Capital Mobility

There is abundant empirical evidence supporting the theory in Bergstrand and Egger's *Knowledge-and-Physical-Capital* model that there is a close linkage between the reduction of trade costs and FDI flows. For instance, as indicated above, using a gravity model with panel dataset from 1990 to 2000 among 17 OECD countries, Bergstrand and Egger (2007) find that FTAs between two countries are associated with a lower level of bilateral investment. Using U.S. outward FDI (OFDI) for the years 2005 to 2015 and applying the same gravity model of FDI as in Bergstrand and Egger (2007), USITC (2016b) also find that U.S. bilateral and regional trade agreements had a significant negative effect on U.S. OFDI 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.[8] The

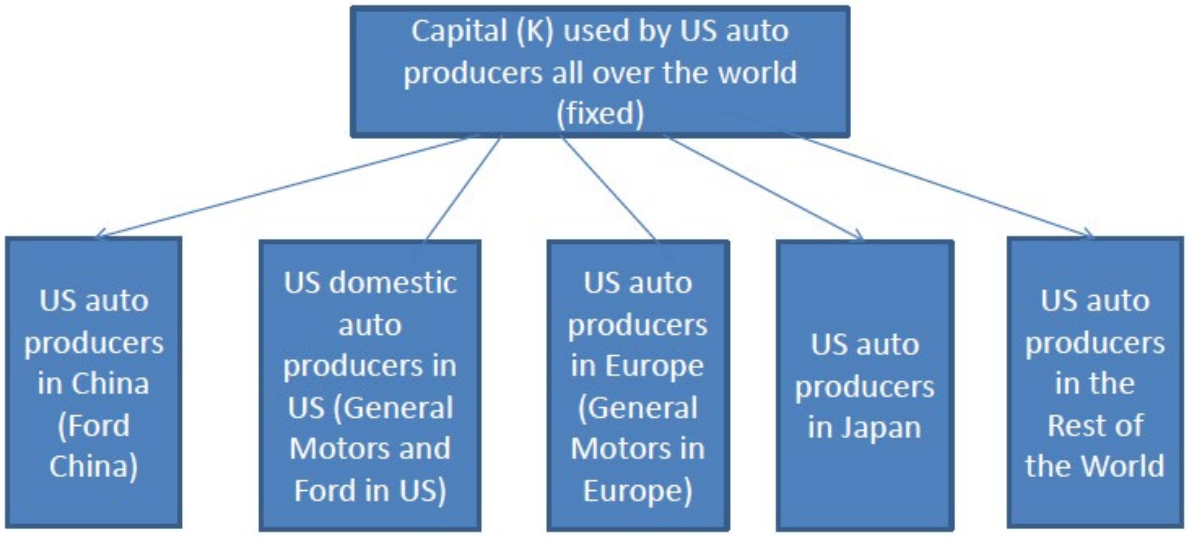
[8] Borchert, Gootiiz, and Mattoo (2013) describe the four different modes of international supply. Mode 1 refers to cross-border trade in services; Mode 3 is defined as services supplied by a provider in one country, through a foreign commercial presence, in the territory of another country.

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 importance of modeling capital and the empirical evidence that supports the linkage between trade costs and FDI, this paper introduces the internationally-mobile capital into a GTAP model framework. When modeling capital, we follow the Bergstrand and Egger's *Knowledge-and-Physical-Capital* model approach, which defines international capital mobility as country i's capital being used abroad. In this section, we explicitly demonstrate how to incorporate this relationship into the GEMPACK programming language of the model by offering code snippets where applicable.

Using capital used by U.S. motor vehicle producers as an example, figure 5 sketches this mechanism: 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:

Figure 5: Mechanism of Cross-Border Capital Movement in the GTAP Model with Internationally-Mobile Capital Incorporated



The capital movement assumption in our model is implemented in the model code in percent change terms based on a constant elasticity of transformation (CET) function as:

Equation ENDW_SUPPLY
 # equation allocates country/sector specific capital across economies #
(**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) + ETRAE(i) * **[**pm_l(I,J,O) - pmes_mnc(I,J,L,O)**]**;

The variable qoes_mnc(I,J,L,O) denotes the percent change in the quantity of capital (input I) used in industry J in region L owned by parent companies in region O. The major difference between our model, and other CGE models with FDI incorporated, is that in our version, capital (input I) used in industry J all over the world, owned by parent companies in region O (denoted by variable qo_I(I,J,O) above) is fixed, thus allowing region/sector-specific capital to reallocate across economies based on the change on relative rate of returns, the pm_I(I,J,O) - pmes_mnc(I,J,L,O) terms in the equation. The coefficient ETRAE(I) is the non-positive CET elasticity of transformation.

We calibrate the model to GTAP 10 Data Base (Aguiar, Narayanan and McDougall, 2019) for 2014, with foreign affiliate sales and FDI stock data incorporated. We aggregate the 141 regions in the GTAP 10 Data Base into 7 regions, namely, India, the United States, the European Union (EU), Japan, China, Australia and New Zealand, and the rest of the world. The model baseline has 69 sectors, and we place model inputs into the model at this level of sectoral aggregation.[9] We obtain the three-dimensional bilateral and sector specific FDI stocks data from Gouel et al. (2012). The three-dimensional bilateral and sector specific FAS data originates from Fukui and Lakatos (2012).

Simulations and Results

Prior to recent FDI reforms in India, foreign firms faced additional costs due to FDI regulations which Indian firms don't face. Simulating the effects of the easing of FDI restrictions requires estimates of the additional costs, or price gaps, generated by FDI regulations, and the extent of the liberalization, that is, the reduction in the price gaps. In terms of the FDI reforms implemented by the Modi government, some FDI reforms apply to all sectors: for instance, the Modi government relaxed FDI regulations for non-resident Indians, and decided that investment by non-resident Indians will be deemed to be domestic investment at par with investment made by residents.[10] Some other reforms target specific sectors, including coal mining, pharmaceuticals, construction services, railway transport services, air transport services, single-brand retailing, insurance and pension, and other financial services (see table 1 for details). For this paper, we first run a scenario simulating the removal of FDI barriers for European Union (EU) firms in the motor vehicles and parts sector in India (MVH sector in GTAP). This simulation is mainly to illustrate how introducing the internationally-mobile capital into the GTAP model framework establishes a linkage between FDI and international trade in the model.

We then develop scenarios where the sectors the Modi government has taken targeted measures to ease FDI restrictions from 2014 to 2017 see a 10 percentage points removal of

[9] Some of the GTAP sectors were disaggregated using industry-level production and trade data.

[10] See Press Note 7, 2015. The Press Note indicates that for the purposes of FDI policy, investment by non-resident Indians under Schedule 4 of FEMA (Transfer or Issue of Security by Persons Resident Outside India) Regulations will be deemed to be domestic investment at par with the investment made by residents.

price gaps, while all the other sectors see only a 5 percentage points removal of price gaps.[11] Finally, we develop scenarios to see how a deeper cutting of FDI red tape in India would affect the Indian economy. We therefore run five simulations: [12]

1) The first scenario simulates the removal of FDI barriers for European Union (EU) firms[13] in the motor vehicles and parts sector in India (MVH sector in GTAP).[14]
2) The second scenario simulates the reduction of FDI barriers faced by all foreign affiliates operating in India, where sectors the Modi government has taken targeted measures to ease restrictions since 2014 see a 10 percentage points removal of price gaps, while all the other sectors see only a 5 percentage points removal of price gaps.[15]
3) The third scenario simulates the reduction of FDI barriers that applies to all EU affiliates operating in India, where sectors the Modi government has taken targeted measures to ease restrictions since 2014 see a 10 percentage points removal of price gaps, while all the other sectors see only a 5 percentage points removal of price gaps.
4) The fourth scenario simulates the removal of all FDI barriers faced by all foreign affiliate operating in India, where all the sectors see a 10 percentage points removal of price gaps.[16]
5) The fifth scenario simulates the removal of all FDI barriers faced by EU firms, where all the EU firms operating in India see a 10 percentage points removal of price gaps.

Results From the First Simulation

The first scenario simulates the removal of FDI barriers for European Union (EU) firms in the motor vehicles and parts sector in India (MVH sector in GTAP). As a result of the removal of these FDI barriers, EU MVH firms increase their FDI in India and thus their output in India

[11] Since the Modi government's pace of FDI reform became more modest from 2018 to 2020, and there were few steps to further reduce FDI barriers, The simulation scenarios only look at the sectors which the Modi government has taken targeted measures to liberalize during 2014–17.

[12] The simulated CGE effects were obtained using the General Equilibrium Modeling Package (GEMPACK), see Harrison et al. (1996), and Horridge et al. (2019). When implementing these five simulations, we first run a simulation to adjust output taxes in India so that the initial equilibrium shows that foreign affiliates in India are levied a 10 percent output tax, while India-owned firms are not levied the 10 percent output tax. In the five FDI policy scenarios we run, the 10 percent output tax on foreign affiliates is either removed or reduced to 5 percent, depending on the scenario. These price gaps are illustrative. One can think that if a 20 percent output tax on foreign affiliates is removed, it will generate approximately twice the effects presented in this paper.

[13] The European Union in this paper includes the United Kingdom.

[14] When implementing the first simulation in GTAP, foreign firms in India faced FDI barriers which translate to a 10 percent output tax that Indian domestic firms don't face. In the first simulation, that 10 percent output tax EU firms in the motor vehicles and parts sector in India faced is removed.

[15] When implementing the simulations in GTAP, foreign firms in India faced FDI barriers which translate to a 10 percent output tax that Indian domestic firms don't face. For the sectors which the Modi government has taken targeted measures to liberalize, that 10 percent output tax faced by foreign firms were removed. For all the other sectors, that output tax was reduced to 5 percent. Appendix table A.1 provides information on the removal of price gaps by sector.

[16] When implementing the simulations in GTAP, foreign firms in India faced FDI barriers which translate to a 10 percent output tax that Indian domestic firms don't face. For this simulation, that 10 percent output tax faced by all foreign firms in India in all sectors were removed.

increases by 36.9 percent in volume. Because of competition from EU producers in India, Indian producers of MVH reduce production by 13.5 percent, while other foreign producers of MVH reduce production by 10.9 to 11.9 percent. Because EU firms of MVH reallocate their investment across economies, their production levels in non-India economies decline by 0.1 to 0.3 percent. As a result of the EU MVH sector's reallocation of investment, Indian imports of European Union motor vehicles and parts decline by 8.8 percent in volume. Labor wages in India increase by 0.2 percent.

Results from the Second and Third Simulation

The second scenario simulates the reduction of FDI barriers faced by all foreign affiliates operating in India, where sectors the Modi government has taken targeted measures to liberalize since 2014 see a 10 percentage points removal of price gaps, whereas all the other sectors see a 5 percentage points removal of price gaps. With the reduction of FDI barriers, there is 0.9 percent more capital in the Indian economy. As a result, real GDP increases by 0.9 percent. Meanwhile, factor returns and product prices also increase, and therefore nominal GDP increases by 1.8 percent. Labor wages in India increases by 3.0 percent.

Table 3 shows the sectors that increase production by more than 1 percent. As can be seen from table 3 below, the sectors where Indian production increases the most are other electrical equipment (11.0 percent), computer and electronic products (10.0 percent), renewable energy electrical equipment (10.0 percent), pharmaceutical products (8.8 percent), medical devices manufacturing (5.9 percent) and paper & paper products (5.3 percent). Though the sectors that the Modi government has taken targeted measures to ease FDI restrictions are mainly services sectors, such as railway transport services, air transport services, as well as insurance and pension, the sectors that see the highest production increase in India as a result of reducing FDI barriers are manufacturing sectors. The reason is partly because the manufacturing sectors in India is much more dependent upon inward FDI compared to the services sectors: the output of foreign affiliates as a share of total production in India's manufacturing sectors is 20 percent, while this share is 10 percent in India's services sectors.[17] Therefore, changes in foreign affiliate sales as a result of reducing FDI barriers has, on average, a larger impact on overall production in India's manufacturing sectors compared to services sectors.

Taking the pharmaceutical products manufacturing sector (BPH sector in GTAP) as an example: this is one of the sectors where the Modi government has taken targeted measures to ease FDI restrictions, and therefore we remove the 10 percentage points price gap that foreign affiliates in India face. As a result of the removal of FDI barriers, foreign pharmaceutical manufacturers in India increase their FDI in India, and therefore their output in India increases by 38.1 percent to 43.6 percent. Since the output of foreign affiliates accounts for 31.5 percent of overall production in India's pharmaceutical products manufacturing sector, the increase in foreign affiliates production has a large impact on overall sectoral production — the sectoral

[17] Authors' calculations based on the 2014 baseline statistics in the GTAP-FDI model.

production in India's pharmaceutical products manufacturing sector increases by 8.8 percent (see appendix table A.2 and table 3). The increases in foreign affiliates production also crowds out production by Indian domestic firms — output of Indian domestic pharmaceutical manufacturers declines by 4.4 percent. Moreover, as a result of the foreign affiliates' reallocation of investment, Indian imports of pharmaceutical products decline by 6.3 percent in volume.

By comparison, the land transport services sector[18] (OTP sector in GTAP) is another sector where the Modi government has taken targeted measures to reduce FDI barriers. The simulation results show that foreign companies in India's land transport services sector increases their output by 28.4 percent to 35.4 percent. Meanwhile, since the output of foreign affiliates only accounts for 1.3 percent in India's land transport services sector, the increase in foreign affiliates production has a relatively small impact on overall sectoral production — sectoral production in India's land transport services sector increases by 1.1 percent (see table 3 below).

Furthermore, as a result of foreign affiliates' expanding their production in India, Indian imports in a number of sectors declines. The sectors where Indian imports decline the most (in percent) are pharmaceutical products manufacturing (6.3 percent), followed by paper and paper products (4.9 percent), other electrical equipment (3.4 percent), other food products (2.8 percent), renewable energy electrical equipment (2.6 percent) and computer and electronic products (2.6 percent). It appears that the linkage between FDI and international trade in the model is reflected mainly in simulation results in India's manufacturing sectors, but not that much in the services sectors. In fact, Indian imports in some services sectors increase slightly. The reason is mainly because services are mostly a non-traded good compared to manufacturing sectors. In 2014, trade as a share of output in India's manufacturing sector is 39.1 percent, while such share in India's services sector is 10.4 percent.[19] Since India's manufacturing sector is much more reliant upon international trade compared to services sectors, the effect of inter-modal switching between trade and FDI dominates the change in imports. By contrast, the increase in factor returns leads to an increase in household income in India, driving up overall imports. This "income effect" dominates the changes in imports in Indian services sectors.

Table 3: Percent change in sectoral production in India

Sector	Easing of all FDI barriers (Simulation 2)	Easing of European FDI barriers (Simulation 3)
Other electrical equipment	11.0	9.5
Computer and electronic products	10.0	8.7
Renewable energy electrical equipment	10.0	8.7

[18] The majority of land transport services are railway transport services.

[19] Authors' calculations based on the 2014 baseline statistics in the GTAP-FDI model.

Pharmaceutical products	8.8	2.9
Medical Devices Manufacturing	5.9	2.9
Paper & Paper Products	5.3	2.9
Motor Vehicles and Parts	4.7	2.4
Other chemical products	4.6	1.4
Other non-metallic mineral products	3.9	0.8
Non-Ferrous Metals	3.7	-0.3
Construction Services	3.4	1.1
Other machinery manufacturing	3.3	1.4
Insurance (includes pension funding)	3.1	2.8
Renewable energy machinery products	2.6	1.2
Extraction of Natural Gas	2.3	2.3
Fabricated metal products	2.1	0.4
Information and communication	2.0	0.4
Petroleum & coke products manufacturing	1.9	0.2
Electricity; air conditioning supply	1.7	0.5
Other iron products manufacturing	1.5	0.1
Steel products manufacturing	1.4	0.1
Gas manufacturing and distribution	1.4	0.4
Water supply and waste management activities	1.4	0.6
Lumber Products	1.2	-0.1
Other food products	1.2	0.5
Land transport services	1.1	0.3
Air transport services	1.1	-0.3
pharmaceutical-related food products	1.1	0.5
Other financial services	1.0	0.4

The third scenario simulates the reduction of FDI barriers that applies to all EU affiliates operating in India, where sectors the Modi government has taken targeted measures to liberalize since 2014 see a 10 percentage points removal of price gaps, while all the other sectors see a 5 percentage points removal of price gaps. With the reduction of FDI barriers for EU firms, there is 0.4 percent more capital in the Indian economy and India's real GDP increases by 0.3 percent. With the increase of factor returns and product prices, India's nominal GDP increases by 1.0 percent. The output effects for selected sectors are shown in the second column of table 3. It appears that a large part of the effects from a reduction in FDI barriers in India will be generated by FDI of EU firms, which is not surprising as output of EU foreign affiliates in India accounts for 37.3 percent of total output of all foreign affiliates in India.[20]

[20] Authors' calculations based on the 2014 baseline statistics in the GTAP-FDI model.

Results from the Fourth and Fifth Simulation

The fourth scenario simulates a deeper cutting of FDI red tape by removing all FDI barriers faced by all foreign affiliates operating in India, where all the sectors see the full 10 percent points removal of price gaps. The macroeconomic results show that a larger sized easing of FDI restrictions in India leads to a higher increase in India's real and nominal GDP, as well as a bigger increase in capital in the Indian economy. With the removal of FDI barriers in the Indian economy, the amount of capital increases by 1.4 percent, compared to 0.9 percent in simulation 2. Real GDP increases by 1.3 percent, compared to 0.9 percent in the second simulation. At the same time, the increase in factor returns and product prices contributes to a nominal GDP increase of 3.4 percent, compared to 1.8 percent in simulation 2. Labor wages in India increases by 5.4 percent, as compared to 3.0 percent in simulation 2.

Table 4 shows the sectors that increase production by more than 1 percent. The sectoral results also demonstrate that a larger sized loosening of FDI restrictions results in a higher increase in sectoral production: for instance, output of the computer and electronic products sector increases by 21.4 percent, as compared to 10.0 percent in simulation 2. The bigger increase in sectoral production is mainly due to the foreign affiliates expanding their production to a larger scale — foreign computer and electronic products manufacturers from different regions increase their production in India by 44.3 to 58.3 percent, as compared to an increase in production of 21.4 percent to 26.9 percent in the second simulation. Meanwhile, the production of domestic Indian manufacturers is estimated to decline by 20.0 percent, as compared to 9.5 percent in the second simulation.

Table 4. Percent change in sectoral production in India

Sector	Removal of all FDI barriers (Simulation 4)	Removal of European FDI barriers (Simulation 5)
Other electrical equipment	23.5	21.8
Computer and electronic products	21.4	20.2
Renewable electrical equipment	21.3	20.1
Paper & Paper Products	11.3	6.7
Motor Vehicles and Parts	9.4	5.3
Other chemical products	9.0	3.0
Non-Ferrous Metals	8.8	-0.3
Pharmaceutical products	8.5	2.8
Medical Devices Manufacturing	6.7	3.3
Other machinery manufacturing	6.4	3.2
Renewable machinery products	5.4	2.8
Other non-metallic mineral products	5.4	1.6
Extraction of Natural Gas	5.1	5.1
Construction Services	5.1	2.0
Insurance (includes pension funding)	3.2	2.8
Fabricated metal products	3.1	0.9

Electricity; air conditioning supply	2.7	1.0
Other food products	2.7	1.3
Other iron products manufacturing	2.6	0.4
pharmaceutical-related food products	2.5	1.2
Steel products manufacturing	2.4	0.3
Information and communication	2.4	0.9
Water supply and waste management activities	2.4	1.4
Gas manufacturing and distribution	2.2	0.8
Petroleum & coke products manufacturing	2.1	0.3
Wheat	1.6	0.7
Land transport services	1.6	0.5
Wholesale trade	1.4	0.5
Retail trade	1.4	0.4
Other financial services	1.2	0.4
Lumber Products	1.1	-0.1

The fifth scenario simulates the removal of the FDI barriers that apply to all EU affiliates operating in India, where EU affiliates in all the sectors see the full 10 percentage points removal of price gaps. With the removal of FDI barriers for EU firms, there is 0.6 percent more capital in the Indian economy and thus real GDP increases by 0.5 percent while nominal GDP increases by 1.8 percent. Production effects for selected sectors are shown in the second column in table 4. Labor wages in India increase by 2.6 percent. It appears that a large part of the effects from a removal of FDI barriers in India would be generated by FDI of EU firms.

Conclusion

This paper develops a GTAP model which incorporates internationally-mobile capital to analyze how increasing inward FDI in India affects the country's GDP, production and trade patterns. Our simulation results show that a larger sized easing of FDI restrictions increases the overall amount of capital in the Indian economy, as well as the country's nominal and real GDP. It also drives up the overall wages and household income. At the sectoral level, since the manufacturing sectors in India are more reliant upon inward FDI compared to the services sectors, increases in foreign affiliate production as a result of reducing FDI barriers has, on average, a larger impact on sectoral production in India's manufacturing sectors compared to services sectors.

In addition, we provide important simulation results on the interaction between international trade and FDI, which received less attention in previous CGE literature. Our simulation results indicate that due to foreign affiliates' expanding their production in India and their reallocation of capital globally, Indian imports decline in some sectors. The sectors where Indian imports decline the most (in percent) are different manufacturing sectors, including pharmaceutical

products manufacturing, paper and paper products, other food products, computer and electronic products and other electrical equipment, while Indian imports in most services sectors increase slightly. As the Indian manufacturing sector is more dependent upon international trade compared to its services sector, the effect of inter-modal switching between trade and FDI dominates the changes in imports in Indian manufacturing sectors. By contrast, the "income effect" dominates the changes in imports in Indian services sectors.

Appendix A

Table A.1 Removal of Price Gaps in Simulation 2 and 3, by Sector

Sector	Removal of Price Gaps (in percentage points)
Other paddy rice	5
Husked paddy rice	5
Wheat	5
Other grains	5
Vegetable and fruit products	5
Oil seeds	5
Cane & beet: sugar crops	5
Fibres crops	5
Other crops	5
Cattle	5
Other animal products	5
Raw milk	5
Wool	5
Forestry products	5
Fishing	5
Coal mining	10
Oil extraction	5
Extraction of natural gas	5
Other mining extraction	5
Cattle meat products	5
Other meat products	5
Vegetable oils	5
Dairy products	5
Processed rice	5
Sugar and molasses	5
pharmaceutical-related food products	5
Other food products	5
Beverages made of grain	5

Wine products	5
Beverages made of other food products	5
Other beverages and tobacco products	5
Manufacture of textiles	5
Manufacture of wearing apparel	5
Leather and related products	5
Lumber Products	5
Paper & Paper Products	5
Petroleum & coke products manufacturing	10
Pharmaceutical products	10
Other chemical products	5
Other non-metallic mineral products	5
Steel products manufacturing	5
Other iron products manufacturing	5
Non-Ferrous Metals	5
Fabricated metal products	5
Motor Vehicles and Parts	5
Manufacture of other transport equipment	5
Computer and electronic products	5
Renewable electrical equipment	5
Other electrical equipment	5
Renewable machinery products	5
Medical devices manufacturing	10
Other machinery manufacturing	5
Other manufacturing: includes furniture	5
Electricity; steam and air conditioning supply	5
Gas manufacturing and distribution	5
Water supply and waste management activities	5
Construction services	10
Wholesale trade	5
Retail trade	10
Land transport services	10
Water transport services	5
Air transport services	10
Information and communication	10
Other financial services	10
Insurance (includes pension funding)	10
Other business services	5
Recreation & Other services	5
Other services (government)	10
Dwellings	5

Table A.2 Foreign Affiliates Sales (FAS) as a Share of Output in India, 2014

Sector	Foreign Affiliate Sales as a Share of Output (in percent)
Motor Vehicles and Parts	65.0
Pharmaceutical-related food product manufacturing	62.5
Other food products	62.4
Computer and electronic products	61.2
Renewable electrical equipment	61.2
Other electrical equipment	59.8
Paper & Paper products	55.8
Pharmaceutical products	31.5
Other chemical products	30.7
Insurance (includes pension funding)	30.0
Renewable machinery products	26.4
Other machinery manufacturing	25.9
Medical Devices Manufacturing	25.6
Construction Services	25.6
Extraction of Natural Gas	24.5
Water supply and waste management activities	24.5
Non-Ferrous Metals	21.5
Other business services	19.8
Information and communication	17.8
Beverages made of other food products	12.9
Wine products	12.9
Other beverages and tobacco products	12.9
Beverages made of grain	12.9
Air transport services	10.3
Electricity; steam and air conditioning supply	9.8
Other non-metallic mineral products	9.6
Gas manufacturing and distribution	7.8
Other financial services	6.4
Steel products manufacturing	6.3
Other iron products manufacturing	6.2

GTAP-FDI 2014 Baseline Statistics, Authors' Calculations

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