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Multinationals and Structural Transformation*

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Abstract

We study the role of multinationals (MNCs) in driving structural transformation. We begin by developing a stylized two-country, three-sector general equilibrium model with multinational production and trade. We show analytically that a decrease in FDI costs leads to an increase in the manufacturing employment share of the host country and a decrease in the source country, consistent with structural transformation. We test the model's firm-level predictions by using confidential microdata to study the response of Japanese MNC parents and affiliates to an exogenous change in China's openness to FDI. We find that the China affiliates of Japanese MNCs in industries where inward FDI was exogenously encouraged experienced increases in manufacturing employment. We also find that MNC parents in industries where inward FDI was exogenously encouraged experienced larger losses in home country manufacturing employment and increases in home country services and R&D employment. Finally, we expand our confidential microdata to cover several high and middle-income countries and implement an accounting decomposition separating the change in overall manufacturing employment shares into MNC and non-MNC components. We find a significant role for MNCs across all countries, suggesting the mechanism we highlight is an important driver of structural transformation.

Keywords: Multinational Firms, Structural Transformation, Manufacturing Employment
JEL classification: F41, F44

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1 Introduction

The central facts of structural transformation involve the evolution of broad sectoral employment and value-added shares as countries develop. In particular, the agricultural share declines, the services share increases, and the manufacturing share follows a "hump" pattern, first rising, and then declining.[1] For decades, the dominant theories of structural change involved non-homothetic preferences and/or asymmetric sectoral productivity growth with non-unitary substitution elasticities (the "Baumol" effect) in a closed economy setting. Recently, both empirical evidence and quantitative theory have suggested a role for international linkages. A growing body of evidence attributes some portion of the declining advanced economy manufacturing employment shares to international trade and/or multinational firms. In addition, quantitative multi-country, multi-sector models suggest that international trade plays some role in structural change. However, there is still no comprehensive understanding of the role of increasing international linkages – including both multinational firms and international trade – in structural transformation, and of the linkages between countries' structural transformation experiences.

This paper studies the relationship between multinational activity and structural transformation in an open economy context. We first build a simple two-country three-sector model featuring multinational firms. We show analytically that a unilateral reduction in inward multinational production (MP) frictions in the manufacturing sector of one country ("China") leads to an increase in its manufacturing employment share and a decrease in the corresponding share in the other, source, country. These implications are consistent with structural transformation in developing and advanced economies. Second, we test the model's firm-level implications using confidential microdata from Japan. We provide causal evidence that a change in China's FDI policies in 2002 increased employment growth in Japanese-owned affiliates exposed to the shock. Moreover, we find that it also reduced manufacturing employment growth in Japanese multinational parent firms exposed to the shock, while increasing service employmentployment growth in these same firms in Japan. Third, we use microdata from five different countries – the U.S., France, Hungary, Japan and China – covering different stages of development. With these data we implement an accounting decomposition to decompose the change in manufacturing employment shares into multinational corporations (MNCs) and non-MNCs components. We show that multinational activity is instrumental in the decline of manufacturing and the increase in services in developed economies, as well as in the increase of manufacturing in developing economies. Overall, our evidence suggests that multinationals contributes significantly to the process of structural transformation worldwide.

Our two-country general equilibrium firm-level model of multinationals and structural change draws from the multinational model of Helpman, Melitz, and Yeaple (2004). Our three sectors are agriculture, manufacturing and services. In order to focus on the role of multinationals in structural change, we do not enrich the model with non-homothetic preferences or other features that induce

[1] Kuznets (1973) and Maddison (1980) document the pattern of structural transformation across OECD countries.

structural change.

In the model, there is a large mass of potential entrants for the heterogeneous manufacturing sector which is the main focus of our model. Firms draw a productivity, and then choose whether to produce. If so, they also choose whether to serve foreign markets. If they choose to serve foreign markets, they choose whether to serve them via exporting or by setting up an affiliate abroad. The latter is what we call multinational production (MP). There is a friction associated with MP in that the productivity of multinational affiliates is reduced in the same fashion as in Ramondo and Rodríguez-Clare (2013), i.e., there is an iceberg cost of transferring technologies from the parent firm to its foreign affiliate.

With the model, we prove several propositions that clarify the role of MNCs in structural transformation. A unilateral FDI liberalization (i.e., a reduction in MP frictions) in one country always increases the share and sizes of firms doing MP in that country, and, when the MP friction decreases from a prohibitively high level, increases the share of manufacturing employment in that country. This aggregate effect occurs despite reduced employment in domestic manufacturing firms in the liberalizing country. Further, the share of manufacturing employment in the source country decreases and the share of service employment increases. Firms that are MNCs grow larger globally through standard scale effects, and so there is also a within-firm increase in service employment in the source country.

To assess the model's firm-level predictions, we turn to Japanese microdata. While confidential microdata can typically not be linked across countries, a unique feature of these microdata is information on the activities of foreign affiliates in all countries, including in China. This setting allows us to exploit an exogenous shock to test the predictions of our theory: in early 2002, China changed the set of industries in which it "encouraged" FDI. We can therefore construct exposure measures for Japanese firms (in Japan) that were affected by this shock because of heterogeneity in the industry mix of their pre-existing affiliates in China. The identification assumption here is that individual Japanese firms did not influence China's FDI policy change.

We then assess the change in exposed firms' manufacturing and service employment shares in Japan using a standard difference-in-differences (DID) approach. First, we show that, compared to Japanese (manufacturing) multinational affiliates in industries (in China) without a change in the FDI policy (i.e., the control group), those in industries that started to encourage FDI in 2002 (i.e., the treatment group) increased their employment and sales by about 20% and 18%, respectively. Thus, the positive impact of the FDI policy change on Japanese multinational affiliates in China is substantial. Second, we find that compared to Japanese multinational corporation (MNC) parents that have manufacturing affiliates in the control group, Japanese MNC parents that have manufacturing affiliates in the treatment group reduced their manufacturing employment and manufacturing employment share (in Japan) by roughly 12.8% and 3.1 percentage points, respectively. Further, shares of employees in the international business unit and R&D staffs in those treated MNC parents' employment increased by about 1.2% and 0.33% compared to MNCs in the control group.[2] Taken together, we show causal evidence that China's FDI policy change in 2002 made Japanese (manufacturing) multinational affiliates in China increase their employment, which sped up the pace of China's structural transformation during the 2000s. Moreover, it also made Japanese MNCs decrease (increase) their manufacturing (service) employment at home, which increased the pace of Japan's structural transformation during the 2000s as well.

Our causal evidence clearly illustrates that the channel highlighted by the theory is operational in the data. However, the setting does not permit a quantitative evaluation of the magnitude of this channel as a driver of structural transformation. A large-scale quantitative model with MNCs would rapidly become intractable, so to provide a first sense of the possible magnitude of this channel, we turn to accounting decomposition exercises in a larger group of countries.

We implement a decomposition exercise building on Foster, Haltiwanger, and Krizan (2006). We achieve this goal by utilizing microdata for five countries encompassing both developed and middle-income countries (US, France, Hungary, Japan and China). This decomposition expresses the change in the manufacturing employment share for each country into components that can be attributed to multinational (MNC) activity and non-multinational (non-MNC) activity. We use the microdata to show that in all the countries we consider, employment changes within and between MNCs are responsible for a substantial fraction of the overall change in the manufacturing employment share.[3] These results suggest that MNCs might be a quantitatively important driver of structural change for many countries.

To summarize, this paper brings together different elements to answer a challenging question– are MNCs a driver of structural change across countries? We show theoretically, unilateral FDI liberalization generates aggregate implications consistent with contributing to the downward part of the "hump" of the manufacturing employment share in advanced economies, and to the upward part of the hump of the manufacturing employment share in developing economies. We find strong support for the firm-level implications of the theory using an exogenous shock to FDI barriers in China. Finally, our decomposition evidence suggests that the role of MNCs in structural transformation might be substantial.

Related Literature A large literature has studied the determinants of structural transformation, typically in theoretical/quantitative frameworks, often in closed economies. Sector-biased productivity growth is one explanation studied in Baumol (1967), and also emphasized by Ngai and Pissarides (2007) who calibrate a CES elasticity of substitution of less than one to obtain changes in sectoral shares in response to change in relative prices. The other mechanism most emphasized in the literature are the role of income effects. To assess their importance, several papers include alterna-

[2]The average share of manufacturing employment is 53%, while the average employment share of R&D staffs and that of the international business unit in the MNC parents are 8.4% and 1.0% respectively.

[3]As our microdata are confidential at the country-level, a downside of the analysis is that we cannot link individual firms in the data across countries in most cases to extend the causal evidence to other countries.

tive, often non-homothetic, preference structures such as Stone-Geary (Kongsamut, Rebelo, and Xie (2001)), non-homothetic CES (Comin, Lashkari, and Mestieri (2021)), a sub-class of PIGL preferences (Boppart (2014)), and augmented CES (Buera and Kaboski (2009), Herrendorf, Herrington, and Valentinyi (2015)) and constant differences of elasticities of substitution (Swiecki (2017)).

More recent work has emphasized that structural transformation should be studied in an open-economy context (Matsuyama (2009)). Uy, Yi, and Zhang (2013), Betts, Giri, and Verma (2017), Teignier (2018), Lewis et al. (2018), Sposi (2019), and Cravino and Sotelo (2019) provide quantitative assessments of the role of international trade and input linkages for structural transformation. Swiecki (2017) embeds all these competing explanations for structural transformation in a single model to assess the strength of each mechanism.[4]

Empirical patterns governing structural transformation are provided for a large number of countries by Kuznets (1973), Maddison (1980) and updated by Jorgenson and Timmer (2010). Many studies documenting empirical patterns have focused on sectoral data, and not emphasized the role of firms in structural transformation. Our paper contributes to a small but fast growing literature documenting long-run patterns using microdata. Other papers studying mechanisms for structural transformation using microdata include, for instance, Herrendorf and Schoellman (2018) who study worker transitions out of agriculture, Gallipoli and Makridis (2018) who study the role of jobs created by growing information technology in structural transformation, and Ding et al. (2019) who investigate how structural transformation had happened both between and within firms in the context of the U.S. We complement this literature by documenting stylized facts using microdata for a number of countries in different stages of development. Further, we emphasize the role of multinationals – to the best of our knowledge this is the first paper to address this channel as a mechanism accelerating the pace of structural transformation across countries.

Our paper is also related to work that has studied explanations the manufacturing decline in several developed countries, albeit without an emphasis on structural transformation. While this literature is large, most closely related are the papers studying trade-based explanations including China's WTO accession (Autor, Dorn, and Hanson (2013), Pierce and Schott (2016)), or offshoring by multinationals (Boehm, Flaaen, and Pandalai-Nayar (2019)), or the interaction of multinationals and trade (Irarrazabal, Moxnes, and Opromolla (2013)). Both the latter paper and Ramondo and Rodríguez-Clare (2013) develop models of multinationals and trade, as does Helpman, Melitz, and Yeaple (2004). None of those papers studies empirically the interdependence of changes in manufacturing employment across countries, which is the key focus of our paper; moreover, none focus on structural change in both home and host countries.

[4]The seminal work by Matsuyama (1992) points out the importance of studying structural transformation in the open economy setting. Matsuyama (2019) develops a model in which trade facilitates increased productivity in production; thus, creating a link between Engel's Law, relative prices, and productivity growth.

2 Model

In this section, we employ a version of the canonical Helpman, Melitz, and Yeaple (2004) model to study how liberalizing foreign direct investment (FDI) in the manufacturing sector affects structural transformation. Our goal is to provide analytical propositions that can be tested in our econometric analysis. In our model, there are two countries and three sectors. The primary sector produces a homogeneous, agricultural good, and the secondary sector is manufacturing, which consists of many differentiated varieties. The tertiary sector produces services, which also consist of many differentiated varieties. For simplicity, we assume both countries are symmetric up to the barriers to FDI.

2.1 Preferences

In country i, the representative consumer has the following two-tier utility function over the two sector's goods:

$$U_i = C_{ia}^{\beta_a} C_{im}^{\beta_m} C_{is}^{\beta_s}, \tag{2.1}$$

where $\beta_a + \beta_m + \beta_s = 1$, and C_{ik} is the composite good produced in sector k. Our preferences have unitary elasticities of income and substitution, and thus do not include the forces of non-homothetic preferences, as well as the "Baumol" effect. This is to highlight the impact of manufacturing FDI liberalization in an open economy on structural transformation. The composite good, C_{ik}, is a CES aggregate of domestic and imported varieties:

$$C_{ik} = \left(\sum_{j=1,2} \int_{\omega \in \Omega_{ji}} q_{ji}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}, \tag{2.2}$$

where j refers to the source country. Ω_{ji} is the set of varieties produced by firms in country j that are sold to country i.

The representative consumer maximizes his/her utility defined in equations (2.1) and (2.2) subject to the following budget constraint:

$$P_{ia}C_{ia} + P_{im}C_{im} + P_{is}C_{is} = w_i \tag{2.3}$$

where P_{ik} is the price index of the sector k composite good in country i, and w_i is the wage rate for the consumer. In each country, there are L_i identical workers who supply their unit labor endowment inelastically, and spend their wage and dividend income on the composite sectoral goods. The budget constraints (2.3) ensure that balanced trade holds period-by-period.

2.2 Technologies

As in Helpman, Melitz, and Yeaple (2004) each country produces one unit of the homogeneous good with one unit of labor. We assume that in equilibrium the two countries produce this good. Hence, the wage rate is equalized across countries and normalized to one.

In both the manufacturing sector and the service sector, there is a large mass of potential entering firms. If a firm in country i chooses to enter sector k ($i \in \{m, s\}$), it pays a country-sector specific entry cost, f_{ikE}. Upon entry, the firm next decides whether to produce, and if so, whether to also export or engage in multinational activity. Each of these activities requires a fixed cost. f_{ijk} denotes the fixed cost of a firm in sector k of country i entering the market in country j. In addition, f^M_{ijk} denotes the fixed cost of a multinational firm in sector k of country i setting up operations in country j. All entry and fixed costs are in terms of units of labor. In addition, we assume that the fixed MP cost in the manufacturing sector, f^M_{ijm}, generates services jobs, as jobs done inside MNC headquarters that are used to pay the fixed MP cost are services jobs in nature (e.g., translation/communication with employees of foreign affiliates, and transferring technology or management know-how to foreign affiliates etc.).

When a firm pays the entry cost, it draws a productivity z from a distribution $G(z)$.[5] If the firm chooses to produce, it then hires labor commensurate with maximizing profits and its choice of production activities. The choice of production activities leads to three types of firms: domestic firms, exporting firms and MNCs. For example, after paying the fixed cost, a domestic firm in country i and sector k hires $\frac{q}{z}$ workers in order to produce and sell q quantity of goods in the domestic market.

In addition to paying fixed costs, firms operating in international markets via exporting or MNC activity need to pay a variable cost. An exporting firm in country i and sector k that sells to country j ($j \neq i$) faces an iceberg trade cost of $\tau_{ijk} \geq 1$. An MNC firm from country i and sector k that sets up an affiliate in country j ($j \neq i$) experiences frictions associated with operating its affiliate; these frictions capture imperfect technology transfer, as well as institutional and other technological frictions. These frictions are captured by $g_{ijk} \geq 1$ and the MNC affiliate has productivity given by $\frac{z}{g_{ijk}}$.

2.3 Firm-level Outcomes

We study how firms choose prices and the mode of production in this subsection. Based on equations (2.1) and (2.2), we derive firm z's demand function in country i as

$$q_{ik}(z) = \frac{p_{ik}^{-\sigma}(z)}{P_{ik}^{1-\sigma}} \beta_k L_i w_i, \tag{2.4}$$

where k is the sector firm z belongs to and P_{ik} is the ideal price index of differentiated goods sold in sector k of country i. Given the cost structure, a domestic firm in country i and an exporting firm from country i that exports to country j use the following pricing rules respectively:

$$p_{ik}(z) \equiv p_{ik}(z) = \frac{w_i}{z\rho} \tag{2.5}$$

[5] The distribution of productivity draws can be assumed to be sector-specific.

and

$$p_{ijk}(z) = \frac{\tau_{ijk} w_i}{z\rho} = \tau_{ijk} p_{ik}(z), \tag{2.6}$$

where $\rho \equiv \frac{\sigma}{\sigma-1}$ is the markup. The resulting profit functions are

$$\pi_{ik}(z) = \left(\frac{z\rho P_{ik}}{w_i}\right)^{\sigma-1} \frac{\beta_k L_i w_i}{\sigma} - w_i f_{iik} \tag{2.7}$$

and

$$\pi_{ijk}(z) = \left(\frac{z\rho P_{jk}}{\tau_{ijk} w_i}\right)^{\sigma-1} \frac{\beta_k L_j w_j}{\sigma} - w_i f_{ijk}. \tag{2.8}$$

Owing to the fixed costs, there are survival and exporting productivity cutoffs, which are given by:

$$z_{iik}^* = \frac{w_i}{\rho P_{ik}} \left(\frac{w_i f_{iik} \sigma}{\beta_k L_i w_i}\right)^{\frac{1}{\sigma-1}}. \tag{2.9}$$

and

$$z_{ijk}^* = \frac{\tau_{ijk} w_i}{\rho P_{jk}} \left(\frac{w_i f_{ijk} \sigma}{\beta_k L_j w_j}\right)^{\frac{1}{\sigma-1}}. \tag{2.10}$$

We assume that the fixed and variable trade costs are sufficiently high so that there is positive selection into exporting among active firms:

$$z_{ijk}^* > z_{iik}^* \quad \forall\, i, j, k.$$

Now, we discuss the behavior of MNCs. Given the cost structure, the affiliate of an MNC (from country i and sector k) in country j sets its output price as:

$$p_{ijk}^M(z) = \left(\frac{g_{ijk} w_j}{\rho z}\right). \tag{2.11}$$

The resulting profit function is:

$$\pi_{ijk}^M(z) = \left(\frac{z\rho P_{jk}}{g_{ijk} w_j}\right)^{\sigma-1} \frac{\beta_k L_j w_j}{\sigma} - w_i f_{ijk}^M, \tag{2.12}$$

Note that the MNC from country i hires labor in its home country to pay the fixed FDI cost. Based on equation (2.12), we can derive the productivity cutoff for doing FDI (relative to the exporting cutoff):

$$z_{ijk}^{*M} = \left[\frac{\frac{w_j f_{ijk}^M}{w_i f_{ijk}} - 1}{\left(\frac{w_i \tau_{ijk}}{w_j g_{ijk}}\right)^{\sigma-1} - 1}\right]^{\frac{1}{\sigma-1}} z_{ijk}. \tag{2.13}$$

We assume that the fixed and variable trade costs, and the fixed and variable MNC costs are such that there is a positive selection into multinationals so that $z_{ijk}^{*M} > z_{ijk}^{*}$. Because wages are equalized, then under the assumption that $f_{ijk}^{M} > f_{ijk}$, we would need $\tau_{ijk} > g_{ijk}$ by a sufficiently small amount to ensure this outcome.

2.4 Equilibrium

The factor market is characterized by perfect competition, while the goods market is characterized by monopolistic competition. Labor is perfectly mobile across sectors within a country, but immobile across countries. Let L_{ik} denote labor employed in sector k of country i. The factor market clearing conditions in each period are given by

$$L_i = L_{ia} + L_{im} + L_{is} \qquad i \in \{1, 2\}. \tag{2.14}$$

We assume that all workers employed to pay the fixed FDI cost are counted as non-manufacturing workers.

We next characterize the goods market clearing condition. For future use, we define the sectoral ideal price index as

$$\begin{aligned} & P_{ik}^{1-\sigma} \\ = \; & P_{iik}^{1-\sigma} + \sum_{j \neq i} P_{jik}^{1-\sigma} \\ \equiv \; & \left[\int_{z_{iik}^{*}}^{\infty} M_{ik}^{e} \left(\frac{w_i}{\rho z} \right)^{1-\sigma} dG_{ik}(z) + \sum_{j \neq i} \int_{z_{jik}^{*M}}^{\infty} M_{jk}^{e} \left(\frac{g_{jik} w_i}{\rho z} \right)^{1-\sigma} dG_{jk}(z) \right] \\ & + \left(\sum_{j \neq i} \int_{z_{jik}^{*}}^{z_{jik}^{*M}} M_{jk}^{e} \left(\frac{w_j \tau_{jik}}{\rho z} \right)^{1-\sigma} dG_{jk}(z) \right). \end{aligned} \tag{2.15}$$

For each sector k of country i, we have

$$L_i P_{ik} C_{ik} = P_{iik} Q_{ik} + \sum_{j \neq i} P_{jik} EX_{jik}, \tag{2.16}$$

where C_{ik} is the individual level consumption, while Q_{ik} is the amount of goods produced by firms in sector k and country i and sold in country i.[6] EX_{ijk} is the amount of exports from country i to country j. Formally, Q_{ik} and EX_{jik} are defined as

$$Q_{ik} = \left(\int_{z_{iik}^{*}}^{\infty} M_{ik}^{e} q_{ik}(z)^{\frac{\sigma-1}{\sigma}} dG_{ik}(z) + \sum_{j \neq i} \int_{z_{jik}^{*M}}^{\infty} M_{jk}^{e} q_{jik}^{M}(z)^{\frac{\sigma-1}{\sigma}} dG_{jk}(z) \right)^{\frac{\sigma}{\sigma-1}} \tag{2.17}$$

[6] In other words, Q_{ik} does not include goods exported from country i to country j where $j \neq i$.

and

$$EX_{jik} = \left(\int_{z_{jik}^*}^{z_{jik}^{*M}} M_{jk}^e \left(\frac{q_{jik}(z)}{\tau_{jik}} \right)^{\frac{\sigma-1}{\sigma}} dG_{jk}(z) \right)^{\frac{\sigma}{\sigma-1}}. \tag{2.18}$$

For future use, we define two J terms as follows:

$$J(z_{ijk}^*) = \int_{z_{ijk}^*}^{\infty} \left[\left(\frac{z}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] dG(z) = \left[\left(\frac{\tilde{z}_{ijk}}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] (1 - G(z_{ijk}^*)),$$

where

$$\tilde{z}_{ijk}^{\sigma-1} = \frac{1}{(1 - G(z_{ijk}^*))} \int_{z_{ijk}^*}^{\infty} z^{\sigma-1} dG(z), \tag{2.19}$$

and

$$J(z_{ijk}^*, z_{ijk}^{*M}) = \int_{z_{ijk}^*}^{z_{ijk}^{*M}} \left[\left(\frac{z}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] dG(z) = \left[\left(\frac{\tilde{z}_{ijk}}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] (G(z_{ijk}^{*M}) - G(z_{ijk}^*)),$$

where

$$\tilde{z}_{ijk}^{\sigma-1} = \frac{\int_{z_{ijk}^*}^{z_{ijk}^{*M}} z^{\sigma-1} dG(z)}{G(z_{ijk}^{*M}) - G(z_{ijk}^*)}.$$

Based on the two J terms defined above, we can express the domestic production and exports as

$$P_{iik}Q_{ik} = \sigma w_i f_{iik} \left[J(z_{iik}^*) + (1 - G(z_{iik}^*)) \right] M_{ik}^e + \sum_{j \neq i} \frac{\sigma w_j \left(f_{jik}^M - f_{jik} \right)}{\left(\left(\frac{\tau_{jik} w_j}{g_{jik} w_i} \right)^{\sigma-1} - 1 \right)} \left[J(z_{jik}^{*M}) + \left(1 - G(z_{jik}^{*M}) \right) \right] M_{jk}^e \tag{2.20}$$

and

$$P_{ijk}EX_{ijk} = \sigma w_i f_{ijk} \left[J(z_{ijk}^*, z_{ijk}^{*M}) + G(z_{ijk}^{*M}) - G(z_{ijk}^*) \right] M_{ik}^e. \tag{2.21}$$

The trade balance condition between countries i and j becomes

$$\sum_k M_{ik}^e \sigma w_i f_{ijk} \left[J(z_{ijk}^*, z_{ijk}^{*M}) + G(z_{ijk}^{*M}) - G(z_{ijk}^*) \right] = \sum_k M_{jk}^e \sigma w_j f_{jik} \left[J(z_{jik}^*, z_{jik}^{*M}) + G(z_{jik}^{*M}) - G(z_{jik}^*) \right]. \tag{2.22}$$

We define a competitive equilibrium of our model economy with country-specific labor endowment processes $\{L_i\}$, fixed cost processes $\{f_{iik}\}^{k=m,s}$, trade cost processes $\{f_{ijk}^{k=m,s}\}$ and $\{\tau_{ijk}\}^{k=m,s}$, FDI cost processes $\{f_{ijk}^M\}^{k=m,s}$ and $\{g_{ijk}\}^{k=m,s}$, productivity processes $\{\bar{z}_{ijk}\}^{k=m,s}$ and common structural parameters $\{\sigma, \theta, \beta_k, , M_{ik}^e\}_{i=1,2,3}^{k=a,m,s}$ as follows.

Definition 1. *A competitive equilibrium is a sequence of goods and factor prices* $\{P_{ia}, P_{im}, P_{is}, w_i\}_{i=1,2}$, *cutoffs* $\{z_{iik}^*, z_{ijk}^*, z_{ijk}^{*M}\}_{i,j=1,2\ i\neq j}^{k=m,s}$, *allocations* $\{L_{ia}, L_{im}, L_{is}, C_{ia}, C_{im}, C_{is}, Q_{ia}, Q_{im}, Q_{is}\}_{i=1,2}$, *and ex-*

ports $\{EX_{ija}, EX_{ijm}, EX_{ijs}\}_{i,j=1,2\ i\neq j}$*, such that, given prices, the allocations solve the firms' profit maximization problems based on the demand function in equation (2.4) and the consumer's maximization problem characterized by equations (2.1)-(2.3), and satisfy the market clearing in equations (2.14) and (2.16). In addition, the cutoffs that solve the zero profit conditions are defined in equations (2.9), (2.10) and (2.13).*

3 Implications of Unilateral FDI Liberalization

Now we study the implications of an FDI liberalization by country one in the manufacturing sector in our model. Specifically, the variable cost of inward manufacturing FDI for one of the countries is reduced. This is our stand-in for China's FDI liberalization in 2002. For simplicity, we assume that the costs of FDI from country one to country two are prohibitively high on both the manufacturing and service sectors.

3.1 Equilibrium after Unilateral FDI Liberalization in the Manufacturing Sector

We consider the case in which there are two countries (China and the U.S.) and country one reduces its MP friction in the manufacturing sector unilaterally. To simplify the analysis, we assume that the iceberg trade cost is the same between the two countries and use $\{\tau_k\}^{k\in\{m,s\}}$ to denote this cost.

We use the J term defined in the previous section to express the free entry conditions. As the wage rate is always one, the two free entry conditions in the manufacturing sector are

$$f_{11m}J(z^*_{11m}) + f_{12m}J\left(A_{12}z^*_{22m}\right) = f_{1mE}, \tag{3.1}$$

and

$$f_{22m}J(z^*_{22m}) + f_{21m}J\left(A_{21}z^*_{11m}, A_{21}B_{21}z^*_{11m}\right) + f_{21m}J^M\left(A_{21}B_{21}z^*_{11m}\right) = f_{2mE}, \tag{3.2}$$

where the new J term for MNCs is defined as

$$J^M(z^{*M}_{21m}) = J^M(A_{21}B_{21}z^*_{11m}) = \left(\int_{z^{*M}_{21m}}^{\infty}\left(\frac{\tau_m z}{g_{21m}z^*_{21m}}\right)^{\sigma-1}dG(z) - \frac{f^M_{21m}}{f_{21m}}\right).$$

In addition, we define

$$A_{12} \equiv \tau_m\left(\frac{f_{12m}}{f_{22m}}\right)^{\frac{1}{\sigma-1}};$$

$$A_{21} \equiv \tau_m\left(\frac{f_{21m}}{f_{11m}}\right)^{\frac{1}{\sigma-1}};$$

and

$$B_{21} \equiv \left[\frac{\frac{f^M_{21m}}{f_{21m}} - 1}{\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} - 1}\right]^{\frac{1}{\sigma-1}}.$$

Note that A_{ij} and B_{ij} denote the ratio of the exporting cutoff (from i to j) to the domestic cutoff (in i), and the ratio of the MNC cutoff (from i to j) to the exporting cutoff (from i to j), respectively. Importantly, they are pinned down by exogenous parameters.[7]

For the service sector, the two free entry conditions are

$$f_{11s}J(z_{11s}^*) + f_{12s}J\left(A_{12}^s z_{22s}^*\right) = f_{1sE}, \tag{3.3}$$

and

$$f_{22s}J(z_{22s}^*) + f_{21s}J\left(A_{21}^s z_{11s}^*,\right) = f_{2sE}, \tag{3.4}$$

where A_{ij}^s and B_{ij}^s are defined analogously as the ones defined for the manufacturing sector. Two important points worth pointing out are (1) various cutoffs in the service sector are unchanged as long as trade and domestic production costs are unchanged; (2) allowing the possibility of MP in the service sector does not change the first property as long as the MP costs themselves are unchanged.

3.1.1 Implications for Survival and Market Competition

The above two equations pin down two survival cutoffs: z_{11m}^* and z_{22m}^*. Moreover, the relationship pinned down by the two equations are always negative. The following proposition summarizes the results:

Proposition 1. *When country one reduces its inward MP friction in the manufacturing sector g_{21m}, country one's survival cutoff in the manufacturing sector decreases, while country two's survival cutoff in the manufacturing sector increases. In addition, the exporting cutoff from country one to country two increases, while the exporting cutoff from country two to country one decreases. Third, the MNC cutoff from country two to country one decreases. Finally, the cutoffs in the service sector are unchanged in both countries.*

Proof. See Appendix. □

In country one, there are two offsetting effects that affect the selection of domestic firms into the manufacturing sector. The direct effect is that survival becomes tougher as more productive foreign firms enter country one by producing there (and charging low prices than what they would charge via exporting). The indirect effect is the so-called delocation effect which is emphasized by economic geography models. Specifically, the lower MP cost from country two to country one makes entry into the manufacturing sector of country two more attractive (compared to country one), which leads to fewer (and more) entrants in the manufacturing sector of country one (and two) respectively.[8] This indirect effect softens the competition in country one and dominates the direct effect. As a result,

[7] Our approach of solving the comparative statics is similar to the one adopted in Demidova (2008). Segerstrom and Sugita (2015) use a similar approach to study how asymmetric trade liberalization affects productivity gains from trade.

[8] We will prove this in Proposition 3.

the survival cutoff in country one declines, which also implies that the exporting cutoff (from two to one) declines (recall that trade costs are unchanged). This, combined with the lower MP cost into country one, also imply the MNC cutoff from country to country one drops.

For country two, the lower MP cost (from country two to country one) does not directly affect the pricing decisions of firms in country two. Thus, the only effect coming from the unilateral FDI liberalization in country one is the delocation effect. Specifically, there are more entrants in the manufacturing sector of country two which leads to tougher competition and a higher survival cutoff (and a higher exporting cutoff from country one to country two).[9]

The following proposition, which is a direct implication of Proposition 1, describes how firms are affected by the unilateral FDI liberalization.

Proposition 2. *When country one reduces its inward MP friction in the manufacturing sector* g_{21m}*, incumbent MNC affiliates in country one expand and more (new) MNCs from country two start doing MP in country one. Surviving domestic firms in country one also expand, while exporters from country one to country two shrink. Third, surviving domestic firms in country two shrink, while exporters from country two to country one expand. As a result, the manufacturing (and services) employment share of MNC parent firms in country two decreases (and increases). Finally, firms in the service sector of both countries are unaffected.*

Proof. See Appendix. □

3.1.2 Implications for the Mass of Entrants

To solve for the mass of entrants, we first calculate the price index. Firms at the survival cutoff have the following operating profits:

$$\pi_{iim} = \frac{(z^*_{iim}\rho P_{im})^{\sigma-1}}{\sigma}\beta_m L,$$

which equals f_{iim}. As a result, the price index can be solved as

$$P_{im} = \left(\frac{\beta_m L}{\sigma f_{iim}}\right)^{\frac{1}{1-\sigma}} \frac{1}{\rho z^*_{iim}} \tag{3.5}$$

As firms from country one cannot implement MP in country two, the ideal price index of the manufacturing sector in country two can be expressed as

$$(\rho z^*_{22m} P_{2m})^{1-\sigma} = \left[M^e_{1m} \int_{z^*_{12m}}^{\infty} \left(\frac{z}{z^*_{22m}\tau_m}\right)^{\sigma-1} dG(z) + M^e_{2m} \int_{z^*_{22m}}^{\infty} \left(\frac{z}{z^*_{22m}}\right)^{\sigma-1} dG(z) \right]. \tag{3.6}$$

[9] Recall that the (general equilibrium) effect on the wage rate via the labor market equilibrium conditions is not present here, as it is exogenously determined by the productivity of the homogeneous good sector.

The ideal price index of the manufacturing sector in country one is more complicated and can be expressed as

$$(\rho z^*_{11m} P_{1m})^{1-\sigma} = \left[M^e_{1m} \int_{z^*_{11m}}^{\infty} \left(\frac{z}{z^*_{11m}} \right)^{\sigma-1} dG(z) + M^e_{2m} \left(\int_{z^*_{21m}}^{z^{*M}_{21m}} \left(\frac{z}{z^*_{11m}\tau_m} \right)^{\sigma-1} dG(z) + \int_{z^{*M}_{21m}}^{\infty} \left(\frac{z}{g_{21m} z^*_{11m}} \right)^{\sigma-1} dG(z) \right) \right]. \quad (3.7)$$

The ideal price index of the service sector can be defined analogously in both countries:

$$(\rho z^*_{iis} P_{is})^{1-\sigma} = \frac{\beta_s L_i}{\sigma f_{iis}} = \left[M^e_{js} \int_{z^*_{jis}}^{\infty} \left(\frac{z}{z^*_{iis}\tau_s} \right)^{\sigma-1} dG(z) + M^e_{is} \int_{z^*_{iis}}^{\infty} \left(\frac{z}{z^*_{iis}} \right)^{\sigma-1} dG(z) \right], \quad (3.8)$$

where $i \in \{1, 2\}$ and $j \neq i$.

The following proposition describes how the mass of manufacturing entrants changes in the two countries after the unilateral FDI liberalization.

Proposition 3. *When country one reduces its inward MP friction in the manufacturing sector,* g_{21m}*, the mass of manufacturing entrants in country one decreases, while the mass of manufacturing entrants in country two increases. In addition, the mass of entrants in the service sector is unchanged in both countries.*

Proof. See Appendix. □

The changes in the mass of manufacturing entrants described in the above proposition are triggered by the delocation effect discussed in the previous subsection.

3.1.3 Implications for Trade Volume and Trade Patterns

Following country one's inward FDI liberalization in the manufacturing sector, manufacturing exports from country one to country two declines, because both the number of entrants in country one, as well as the fraction of firms that export among entrants (and active firms), decline. Total exports equal:

$$EX_{12m} \equiv M^e_{1m} \sigma f_{12m} \int_{z^*_{12m}}^{\infty} \left(\frac{z}{z^*_{12m}} \right)^{\sigma-1} dG(z), \quad (3.9)$$

Manufacturing exports from country two to country one equal:

$$EX_{21m} \equiv M^e_{2m} \sigma f_{21m} \int_{z^*_{21m}}^{z^{*M}_{21m}} \left(\frac{z}{z^*_{21m}} \right)^{\sigma-1} dG(z), \quad (3.10)$$

Labor employed in the manufacturing sector of country one arises from three activities: (1) total sales of domestic firms; (2) total export sales of exporting firms from country one to country two; (3) labor used in the variable cost of country two's MNC affiliates in country one ($\frac{\sigma-1}{\sigma}$ fraction of total sales of these firms):

$$LD_1 = M^e_{1m} \sigma \left[f_{11m} \int_{z^*_{11m}}^{\infty} \left(\frac{z}{z^*_{11m}} \right)^{\sigma-1} dG(z) + f_{12m} \int_{z^*_{12m}}^{\infty} \left(\frac{z}{z^*_{12m}} \right)^{\sigma-1} dG(z) \right] + M^e_{2m} (\sigma-1) f_{21m} \int_{z^{*M}_{21m}}^{\infty} \left(\frac{\tau_m z}{g_{21m} z^*_{21m}} \right)^{\sigma-1} dG(z), \quad (3.11)$$

where the last term is the labor used in the variable cost of country two's MNC affiliates in country one. Note that total sales (of either domestic or exporting firms) equal wage payments to labor used in the variable, fixed and entry costs.

Labor employed in the manufacturing sector of country two also arises from three activities: (1) total sales of domestic firms; (2) total export sales of exporting firms from country two to country one; (3) labor used in the fixed cost of country two's MNC affiliates in country one and used in the entry cost paid in country two ($\frac{1}{\sigma}$ fraction of total sales of these firms):

$$LD_2 = M_{2m}^e \sigma \left[f_{22m} \int_{z_{22m}^*}^{\infty} \left(\frac{z}{z_{22m}^*} \right)^{\sigma-1} dG(z) + f_{21m} \int_{z_{21m}^*}^{z_{21m}^{*M}} \left(\frac{z}{z_{21m}^*} \right)^{\sigma-1} dG(z) \right] + M_{2m}^e f_{21m} \int_{z_{21m}^{*M}}^{\infty} \left(\frac{\tau_m z}{g_{21m} z_{21m}^*} \right)^{\sigma-1} dG(z), \tag{3.12}$$

where the last term comes from country two's MNC affiliates in China and is used to pay for the fixed MNC cost and the entry cost in country two. Note that exporters from country two to country one are in the productivity range of z_{21m}^* and z_{21m}^{*M}.

The number of workers working in the service sector in country i can be define analogously:

$$\tilde{LD}_i = M_{is}^e \sigma \left[f_{iis} \int_{z_{iis}^*}^{\infty} \left(\frac{z}{z_{iis}^*} \right)^{\sigma-1} dG(z) + f_{ijs} \int_{z_{ijs}^*}^{\infty} \left(\frac{z}{z_{ijs}^*} \right)^{\sigma-1} dG(z) \right], \tag{3.13}$$

where $i \in \{1, 2\}$ and $j \neq i$.

There is an important distinction between the number of workers working in the manufacturing sector and the number of manufacturing workers (i.e., jobs), as the fixed MP cost generates service employment. This difference is relevant for country two, as there are MNCs in country two that conduct outward manufacturing FDI in country one. Specifically, the number of workers who have manufacturing jobs in country two is

$$LD_2^m = LD_2 - M_{2m}^e \left[1 - G(z_{21m}^{*M}) \right] f_{21m}^M, \tag{3.14}$$

where the second term on the right hand side is the number of services jobs created by MNC parent firms in country two. Accordingly, the number of service jobs in country two becomes

$$LD_2^s = \tilde{LD}_2 + M_{2m}^e \left[1 - G(z_{21m}^{*M}) \right] f_{21m}^M. \tag{3.15}$$

For country one, the number of workers working in the manufacturing (or service) sector is the same as the number of manufacturing (or services) workers:

$$LD_1^m = LD_1; \quad LD_1^s = \tilde{LD}_1.$$

3.1.4 Special Case with Pareto Distribution: Implications for Trade Patterns and Structural Transformation

In order to derive additional analytical results, we add two simplifying assumptions. First, we assume that the productivity draw z in both countries follows a Pareto distribution with a shape coefficient of k, and we normalize the minimum productivity to one:

$$G(z) = 1 - z^{-k}, \tag{3.16}$$

where a larger k implies a smaller variance of the productivity distribution. Under the Pareto assumption, the free entry conditions can be simplified to:

$$\frac{(\sigma-1)f_{11m}}{k-(\sigma-1)}(z_{11m}^{*})^{-k} + \frac{(\sigma-1)f_{12m}}{k-(\sigma-1)}(A_{12}z_{22m}^{*})^{-k} = f_{1me}, \tag{3.17}$$

and

$$\frac{(\sigma-1)f_{22m}(z_{22m}^{*})^{-k}}{k-(\sigma-1)} + \frac{kf_{21m}(A_{21}z_{11m}^{*})^{-k}}{k-(\sigma-1)}\left[1-(B_{21})^{-k+(\sigma-1)}\right] - f_{21m}(A_{21}z_{11m}^{*})^{-k}\left[1-(B_{21})^{-k}\right]$$
$$+f_{21m}(A_{21}B_{21}z_{11m}^{*})^{-k}\left[\frac{k\left(\frac{\tau_m B_{21}}{g_{21m}}\right)^{\sigma-1}}{k-(\sigma-1)} - \frac{f_{21m}^{M}}{f_{21m}}\right] = f_{2mE}, \tag{3.18}$$

where A_{12}, B_{12}, and B_{21} are defined above. The two equations that pin down the mass of manufacturing entrants become:

$$\frac{\beta_m L}{\sigma f_{22m}} = \left[M_{2m}^{e}\frac{k(z_{22m}^{*})^{-k}}{k-(\sigma-1)} + M_{1m}^{e}\frac{k(z_{12m}^{*})^{-k}}{k-(\sigma-1)}\left(\frac{A_{12}}{\tau_m}\right)^{\sigma-1}\right], \tag{3.19}$$

and

$$\frac{\beta_m L}{\sigma f_{11m}} = \left[M_{1m}^{e}\frac{k(z_{11m}^{*})^{-k}}{k-(\sigma-1)} + M_{2m}^{e}\frac{k\,(z_{21m}^{*})^{-k}}{[k-(\sigma-1)]}\left(B_{21}^{-k}(A_{21}B_{21})^{\sigma-1}\left(\frac{1}{g_{21m}^{\sigma-1}} - \frac{1}{\tau_m^{\sigma-1}}\right) + \frac{A_{21}^{\sigma-1}}{\tau_m^{\sigma-1}}\right)\right]. \tag{3.20}$$

In addition, the aggregate labor demand for manufacturing workers can be stated as:

$$LD_1 = M_{1m}^{e}\left[\frac{\sigma f_{11m}k(z_{11m}^{*})^{-k}}{k-(\sigma-1)} + \frac{\sigma f_{12m}k(z_{12m}^{*})^{-k}}{k-(\sigma-1)}\right] + M_{2m}^{e}\frac{(\sigma-1)f_{21m}k\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}\left(z_{21m}^{*M}\right)^{-k}}{k-(\sigma-1)}B_{21}^{\sigma-1}, \tag{3.21}$$

and

$$LD_2 = M^e_{2m}\left[\frac{\sigma f_{22m}k(z^*_{22m})^{-k}}{k-(\sigma-1)} + \frac{\sigma f_{21m}k(z^*_{21m})^{-k}}{k-(\sigma-1)}\left[1-(B_{21})^{-k+(\sigma-1)}\right]\right] + M^e_{2m}\frac{f_{21m}k\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}\left(z^{*M}_{21m}\right)^{-k}}{k-(\sigma-1)}B^{\sigma-1}_{21}. \tag{3.22}$$

The second simplifying assumption we make is that the two countries are symmetric (in terms of production, preferences and trade/MP costs) before the unilateral FDI liberalization. This implies that the initial MP friction from country two to country one is also prohibitively high. Our goal is to investigate how a small change in the MP friction (from country two to country one) that leads to the appearance of a small number of MNCs affects trade patterns and manufacturing employment.

First, we derive the change in cutoffs in the two economies. Log linearization (up to the first order) of equations (3.17) and (3.18) imply that:

$$-frac_{dom}\frac{dz^*_{11m}}{z^*_{11m}} - (1-frac_{dom})\frac{dz^*_{22m}}{z^*_{22m}} = 0, \tag{3.23}$$

and

$$-frac_{dom}\frac{dz^*_{22m}}{z^*_{22m}} - (1-frac_{dom})\left[\frac{dz^*_{11m}}{z^*_{11m}}\left[1-\left(1-\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}\right)B^{-k+(\sigma-1)}_{21}\right] + \frac{dg_{21m}}{g_{21m}}\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}B^{-k+(\sigma-1)}_{21}\right] = 0,$$

where:

$$frac_{dom} = \frac{\frac{(\sigma-1)f_{11m}}{k-(\sigma-1)}(z^*_{11m})^{-k}}{\frac{(\sigma-1)f_{11m}}{k-(\sigma-1)}(z^*_{11m})^{-k} + \frac{(\sigma-1)f_{12m}}{k-(\sigma-1)}(A_{12}z^*_{11m})^{-k}} = \frac{f_{11}\tau^k_m\left(\frac{f_{12}}{f_{11}}\right)^{\frac{k}{\sigma-1}}}{f_{12} + f_{11}\tau^k_m\left(\frac{f_{12}}{f_{11}}\right)^{\frac{k}{\sigma-1}}} > \frac{1}{2},$$

under the assumption that the two countries are symmetric initially. As B_{21} would go to infinity when FDI is not present, we have to make a slightly relaxed assumption that the initial level of g_{21m} is arbitrarily close to τ_m (i.e., the prohibitively high level), but still below it. As a result, B_{21} is extremely large, but not infinite. Moreover, the allocation of resources and firms are still (almost) identical under this assumption. Thus, we have:

$$-frac_{dom}\frac{dz^*_{22m}}{z^*_{22m}} - (1-frac_{dom})\left(\frac{dz^*_{11m}}{z^*_{11m}} + \frac{dg_{21m}}{g_{21m}}B^{-k+(\sigma-1)}_{21}\right) = 0. \tag{3.24}$$

As a result, we have:

$$\frac{dz^*_{22m}}{z^*_{22m}} = -\frac{frac_{dom}(1-frac_{dom})\frac{dg_{21m}}{g_{21m}}B^{-k+(\sigma-1)}_{21}}{frac^2_{dom} - (1-frac_{dom})^2} > 0, \tag{3.25}$$

and

$$\frac{dz^*_{11m}}{z^*_{11m}} = \frac{(1-frac_{dom})^2 \frac{dg_{21m}}{g_{21m}} B_{21}^{-k+(\sigma-1)}}{frac_{dom}^2 - (1-frac_{dom})^2} < 0. \tag{3.26}$$

Note that as all A_{ij}'s are unchanged after the unilateral FDI liberalization, we must have:

$$\frac{dz^*_{22m}}{z^*_{22m}} = \frac{dz^*_{12m}}{z^*_{12m}}; \quad \frac{dz^*_{11m}}{z^*_{11m}} = \frac{dz^*_{21m}}{z^*_{21m}}.$$

Next, we calculate changes in the mass of entrants in both countries. Log linearization of equations (3.19) implies that:

$$frac_{price}\left(\frac{dM^e_{2m}}{M^e_{2m}} - k\frac{dz^*_{22m}}{z^*_{22m}}\right) + (1-frac_{price})\left(\frac{dM^e_{1m}}{M^e_{1m}} - k\frac{dz^*_{11m}}{z^*_{11m}}\right) = 0, \tag{3.27}$$

where:

$$frac_{price} \equiv \frac{M^e_{2m}}{M^e_{2m} + M^e_{1m}\frac{A_{12}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}} = \frac{f_{22}\tau_m^k\left(\frac{f_{12}}{f_{22}}\right)^{\frac{k}{\sigma-1}}}{f_{12} + f_{22}\tau_m^k\left(\frac{f_{12}}{f_{22}}\right)^{\frac{k}{\sigma-1}}} > \frac{1}{2},$$

when we start from the symmetric case. Note that as we assume $f_{11} = f_{22}$ and $f_{12} = f_{21}$, it must be true that:

$$frac_{price} = frac_{dom}.$$

Log linearization of equation (3.20) leads to:

$$frac_{price}\left(\frac{dM^e_{1m}}{M^e_{1m}} - k\frac{dz^*_{11m}}{z^*_{11m}}\right) + (1-frac_{price})\left[\left(\frac{dM^e_{2m}}{M^e_{2m}} - k\frac{dz^*_{22m}}{z^*_{22m}}\right) - \tau_m^{\sigma-1}g_{21m}^{1-\sigma}(\sigma-1)B_{21}^{-k+(\sigma-1)}\frac{dg_{21m}}{g_{21m}}\right] = 0,$$

which can be simplified to:

$$frac_{price}\left(\frac{dM^e_{1m}}{M^e_{1m}}\right) + (1-frac_{price})\left[\left(\frac{dM^e_{2m}}{M^e_{2m}}\right) - \tau_m^{\sigma-1}g_{21m}^{1-\sigma}(\sigma-1)B_{21}^{-k+(\sigma-1)}\frac{dg_{21m}}{g_{21m}}\right] = 0, \tag{3.28}$$

thanks to equation (3.23). Similarly, we can rewrite equation (3.27) as:

$$frac_{price}\left(\frac{dM^e_{2m}}{M^e_{2m}}\right) + (1-frac_{price})\left[\left(\frac{dM^e_{1m}}{M^e_{1m}}\right) + kB_{21}^{-k+(\sigma-1)}\frac{dg_{21m}}{g_{21m}}\right] = 0, \tag{3.29}$$

thanks to equation (3.24). In total, we can solve for the percentage change in the mass of entrants as:

$$\frac{dM_{1m}^{e}}{M_{1m}^{e}} = (1-frac_{pirce})B_{21}^{-k+(\sigma-1)}\left[\frac{(\sigma-1)\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} frac_{price} + k(1-frac_{price})}{frac_{price}^{2} - (1-frac_{pirce})^{2}}\right]\frac{dg_{21m}}{g_{21m}} < 0. \tag{3.30}$$

and

$$\frac{dM_{2m}^{e}}{M_{2m}^{e}} = -(1-frac_{pirce})B_{21}^{-k+(\sigma-1)}\left[\frac{(\sigma-1)\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}(1-frac_{price}) + kfrac_{price}}{frac_{price}^{2} - (1-frac_{pirce})^{2}}\right]\frac{dg_{21m}}{g_{21m}} > 0, \tag{3.31}$$

where, as a reminder, the FDI liberalization is captured by:

$$\frac{dg_{21m}}{g_{21m}} < 0.$$

Finally, we turn to the change in manufacturing employment. Since preferences are Cobb-Douglas and countries start from being symmetric, we need to know only how manufacturing employment changes in one country in order to pin down the allocation of manufacturing jobs in the world. We calculate the change of manufacturing employment in country one to achieve this goal. Under the two above simplifying assumptions, labor demand in country one is:

$$\frac{k-(\sigma-1)}{k\sigma}LD_1 = M_{1m}^{e}\left(f_{11m}(z_{11m}^{*})^{-k} + f_{12m}(z_{12m}^{*})^{-k}\right) + M_{2m}^{e}\frac{\sigma-1}{\sigma}f_{21m}\left(z_{21m}^{*M}\right)^{-k}B_{21}^{\sigma-1}. \tag{3.32}$$

Recall that:

$$\frac{dz_{11m}^{*}}{z_{11m}^{*}} = \frac{(1-frac_{dom})^{2}B_{21}^{-k+(\sigma-1)}}{frac_{dom}^{2} - (1-frac_{dom})^{2}}\frac{dg_{21m}}{g_{21m}};$$

$$\frac{dz_{22m}^{*}}{z_{22m}^{*}} = -\frac{frac_{dom}(1-frac_{dom})B_{21}^{-k+(\sigma-1)}}{frac_{dom}^{2} - (1-frac_{dom})^{2}}\frac{dg_{21m}}{g_{21m}};$$

$$\frac{dM_{1m}^{e}}{M_{1m}^{e}} = (1-frac_{pirce})B_{21}^{-k+(\sigma-1)}\left[\frac{(\sigma-1)frac_{price} + k(1-frac_{price})}{frac_{price}^{2} - (1-frac_{pirce})^{2}}\right]\frac{dg_{21m}}{g_{21m}};$$

$$\frac{dM_{2m}^{e}}{M_{2m}^{e}} = -(1-frac_{pirce})B_{21}^{-k+(\sigma-1)}\left[\frac{(\sigma-1)(1-frac_{price}) + kfrac_{price}}{frac_{price}^{2} - (1-frac_{pirce})^{2}}\right]\frac{dg_{21m}}{g_{21m}}.$$

For the term of $M_{1m}^{e}\left(f_{11m}(z_{11m}^{*})^{-k} + f_{12m}(z_{12m}^{*})^{-k}\right)$, log linearization yields:

$$\frac{d\left[M_{1m}^{e}\left(f_{11m}(z_{11m}^{*})^{-k} + f_{12m}(z_{12m}^{*})^{-k}\right)\right]}{M_{1m}^{e}\left(f_{11m}(z_{11m}^{*})^{-k} + f_{12m}(z_{12m}^{*})^{-k}\right)} = C\left[(\sigma-1)frac^{2} + (1-frac)(k+(\sigma-1)frac)\right]\frac{dg_{21m}}{g_{21m}} < 0,$$

where

$$frac \equiv frac_{dom} = frac_{price} > \frac{1}{2}; \quad C \equiv \frac{(1-frac)B_{21}^{-k+(\sigma-1)}}{frac^2 - (1-frac)^2} > 0.$$

For the term of $M_{2m}^e \frac{\sigma-1}{\sigma} f_{21m} \left(z_{21m}^{*M}\right)^{-k} B_{21}^{\sigma-1}$, log linearization yields:

$$-C \left[(\sigma-1)(1-frac) + kfrac + [k-(\sigma-1)] \left[(1-frac) + \frac{B_{21}^{\sigma}}{\frac{f_{21m}^M}{f_{21m}} - 1} \right] + (\sigma-1)(1-frac) \right] \frac{dg_{21m}}{g_{21m}},$$

which can be further reduced to:

$$\frac{d\left[M_{2m}^e \frac{\sigma-1}{\sigma} f_{21m} \left(z_{21m}^{*M}\right)^{-k} B_{21}^{\sigma-1}\right]}{M_{2m}^e \frac{\sigma-1}{\sigma} f_{21m} \left(z_{21m}^{*M}\right)^{-k} B_{21}^{\sigma-1}} = -C \left[k + (\sigma-1)(1-frac) + [k-(\sigma-1)] \left(\frac{B_{21}^{\sigma}}{\frac{f_{21m}^M}{f_{21m}} - 1} \right) \right] \frac{dg_{21m}}{g_{21m}} > 0.$$

The ratio of the two terms showing up in the right hand side of equation (3.32) is:

$$\frac{M_{2m}^e \frac{\sigma-1}{\sigma} f_{21m} \left(z_{21m}^{*M}\right)^{-k} B_{21}^{\sigma-1}}{M_{1m}^e \left(f_{11m}(z_{11m}^*)^{-k} + f_{12m}(z_{12m}^*)^{-k} \right)} = (1-frac)\frac{\sigma-1}{\sigma} B_{21}^{-k+(\sigma-1)}.$$

In total, we have:

$$\frac{dLD_1}{LD_1} \approx C \left[\frac{\left[(\sigma-1)frac^2 + (1-frac)(k+(\sigma-1)frac)\right]}{1+(1-frac)\frac{\sigma-1}{\sigma}B_{21}^{-k+(\sigma-1)}} - \frac{\left[(1-frac)\frac{\sigma-1}{\sigma}B_{21}^{-k+(\sigma-1)}\right][k-(\sigma-1)]\left(\frac{B_{21}^{\sigma}}{\frac{f_{21m}^M}{f_{21m}}-1}\right)}{1+(1-frac)\frac{\sigma-1}{\sigma}B_{21}^{-k+(\sigma-1)}} \right] \frac{dg_{21m}}{g_{21m}} \tag{3.33}$$

Note that B_{21} is extremely large. also, because $C > 0$, $\frac{f_{21m}^M}{f_{21m}} - 1 > 0$, and $\frac{f_{21m}^M}{f_{21m}} - 1 < 0$, we must have

$$\frac{dLD_1}{LD_1} > 0,$$

when $k < 2\sigma - 1$. This yields the following proposition:

Proposition 4. *Assume that the slope parameter of the Pareto distribution is not too large: $k < 2\sigma - 1$. When country one reduces its inward MP friction in the manufacturing sector g_{21m} from τ_m (i.e., a prohibitively high level) by a small amount, manufacturing employment of country one increases, while it decreases in country two. Country one exports manufacturing goods (on net) and imports the homogeneous good. Country two imports manufacturing goods (on net) and exports the homogeneous good. Trade is balanced in the service sector between the two countries both before and after the unilateral FDI liberalization. However, the service employment of country two increases after the unilateral FDI liberalization in country one.*

Proof. See Appendix. □

Why do we need the condition that $k < 2\sigma - 1$ in order to generate the result that manufacturing employment increases in country one? When the inward MP friction decreases (from a prohibitively high level), there are two offsetting effects on manufacturing employment of country one. The first effect is positive owing to the new manufacturing jobs created by MNC affiliates in country one. The second effect is negative, because the mass of domestic (and exporting) manufacturing firms of country one declines. The difference is that country two's MNC affiliates in country one (which inherit (partially) the productivity from their parent firms) are more productive than domestic and exporting firms of country one on average. This is because of selection effects, i.e., MNC firms are more productive on average than domestic and exporting firms. The greater the productivity of these multinational firms (i.e., firms in the right tail of productivity distribution) the stronger the first effect. This explains why a smaller k (and therefore a larger variance of the productivity distribution) is needed. In fact, as k declines and approaches $\sigma - 1$ from above, the maximum positive impact on the manufacturing employment of country one increases.[10]

The result that the service employment share increases in country two is a by-product of the increasing number of manufacturing MNCs of country two (after the unilateral FDI liberalization). First, as the service sector is symmetric between the two countries and the preference over sector-specific composite goods is Cobb-Douglas, sales and total wage payments to workers *working* in the service sector are unchanged in both countries after the FDI liberalization. However, as more manufacturing firms in country two become MNCs, the total fixed MP cost paid by them and services jobs (i.e., workers) generated by the this aggregate fixed MP cost increase. This leads to an overall increase in the share of services workers in the labor force of country two, although the share of workers working in the service sector is unchanged in country two.

We now present the following proposition that discusses how the mass of active firms changes in each country after the unilateral FDI liberalization. As a reminder, the mass of entrants and that of active firms are different concepts, as the pool of active firms is a truncated sample of entrants.

Proposition 5. *Assume that the slope parameter of the Pareto distribution is not too large: $k < 2\sigma - 1$. When country one reduces its inward MP friction in the manufacturing sector g_{21m} from τ_m (i.e., a prohibitively high level) by a small amount, the mass of domestic active firms decreases (and increases) in country one (and two) respectively.*

Proof. See Appendix. □

This section establishes several testable propositions on the effects of an inward FDI liberalization. In the next section, we provide causal evidence for Propositions 2 and 4. We show that following an inward FDI liberalization by one country, that country experiences an increase in its manufacturing

[10] Simulation results are available upon request.

employment share, while the other country experiences a decrease in its manufacturing employment share (Proposition 4), and that incumbent MNC affiliates in country one expand, while surviving domestic firms in country two decrease in size. (Proposition 2). Moreover, we show that the manufacturing (and services) employment share within incumbent MNC parent firms of country two declines (and increases) following the unilateral FDI liberalization, respectively (Proposition 2).

4 Implications of Unilateral Trade Liberalization

In this section, we study the effect of unilaterally reducing the iceberg trade cost on market competition and sectoral employment. For simplification, we drop MP from our model and assume trade is possible in both the manufacturing sector and the service sector. The two free entry conditions in the manufacturing sector are

$$f_{11m}J(z^*_{11m}) + f_{12m}J\left(A_{12}z^*_{22m}\right) = f_{1mE}, \tag{4.1}$$

and

$$f_{22m}J(z^*_{22m}) + f_{21m}J\left(A_{21}z^*_{11m}\right) = f_{2mE}, \tag{4.2}$$

where we define

$$A_{12} \equiv \tau_m^{12}\left(\frac{f_{12m}}{f_{22m}}\right)^{\frac{1}{\sigma-1}};$$

$$A_{21} \equiv \tau_m^{21}\left(\frac{f_{21m}}{f_{11m}}\right)^{\frac{1}{\sigma-1}}.$$

Note that τ_m^{12} represents the iceberg trade cost from country one to country two in the manufacturing sector. We can define the two free entry conditions in the service sector analogously. The mass of entrants can be solved using the definition of the ideal price index as

$$(\rho z^*_{iik}P_{ik})^{1-\sigma} = \frac{\beta_s L_i}{\sigma f_{iik}} = \left[M^e_{jk}\int_{z^*_{jik}}^{\infty}\left(\frac{z}{z^*_{iik}\tau_k^{ji}}\right)^{\sigma-1} dG(z) + M^e_{ik}\int_{z^*_{iik}}^{\infty}\left(\frac{z}{z^*_{iik}}\right)^{\sigma-1} dG(z)\right], \tag{4.3}$$

where $i \in \{1,2\}$, $j \neq i$ and $k \in \{m,s\}$. The following proposition summarizes the effect of an unilateral trade liberalization on market competition, firm mass and manufacturing employment.

Proposition 6. *When the iceberg trade cost from country one to country two in the manufacturing sector τ_m^{12} falls, country one's survival cutoff in the manufacturing sector increases, while country two's survival cutoff in the manufacturing sector decreases. In addition, the exporting cutoff from country one to country two decreases, while the exporting cutoff from country two to country one increases. As a result, firms sell in country one (domestic firms from country one and exporting firms from country two to country one) shrink in size, while they increase size in country two. Furthermore, the mass of entrants increases and decreases in country one and country two, respectively. Finally,*

country one's trade surplus in the manufacturing sector and its manufacturing employment share increase, when the unilateral iceberg trade cost from country two to country one is reduced.
There is no change in the service sector concerning all variables discussed above.

Proof. The first thing to note is that as neither the free entry conditions nor the equation that determines the mass of entrants changes in the service sector in both countries, all variables (i.e., cutoffs, the mass of entrants, exports and imports) are unchanged when τ_m^{12} is reduced. In particular, as the two countries are symmetric before the reduction of τ_m^{12}, the trade is balanced in the service sector both before and after the unilateral trade liberalization.

Second, (in the proof of Proposition 1) we have shown that when the two curves intersect, the one represented by equation (3.1) has a smaller slope than the one represented by equation (3.2) in absolute value:

$$\left|\frac{dz^*_{11m}}{dz^*_{22m}}\right|_{FE1} < \left|\frac{dz^*_{11m}}{dz^*_{22m}}\right|_{FE2},$$

where $FE1$ refers to equation (4.1) while $FE2$ refers to equation (4.2). A reduction in τ_m^{12} shifts the curve of $FE1$ upward in the domain of (z^*_{22m}, z^*_{11m}) without affecting the curve of $FE2$. As a result, z^*_{11m} and z^*_{22m} increases and decreases respectively. Since A_{12} drops and A_{21} does not change, $z^*_{12m} = A_{12}z^*_{22m}$ and $z^*_{21m} = A_{21}z^*_{11m}$ declines and increases respectively.

Third, as

$$z^{*,after}_{11m} > z^{*,before}_{11m}; \quad z^{*,after}_{22m} < z^{*,before}_{22m},$$

we must have[11]

$$P^{after}_{m1} < P^{before}_{m1}; \quad P^{after}_{m2} > P^{before}_{m2}.$$

In other words, market competition becomes tougher in the manufacturing sector of country one (due to more entries), while it becomes less tougher in the manufacturing sector of country two. Therefore, sales and operating profit of domestic firms shrink and increases in country one and country two , respectively. For exporting plants that sell from country two to country one, they also shrink in size as P_{m1} declines. For exporting plants that sell from country one to country two, they also shrink in size as P_{m2} goes up and τ_m^{12} goes down.

Fourth, we discuss how the mass of entrants changes in the two economies. (in the proof of Proposition 3) we have shown that when the two curves intersect, the one represented by equation (4.3) with $i = 1$ and $k = m$ has a smaller slope than the one represented by equation (4.3) with $i = 2$ and $k = m$ in absolute value:

$$\left|\frac{dM^e_{1m}}{dM^e_{2m}}\right|_{country\ 2} > \left|\frac{dM^e_{1m}}{dM^e_{2m}}\right|_{country\ 1},$$

where *country* 2 refers to equation (4.3) with $i = 2$ and $k = m$ and where *country* 1 refers to

[11]Note that the nominal spending on manufacturing good is always $\beta_m L$.

equation (4.3) with $i = 1$ and $k = m$. When τ_m^{12} falls, z^*11m and z_m^{21} go up. As a result, the curve representing country one shifts upward. When τ_m^{12} falls, z^*22m and z_m^{12} go down(and τ_m^{12} also goes down). Thus, the curve representing country one shifts downward. Therefore, we must have the mass of manufacturing entrants increases in country one (M_{2m}^e) and decreases in country two (M_{2m}^e).

Finally, we discuss how manufacturing employment and trade balance change after the unilateral trade liberalization. First, national accounting identity reveals that

$$sales_{1m} = P_{1m}C_{1m} + EX_{12m} - EX_{21m},$$

where $sales_{1m}$ is the total revenue of the manufacturing sector in country one, which is also the total wage payment to manufacturing workers (thanks to the free entry condition), and EX_{12m} and EX_{21m} are defined in equations (3.9) and (3.10). Thanks to the Cobb-Douglas preference, total consumption of manufacturing goods by workers in country one $P_{1m}C_{1m}$ is $\beta_m L_1$ which is not affected by τ_m^{12}. Next, as M_{1m}^e increases and z_{12m}^* goes down, total manufacturing exports from country one to country two EX_{12m} increases. Conversely, as M_{2m}^e decreases and z_{21m}^* goes up, total manufacturing exports from country two to country one EX_{21m} decreases. In total, total revenue of the manufacturing sector in country one ($sales_{1m}$) increases, which implies total revenue of the manufacturing sector in country two ($sales_{2m}$) decreases. As the wage rate is always one. Manufacturing employment (and its share in total employment) increases and decreases in country one and country two, respectively. □

The key insight behind the above proposition is again the delocation effect emphasized by economic geography models or the home-market effect emphasized by trade models. Since market access from country one to country two becomes easier after the unilateral trade liberalization, more manufacturing firms enter into country one which intensifies market competition. As a result, the survival cutoff increases. The opposite story happens in the manufacturing sector of country two, which leads to a lower survival cutoff and fewer entrants into the manufacturing sector of country two. Exactly because of this delocation effect, manufacturing exports from country one to country two increases and vice versa for manufacturing exports from country two to country one. This leads to a higher manufacturing employment share and a smaller employment share of the agricultural sector. For country two, it is going to have trade deficit in the manufacturing sector and a declining manufacturing employment share after the unilateral trade liberalization.

The change in the trade balance of manufacturing goods is the key to understanding the nature of structural transformation in our model. Specifically, manufacturing employment share increases in one country, when the trade surplus in its manufacturing sector increases. An unilateral trade liberalization (done by country two) and an unilateral FDI liberalization (done by country one) increase country one's manufacturing employment share for exactly the same reason that country one's trade surplus in the manufacturing sector increases. However, there are three key differences between the two types of liberalization.

First, an unilateral trade liberalization always increases trade surplus of manufacturing goods and the manufacturing employment share in country one, while an unilateral FDI liberalization has such effects only when we start from the level of MP frictions that are sufficiently large. Second, the driving force for the increasing trade surplus of manufacturing goods is different between the two liberalizations. For the unilateral trade liberalization, there are more exporters from country one and they expand after the liberalization, which drive the increasing trade surplus of manufacturing goods.[12] For the unilateral FDI liberalization, there are actually fewer exporters from country one and they shrink (as market competition is intensified in country two). However, manufacturing exports from country two to country one shrink more, as the most productive firms switch from exporting to doing MP. They drive the increasing trade surplus of manufacturing goods in country one. Finally, firms are affected in opposite ways between the two liberalization episodes. For the trade liberalization, domestic and exporting firms of country one shrink and expand respectively, as country one and country two (i.e., the manufacturing sector) become more and less competitive.[13] However, domestic and exporting firms of country one expand and shrink respectively, as country one and country two (i.e., the manufacturing sector) become less and more competitive, when country one implements FDI liberalization. In total, the two liberalization episodes yield different implications at both the firm level and the aggregate level.

5 Employment Effects of FDI Liberalization: the Change of China's FDI Policy in 2002

The previous section showed theoretically how MNCs might contribute to structural transformation in the aggregate, albeit in a stylized setting. We next provide causal evidence for how increased MP induced by lower barriers to FDI affects MNCs' employment and the process of structural transformation in both the home country and the host country. Specifically, we present evidence on how relaxing barriers to inward FDI affects MNCs' employment globally, using an exogenous change of China's FDI policy in early 2002 and microdata of Japanese MNCs. We use China and its FDI policy change in 2002 in our empirical exercise, as China is one of the largest recipient countries of inward FDI in the world and its FDI policy change in 2002 was substantial, making the shock relevant. We utilize data of Japanese MNCs, as China is the biggest destination economy of Japan's outward FDI, and because Japanese microdata permit detailed analysis of affiliate activity in all countries.

5.1 China's FDI Policy: 1978-2007

From 1949 to 1978, China was a closed economy under rigid central planning, and there were almost no MNCs in the country. In December 1978, China initiated an open-door policy to promote foreign

[12] Declining manufacturing exports from country two to country one also contribute to the increasing trade surplus of manufacturing goods in country one.

[13] The opposite story holds for domestic and exporting firms of country two.

trade and investment. A "Law on Sino-Foreign Equity Joint Ventures" was passed in July 1979 to attract FDI. Moreover, from the 1980s to the early 1990s, a series of laws on FDI and implementation measures were further introduced and revised. As a result, we had witnessed a surge of inward FDI during that period.

Despite of the removal of barriers to inward FDI from the late 1970s to the early 1990s, MNCs operating in China still faced significant obstacles.[14] As a part of China's efforts to join the WTO, the government continued to relax barriers to inward FDI from mid-1990s and onward. In particular, the central government of China announced the "Catalogue for the Guidance of Foreign Investment Industries" (henceforth, the Catalogue) in 1995, which, together with the modifications made in 1997, became the government guidelines for regulating the inflows of FDI. The Catalogue classified the level of restriction on inward FDI for all products into four categories (from low to high): (1) FDI was supported, (2) FDI was permitted, (3) FDI was restricted, and finally, (4) FDI was prohibited. To comply with China's accession commitments for entry into the WTO, China substantially revised the Catalogue in March 2002 by relaxing FDI restrictions for many products. Specifically, it removed or substantially increased the limit on the equity share of MNCs that can be held by foreign entities in certain industries.[15] As a result, the inflow of FDI into China soared between 2001 to 2007. And, this was particularly true for FDI inflows into wholly foreign owned enterprises. According to China's external economic statistical yearbook, FDI inflows into wholly foreign owned enterprises increased from around 22 billion USD in 2002 to around 60 billion USD in 2007, while FDI inflows into joint ventures decreased from roughly 22 billion USD in 2001 to around 20 billion USD in 2007. In short, the change of the FDI policy in early 2002 substantially reduced the barriers to inward FDI and had resulted in a sharp increase in FDI flows into China.[16]

We use China's FDI policy change in early 2002 as a quasi-natural experiment for studying how lower barriers to inward FDI affects MNCs' employment at home and in the destination market. Our identification strategy rests on two arguments. First, the exact timing of this policy change was plausibly unexpected, as the timing of China's accession to WTO (Dec./2001) was uncertain ex ante and the FDI policy change is a part of the commitments China made when joining the WTO.[17] More importantly, this policy change was arguably exogenous for Japanese MNCs that have manufacturing affiliates in China. The Chinese government might make industry-specific FDI policies based on the growth trend of productivity in each industry.[18] However, it is unlikely that the Chinese government

[14] For example, MNCs had to meet local content requirements in manufacturing and exporting products, and were required to transfer advanced technologies to local partner firms.

[15] The central government also simplified procedures of obtaining approval for setting up a multinational affiliate in certain industries.

[16] There were minor revisions of the Catalogue made in November 2004, and the government also issued the fifth and sixth revised versions of the Catalogue in October 2007 and December 2011, respectively.

[17] We check for anticipation effects by examining pretrends and find no evidence for them.

[18] A hypothetical example would be that the government decides to relax FDI restrictions in the car industry, as domestic car producers are sufficiently productive and thus can compete (and benefit) from foreign firms that conduct MP in China.

takes into account the economic situations of Japanese local affiliates and their parent industries in Japan when making the its own FDI policies. In short, endogeneity issues of the FDI policy change for analyses based on Chinese firms are not likely to be a concern in our context, as we study the effects of FDI policy change on firms from a specific foreign country.

5.2 Datasets of FDI Regulations

To measure changes in FDI regulations upon China's accession to the WTO, we compare the 1997 and 2002 versions of the Catalogue.[19] As a result, we construct a dataset that categorizes the change of FDI restrictions from 1997 to 2002 for each manufacturing product into the following three groups: (1) FDI became more welcome; (2) FDI became less welcome; (3) no change in FDI regulations. Products whose restriction levels went down (or up) from 1997 to 2002 are qualified for the first (or the second) group. If there is no change in the level of restriction, the product is included into the third group.

As we are going to implement a difference-in-differences (DID) analysis using differential changes in the FDI policy across industries from 1997 to 2002, we aggregate the changes in the restriction level of FDI from the Catalogue product level to the ASIF industry level. Specifically, we convert the product classifications of the Catalogue into the four-digit Chinese Industry Classification (CIC) of 2003 (which is the industry classification used in ASIF) using the Industrial Product Catalogue from the National Bureau of Statistics of China. As the product classifications of the Catalogue are generally more disaggregated than the four-digit CIC, it is possible that two or more products from the Catalogue are sorted into the same four digit CIC industry of the ASIF. The aggregation process leads to four possible scenarios of the FDI policy change at the industry level: (1) (FDI) encouraged Industries; (2) (FDI) discouraged Industries; (3) no-change industries; (4) mixed industries. Among all the 424 four-digit CIC industries, 112 are (FDI) encouraged industries, while 300 are no-change industries. Only 7 industries are (FDI) discouraged industries, and 5 are mixed industries. The first group (i.e., FDI encouraged industries) is the treatment group in our regression analysis, while the latter three groups serve as the control group in our regression analysis.[20]

5.3 Japanese MNCs in China

We merge the Basic Survey on Overseas Business Activities (BSOBA) with the Basic Survey of Japanese Business Structure and Activities (BSJBSA) in order to identify whether firms in BSJBSA

[19] We follow the same procedure used in Lu, Tao, and Zhu (2017) to construct our datasets that describe longitudinal changes in China's FDI policies.

[20] Again, we follow the same procedure used in Lu, Tao, and Zhu (2017) to construct the dataset that describes the FDI policy change at the industry level. For all Catalogue products in a four-digit CIC industry, if the restriction level of inward FDI either goes down or stays the same, we categorize this industry as the (FDI) encouraged industry. The opposite definition applies to the (FDI) discouraged industry. If there was no change in the restriction level of inward FDI for all Catalogue products under a four-digit CIC industry, we define this industry as the no-change industry. Finally, if the restriction level of inward FDI goes down for some Catalogue products and up for some other Catalogue products within a four-digit CIC industry, we categorize this industry as the mixed industry.

have manufacturing affiliates in China. In BSOBA, there are 17,623 manufacturing observations (manufacturing affiliate-year pairs) in China for 1998-2007, and we are able to match 15,476 of them with their parent firms in BSOBA (matching rate: 86%) using concordance codes provided by the data provider.[21] In the matched dataset, we identify parent firms that have had at least one manufacturing affiliate in China before 2007.[22] For each identified parent firm, we find the founding year of its first manufacturing affiliate in China and collect all its observations (over years) after that founding year in BSJBSA into a sample. In the end, we construct a sample of multinational parent firms that has 13,892 observations spanning from 1998 to 2007. The first four rows of Table 1 present summary statistics concerning the manufacturing affiliates in China, while the last six rows present summary statistics concerning the MNC parent firms in Japan. On average, manufacturing affiliates in China employ 177 employees, and their parent firms in Japan have roughly half of their employees working as manufacturing workers. These statistics show that many of the MNC parent firms actually do not have many manufacturing workers, which hints that within-firm structural transformation had been in place. The table also shows that roughly 30% of our observations (both in terms of parents and the manufacturing affiliates) have received favorable changes in the FDI policies in 2002 and roughly 2/3 of our observations are after the FDI policy change.

TABLE 1: Summary statistics of the whole sample

Variable	Obs.	mean	std. dev.	min	max
		Panel A: Affiliate			
$log(empl.)$	15,318	5.174	1.422	0.693	11.082
$log(sales)$	15,476	6.755	1.758	0	13.379
$treatment$	15,476	0.306	0.252	0	1
$post02$	15,476	0.729	0.445	0	1
		Panel B: Parent firm			
$log(empl.)$	13,892	6.346	1.308	3.912	11.300
$log(manuf.\ empl.)$	13,892	5.028	2.325	0	10.836
$manuf.\ share$	13,892	0.510	0.287	0	1
R&D empl. share	13,892	0.074	0.099	0	0.912
IB unit empl. share	13,892	0.009	0.021	0	0.749
$treatment$	13,892	0.291	0.237	0	1
$post02$	13,892	0.607	0.488	0	1

Time span: 1998-2007. $empl.$: total employment; $manuf.\ empl.$:manufacturing employment; $manuf.\ share$: share of manufacturing employment on total domestic employment; IB unit empl. share: share of international business unit employment in parent firm's employment; R&D share: share of R&D personnels in parent employment.

The FDI policy change happened at the four-digit industry level, while observations in BSOBA report industry affiliations at the three-digit level. Therefore, we merge observations from BSOBA with those from ASIF in order to better identify their industry affiliations. We first translate the

[21]The major reasons why we cannot identify parent firms of some Japanese affiliates in China include (1) the parent firms are not included in BSJBSA and/or (2) the parent firms do not fill out BSJBSA in certain years.

[22]Many observations of BSOBA between 1998 and 2007 were established before 1998.

(English) company and province names of each Japanese manufacturing affiliate in China that appears in BSOBA into Chinese.[23] We then match one observation from BSOBA with another one from ASIF, only when their company names and locating provinces are the same. As a result, we are able to match roughly 40% observations from BSOBA to observations from ASIF. For matched affiliates, we use their four-digit CIC industry affiliations to determine whether they are in the treatment group. For matched observations, we identify their parent firms in BSJBSA for years between 1998 and 2007. In the end, we obtain a matched sample with roughly 6,000 observations at the affiliate-year level and roughly $5,500$ observations at the parent-year level. Summary statistics of the matched sample presented by Table 2 show that observations in the matched sample are quite comparable to those in the full sample. We use the matched sample as our main sample and report regression results in what follows.

TABLE 2: Summary statistics of the matched sample

Variable	Obs.	mean	std. dev.	min	max
			Panel A: Affiliate		
$log(empl.)$	5,934	5.393	1.334	1.099	9.709
$log(sales)$	5,991	7.033	1.715	0	13.379
$treatment$	5,991	0.287	0.452	0	1
$post02$	5,991	0.722	0.448	0	1
			Panel B: Parent firm		
$log(empl.)$	5,468	6.475	1.301	3.932	11.300
$log(manuf.\ empl.)$	5,468	5.308	2.214	0	10.836
$manuf.\ share$	5,468	0.531	0.272	0	1
R&D empl. share	5,468	0.084	0.108	0	0.912
IB unit empl. share	5,468	0.010	0.023	0	0.749
$treatment$	5,468	0.282	0.450	0	1
$post02$	5,468	0.611	0.487	0	1

Time span: 1998-2007. *empl.*: total employment; $manuf.$ *empl.*:manufacturing employment; $manuf.\ share$: share of manufacturing employment on total domestic employment; IB unit empl. share: share of international business unit employment in parent firm's employment; R&D share: share of R&D personnels in parent employment.

As 60% observations from BSOBA cannot be matched to ASIF, we also use the whole sample to implement our analysis as the robustness checks. When utilizing the whole sample, we use each affiliate's three-digit industry affiliation reported in BSOBA to determine the *level* of treatment it receives. Specifically, we calculate the fraction of treated (four-digit CIC) industries within each three-digit industry and define this fraction as the level of treatment at the three-digit industry level. We then generate the level of treatment for each affiliate in BSOBA based on its industry affiliation. For instance, if one observation happens to be in a three-digit industry where most four-digit CIC industries within this three-digit industry are treated, this observation receives a level of treatment close to one. We use this definition to define the variable of *treatment* when using the whole sample

[23] ASIF data we have access to are in Chinese.

to implement analysis. Regression results based on the whole sample are reported in Appendix D and are qualitatively similar to results we obtain by using the matched sample.

For regressions at the parent firm level, we define a parent firm as treated if its first manufacturing affiliate established in China is treated by the definition above (belonging to an FDI encouraged industry). The affiliate is treated in affiliate-level regressions if it belongs to a treated industry.

5.4 Estimating Equations

Our first estimating equation investigates the effects of China's FDI liberalization on Japanese manufacturing affiliates in China:

$$y_{it} = \beta_0 + \beta_1 * treatment_i * post02_t + \delta_i + \delta_{pt} + \epsilon_{it}, \tag{5.1}$$

where i refers to the manufacturing affiliate in China and t denotes year, while ϵ_{it} is the random error term. As we focus on changes in employment and sales over time, we always include affiliate fixed effects δ_i into our regression. We further include year (or city-year fixed effects) in the regressions and cluster the standard errors at the affiliate-industry level. Outcome variables of interest, y_{it}, include the affiliate's (log) total employment and sales.[24] $treatment_i$ indicates whether affiliate i belongs to one of the FDI encouraged industries. $post_{02}$ equals one if the year is equal to or later than 2002 (i.e., after the FDI policy change).[25] We are interested in the estimated coefficient, β_1, as it shows how the manufacturing affiliates in China that are in the treatment group have behaved differently after the FDI policy change (compared to those that are in the control group).

Our second estimating equation investigates the effects of China's FDI liberalization on Japanese MNCs' domestic employment:

$$y_{it} = \beta_0 + \beta_1 * treatment_i * post02_t + \delta_i + \delta_{pt} + \epsilon_{it}, \tag{5.2}$$

where i refers to the parent firm. The variable of interest y_{it} is alternatively (1) total employment, (2) manufacturing employment, (3) manufacturing employment share, (4) employment of R&D personnel in parent's employment, and (5) employment share of the international business unit in parent' employment. δ_i and δ_{pt} are parent firm and prefecture-year fixed effects which are always included into the regressions. $treatment_i$, indicates whether parent firm i's first manufacturing affiliate in China is in one of FDI encouraged industries. Again, we are interested in the estimated coefficient, β_3, as it shows how MNC parent firms that have affiliates in FDI encourage industries behave differently after the FDI policy change. In all specifications, we also check for differential pre-trends between the control and treatment groups.

[24] Unfortunately, there is no breakdown of employment into manufacturing and services at the affiliate level.

[25] Note that the year defined in the Japanese datasets starts from April/1 of the current year to March/31 of next year. As the FDI policy in China happened in March/2002, the year of 2002 is treated as the first year after the policy change.

5.5 Regression Results

TABLE 3: China's FDI liberalization and Japanese affiliates

	(1)	(2)	(3)	(4)
	log(tot. empl.)		log(tot. sales)	
$treatment_i * post02_t$	0.192***	0.205***	0.166	0.181*
	(0.0683)	(0.0765)	(0.121)	(0.0968)
affiliate fixed effects	Yes	Yes	Yes	Yes
year fixed effects	Yes	No	Yes	No
city-year fixed effects	No	Yes	No	Yes
N	5717	5448	5777	5504
R^2	0.928	0.934	0.855	0.871

Std. err. are clustered at affiliate industry level and included into the parentheses. * 0.10 ** 0.05 *** 0.01

Table 3 presents the regression results from estimating (5.1) and shows that Japanese manufacturing affiliates in the treated group have increased their employment and sales substantially from 2002 and onward relative to those in the control group. Moreover, the magnitudes of the relative increases in employment and sales are large (a 20% relative increase of employment and a 18% relative increase of sales). These magnitudes are also consistent with the finding from our decomposition exercise (in the case of China) that will be presented in the next section: foreign manufacturing affiliates have contributed substantially to the increase of manufacturing employment share in China.

Table 4 presents the baseline results of estimating (5.2). Column 1 shows that there is a significantly negative change in the overall employment of Japanese MNC parent firms after China's unilateral FDI liberalization.[26] Columns 3 and 5 indicate that there is a substantial reduction in terms of manufacturing employment and its share in total employment in those parent firms, although the estimates for log manufacturing employment are noisy. What is interesting and surprising is that the magnitudes of such reductions are large (a 12.8% reduction in manufacturing employment and a reduction of 3.1 percentage points in the share of manufacturing employment), given that China is just one destination market for Japan's outward FDI. We also add parent industry year fixed effects into the regressions to control for uneven productivity growth at the industry level that can affect manufacturing employment growth in various industries differently.[27]

Our estimation includes year and firm fixed effects. Threats to identification come purely from variables that might be correlated with the treatment, which is at the industry-level in the year of 2002. China's FDI policy change occurred during a period of import and export tariffs declines. If these changes also differentially impacted the treated industries, our estimates might be capturing the overall effect of globalization on MNC-related structural transformation, rather than purely the

[26] This result becomes insignificant, when we use the whole sample whose result is reported in Table A7 in the Appendix.

[27] We are able to include parent industry-year fixed effects into the regressions, as they are defined at the two-digit level while the treatment is defined at the four-digit CIC industry level.

MNC-driven structural transformation coming from a decrease in MP frictions.[28] In order to control for the effects of trade liberalization on MNCs' domestic employment, we include import/export shares (in total sales) at the parent firm level into our regressions.[29] Even-numbered columns of Table 4 present the regression results and show that our estimation results are robust to the inclusion of trade-related variables. Interestingly, the share of exports (and imports) in total sales is positively associated with manufacturing employment. This is intuitive, as the majority of exports from Japan are manufacturing goods, and a substantial fraction of imported goods into Japan are intermediate manufacturing goods.

Table 4: China's FDI liberalization and domestic employment of Japanese MNCs

	(1)	(2)	(3)	(4)	(5)	(6)
	log(tot. empl.)		log(manuf. empl.)		share of manuf. empl.	
$treatment_i * post02_t$	-0.0758***	-0.0752***	-0.126	-0.128	-0.0308**	-0.0307**
	(0.0163)	(0.0166)	(0.107)	(0.107)	(0.0118)	(0.0119)
import share		-0.00667		0.263		-0.00140
		(0.0580)		(0.282)		(0.0527)
export share		0.0616		0.220		0.0121
		(0.0521)		(0.260)		(0.0325)
firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
prefecture-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
parent industry-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	5249	5249	5249	5249	5249	5249
R^2	0.986	0.986	0.921	0.921	0.904	0.904

Std. err. are clustered at affiliate industry level and included into the parentheses. * 0.10 ** 0.05 *** 0.01

We also investigate how China's FDI policy change affects employment composition at the headquarters, a key observable related to overall structural transformation in our theory. Since the fixed FDI cost in our model can be interpreted as the cost of transferring technologies from the parent firm to its affiliates, we calculate the employment shares of $R\&D$ personnel and the international business unit employees in parent firm's employment. Results presented in Table 5 show that after China's FDI policy change the employment share of $R\&D$ employees and that of international business unit employees increase by about 1.2 and 0.32 percentage points respectively. As the average shares of these two types of employment are 8.4% and 1.0% respectively, these changes are quantitatively substantial.[30]

[28] Note that while the average tariff decline faced by the Japanese MNC parent firms is soaked up by the parent industry-year fixed effects, the empirical specifications cannot control for time-varying firm specific effects of tariff reductions.

[29] Ideally, we would want to construct firm-level import/export tariffs based on their transaction records of imports/exports. However, transaction-level trade data are not available in Japan. The industry classification of BSJBSA is also relatively coarse. Therefore, we use the import/export shares to control for the effects of trade on domestic employment.

[30] Note that the domestic employment of a Japanese MNC might increase, when its manufacturing affiliate(s) in China faces lower MP frictions. This type of scale effect is a feature of most models of MNCs, and occurs because

Table 5: China's FDI liberalization and domestic employment of Japanese MNCs' headquarters

	(1)	(2)	(3)	(4)
	share of R&D empl. at parent		share of IB empl. at parent	
$treatment_i * post02_t$	0.0119*	0.0116*	0.00316***	0.00329***
	(0.00612)	(0.00618)	(0.00108)	(0.00118)
import share		0.0118		-0.00875
		(0.0200)		(0.0111)
export share		-0.0210		0.00614
		(0.0137)		(0.00527)
firm fixed effects	Yes	Yes	Yes	Yes
prefecture-year fixed effects	Yes	Yes	Yes	Yes
parent industry-year fixed effects	Yes	Yes	Yes	Yes
N	5249	5249	5249	5249
R^2	0.878	0.878	0.500	0.500

Std. err. are clustered at affiliate industry level and included into the parentheses. Share of IB empl. at parent: share of international business unit employment in parent firm's employment. * 0.10 ** 0.05 *** 0.01

The fundamental assumption of a DID analysis is the parallel trends assumption. In our context, this assumption means Japanese MNCs (and their manufacturing affiliates in China) in the treatment group and those in the control group would have similar time trends (for various observables of interest), if there was such no such FDI policy change in China in 2002. That is, firms in the two groups should have similar time trends (for all variables of interest) before the policy change but divergent time trends after it. In order to test this assumption, we run the following regression:

$$y_{it} = \beta_0 + \sum_{t=1999,2000,....,2007} \beta_t * treatment_i * year_t + \delta_i + \delta_{pt} + \epsilon_{it}. \tag{5.3}$$

where $year_t$ a year dummy. We then plot the estimated coefficients of β_{1999}-β_{2007} for three key variables of our regressions: affiliate's log total employment, MNC parent firm's manufacturing employment share at home, and shares of $R\&D$ jobs at the MNC's parent firm. Figures 1-3 show that the parallel trends assumption holds well for all the five key variables we are interested in, although some estimates after 2002 are noisy.

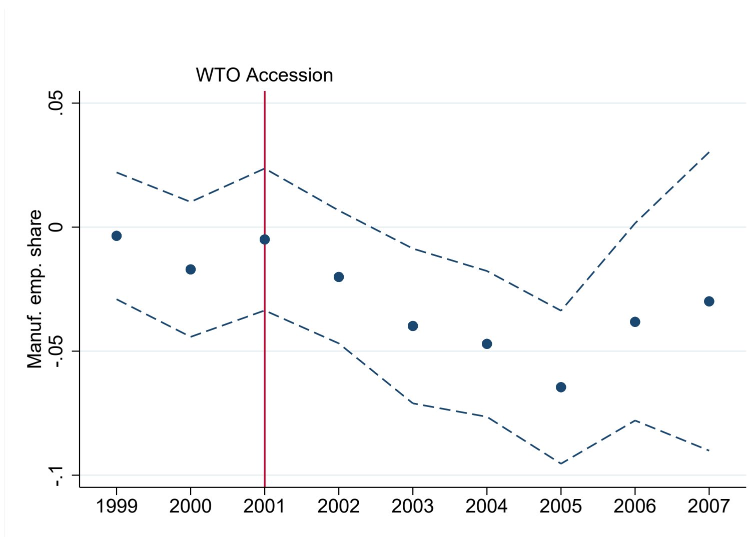
Although the above analysis shows that the parallel trends assumption holds in our context, we discuss the potential anticipation effect that originates from the FDI policy change in 2002. If Japanese MNCs that plan to conduct or expand their MP in China had anticipated the policy change and thus entered into those (FDI) encouraged industries before 2002, we would have not found the

access to lower cost inputs can increase a firm's scale. Under certain parameterizations, the scale effect can be large enough to overcome the reallocation of manufacturing employment abroad in theory, which would imply that firm total employment and firm manufacturing employment both increase in Japan. We therefore highlight the estimation results related to shares of manufacturing/international business/R&D employment instead of employment levels, as these more closely test the predictions of our theory at the firm-level.

Figure 1: Parallel trends assumption: total employment of affiliates

Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

Figure 2: Parallel trends assumption: share of manufacturing employment at the parent firm



Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

Figure 3: Parallel trends assumption: share of R&D employment at the parent firm

Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

employment effects on firms in the treatment group. In other words, any potential anticipation effect bias us towards finding a non-result, and the employment effects documented above are therefore likely to be the lower bounds of the true effects.

Another threat to our identification is that the Chinese government had implemented its 10th Five-Year Plan during 2001-2005, which specified certain industries to be supported by the government's favorable policies. Our empirical exercises would capture the effect originating from the 10th Five-Year Plan, if the supported industries specified by the Plan were similar to the FDI-encouraged industries induced by the FDI policy change. In order to deal with this concern, we compute the correlation between our treated industries and the supported industries specified by the 10th Five-Year Plan and find that the correlation coefficient (0.094) is extremely small. Therefore, it is unlikely that our empirical exercises capture the effect of the 10th Five-Year Plan, instead of the FDI policy change.

Results presented above show that the intensive margin predictions of our model are consistent with the empirical findings. Another key prediction from our model is that after the inward MP cost goes down in a sector there are foreign MNCs that enter into this sector. In our empirical context, this extensive margin prediction implies that we should observe more FDI entries into the FDI-encouraged industries compared to the other industries after 2002. Table 6 shows that both the number of new affiliates in the FDI-encouraged industries and the share of new affiliates accounted for by the FDI-encouraged industries began to increase after 2002, which is consistent with our model's prediction at the extensive margin.[31]

[31] One Cavaet here is that our sample does not include every manufacturing FDI entrant into China, as the response

Table 6: Number of new manufacturing affiliates entering into China

Founding year	Non-encouraged industries	Encouraged industries	Total	Share of encouraged industries
1998	51	105	156	67.3%
1999	60	94	154	61.0%
2000	95	167	262	63.7%
2001	164	257	421	61.0%
2002	243	431	674	64.0%
2003	226	450	676	66.6%
2004	243	427	670	63.7%
2005	187	337	524	64.3%
2006	114	208	322	64.6%
2007	71	147	218	67.4%

Time span: 1998-2007. FDI-encouraged industries and non-encouraged industries are defined at the three-digit industry level (reported by the Basic Survey on Overseas Business Activities). Specifically, we calculate the fraction of treated (four-digit CIC) industries within each three-digit industry and treat this faction as the level of encouragement for each three-digit industry. We then rank the three-digit industries based on their encouragement levels (in a desceding order) and categorize indsutreis of the upper half as the encouraged industries (and the bottom half as the non-encouraged industries).

6 Decomposition

In the previous section, we presented micro-econometric evidence showing that China's opening to FDI caused an increase in the manufacturing employment of Japanese affiliates in China, while their Japanese parents experienced a reduction in their manufacturing employment, combined with an increased employment in services. Are similar patterns of headquarter and foreign affiliates employment observed in other countries as MNCs expand their operations? In this section we use firm and establishment-level data from five countries in different stages of development to evaluate whether MNCs have a quantitatively important role in the observed structural transformation path of these countries.

To assess the role of multinationals in the process of structural transformation we decompose the change of a country's total manufacturing employment into a multinational and a non-multinational component. In addition, for each group, we calculate the contribution of firms that continue operations, those that enter, and those that exit the market. This approach allows us to measure the relative importance of MNCs in the process of structural transformation for a broader set of countries than can be used in the causal analysis.

This type of decomposition exercise presented in Foster, Haltiwanger, and Krizan (2006) and Melitz and Polanec (2015) have been extensively used in the literature on firm dynamics. In this paper, we apply this decomposition to micro-data for five countries at different levels of economic development, and compare the margins through which manufacturing employment changes at different points in an economy's structural transition.

rate at of the survey is not 100%. In order to overcome this issue, we use the founding year of each affiliate to define entry (i.e., not the year when the affiliate starts to show up in the survey). We also extend our dataset to 2014 in order to calculate the number of entries more precisely, as many affiliates start to respond to the survey several years after their establishment.

While our approach allows us to carefully account for the process of structural transformation at a micro level, both into and out of manufacturing, it also poses challenges. First, micro-data in different countries features information collected in a non-uniform way.[32] Second, although we have information on firm-level employment for manufacturing firms in all countries in our sample, most countries do not have firm-level employment information for services firms; this information is required to apply the Melitz and Polanec (2015) decomposition. We therefore choose the Foster, Haltiwanger, and Krizan (2006) (FHK) decomposition as our baseline, as it can be best applied to all countries in our analysis. Appendix B discusses each micro-dataset in detail, and highlights features that are common across countries and that are unique to each dataset we consider.

6.1 FHK Decomposition

The FHK decomposition method separates the aggregate change in manufacturing employment in five components indicated in the right-hand side of equation (6.1):

$$\begin{aligned}\Delta\frac{L_{m,t}}{L_t} = & \underbrace{\sum_{i\in C} w_{it-1}\Delta\frac{L_{i,m,t}}{L_{i,t}}}_{\text{within effect}} + \underbrace{\sum_{i\in C}\left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right)\Delta w_{it}}_{\text{between effect}} + \underbrace{\sum_{i\in C}\Delta w_{it}\Delta\frac{L_{i,m,t}}{L_{i,t}}}_{\text{covariance}} \\ & + \underbrace{\sum_{i\in N} w_{it}\left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1}\right)}_{\text{entry}} - \underbrace{\sum_{i\in X} w_{it-1}\left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right)}_{\text{exit}}\end{aligned} \quad (6.1)$$

where $L_{m,t}$ and L_t are aggregate manufacturing employment and aggregate total employment in period t; $L_{i,m,t}$ and $L_{i,t}$ are manufacturing employment and total employment in firm i and period t; w_{it} is firm i's share of aggregate total employment in period t, $\frac{L_{it}}{L_t}$; and $l_{m,t-1} = \frac{L_{m,t-1}}{L_{t-1}}$ is the aggregate manufacturing employment share at the beginning of the period. Aggregate manufacturing employment and aggregate total employment in year t as the sum of manufacturing or total employment across all firms in year t. Finally, C, N, and X denote continuing, new, and exiting firms.

The first three terms in the right-hand side of equation (6.1) involve continuing firms only. The first term, $\sum_{i\in C} w_{it-1}\Delta\frac{L_{i,m,t}}{L_{i,t}}$, captures the "within" effect for continuing firms. That is, it captures the change in the share of manufacturing employment in the aggregate that comes from increases or decreases in manufacturing employment *within* continuing firms. The second term, $\sum_{i\in C}\left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right)\Delta w_{it}$, captures the "between" effect for continuing firms. This reflects the change in the aggregate share of manufacturing that arises due to the reallocation of employment towards or away from above-average size firms, represented by the change in their economy-wide employment share, Δw_{it}. The third term captures a covariance or cross-term across these two

[32] Notice that the confidential nature of the firm level dataset precludes us from linking information across countries.

effects.

The final two terms of equation 6.1 capture entry and exit. The effect of entry is the weighted sum of each entering firm i's manufacturing employment share in period t less the aggregate manufacturing employment share in the initial year. The effect of exit is the weighted sum of each exiting firm i's manufacturing employment share in period $t-1$ less the aggregate manufacturing employment share in the initial year. Therefore, the net effect of entry and exit depends on whether manufacturing employment of new firms is on average greater than or less than the manufacturing employment of exiting firms. Notice that the decomposition below also captures the employment dynamics of "Services" firms, which here are defined as firms with zero manufacturing employment. of all firms in the economy, regardless of whether the firm is a manufacturing or service company.[33]

While implementing equation (6.1) provides a clear portrait of the sources of the decline or increase in the aggregate manufacturing employment share, it does not show the specific role of MNCs in these changes. Next, we extend this decomposition to distinguish changes in manufacturing employment by MNCs and non-MNCs.

6.1.1 FHK Decomposition with Multinationals and a Service Sector

We begin with the decomposition in equation (6.1) and then separate the firms into MNCs and non-MNCs groups:

$$
\begin{aligned}
\Delta \frac{L_{m,t}}{L_t} = & \sum_{i\in C_{MNC}} w_{it-1}\Delta\frac{L_{i,m,t}}{L_{i,t}} + \sum_{i\in C_{MNC}} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right)\Delta w_{it} + \sum_{i\in C_{MNC}} \Delta w_{it}\Delta\frac{L_{i,m,t}}{L_{i,t}} \\
& + \sum_{i\in N_{MNC}} w_{it}\left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1}\right) - \sum_{i\in X_{MNC}} w_{it-1}\left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right) \\
& + \sum_{i\in C_{Non-MNC}} w_{it-1}\Delta\frac{L_{i,m,t}}{L_{i,t}} + \sum_{i\in C_{Non-MNC}} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right)\Delta w_{it} + \sum_{i\in C_{Non-MNC}} \Delta w_{it}\Delta\frac{L_{i,m,t}}{L_{i,t}} \\
& + \sum_{i\in N_{Non-MNC}} w_{it}\left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1}\right) - \sum_{i\in X_{Non-MNC}} w_{it-1}\left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1}\right) + \underbrace{l_{m,t-1}(w_{mt} - w_{mt-1})}_{\text{service effect}}
\end{aligned}
\tag{6.2}
$$

This decomposition, which we implement on our data, contains eleven terms. The first five terms are associated with manufacturing MNCs, the next five terms are associated with manufacturing non-MNCs, and the final term is the employment shift from the service sector into manufacturing; where a firm is considered manufacturing if it has one employee or more employees in a manufacturing sector, and is consider a service firm otherwise. As before, the w_{it} terms capture firm i's employment as a share of aggregate total employment in period t

[33]For services firms $\frac{L_{i,m,t}}{L_{i,t}}$ and $\Delta\frac{L_{i,m,t}}{L_{i,t}}$ are zero and therefore the within and between component of the decomposition are 0 and $\sum_{i\in C}\left(0 - l_{m,t-1}\right)\Delta w_{it}$, respectively.

While the terms capturing MNCs and non-MNCs are similar to those in equation (6.1)–featuring the within, between and covariance effects by continuing MNCs/non-MNCs and the entry and exit of MNCs/non-MNCs)–this decomposition differs from (6.1) in that it explicitly distinguish the contribution of manufacturing firms, MNCs or non-MNCs, from the contribution of services firms, regardless of their MNC status. The reason why we explicitly separate manufacturing from services firms is because for most countries in our sample the available data lack information on MNC/non-MNC in the service sector, so we treat services firms as a third category. Conveniently, in the decomposition presented in equation (6.2) the net contribution of services firms to the observed changes in the share of aggregate manufacturing employment in the economy is expressed only as function of the aggregate manufacturing employment share and its changes over time, which are easily observed for all countries in our sample.[34]

China's decomposition: the manufacturing survey and census data of China does not breakdown firm's employment in its manufacturing and services components. Therefore, to implement the decomposition exercise for China we modify equation (6.2). Specifically, we assume all jobs in firms classified as manufacturing firms are manufacturing jobs. While this could potentially overstate the manufacturing jobs in these firms, reforms of state-owned enterprises in the late 1990s and early 2000s had made services departments of many large manufacturing firms (most of which were state owned) independent private services firms. Therefore, we believe the upward bias in China's manufacturing employment is relatively small in our sample period.

As a result of this data limitation, there is no within-group change in the manufacturing employment share. Therefore, $\frac{L_{i,m,t}}{L_{i,t}} = \frac{L_{i,m,t-1}}{L_{i,t-1}} = 1$ and $\Delta \frac{L_{i,m,t}}{L_{i,t}} = 0$. Substituting in equation (6.2) the decomposition for China becomes:

$$\begin{aligned}\Delta \frac{L_{m,t}}{L_t} = & \underbrace{(1 - l_{m,t-1}) \left(\sum_{i \in C_{non-MNC}} \Delta w_{it} + \sum_{i \in N_{non-MNC}} w_{it} - \sum_{i \in X_{non-MNC}} w_{it-1} \right)}_{\text{manuf Non-MNCs}} \\ & + \underbrace{(1 - l_{m,t-1}) \left(\sum_{i \in C_{MNC}} \Delta w_{it} + \sum_{i \in N_{MNC}} w_{it} - \sum_{i \in X_{MNC}} w_{it-1} \right)}_{\text{manuf MNCs}} + \underbrace{l_{m,t-1}(w_{mt} - w_{mt-1})}_{\text{services}}.\end{aligned} \tag{6.3}$$

6.2 Data

We describe the five microdata sources that underlie our analysis in detail in Appendix B. Table 7 summarizes the start and end years of the sample in each country in our data, together with the share of manufacturing employment in MNCs in each of these years.

[34] Appendix A present the details of the derivation of the service term in equation 6.2.

Table 7: Multinational Share of Manufacturing Employment

	Start Year	MNCs Share	End Year	MNCs Share
China	1998	0.05	2013	0.18
Hungary	1992	0.24	2010	0.49
U.S.	1993	0.33	2011	0.29
Japan	1995	0.16	2005	0.16
France	1999	0.34	2016	0.35

Note: For China and Hungary, manufacturing employment at affiliates of foreign MNCs; for U.S., Japan and France, manufacturing employment of domestic MNCs.

As is clear from the table, the share of manufacturing employment in multinationals increased by more than a factor of three in China during this time period. On the other hand, the multinational manufacturing employment share in the advanced economies in the data either decreased (the US) or stayed stable (Japan and France). The share of manufacturing employment in multinationals also doubled in Hungary, a middle income economy that received inward FDI following the collapse of the Soviet Union and its EU accession.[35]

6.3 Results

Table 8 presents the results of the decomposition in equation (6.2) ((6.3) for China). Panel A includes the total change, as well as the sum of all the terms related to multinationals and non-multinationals, and Panel B breaks down the multinational component into the role of (multinational) continuing firms, entry and exit. For some of our countries, the analogous breakdown for non-MNCs and the component due to services (the remaining terms in the decomposition) are contained in Appendix B.

The table makes clear the multinational firms accounted for the majority of the decline in manufacturing employment in the US (in both the 1990s and 2000s) and the expansion in China post its WTO accession. In the U.S., the net negative effects of MNCs are due to both declines by continuing firms and firms exiting the market. In China, the expansion is largely due to the entry of MNCs.[36]

For both France and Japan, the net (negative) effect of MNCs on manufacturing employment share is substantial in the 1990s, largely coming from structural transformation among continuing MNCs. The picture is different, when we focus on the 2000s. In France, while the net effect of MNCs

[35] In this section, MNCs mean MNC affiliates in China and Hungary and MNC parents and their domestic affiliates in Japan, France and the US.

[36] In the decomposition exercise, we abstract from the case of an Non-MNC firm becoming an MNC firm, or vice versa. Therefore, entry and exit in the MNC and Non-MNC component simply refers to firms entering into, or exiting from, the *market*. In other words, when a firm switches from a Non-MNC in the previous year to an MNC in the current year (i.e., a *mode* switching), we treat it as a continuing MNC. Similarly, when a firm switches from an MNC in the previous year to a non-MNC in the current year, we treat it as a continuing non-MNC (i.e., an exporter). As a result, a part of the decline in the manufacturing employment share of continuing MNCs comes from those MNCs that have switched from Non-MNCs. This is consistent with our model's assumptions.

Table 8: FHK Decomposition: Role of Multinationals

	Panel A			Panel B: MNCs			
	Total	MNC	NonMNC	Total	Cont.	Entry	Exit
	Period: 1990's						
China	-	-	-	-	-	-	-
Hungary	0.05	0.04	-0.02	0.04	0.01	0.03	-0.01
U.S.	-0.05	-0.04	0.00	-0.04	-0.02	0.00	-0.02
Japan	-0.03	-0.01	-0.02	-0.01	-0.01	0.00	-0.01
France*	-0.04	-0.01	-0.02	-0.01	-0.03	0.02	0.00
	Period: 2000's						
China	0.05	0.03	0.01	0.03	0.01	0.04	-0.01
Hungary	-0.05	0.002	-0.04	0.002	0.01	0.01	-0.02
U.S.	-0.04	-0.03	0.00	-0.03	-0.02	0.00	-0.02
Japan	-0.03	0.00	-0.03	0.00	0.00	0.01	-0.01
France†	-0.02	0.00	-0.02	0.00	-0.02	0.03	-0.01

Note: * and † correspond to France decomposition results for 2000's and 2010's periods, respectively.

is close to zero, this is for most part due to the offsetting effects of entry on the declines within continuing MNCs. In Japan, the net effect of MNCs is close to zero as well, as both entering MNCs offset the negative effect and continuing MNCs stop reducing manufacturing employment share.[37] Turning to Hungary, MNCs were a net positive contributor to the manufacturing employment share in both decades, even though Hungary's overall manufacturing employment share actually declined in the 2000s. The role of MNCs in offsetting the manufacturing decline in Hungary in the 2000s comes from both entry and continuing firms, while their large role in the expansion in Hungary in the 1990s comes primarily due to entry.

7 Conclusion

We show that multinationals play an important role as drivers of structural transformation in many countries. Theoretically, we build a simple model to show that a country decreasing its inward MP frictions will experience an increase in its manufacturing employment level and share, while the source country of the MNCs will experience a decrease in its manufacturing employment share, but an increase in its non-manufacturing employment shares (for instance in services). We test the predictions of the model using microdata on Japanese MNCs and their affiliates in China before and after China's FDI liberalization in 2002. This shock, which was exogenous to Japanese MNCs, results in an increase in treated Japanese manufacturing affiliate employment in China, a decrease in the employment level and shares of the manufacturing affiliates of these treated firms in Japan, and an increase in their services and R&D shares. These causal results are consistent with the mechanisms of our theory. Finally, to provide a first pass at understanding how important the channel we identify

[37]Data from World Bank show that the export share in Japan's GDP had increased from 10.5% in 2000 to 17.2% in 2008. As most MNCs are engaged in exporting activities and most exports from Japan and manufacturing goods, the exporting boom in 2000s explains why continuing MNCs had stopped reducing manufacturing employment in 2000s.

might be in aggregate, we conduct a simple accounting decomposition exercise to split the changes in manufacturing shares in five developed and middle-income countries into components owing to MNCs and to other firms. The results suggest that the MNC channel for structural change is quantitatively important for those countries.

This paper isolated a new channel through which multinational activity and globalization affect countries in the long-run. FDI flows and the size of multinationals are rapidly increasing with globalization, and so the effect of these firms could be expected to be even larger in the future. A full quantitative evaluation of the importance of this channel for a larger set of countries, while outside the scope of this paper, would be useful in future research.

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Appendix A Decomposition with Explicit Consideration of Services Firms

In this section we abstract from the distinction between MNCs and Non-MNCs and we focus on how to express the decomposition of the share of manufacturing employment in the economy when we explicitly distinguish manufacturing from services firms. For each of the continuing (C), entry (N) and exit X categories we introduce subscripts s and m to denote services and manufacturing firms, respectively.

$$
\begin{aligned}
\Delta \frac{L_{m,t}}{L_t} &= \sum_{i \in C} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}} \\
&\quad + \sum_{i \in N} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \\
&= \sum_{i \in C_m} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C_m} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C_m} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}} \\
&\quad + \sum_{i \in N_m} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X_m} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) + \\
&\quad \sum_{i \in C_s} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C_s} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C_s} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}} \\
&\quad + \sum_{i \in N_s} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X_s} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right)
\end{aligned}
\tag{A.1}
$$

Now, lets focus on the services terms only. Then, we have:

$$
\begin{aligned}
&\sum_{i \in C_s} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C_s} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C_s} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}} \\
&\quad + \sum_{i \in N_s} w_{it} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) - \sum_{i \in X_s} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \\
&= 0 + \sum_{i \in C_s} (0 - l_{m,t-1}) \Delta w_{it} + 0 + \sum_{i \in N_s} w_{it} (0 - l_{m,t-1}) - \sum_{i \in X_s} w_{it-1} (0 - l_{m,t-1}) \\
&= -l_{m,t-1} \sum_{i \in C_s} \Delta w_{it} - l_{m,t-1} \sum_{i \in N_s} w_{it} + l_{m,t-1} \sum_{i \in X_s} w_{it-1} \\
&= -l_{m,t-1} \left[\sum_{i \in C_s} w_{it} + \sum_{i \in N_s} w_{it} - \sum_{i \in C_s} w_{it-1} - \sum_{i \in N_s} w_{it-1} \right] \\
&= -l_{m,t-1} \left[w_{st} - w_{st-1} \right]
\end{aligned}
\tag{A.2}
$$

The first two terms in the second-to-the-last brackets are just the total employment share of services firms in period t, and the latter two terms in the second-to-the-last brackets represent the total employment share of services firms in the initial period, $t-1$. By defining $w_{st} = \sum_{i \in C_s} w_{it} + \sum_{i \in N_s} w_{it}$ it is apparent that to compute the decomposition we only need to know the change in the share of service employment over time. Notice that we can write the change in the share of services as: $w_{st} - w_{st-1} = 1 - w_{mt} - (1 - w_{mt-1}) = w_{mt-1} - w_{mt}$, therefore, the net contribution of the services terms becomes: $l_{m,t-1}(w_{mt} - w_{mt-1})$, which is solely a function of the share of aggregate manufacturing employment in the economy.

In the above notation we assume the economy has only two sectors, manufacturing and services. More realistically with the presence of an agriculture sector, the (s) terms in equation (A.1) and (A.2) will represent the employment of firms in the service and agriculture sectors.

The final decomposition becomes:

$$\begin{aligned}
\Delta \frac{L_{m,t}}{L_t} &= \sum_{i \in C} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}} \\
&\quad + \sum_{i \in N} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \\
&= \sum_{i \in C_m} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C_m} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C_m} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}} \\
&\quad + \sum_{i \in N_m} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X_m} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \\
&\quad + l_{m,t-1}(w_{mt} - w_{mt-1})
\end{aligned} \tag{A.3}$$

Appendix B Data

B.1 China

Our dataset from China is a firm-level production data set of Chinese manufacturing firms from 1998 to 2013, which comes from the Annual Survey of Industrial Firms (ASIF) complied by the National Bureau of Statistics (NBS) of China. All state-owned enterprises and "above-scale" non-state-owned enterprises (i.e., private firms) are included in the data set.[38] We use unique numerical identifiers to link firms over time. This dataset is the one that is used commonly in the literature, such as the one used in Brandt, Van Biesebroeck, and Zhang (2012), and Yu (2015).

Admittedly, our dataset from China is not a full census of manufacturing firms, which implies that our dataset misses many small firms. However, as Brandt, Van Biesebroeck, and Zhang (2012) showed, total output and employment captured by our survey dataset in 2004 account for more than 80% and 60% of the total output and employment reported from the census data in 2004. Therefore, our dataset captures the majority of manufacturing employment in China during 1998-2013. In addition, we have obtained China's manufacturing census date in 2004 and 2008. We then use the census data of the two years to do the decomposition exercise and show that it yields similar results as our empirical results obtained

[38] The "above-scale" firms are defined as firms with annual sales of RMB 5 million (or equivalently, about US$830,000) or more.

from using the manufacturing survey during 1998-2013.

In the dataset, there is information on each firm's total employment, and no information on the breakdown of total employment into manufacturing jobs and service jobs. The dataset also contains information on firms' equity structure. Specifically, each firm is required to report its equity into the following six categories: state equity, collective equity, equity held by individual persons, equity held by legal persons, equity held by Hong Kong, Macau and Taiwan entities (HMT), equity held by foreign entities. China's laws concerning foreign direct investment treat firms with more than 25% equity held by HMT or foreign entities as foreign invested enterprises (FIEs). As a result, these firms are subject to policies (e.g., tax policies, subsidies) targeted at foreign firms. We use the same definition as the official definition of FIEs in China to define MNCs.

Table A1 reports average employment of all firms, the share of MNCs, and average employment of MNCs during our sample period. On average, 20% of our observations are MNCs, and average employment is higher in MNCs than in non-MNCs. Table A2 shows information on employment by all firms and by MNCs year by year. Two patterns show up clearly from this table. First, the number of MNCs had increased substantially during our sample period, while the share of MNCs had increased from 1998 to 2004 (and flattened after 2004). Second, the average employment of MNCs was lower than the average employment of all firms (and non-MNCs) in early years, but this pattern was reversed after 2001.

Table A1: Summary Statistics of Chinese Manufacturing Firms

	Obs.	mean	std. dev.	median
employment	4,026,129	275.6	981.6	125
MNC status	4,042,217	0.20	0.40	0
employment by MNCs	800,961	385.1	1108.6	182

MNCs are defined as firms with more than 25% equity held by Hong Kong-Macau-Taiwan or foreign entities.

Since there is no information on the breakdown of total employment into manufacturing jobs and service jobs at the firm level in ASIF, we use equation (6.3) to implement the decomposition exercise. We obtain information on overall employment and employment share of the manufacturing sector from the website of China's bureau of statistics (i.e., the Statistical Yearbook). Based on these aggregate statistics, we calculate the total change in the manufacturing employment share and employment shift from other sectors to the manufacturing sector. As Table A1 shows, MNC affiliates have substantially higher employment than domestic firms. Therefore, it is reasonable to assume that ASIF covers most MNC affiliates, as its threshold on employment is low (eight). We utilize observations of MNC affiliates in ASIF and the aggregate statistics to calculate the middle three terms that are related to MNCs and the last term in equation (6.3). We then calculate the sum of the first three terms in equation (6.3) by deducting the sum of the last four terms from the total change in the manufacturing employment share.

Figure A1 presents the decomposition result for each 5-year interval (from year t to year t+5) starting from 1998 ending in 2008. Overall, it is clear that MNC affiliates had contributed

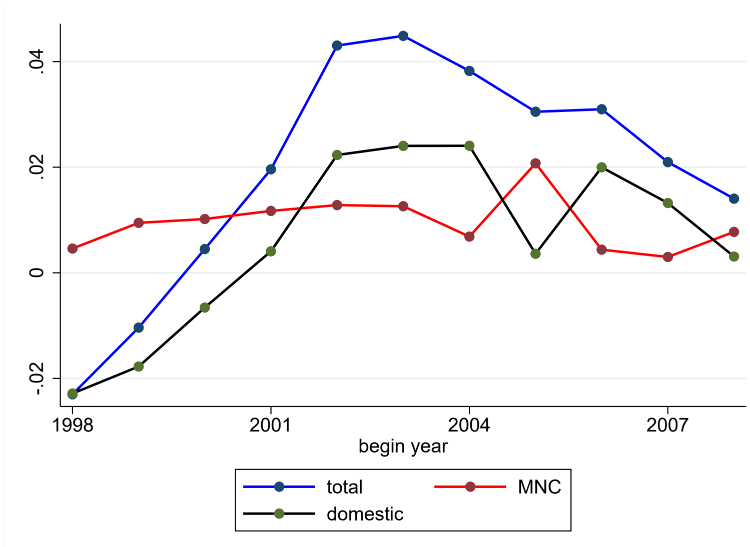
TABLE A2: Summary stats for employment by year

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	341.3	324.2	311.3	289.4	277.2	269.7	220.7	237.6	227.5	219.2	192.8	190.4	355.8	326.4	319.5	417.0
	(133)	(129)	(125)	(120)	(116)	(113)	(93)	(100)	(95)	(90)	(80)	(79)	(123)	(194)	(200)	(325)
	[148683]	[146079]	[147207]	[155572]	[165668]	[180940]	[256201]	[247798]	[278346]	[311981]	[385594]	[404314]	[321604]	[265098]	[289879]	[321165]
MNCs	293.6	295.7	300.9	299.4	306.3	327.0	308.0	339.2	349.3	349.9	332.6	326.3	518.1	503.6	498.6	616.0
	(148)	(150)	(150)	(150)	(150)	(153)	(143)	(152)	(153)	(153)	(140)	(135)	(220)	(265)	(269)	(401)
	[26045]	[26376]	[27950]	[30860]	[33889]	[37997]	[56209]	[55009]	[59807]	[66264]	[74809]	[74344]	[75434]	[50320]	[52652]	[52996]

For each year, mean, medium (in parenthesis) and count (in bracket) are reported in three rows.

substantially to the overall increase of manufacturing employment share in China during 1998-2013.[39] Figure A2 decompose the overall contribution by MNC affiliates into contributions by entering, continuing and exiting MNC affiliates for each 5-year interval (from year t to year $t+5$) starting from 1998. It is clear that the driving force is the entering MNC affiliates during the period of 1998-2013.

FIGURE A1: Decomposition Result for China (5-year window)



Note: We decompose the change in the manufacturing employment share into the three terms for each 5-year interval (from year t to year $t+5$) starting from 1998. The difference between the total change and the sum of the contributions made by domestic firms and MNC affiliates is the employment shift from other sectors to the manufacturing sector.

Finally, we use the census data in 2004 and 2008 to implement the decomposition exercise again. The result show that MNC affiliates contributed to the overall change of manufacturing employment by 25% (0.61%/2.42%) which is substantial.

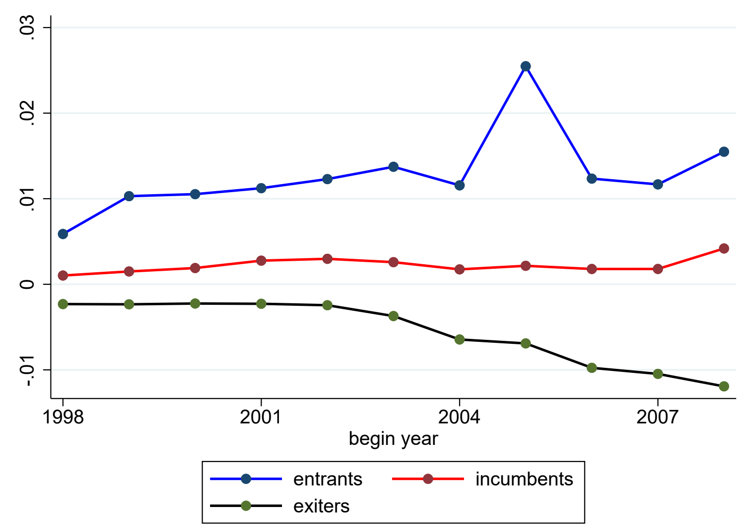
B.2 Japan

The firm-level dataset used in the decomposition exercise is called the Basic Survey of Japanese Business Structure and Activities (BSJBSA) and obtained from the Ministry of Economy, Trade and Industry (METI) of Japan. Its time span is from 1995 to 2016 with around 28,000 firms a year. This firm-level dataset provides information about business activities of Japanese firms and covers firms from a large set of industries that employ more than 50 workers and have more than 30 million Japanese yen in total assets.[40] We restrict our sample to manufacturing firm which account for roughly 45% of all observations. In the survey, the firm also reports the number of its domestic and foreign affiliate(s) in manufacturing and non-manufacturing

[39]The manufacturing employment share shrank substantially in late 1990s and early 2000s due to the large scale privatization of state owned enterprises. However, MNC affiliates still had contributed positively during this period.

[40]The industries included are mining, manufacturing, wholesale and retail trade, and eating and drinking places (excluding "Other eating and drinking places").

Figure A2: Contributions by MNCs in China (5-year window)



Note: We present the contributions by entering, continuing and exiting MNC affiliates for each 5-year interval (from year t to year $t+5$) starting from 1998. The sum of these three components equals the overall contribution by MNC affiliates.

sectors. Based on this information, we can identify whether the firm is a MNC parent firm that has manufacturing affiliate(s) abroad. Finally, BSJBSA has break-down of employment at the firm level. In particular, it report employment at the headquarters (and branches) and manufacturing/services/R&D employment at the headquarters.

The dataset we use in our difference-in-differences analysis is called the Basic Survey on Overseas Business Activities (BSOBA) and also obtained from METI for the period of 1995-2016. This survey contains information about overseas subsidiaries of Japanese MNCs and covers two types of overseas subsidiaries of Japanese MNCs: (1) direct subsidiaries with ratios of investment by Japanese enterprises' being 10% or higher as of the end of the year, (2) second-generation subsidiaries with the ratio of investment by Japanese subsidiaries of 50% or higher as of the end of the year. Tracing the identification codes over time, we are able to construct a panel of affiliates and parent firms from 1995 to 2016. The matched dataset contains on average 2300 parent firms and 15000 affiliates each year. Based on this matched dataset (and further matched with China's ASIF), we are able to identify the 4-digit industry affiliations of Japanese MNCs' manufacturing affiliates in China for the period of 1998-2007.

Table A3: Summary Statistics of Japanese Manufacturing Firms

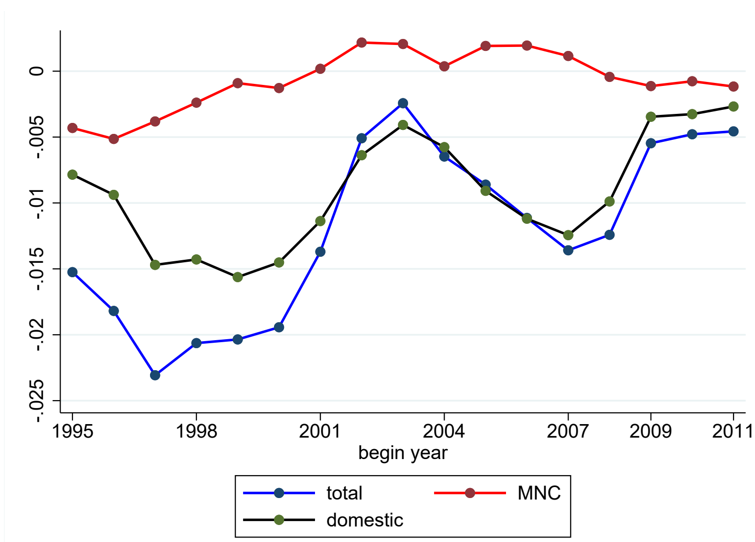
	Obs.	mean	std. dev.	median
employment	288,977	399.5	1646.7	140
MNC status	288,979	.11	.31	0
employment by MNCs	32,025	1572.6	4530.0	435

MNCs are defined as parent firms that have manufacturing affliates abroad.

Table A3 reports average employment of all firms, the share of MNC (parent) firms, and average employment of MNC (parent) firms during our sample period. On average, there are 13,000 manufacturing firms in BSJBSA each year, 11% of which are MNCs. Both mean and medium of MNCs' employment are about 2.5-3 times higher than those statistics of non-MNCs. Therefore, MNCs are much bigger than non-MNCs in terms of size. Since there is information on the breakdown of total employment into manufacturing jobs in BSJBSA, we use equation (6.2) to implement the decomposition exercise. We obtain information on overall employment and employment share of the manufacturing sector from the website of Japan's bureau of statistics (i.e., survey of employment by sectors). Based on these aggregate statistics, we calculate the total change in the manufacturing employment share and employment shift from other sectors to the manufacturing sector.

As Table A3 shows, MNC parents have substantially higher employment than domestic firms. Therefore, it is reasonable to assume that BSJBSA covers most MNC parents, as MNC parents tend to be big in size. We utilize observations of MNC parents in BSJBSA and the aggregate statistics to calculate the middle five terms (related to MNCs) and the last term in equation (6.2). We then calculate the sum of the middle five terms in equation (6.2) that are related to non-MNCs by deducting the sum of the first five terms and the last term from the total change in the manufacturing employment share.

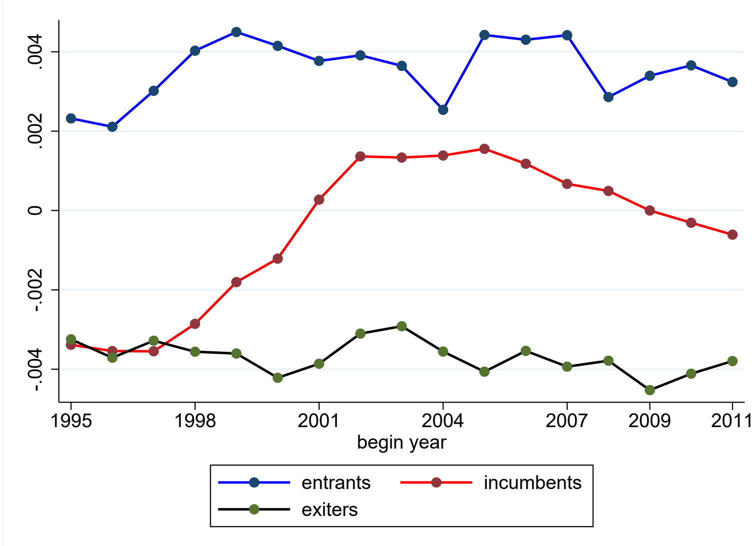
FIGURE A3: Decomposition Result for Japan (5-year window)



Note: We decompose the change in the manufacturing employment share into the three terms for each 5-year interval (from year t to year $t+5$) starting from 1995. The difference betwwen the total change and the sum of the contributions made by domestic firms and MNC parent firms is the employment shift from other sectors to the manufacturing sector..

Figure A3 presents the decomposition result for each 5-year interval (from year t to year $t+5$) starting from 1995 ending in 2011. Overall, it is clear that MNC firm parents had contributed substantially to the overall decline of manufacturing employment share in Japan

FIGURE A4: Contributions by Multinational Parent Firms in Japan (5-year window)



Note: We present the contributions by entering, continuing and exiting MNC parent firms for each 5-year interval (from year t to year $t+5$) starting from 1995. The sum of these three components equals the overall contribution by MNC parents.

during the first half of our sample period (i.e., 1995-2005). However, the contribution by MNC firm parents to the overall decline of manufacturing employment share is small and sometimes even negative in the second half of our sample period. A further look a Figure A4 shows that it is the continuing MNC parent firms that drive the results. Specifically, they had contributed substantially to the decline of manufacturing employment in the early years, but not so in later years.

B.3 Hungary

The Hungarian data comes from the APEH dataset that firm-level data on balance sheets reported to tax authorities for all firms subject to capital taxation in agriculture, manufacture and services activities over the period 1992-2008. This panel data, which allows to track the evolution of firms over time.

The database reports information on firms' value added, sales, output, stock of capital, employment, wages and materials. Additionally, the dataset reports a firm's ownership status, which we use to construct a variable for multinational firms. Following the standard literature, we define a firm as foreign if more than 10% of their shares belong to foreign owners. Firm size varies significantly in the database, spanning from single-employee firms to corporations employing thousands of workers. Since micro firms are more prone to measurement error problems, we keep in the sample firms that have at least have a minimum of three employees in their lifetime. After this, our data covers approximately all employment in manufacturing and service activities –95% and 93% respectively– and more than 98% and 85% of their value added compared to EU-KLEMS data.

Table A4 presents main summary statistics of the Hungarian data. The average number of employees in the sample is 26 and its median is 6 with a standard deviation of 311 workers.

MNC account for 14% of observations and 9% of firms in the sample. As expected, MNC are larger and employ –on average– 80 employees.

Table A4: Hungary: Descriptive Statistics

	Observations (1)	Mean (2)	Std. Dev. (3)	Median (4)
Employment	1,334,225	26	311	6
MNC	1,334,225	0.14	0.34	0.00
Employment by MNC	242,014	80	350	13

Notes: Source: APEH.

B.4 France

Data for France comes from different sources collected by the French Statistic Institute (INSEE). The first source is the Financial linkages between enterprises survey, referred as *LIFI*. This survey collects information from French companies in the private sector, whose portfolio of equity securities exceeds €1.2 million, and whose turnover exceeds €60 million, or whose salaried workforce exceeds 500 people, regardless of the sector of activity. Besides, the heads of groups from the previous year or companies directly owned by a foreign company are questioned. From the *LIFI* database, we obtain information regarding the firm's capital holding links between enterprises. Data on linkages are recorded on 31 December to constitute groups of enterprises and establish statistics concerning these groups and the enterprises within them.

The second database used is the *FICUS-FARE* and contains information on firms' balance sheets. It corresponds to the file approaching the results of the Elaboration of annual statistics of companies. From the *FICUS-FARE*, we obtain data for each enterprise that is recorded using the unique business identifier *Siren*. With the data, we obtain information regarding the sector (NAF classification) and total employment.[41]

B.4.1 Specifics on the LIFI

LIFI is composed of various databases that can be linked to each other. For our purposes, we rely on the entities source which contains all relevant information on each affiliate including the country of origin and the relation concerning the head of the group.[42] The second data we use is the head of group data. We use the information herein to know the country of origin of the Head.

[41] As of 2012 there are some changes to five mayor groups relabelled as *entreprises profilées* (EP). These five groups are: Accor, Renault, Ceux de SEB, Saint Gobain, PSA DAF (Peugeot) and Adia. To have a continuous series before 2012, we collapse in a group all the enterprises that belong to the EPs.

[42] In particular, the variable that allows to identify the relationship with the head, if any, is called the *contour*. Particularly, each enterprise can be classified as any of the following: a Head of group (T) or as we call it a Head Quarter (HQ), an affiliate (C), a joint venture (JV), an Aggregated (E) and a Moving (M). We only keep firms that are either an HQ or a C. The remaining types we do not use since they are firms that don't belong to any group, or are in some transition e.g. changing their HQ or becoming independent of the group. Those enterprises classified as joint ventures stop being recorded as such in 2009, from this year onward they are considered individual firms if they do not belong to a specific group.

B.4.2 Specifics on the FICUS-FARE

FICUS-FARE are enterprises recorders with their respective identifier, *Siren*. We use the firms' sector recorded using the NAF french classification. For the specific case of the EP's we use the sector of the largest sized firm before collapsing before 2012.

B.4.3 Definition of Multinationals

Using the information from the LIFI about the country of the affiliates and the head of the group, we establish the definition of a multinational firm.[43] More precisely defining a multinational is based on the following criteria:

- A Multinational is either local or foreign depending on the Head Quarter's nationality. A local MNC has French HQ while a foreign MNC has foreign HQ.
- To identify local MNC we establish that if inside the group, the HQ is french but there is one or more affiliates that are not in french territory, then the HQ and the affiliates make part of a local MNC. For example, Peugeot HQ is located in France but has some affiliates outside the French territory. Then we classify Pegeout as a local MNC.
- To identify a foreign MNC we check that the HQ is not in french territory. Hence, all affiliates of this HQ in France will be identified as foreign MNC. For example, Airbus HQ is in the Netherlands but since some affiliates are in France, we classify Airbus as a foreign MNC.

B.5 USA

The information for the U.S. comes from the restricted-use microdata from the U.S. Census Bureau. For this analysis we use the Longitudinal Business Dataset (LBD), and the Linked/Longitudinal Firm Trade Transaction Database (LFTTD).

The LBD provides employment and payroll information for the universe of establishments, covering all industries and all U.S. States, with each establishment having a unique firm identifier. To calculate firm's total employment we sum the number of employees for all establishments that share the same firm identifier. Then, we calculate the share of manufacturing employment within the firm by summing the employment in all establishments which primary activity is classified in sectors 31, 32 or 33 of the NAICS 2-digit industry code, and dividing it by firm's total employment. Firms with positive manufacturing employment shares are label as manufacturing firms. All other firms are labeled as services.[44]

To classify firms as MNCs and Non-MNCs we rely on the LFTTD, a firm-level dataset constructed from customs declaration forms collected by the U.S. Customs and Border Protection (CBP), which contains the universe of cross-border trade transactions between U.S. and its foreign partners during the period 1992-2018. In particular, to allow us to distinguish between MNCs and non-MNCs, we use a related party trade indicator in the LFTTD. The related party trade indicator is compiled from the U.S. customs documentation, which includes

[43] We tried to use the information regarding shareholding to elaborate the definition of multinationals but the information is widely underreported for most of the affiliates. i.e 80% of missing values.

[44] Establishments in agriculture NAICS codes are dropped from the sample.

Table A5: Summary statistics France

	2000	2005	2010	2015
	Total/mean/p50/count			
All firm's employment	14,611,434	15,333,296	15,101,981	16,175,534
	(14.37)	(14.23)	(14.65)	(20.89)
	(3.29)	(2.51)	(3.44)	(3.86)
	[1,206,467]	[1,249,953]	[1,164,408]	[882,052]
Local MNC employment	2,776,447	3,063,170	3,016,458	3,325,442
	(244)	(228)	(200)	(152)
	(41.92)	(35)	(34)	(27)
	[17,609]	[19,453]	[21,830]	[31,523]
Foreign MNC employment	2,211,732	2,461,047	2,562,229	2,654,709
	(183)	(165)	(160)	(135)
	(48)	(43)	(36)	(31)
	[12,611]	[15,561]	[16,350]	[20,657]

Notes: Mean in parenthesis, median in parenthesis and count in square brackets.

a yes-no mandatory question that asks if the cross border shipment is between related parties. For U.S. imports, a transaction is considered to take place between related parties if one of the trade partners directly or indirectly owns 5 percent or more of the outstanding voting stock or shares of its partner. For U.S. exports, a related party transaction is a transaction involving trade transactions where either party owns directly or indirectly 10 percent or more of the other party.

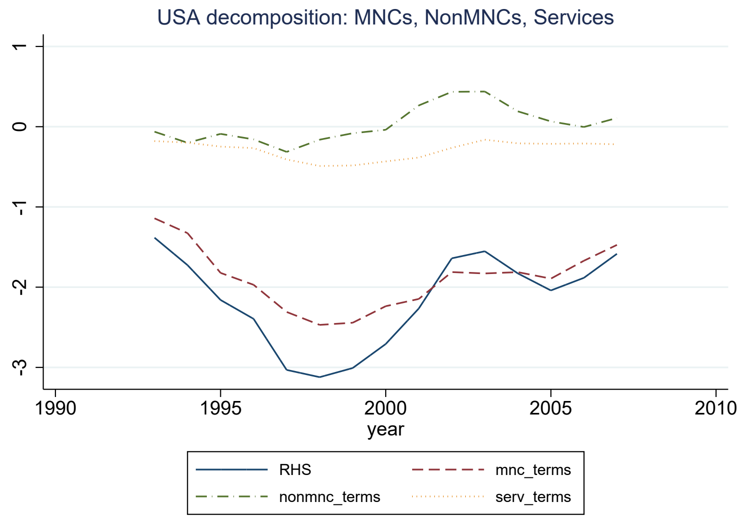
We classify a firm as MNCs if it has conducted cross-border transaction with one or more related parties. Notice that the relate party trade indicator does not allow us to distinguish whether the MNCs corresponds to a US parent or to an US affiliate of a foreign parent.[45]

Figure A5 presents the decomposition result for each 5-year interval (from year t to year $t+5$) starting from 1993 ending in 2007. Overall, the figure shows that MNCs had contributed substantially to the overall decline of manufacturing employment share in the U.S. during this period (red-dot line is below zero line for the entire period), nonetheless, the the negative contribution of MNCs to the share of manufacturing employment has been of lower magnitude in second half of the period.

Figure A6 decompose the overall contribution of MNCs into their continuing, enter and exit components for each 5-year interval (from year t to year $t + 5$) starting from 1993. The figure shows that the main driving force behind the negative contribution of MNCs to the share of manufacturing employment is lead by continuing firms, which also account for the majority of the manufactuing employment.

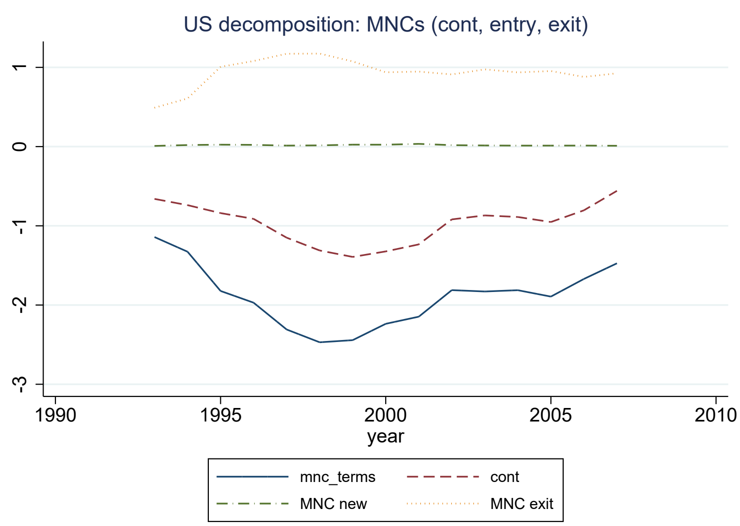
[45] To overcome this limitation and provide more accurate measures of international ownership, we are currently working in using the global ultimate from Orbis to identify MNCs as well as their country of origin.

Figure A5: Decomposition Result for U.S. (5-year window)



Note: We decompose the change in the manufacturing employment share into the three terms for each 5-year interval (from year t to year $t+5$) starting from 1993. The blue line represents the sum of the contributions made by MNCs, non-MNCs and service firms.

Figure A6: Contributions by MNCs in U.S. (5-year window)



Note: We decompose the change in the manufacturing employment share into the three terms for each 5-year interval (from year t to year $t+5$) starting from 1993. The blue line represents the sum of the contributions made by continuing, exit and entry firms for the MNCs firms.

Appendix C Proofs of Propositions in Section 3

Proposition 1 *When country one reduces its inward MP friction in the manufacturing sector g_{21m}, country one's survival cutoff in the manufacturing sector decreases, while country two's survival cutoff in the manufacturing sector increases. In addition, the exporting cutoff from country one to country two increases, while the exporting cutoff from country two to country one decreases. Finally, the cutoffs in the service sector do not change.*

Proof. First, we analyze the slopes of the two curves represented by equations (3.1) and (3.2), when they intersect. For equation (3.1), we have

$$\left|\frac{dz_{11m}^{*}}{dz_{22m}^{*}}\right| = \frac{2f_{12m}J'\left(A_{12}z_{22m}^{*}\right)}{f_{11m}J'(z_{11m}^{*})} = \frac{2z_{11m}^{*}f_{12m}\left[J(A_{12}z_{22m}^{*})+1-G\left(A_{12}z_{22m}^{*}\right)\right]}{z_{22m}^{*}f_{11m}\left[J(z_{11m}^{*})+1-G\left(z_{11m}^{*}\right)\right]}.$$

For equation (3.2), we have

$$\left|\frac{dz_{11m}^{*}}{dz_{22m}^{*}}\right|$$

$$= \frac{z_{11m}^{*}\left[f_{22m}\left(J(z_{22m}^{*})+1-G\left(z_{22m}^{*}\right)\right)\right]}{z_{22m}^{*}\left[f_{21m}\left(J(A_{21}z_{11m}^{*},D_{21}z_{11m}^{*})+G\left(D_{21}z_{11m}^{*}\right)-G\left(A_{21}z_{11m}^{*}\right)\right)+f_{21m}\int_{D_{21}z_{11m}^{*}}^{\infty}\left(\frac{\tau_m z}{A_{21}z_{11m}^{*}}\right)^{\sigma-1}dG(z)\right]},$$

where $D_{21}\equiv A_{21}B_{21}$ Note that $A_{12}=A_{21}$, when the bilateral iceberg trade cost is the same between any country pair in the manufacturing sector.

We analyze the slopes of the two curves when they intersect with each other. For the first derivative above, we have

$$\frac{z_{11m}^{*}f_{12m}\left[J(A_{12}z_{22m}^{*})+1-G\left(A_{12}z_{22m}^{*}\right)\right]}{z_{22m}^{*}f_{11m}\left[J(z_{11m}^{*})+1-G\left(z_{11m}^{*}\right)\right]} = \frac{z_{11m}^{*\sigma}}{z_{22m}^{*\sigma}}\frac{f_{12m}}{f_{11m}}A_{12}^{1-\sigma}\frac{\int_{A_{12}Z_{22m}^{*}}^{\infty}z^{\sigma-1}dG(z)}{\int_{Z_{11m}^{*}}^{\infty}z^{\sigma-1}dG(z)} < \frac{z_{11m}^{*\sigma}\tau_m^{1-\sigma}}{z_{22m}^{*\sigma}} < \frac{z_{11m}^{*\sigma}}{z_{22m}^{*\sigma}},$$

as $f_{11m}=f_{22m}$, $\tau_m>1$ (costly trade) and $z_{11m}^{*}<A_{12}Z_{22m}^{*}$ (selection into exporting). For the second derivative above, we have

$$\frac{z_{11m}^{*}f_{22m}\left(J(z_{22m}^{*})+1-G\left(z_{22m}^{*}\right)\right)}{z_{22m}^{*}\left[f_{21m}\left(J(A_{21}z_{11m}^{*},D_{21}z_{11m}^{*})+G\left(D_{21}z_{11m}^{*}\right)-G\left(A_{21}z_{11m}^{*}\right)\right)+f_{21m}\int_{D_{21}z_{11m}^{*}}^{\infty}\left(\frac{\tau_m z}{g_{21m}A_{21}z_{11m}^{*}}\right)^{\sigma-1}dG(z)\right]},$$

which equals

$$\frac{z_{11m}^{*\sigma}}{z_{22m}^{*\sigma}}\frac{f_{22m}}{f_{21m}A_{21}^{1-\sigma}}\frac{\int_{Z_{22m}^{*}}^{\infty}z^{\sigma-1}dG(z)}{\int_{A_{21}Z_{11m}^{*}}^{D_{21}Z_{11m}^{*}}z^{\sigma-1}dG(z)+f_{21m}\int_{D_{21}Z_{11m}^{*}}^{\infty}(\frac{\tau_m z}{g_{21m}})^{\sigma-1}dG(z)} > \frac{z_{11m}^{*\sigma}}{z_{22m}^{*\sigma}},$$

as $\frac{f_{22m}}{f_{21m}A_{21}^{1-\sigma}}=\tau_m^{\sigma-1}$, and $z_{22m}^{*}<A_{21}Z_{11m}^{*}$ (selection into exporting). Therefore, when the two curves intersect, the one represented by equation (3.1) has a smaller slope than the one

represented by equation (3.2) in absolute value.

Next, note that a reduction in g_{21m} does not move the curve represented by equation (3.1). To the contrary, a reduction in g_{21m} shifts the curve represented by equation (3.2) to the right. That is, form a given z^*_{11m}, z^*_{22m} implied by equation (3.2) increases when $g_{21m} = g_{31m}$ go down. Therefore, we must have the following result after country one implements the unilateral FDI liberalization:

$$z^{*,after}_{11m} < z^{*,before}_{11m}; \quad z^{*,after}_{22m} > z^{*,before}_{22m}.$$

As a result, we must have

$$z^{*,after}_{12m} = A_{12} z^{*,after}_{22m} > z^{*,before}_{12m} = A_{12} z^{*,before}_{22m};$$

$$z^{*,after}_{21m} = A_{21} z^{*,after}_{11m} < z^{*,before}_{21m} = A_{21} z^{*,before}_{11m},$$

and

$$z^{*M,after}_{21m} = A_{21} B^{after}_{21} z^{*,after}_{11m} < z^{*M,before}_{21m} = A_{21} B^{before}_{21} z^{*,before}_{11m},$$

as A_{12} and A_{21} are unaffected by the reduction of g_{21m}, while B_{21} decreases as g_{21m} goes down.

Finally, as the free entry conditions in the service sector of both countries are unaffected by the change in g_{21m}, all the cutoffs in the service sector are unchanged. □

Proposition 2 *When country one reduces its inward MP friction in the manufacturing sector g_{21m}, incumbent MNC affiliates in country one expand and more (new) MNCs from country two start doing MP in country one. Surviving domestic firms in country one also expand, while exporters from country one to country two shrink. Third, surviving domestic firms in country two shrink, while exporters from country two to country one expand. As a result, the manufacturing (and services) employment share of MNC parent firms in country two decreases (and increases). Finally, firms in the service sector of both countries are unaffected.*

Proof. As it is true that

$$z^{*,after}_{11m} < z^{*,before}_{11m}; \quad z^{*,after}_{22m} > z^{*,before}_{22m},$$

we must have[46]

$$P^{after}_{m1} > P^{before}_{m1}; \quad P^{after}_{m2} < P^{before}_{m2}.$$

In other words, market competition becomes less tougher in the manufacturing sector of country one, while it becomes tougher in the manufacturing sector of country two (due to more entries). Since the MNC cutoff form country two to country one declines, more (new) MNCs from country two start doing MP in country one. As P_{m1} goes up and g_{21m} goes down, revenue and profits of incumbent MNC affiliates in country one increase. As P_{m1} goes up, surviving domestic firms in country one and exporters from country two to country one expand. As P_{m2} goes down, surviving domestic firms in country two and exporters from country one to country two shrink in terms of sales and the number of (manufacturing) workers used in the variable cost and the fixed production cost. Since the fixed MP cost (f^M_{21m}) which consists of

[46]Note that the nominal spending on manufacturing good is always $\beta_m L$.

services jobs is unchanged in the manufacturing sector, the share of manufacturing (services) employment drops (and increases) in MNC parent firms in country two.

Finally, firms in the service sector of both countries are unaffected by the change in g_{21m}, as cutoffs in the service sector are unchanged. □

Proposition 3 *When country one reduces its inward MP friction in the manufacturing sector, g_{21m}, the mass of manufacturing entrants in country one decreases, while the mass of manufacturing entrants in country two increases. In addition, the mass of entrants in the service sector of both countries are unchanged.*

Proof. We know that

$$(\rho z^*_{iim} P_{im})^{1-\sigma} = \frac{\beta_m L}{\sigma f_{iim}},$$

which is a constant. Moreover, the above two equations pin down two downward sloping lines in the domain of M^e_{1m} and M^e_{2m}. The slope of two curves are

$$\Big|\frac{dM^e_{1m}}{dM^e_{2m}}\Big|_{country\ 2} = \frac{\tau_m^{\sigma-1}\int_{z^*_{22m}}^{\infty} z^{\sigma-1} dG(z)}{\int_{z^*_{12m}}^{\infty} z^{\sigma-1} dG(z)}$$

and

$$\Big|\frac{dM^e_{1m}}{dM^e_{2m}}\Big|_{country\ 1} = \frac{\int_{z^*_{21m}}^{z^{*M}_{21m}} \left(\frac{z}{\tau_m}\right)^{\sigma-1} dG(z) + \int_{z^{*M}_{21m}}^{\infty} \left(\frac{z}{g_{21m}}\right)^{\sigma-1} dG(z)}{\int_{z^*_{11m}}^{\infty} z^{\sigma-1} dG(z)},$$

where $z^*_{21m} = A_{21} z^*_{11m}$ and $z^*_{12m} = A_{12} z^*_{22m}$. We assume that there is a selection into exporting, which means $A_{12} > 1$ and $A_{21} > 1$ when the two countries ares symmetric. Therefore, we must have

$$\Big|\frac{dM^e_{1m}}{dM^e_{2m}}\Big|_{country\ 2} > \tau_m^{\sigma-1} > 1 > \Big|\frac{dM^e_{1m}}{dM^e_{2m}}\Big|_{country\ 1},$$

when the two downward sloping lines intersect. Therefore, the slope of the line implied by equation (3.7) is smaller than the slope of the line implied by equation (3.6) in absolute term.

Note that when g_{21m} goes down, z^*_{11m} goes down. As a result, the line implied by equation (3.7) moves inward. To the contrary, the line implied by equation (3.6) moves outward as z^*_{22m} goes up. Therefore, the mass of entrants in the manufacturing sector of country one must decrease, while the mass of entrants in the manufacturing sector of country two must increase.

Finally, as the cutoffs and the trade costs are unchanged when country one reduces its inward MP friction in the manufacturing sector, the mass of entrants in the service sector is unchanged in both countries. □

Proposition 4 *Assume that the slope parameter of the Pareto distribution is not too large: $k < 2\sigma - 1$. When country one reduces its inward MP friction in the manufacturing sector g_{21m} from τ_m (i.e., a prohibitively high level) by a small amount, manufacturing employment of country one increases, while it decreases in country two. Country one exports manufacturing goods (on net) and imports the homogeneous good. Country two imports manufacturing goods (on net) and exports the homogeneous good. Trade is balanced in the service sectors between* *the two countries both before and after the unilateral FDI liberalization. However, the service employment of country one increases after the unilateral FDI liberalization in country one.*

Proof. Equation (3.33) shows that when B_{21} is extremely big (and also relative to other terms in the equation),

$$\frac{dLD_1}{LD_1} > 0.$$

Thus, the manufacturing employment share increases in country one. Moreover, as the expenditure on manufacturing goods worldwide equals $\beta(L_1 + L_2)$ which is unchanged, the number of workers working in the manufacturing sector of country two (and the total wage payment to them), $LD_2 = \beta(L_1 + L_2) - LD_1$ decreases. Furthermore, as the number of manufacturing entrants in country two and the MNC cutoff for country two increases and decreases respectively, $LD_2^m = LD_2 - M_{2m}^e \left[1 - G(z_{21m}^{*M})\right]$ declines even more than LD_2. In total, manufacturing employment share declines in country two.

Next, as both the number of entrants and the cutoffs are unchanged in the service sector of both countries, the total sales of the service sector and wage payments to workers working in the service sector in equation (3.13) are unchanged in both countries. Moreover, as all the parameters used in equation (3.13) are the same between thw two countries, trade is always balanced in the service sector. The service employment share of country one is unchanged after the unilateral FDI liberalization as $LD_1^s = \tilde{LD}_1$. However, the service employment share of country two increases after the unilateral FDI liberalization as

$$LD_2^s = \tilde{LD}_2 + M_{2m}^e \left[1 - G(z_{21m}^{*M})\right] f_{21m}^M,$$

where $\tilde{LD}_2$ is unchanged while M_{2m}^e and $G(z_{21m}^{*M}$ increases and declines respectively. This completes the proof for the first part.

Third, we discuss trade patterns in the manufacturing sector and in the service sector. that there is a *difference* between the net exports of manufacturing goods from country one to country two and the change in manufacturing employment starting from the world without MP, as a fraction of country two's MNC affiliates' sales in country one is repatriated to country two (as the payment of fixed MP cost and the profits). Specifically, the total sales of manufacturing goods made by country one equals

$$sales_1 = M_{1m}^e \left[\frac{\sigma f_{11m} k (z_{11m}^*)^{-k}}{k-(\sigma-1)} + \frac{\sigma f_{12m} k (z_{12m}^*)^{-k}}{k-(\sigma-1)}\right] + M_{2m}^e \frac{\sigma f_{21m} k \left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} \left(z_{21m}^{*M}\right)^{-k}}{k-(\sigma-1)} B_{21}^{\sigma-1},$$

which differs from the payment to manufacturing workers in country one (equation (i.e., 3.21)) only in the last term (noting the difference between σ and $\sigma - 1$). Therefore, Log linearization (up to the first order) of $sales_1$ around $g_{21m} \approx \tau_m$ leads to

$$\frac{dsales_1}{sales_1} \approx C \left[\frac{\left[(\sigma-1)frac^2 + (1-frac)(k+(\sigma-1)frac)\right]}{1+(1-frac)B_{21}^{-k+(\sigma-1)}} - \frac{\left[(1-frac)B_{21}^{-k+(\sigma-1)}\right][k-(\sigma-1)]\left(\frac{B_{21}^{\sigma}}{\frac{f_{21m}^M}{f_{21m}}-1}\right)}{1+(1-frac)B_{21}^{-k+(\sigma-1)}}\right] \frac{dg_{21m}}{g_{21m}}. \tag{C.1}$$

As B_{21} is extremely large (and also relative to other terms in the above equation) when we reduce g_{21m} from the point around $g_{21m} \approx \tau_m$, we must have

$$\frac{dsales_1}{sales_1} > 0.$$

when $k < 2\sigma - 1$. Therefore, country one exports manufacturing goods (on net) and imports the homogeneous good. This completes the second part of the proof.

As preferences are Cobb-Douglas across the two sectors, there is no reallocation of expenditure between sectors (after the unilateral FDI liberalization). Therefore, the result that manufacturing employment of country one increases must imply that manufacturing employment of country two decreases. Similarly, the result that country one exports manufacturing goods (on net) and imports the homogeneous good must imply that country two imports manufacturing goods (on net) and exports the homogeneous good. This completes the proof. □

Proposition 5 *Assume that the slope parameter of the Pareto distribution is not too large: $k < 2\sigma - 1$. When country one reduces its inward MP friction in the manufacturing sector g_{21m} from τ_m (i.e., a prohibitively high level) by a small amount, the mass of domestic active firms decreases (and increases) in country one (and two) respectively*

Proof. The mass of active firms in country i ($i \in \{1, 2\}$) is

$$M_{im}^{active} = M_{im}^{e} \left(z_{iim}^{*}\right)^{-k}.$$

Thus, the (percentage) change in the mass of firms equals

$$\frac{dM_{im}^{active}}{M_{im}^{active}} = \frac{dM_{im}^{e}}{M_{im}^{e}} - k\frac{z_{iim}^{*}}{z_{iim}^{*}}. \tag{C.2}$$

Recall that

$$\frac{dz_{11m}^{*}}{z_{11m}^{*}} = \frac{(1-frac_{dom})^2 B_{21}^{-k+(\sigma-1)}}{frac_{dom}^2 - (1-frac_{dom})^2}\frac{dg_{21m}}{g_{21m}};$$

$$\frac{dz_{22m}^{*}}{z_{22m}^{*}} = -\frac{frac_{dom}(1-frac_{dom}) B_{21}^{-k+(\sigma-1)}}{frac_{dom}^2 - (1-frac_{dom})^2}\frac{dg_{21m}}{g_{21m}};$$

$$\frac{dM_{1m}^{e}}{M_{1m}^{e}} = (1-frac_{pirce}) B_{21}^{-k+(\sigma-1)} \left[\frac{(\sigma-1)frac_{price} + k(1-frac_{price})}{frac_{price}^2 - (1-frac_{price})^2}\right]\frac{dg_{21m}}{g_{21m}};$$

$$\frac{dM_{2m}^{e}}{M_{2m}^{e}} = -(1-frac_{pirce}) B_{21}^{-k+(\sigma-1)} \left[\frac{(\sigma-1)(1-frac_{price}) + k frac_{price}}{frac_{price}^2 - (1-frac_{pirce})^2}\right]\frac{dg_{21m}}{g_{21m}}.$$

Therefore, equation (C.2) implies

$$\frac{dM_{1m}^{active}}{M_{1m}^{active}} = (1-frac_{pirce}) B_{21}^{-k+(\sigma-1)} \left[\frac{(\sigma-1)frac_{price}}{frac_{price}^2 - (1-frac_{pirce})^2}\right]\frac{dg_{21m}}{g_{21m}} < 0, \tag{C.3}$$

and

$$\frac{dM_{2m}^{active}}{M_{2m}^{active}} = -(1 - frac_{pirce})B_{21}^{-k+(\sigma-1)}\left[\frac{(\sigma-1)(1-frac_{price})}{frac_{price}^2-(1-frac_{pirce})^2}\right]\frac{dg_{21m}}{g_{21m}} > 0. \tag{C.4}$$

□

Appendix D Employment Effects of FDI Liberalization: results using the whole sample

In this section of the appendix, we report regression results using the whole sample and the definition of the treatment at the three-digit BSOBA industry level. Since the results are qualitatively similar to the ones using the matched sample, we do not discuss the results reported here.

D.1 Regression Results

Table A6: China's FDI liberalization and Japanese affiliates

	(1)	(2)	(3)	(4)
	log(tot. empl.)		log(tot. sales)	
$treatment_i * post02_t$	0.245*	0.263*	0.432*	0.424*
	(0.142)	(0.132)	(0.233)	(0.217)
affiliate fixed effects	Yes	Yes	Yes	Yes
year fixed effects	Yes	No	Yes	No
city-year fixed effects	No	Yes	No	Yes
N	14553	14504	14703	14654
R^2	0.930	0.933	0.865	0.869

Std. err. are clustered at affiliate industry level and included into the parentheses. * 0.10 ** 0.05 *** 0.01

Table A7: China's FDI liberalization and domestic employment of Japanese MNCs

	(1)	(2)	(3)	(4)	(5)	(6)
	log(tot. empl.)		log(manuf. empl.)		share of manuf. empl.	
$treatment_i * post02_t$	-0.0276	-0.0286	-0.0563	-0.0615	-0.0331**	-0.0333**
	(0.0420)	(0.0420)	(0.100)	(0.100)	(0.0125)	(0.0125)
import share		0.0345		0.282**		0.00103
		(0.0363)		(0.126)		(0.0191)
export share		0.0473		0.194		0.00878
		(0.0499)		(0.136)		(0.0200)
firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
prefecture-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
parent industry-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	13727	13727	13727	13727	13727	13727
R^2	0.981	0.981	0.912	0.912	0.890	0.890

Std. err. are clustered at affiliate industry level and included into the parentheses. * 0.10 ** 0.05 *** 0.01

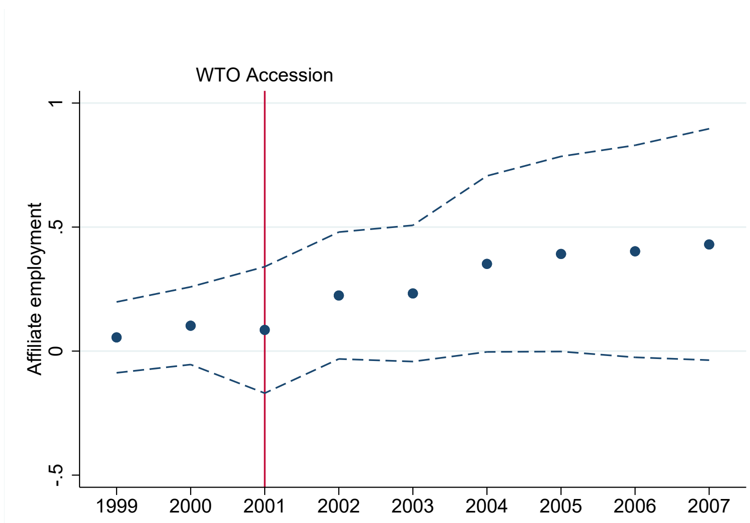
Table A8: China's FDI liberalization and domestic employment of Japanese MNCs' headquarters

	(1)	(2)	(3)	(4)
	share of R&D empl. at parent		share of IB empl. at parent	
$treatment_i * post02_t$	0.0135*	0.0136*	0.00111	0.00108
	(0.00744)	(0.00745)	(0.00265)	(0.00264)
import share		0.00570		-0.00101
		(0.0122)		(0.00468)
export share		-0.00874		0.00175
		(0.0129)		(0.00332)
firm fixed effects	Yes	Yes	Yes	Yes
prefecture-year fixed effects	Yes	Yes	Yes	Yes
parent industry-year fixed effects	Yes	Yes	Yes	Yes
N	13727	13727	13727	13727
R^2	0.837	0.837	0.529	0.529

Std. err. are clustered at affiliate industry level and included into the parentheses. Share of IB empl. at parent: share of international business unit employment in parent firm's employment. * 0.10 ** 0.05 *** 0.01

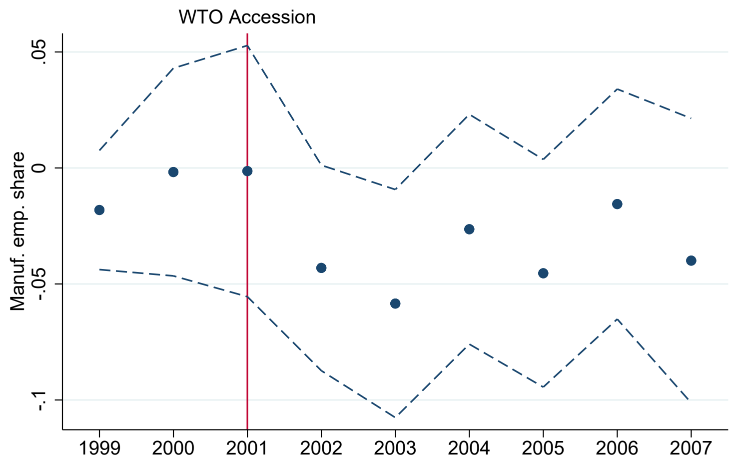
D.2 Parallel-trends Assumptions

Figure A7: Parallel trends assumption: total employment of affiliates



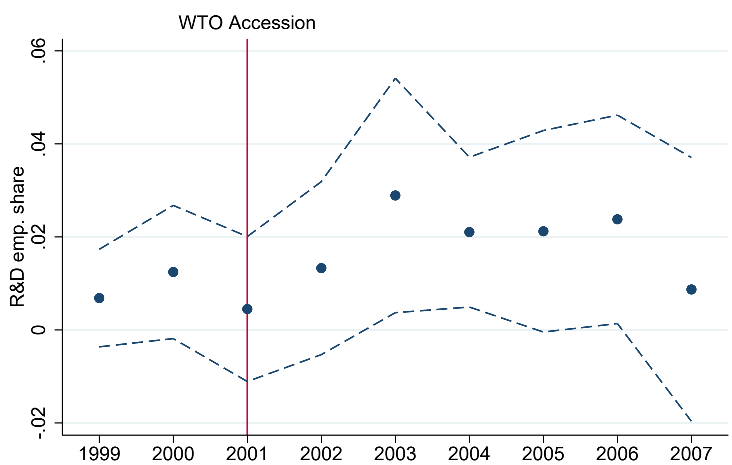
Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

Figure A8: Parallel trends assumption: share of manufacturing employment at the parent firm



Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

Figure A9: Parallel trends assumption: share of R&D employment at the parent firm



Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.