Multinationals and Structural Transformation*

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Abstract

We study the role of multinationals (MNCs) in facilitating firm-level and aggregate structural transformation. Using a stylized model of multinational production and trade, we show that an inward multinational liberalization in the manufacturing sector raises employment in host country firms, and decreases manufacturing employment, while also raising services employment, in the parent firms. We also show the conditions under which aggregate structural transformation occurs. We test the model's firm-level predictions by using confidential microdata from Japan. We study the response of Japanese MNC parents and of their affiliates in China to an exogenous change in China's openness to foreign direct investment (FDI). We find that in industries where inward FDI was encouraged, Japan MNC's affiliates in China experienced increases in their employment. We also find that MNC parents in the encouraged industries experienced decreases in home country manufacturing employment and increases in home country services and R&D employment. Finally, using microdata for several advanced and middle-income countries, we decompose 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 global driver of structural transformation.

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1 Introduction

Recent research has highlighted the role of multinationals in leading to changes in firm-level and aggregate manufacturing and non-manufacturing employment.[1] This raises the question of the role of multinationals in structural transformation, which, after all, is about how manufacturing and non-manufacturing employment shares evolve over time. Specifically, as countries develop, the agriculture employment shares decline, services employment shares rise, and manufacturing employment shares tend to follow a hump pattern.[2] Assessing the role of multinationals in this process is the goal of our paper.[3] In particular, through which theoretical channel(s) does liberalizing multinational production affect structural transformation at the firm and aggregate levels? Is there empirical evidence for the role of multinationals in structural transformation? Is this likely to be a quantitatively relevant channel when explaining structural transformation?

Our paper addresses these questions. First, we develop and solve a three-sector model featuring international trade and multinational firms. We derive both firm-level and aggregate implications of our model. In particular, in response to a unilateral reduction in multinational frictions, we are able to show the conditions under which both firm-level and aggregate structural change occur at the affiliates and parents, and in the home and host countries. Second, we test the model's firm-level predictions using confidential microdata from Japan. We use a quasi-random policy experiment to show that a change in China's foreign direct investment (FDI) policies in 2002 increased employment growth in Japanese-owned manufacturing affiliates in China 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 their service employment growth. Thus, we find firm-level structural transformation at the parents and at their affiliates in China. Third, we use micro data from five countries – the U.S., France, Hungary, Japan, and China – to decompose the change in the aggregate manufacturing employment share into multinational (MNC) and non-multinational (non-MNC) components. We show that MNCs play an outsized role in accounting for decreases in the manufacturing employment share in the advanced economies and increases in the manufacturing employment share in the emerging market economies. Overall, our theoretical and empirical work point to the importance of multinationals in driving firm-level and aggregate structural change.

Our two-country, multi-sector general equilibrium firm-level model of multinationals, trade, and structural change draws from the multinational model of Helpman, Melitz, and Yeaple (2004). Our three sectors are agriculture, manufacturing and services. The model features monopolistic competition with heterogeneous firms that vary in their productivity. Firms can serve foreign markets via

[1]See for instance Muendler and Becker (2010), Boehm, Flaaen, and Pandalai-Nayar (2020), and Kovak, Oldenski, and Sly (2021).

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

[3]In the international dimension, quantitative multi-country models of structural transformation suggests that international trade plays a role in structural change. See, for example, Uy, Yi, and Zhang (2013), Swiecki (2017), and Sposi (2019).

exporting or multinational production (MP). Both sets of international activity face fixed costs and variable costs. The variable cost of MP draws from Ramondo and Rodríguez-Clare (2013) and consists of an iceberg-type reduction in productivity for the foreign affiliate of the multinational parent firm. Selection into exporting or MP plays a key role in the model's outcomes.

We then develop several propositions that clarify the role of MNCs in structural transformation. We show that at the firm-level a unilateral reduction in MP frictions in the manufacturing sector by the host country leads to an expansion in employment by incumbent manufacturing affiliates, and a reduction in manufacturing employment by incumbent manufacturing parents. Hence, at the firm-level, the manufacturing employment share increases in the host country, e.g., and emerging market economy such as China, and decreases in the home country, e.g., an advanced economy such as Japan. The outcome in the host country reflects two offsetting effects, the direct effect from the lower MP friction, which leads to increased entry by MNCs from abroad, thus tending to reduce employment at existing affiliates, and an indirect effect arising from the general equilibrium consequences of the policy change. We show that the indirect effect dominates the direct effect. In the home country, only the general equilibrium effects operate, and they do so in the opposite way as in the host country. At the aggregate level, we show the conditions under which a hump-pattern in the host country's manufacturing employment share can occur as the MP friction is reduced.

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 data is that it provides information on the activities of Japanese foreign affiliates in all countries, including in China. This setting allows us to exploit a plausibly exogenous policy change to test the predictions of our theory: in early 2002, China changed the set of industries in which it "encouraged" FDI. This allow us to construct exposure measures for Japanese firms (in Japan) affected by the shock given the heterogeneity in the industry mix of their pre-existing affiliates in China. The identification assumption 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 approach. First, we show that, compared to Japanese affiliates in China operating in manufacturing industries not affected by the FDI policy (i.e., the control group), those affiliates in manufacturing industries that started to encourage FDI in 2002 (i.e., the treatment group) increased their manufacturing employment and sales by about 20% and 17%, 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 MNC parents that have manufacturing foreign affiliates in the control group, Japanese MNC parents with foreign affiliates in the treatment group reduced their manufacturing employment and manufacturing employment share (in Japan) by roughly 11.5% and 2.8 percentage points, respectively. Further, shares of employees in the international business unit and R&D staff in those treated MNC parents experienced an employment increase of about 0.29 and 1.26 percentage points compared to MNCs in the control group.[4] Taken together, our estimates show 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 also increased the pace of Japan's structural transformation during the 2000s.

Our estimates clearly illustrate that the channel highlighted by the theory is operational for Japanese manufacturing multinational parents and their affiliates in China. To assess whether these results could carry over to other settings, we implement an accounting decomposition exercise in a larger group of countries. Specifically, we utilize micro-data from five countries encompassing both developed and middle-income countries (U.S., France, Hungary, Japan and China). Our exercise builds on Foster, Haltiwanger, and Krizan (2006). We decompose the change in the manufacturing employment share for each country into components that can be attributed to multinationals (MNCs) and non-multinationals (non-MNCs). We find that in all five countries, employment changes within and between MNCs are responsible for a substantial fraction of the overall change in the manufacturing employment share.[5] 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 that a unilateral inward MP liberalization generates firm-level and 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 our 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 Our paper is related to two main literatures. First, it is related to the large literature on the effects of multinationals, including their effects in China. Second, it is related to the structural change literature especially regarding implications for manufacturing employment. The first literature has typically not emphasized the implications for structural transformation, and the latter literature has typically not emphasized the role of multinationals.

One strand of the multinational literature has studied explanations for the manufacturing decline in several developed countries that emphasizes trade-based explanations including China's accession into the World Trade Organization (WTO) (Autor, Dorn, and Hanson (2013), Pierce and Schott (2016)), or offshoring by multinationals (Muendler and Becker (2010), Boehm, Flaaen, and Pandalai-Nayar (2020), Kovak, Oldenski, and Sly (2021)).

[4] The average share of manufacturing employment for firms in Japan is 53%, while the average employment share of the international business unit and that of R&D staff in the MNC parents are 1.0% and 8.3% respectively.

[5] As our microdata are confidential at the country-level, with the exception of Japan, we cannot link individual firms in the data across countries.

A related literature studies the interaction of multinationals and trade. An important early paper is Helpman, Melitz, and Yeaple (2004). Irarrazabal, Moxnes, and Opromolla (2013) extends the Helpman, Melitz, and Yeaple (2004) model to include intra-firm trade. The paper also estimates the model and conducts counterfactuals. Arkolakis et al. (2018) develops a model of multinationals, trade, and innovation, also drawing from Helpman, Melitz, and Yeaple (2004). Finally, Ramondo and Rodríguez-Clare (2013) develops a model of multinationals and trade with a framework drawing from Eaton and Kortum (2002). While these two literatuers have made excellent contributions, they have not studied empirically the interdependence of changes in manufacturing employment across countries, which is the key focus of our paper; moreover, they do not study firm-level or aggregate structural change in both home and host countries.

Our paper is also related to literature studying the role of multinationals in the transmission of shocks across countries (Alfaro and Chen (2012), Alviarez, Cravino, and Levchenko (2017), Boehm, Flaaen, and Pandalai-Nayar (2019)), to the role of multinationals in growth, innovation, and productivity (Alfaro et al. (2010), Ramondo and Rodríguez-Clare (2013), Alfaro (2016), Alfaro and Chen (2018), Arkolakis et al. (2018), Alviarez (2019) among others), and to the labor market impact of multinationals (Becker, Ekholm, and Muendler (2013)). Of these papers, Alfaro and Chen (2018) is closely related to ours. It also has a framework that draws from Helpman, Melitz, and Yeaple (2004) to generate implications for multinationals that are then tested with micro-level data. However, there are two key differences. First, their main theoretical exercise is a symmetric reduction in MP frictions; our main exercise is a unilateral reduction in MP frictions. These exercises have different qualitative implications for cutoffs and firm-level employment. Also, our asymmetry leads to a home market effect. Second, on the empirical side, they conduct a panel-data estimation, while we focus on a single policy change involving China. In addition, we study the outcome of that change for both affiliates and parents.

Also related are papers studying the creation of affiliates and the life-cycle of multinationals and their relationships with their affiliates (Feinberg and Keane (2006), Garetto, Oldenski, and Ramondo (2021), Ramondo, Rappoport, and Ruhl (2016), Gumpert et al. (2020)). Finally, a smaller strand of the literature has focused on MNCs operating in China and Japan, and FDI from Japan in China (Chen, Tian, and Yu (2019), Head and Ries (2003)).

A large literature has studied the determinants of structural transformation, typically in theoretical/quantitative frameworks, often in closed economies. More recent work has emphasized that structural transformation should be studied in an open-economy context (Matsuyama (2009)).[6] 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

[6]The pioneering work by Matsuyama (1992) shows 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.

explanations for structural transformation in a single model to assess the strength of each mechanism. We contribute to this literature by solving a firm-level model of structural change under monopolistic competition. Related, there are home market effects, which do not occur in the perfect competition models given above.

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 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. (2022) who investigate how structural transformation occurred both between and within firms in the context of the U.S. Of these papers, Ding et al. (2022) is the closest to ours, because of its work on within-firm structural transformation. 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 and provide estimates of their impact using quasi-random exogenous variation – 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.

The paper is organized as follows. Section 2 lays out our model, and section 3 examines the implications of a unilateral FDI liberalization. Section 4 presents our empirical analysis, and the next section provides our accounting decompositions. The final section concludes.

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 – agriculture, manufacturing, and services. The agriculture sector produces a homogeneous good, and manufacturing and services both 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 three 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.[7] 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 utility defined in equations (2.1) and (2.2) subject to the following budget constraint:

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

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 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.

The manufacturing and services sectors have a large mass of potential entering firms. If a firm in country i chooses to enter sector k ($k \in \{m, s\}$), it pays a country-sector specific entry cost f_{ikE}, in units of labor, and draws a productivity z from a distribution $G(z)$.[8] Upon entry, the firm next decides whether to produce, and if so, whether to also export or engage in multinational activity. The choice of production activities leads to three types of firms: domestic firms, exporting firms, and MNCs. Each of these activities requires a fixed cost denoted by f_{iik}, f_{ijk}, and f^M_{ijk}, respectively, again, in units of country i's labor. f^M_{ijk} denotes the fixed cost of a multinational firm in sector k of country i setting up operations in country j.

We also assume that f^M_{ijm}, i.e., multinational fixed costs in the manufacturing sector, is attributed to labor in the services sector, because such costs tend to occur at MNC headquarters and are ser-

[7] For recent frameworks with non-homothetic preferences, see Kongsamut, Rebelo, and Xie (2001) (Stone-Geary preferences), Comin, Lashkari, and Mestieri (2021) (non-homothetic CES preferences), Boppart (2014) (sub-class of PIGL preferences), Buera and Kaboski (2009) and Herrendorf, Herrington, and Valentinyi (2015) (augmented CES), Swiecki (2017) (constant differences of elasticities of substitution). For recent fameworks with the Baumol (1967) effect, see Ngai and Pissarides (2007).

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

vices in nature (e.g., translation/communication with employees of foreign affiliates, and transferring technology or management know-how to foreign affiliates etc.). Henceforth, to distinguish between MNC headquarters and the MNC (domestic) production operations, we will call the latter a *plant*.

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 capturing imperfect technology transfer, as well as institutional and other technological frictions. These frictions are captured by $g_{ijk} \geq 1$; hence, the MNC affiliate has productivity given by $\frac{z}{g_{ijk}}$.

2.3 Firm-level Outcomes

We now study how firms choose prices and the mode of production. Euquations (2.1) and (2.2) imply that domestic demand for a variety produced by a firm with productivity z (in sector k and country i) is given by:

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

where P_{ik} is the ideal price index of differentiated goods sold in sector k and country i. Given the cost structure, monopolistically competitive firms in country i will use the following pricing rules for domestic sales and for exporting, respectively:

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

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 for domestic production and exports 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

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

The profit functions imply the following survival and exporting productivity cutoffs:

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

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, an affiliate of an MNC (from country i and sector k) in country j sets its output price as:

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

The resulting profit function is:

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

From (2.12), we can derive the productivity cutoff for doing FDI (relative to the exporting cutoff):

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

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 $z^{*M}_{ijk} > z^*_{ijk}$. Because wages are equalized, then under the assumption that $f^M_{ijk} > f_{ijk}$, we would need $\tau_{ijk} > g_{ijk}$ by a sufficiently small amount to ensure this outcome.

2.4 Sectoral Prices, Free Entry Conditions, and Equilibrium

We define the sectoral ideal price index as:

$$\begin{aligned}
& P^{1-\sigma}_{ik} = P^{1-\sigma}_{iik} + \sum_{j\neq i} P^{1-\sigma}_{jik} \\
\equiv \; & \left[\int_{z^*_{iik}}^{\infty} M^e_{ik} \left(\frac{w_i}{\rho z}\right)^{1-\sigma} dG_{ik}(z) + \sum_{j\neq i} \int_{z^{*M}_{jik}}^{\infty} M^e_{jk} \left(\frac{g_{jik} w_i}{\rho z}\right)^{1-\sigma} dG_{jk}(z)\right] \\
& + \left(\sum_{j\neq i} \int_{z^*_{jik}}^{z^{*M}_{jik}} M^e_{jk} \left(\frac{w_j \tau_{jik}}{\rho z}\right)^{1-\sigma} dG_{jk}(z)\right).
\end{aligned} \tag{2.14}$$

We assume that there is free entry in each of the two sectors of both countries, which implies that the expected profit from entry equals the entry cost or:

$$\int_{z_{iik}^*}^{\infty} \pi_{ik}(z)dG(z) + \int_{z_{ijk}^*}^{z_{ijk}^{*M}} \pi_{ijk}(z)dG(z) + \int_{z_{ijk}^{*M}}^{\infty} \pi_{ijk}^M(z)dG(z) = f_{ikE}, \tag{2.15}$$

where the three terms of the left hand side are the expected profit earned from the domestic market, the exporting market, and by conducting multinational production. (As a reminder, wages are normalized to one.) The free entry condition pins down the mass of potential entrants, M_{ik}^e, in each of the two sectors of both countries. We next define three "J" terms, following Melitz (2003):

$$J(z_{ijk}^*) = \int_{z_{ijk}^*}^{\infty} \left[\left(\frac{z}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] dG(z) = \left[\left(\frac{\tilde{z}_{ijk}}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] (1 - G(z_{ijk}^*)), \tag{2.16}$$

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

$$J^X(z_{ijk}^*, z_{ijk}^{*M}) = \int_{z_{ijk}^*}^{z_{ijk}^{*M}} \left[\left(\frac{z}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] dG(z) = \left[\left(\frac{\tilde{z}_{ijk}^X}{z_{ijk}^*} \right)^{\sigma-1} - 1 \right] (G(z_{ijk}^{*M}) - G(z_{ijk}^*)), \tag{2.17}$$

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

$$J^M(z_{21m}^{*M}) = J^M(A_{21}B_{21}z_{11m}^*) = \left(\int_{z_{21m}^{*M}}^{\infty} \left(\frac{\tau_m z}{g_{21m} z_{21m}^*} \right)^{\sigma-1} dG(z) - \frac{f_{21m}^M}{f_{21m}} \right) \tag{2.18}$$

where

$$A_{ij} \equiv \tau_m \left(\frac{f_{ijm}}{f_{jjm}} \right)^{\frac{1}{\sigma-1}} ; B_{ji} \equiv \left[\frac{\frac{f_{jim}^M}{f_{jim}} - 1}{\left(\frac{\tau_m}{g_{jim}} \right)^{\sigma-1} - 1} \right]^{\frac{1}{\sigma-1}}$$

A_{ij} and B_{ij} denote the ratio of the exporting cutoff (from i to j) to the domestic cutoff (in j), and the ratio of the MNC cutoff (from i to j) to the exporting cutoff (from i to j), respectively, in the manufacturing sector. Importantly, they are pinned down by exogenous variables and parameters.[9]

We use the J terms above to rewrite the free entry conditions. Under the assumption that the costs for country 1 MNCs to set up manufacturing affiliates in country 2 are prohibitively high, we have for manufacturing:

$$f_{11m}J(z_{11m}^*) + f_{12m}J(A_{12}z_{22m}^*) = f_{1mE}, \tag{2.19}$$

[9]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.

and

$$f_{22m}J(z^*_{22m}) + f_{21m}J^X(A_{21}z^*_{11m}, A_{21}B_{21}z^*_{11m}) + f_{21m}J^M(A_{21}B_{21}z^*_{11m}) = f_{2mE}, \tag{2.20}$$

For the services sector, the two free entry conditions are:

$$f_{11s}J(z^*_{11s}) + f_{12s}J\left(A^s_{12}z^*_{22s}\right) = f_{1sE}, \tag{2.21}$$

and

$$f_{22s}J(z^*_{22s}) + f_{21s}J\left(A^s_{21}z^*_{11s},\right) = f_{2sE}, \tag{2.22}$$

where A^s_{ij} and B^s_{ij} are the services sector counterparts to A_{ij} and B_{ij}. We have also assumed that the costs of setting up services affiliates in the other country are prohibitively high.

The factor market is characterized by perfect 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:

$$L_i = L_{ia} + L_{im} + L_{is} \qquad i \in \{1, 2\}. \tag{2.23}$$

As a reminder, we assume that all workers employed to pay the fixed MNC cost in manufacturing are counted as services workers.

We next characterize the goods market clearing condition. For each sector k of country i, we have:

$$L_iP_{ik}C_{ik} = P_{iik}Q_{ik} + \sum_{j \neq i} P_{jik}EX_{jik}, \tag{2.24}$$

where C_{ik} is individual consumption of sector k goods, and Q_{ik} is sector k output produced and sold in country i.[10] EX_{ijk} is exports from country i to country j in sector k. Formally, Q_{ik} and EX_{jik} are defined as:

$$Q_{ik} = \left(\int_{z^*_{iik}}^{\infty} M^e_{ik} q_{ik}(z)^{\frac{\sigma-1}{\sigma}} dG_{ik}(z) + \sum_{j \neq i} \int_{z^{*M}_{jik}}^{\infty} M^e_{jk} q^M_{jik}(z)^{\frac{\sigma-1}{\sigma}} dG_{jk}(z) \right)^{\frac{\sigma}{\sigma-1}} \tag{2.25}$$

and

$$EX_{jik} = \left(\int_{z^*_{jik}}^{z^{*M}_{jik}} M^e_{jk} \left(\frac{q_{jik}(z)}{\tau_{jik}} \right)^{\frac{\sigma-1}{\sigma}} dG_{jk}(z) \right)^{\frac{\sigma}{\sigma-1}}. \tag{2.26}$$

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

We can express Q_{ik} and EX_{ijk} as:

$$P_{iik}Q_{ik} = \sigma w_i f_{iik}\left[J(z^*_{iik}) + (1 - G(z^*_{iik}))\right] M^e_{ik} + \sum_{j\neq i} \frac{\sigma w_j \left(f^M_{jik} - f_{jik}\right)}{\left(\left(\frac{\tau_{jik} w_j}{g_{jik} w_i}\right)^{\sigma-1} - 1\right)} \left[J^M(z^{*M}_{jik}) + \left(1 - G(z^{*M}_{jik})\right)\right] M^e_{jk} \tag{2.27}$$

and

$$P_{ijk}EX_{ijk} = \sigma w_i f_{ijk}\left[J^X(z^*_{ijk}, z^{*M}_{ijk}) + G(z^{*M}_{ijk}) - G(z^*_{ijk})\right] M^e_{ik}. \tag{2.28}$$

The trade balance condition between countries i and j is:

$$\sum_k M^e_{ik}\sigma w_i f_{ijk}\left[J^X(z^*_{ijk}, z^{*M}_{ijk}) + G(z^{*M}_{ijk}) - G(z^*_{ijk})\right] = \sum_k M^e_{jk}\sigma w_j f_{jik}\left[J^X(z^*_{jik}, z^{*M}_{jik}) + G(z^{*M}_{jik}) - G(z^*_{jik})\right]. \tag{2.29}$$

The above simply states that i's exports equal j's exports. 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 $\{f^{k=m,s}_{ijk}\}$ and $\{\tau_{ijk}\}^{k=m,s}$, FDI cost processes $\{f^M_{ijk}\}^{k=m,s}$ and $\{g_{ijk}\}^{k=m,s}$, productivity processes $\{\bar{z}_{ijk}\}^{k=m,s}$ and common structural parameters $\{\sigma, \theta, \beta_k\}^{k=a,m,s}_{i=1,2,3}$ as follows.

Definition 1. *A competitive equilibrium is a sequence of goods and factor prices* $\{P_{ia}, P_{im}, P_{is}, w_i\}_{i=1,2}$, *endogenous masses of potential entrants* $\{M^e_{ik}\}^{k=m,s}_{i=1,2}$, *cutoffs* $\{z^*_{iik}, z^*_{ijk}, z^{*M}_{ijk}\}^{k=m,s}_{i,j=1,2\ i\neq j}$, *allocations* $\{L_{ia}, L_{im}, L_{is}, C_{ia}, C_{im}, C_{is}, Q_{ia}, Q_{im}, Q_{is}\}_{i=1,2}$, *and exports* $\{EX_{ija}, EX_{ijm}, EX_{ijs}\}_{i,j=1,2\ i\neq j}$, *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 (2.23) and (2.24). In addition, the cutoffs that solve the zero profit conditions are defined in equations (2.9), (2.10) and (2.13), and the mass of potential entrants satisfies the free entry condition in equation (2.15).*

3 Implications of Unilateral FDI Liberalization

As described in the previous section, our model has certain features that are asymmetric across countries. For example, country 2's firms can set up manufacturing affiliates in country 1, but not the other way around. These features connect with our econometric analysis in the next section, which involves Japanese multinational firms and their affiliates in China. Hence, we will think of country 1 as China and country 2 as Japan. In this section, we study the model's implications of an FDI liberalization by country 1 in the manufacturing sector. Specifically, the variable cost of inward manufacturing FDI in country 1, g_{21m}, is reduced. This captures China's FDI liberalization in 2002, the focus of our empirical analysis. Also, to simplify our analysis, we assume that the iceberg trade costs are symmetric between a pair of countries, i.e., $\tau_{ijk} = \tau_{jik}$.[11] Below, we first discuss the firm-

[11] Appendix D presents implications of a unilateral trade liberalization.

level implications; then, we turn to the aggregate implications. In both, we characterize changes in employment shares as structural change.

3.1 Implications for Survival, Market Competition, and Firm Employment

Equations (2.19) and (2.20) pin down the survival cutoffs in each country: z^*_{11m} and z^*_{22m}. Moreover, the two equations imply these two cutoffs are negatively related. This leads to the following proposition about cutoffs:

Proposition 1. *When country 1 reduces its inward MP friction in the manufacturing sector g_{21m}, country 1's survival cutoff (in the manufacturing sector) decreases, while country 2's survival cutoff increases. In addition, the exporting cutoff from country 1 to country 2 increases, while the exporting cutoff from country 2 to country 1 decreases. Third, the MNC cutoff from country 2 to country 1 decreases. Finally, the cutoffs in the service sector are unchanged in both countries.*

Proof. See Appendix C. □

In country 1, there are two offsetting effects that affect the selection of domestic firms into the manufacturing sector. The first, direct, effect is that survival becomes tougher as productive foreign firms enter country 1 by producing there (and charging lower prices than what they would charge via exporting). The second, indirect, effect is similar to the home market effect. Specifically, the lower MP cost from country 2 to country 1 makes entry into the manufacturing sector of country 2 more attractive (compared to country 1), which leads to more (fewer) entrants in the manufacturing sector of country 2 (1) respectively.[12] This indirect effect softens the competition in country 1 and dominates the direct effect. As a result, the survival cutoff in country 1 declines, which also implies that the exporting cutoff (from 2 to 1) declines (recall that trade costs are unchanged). This, combined with the lower MP cost into country 1, also imply the MNC cutoff from country 2 to country 1 falls.

For firms in country 2, the lower MP cost (from country 2 to country 1) does not directly affect their pricing decisions. Thus, the only effect coming from the unilateral FDI liberalization in country 1 is the home market effect. Specifically, there are more entrants in the manufacturing sector of country 2 which leads to tougher competition and a higher survival cutoff (and a higher exporting cutoff from country 1 to country 2).[13]

Proposition 1 shows that cutoffs in the service sector are unchanged. As long as trade and domestic production costs are unchanged, the cutoffs will not change. In our model, we do not allow for MP in the service sector. Allowing for that possibility does not affect our result.

In our model, a decline in g_{21m} affects the manufacturing sector survival and exporting cutoffs only though the general equilibrium effects on the sectoral price level P_{1m} and P_{2m}. For example, an

[12] See Appendix C for the proof. Arkolakis et al. (2018) also has a home market effect in their model.

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

increase in the sectoral price level implies a lower cutoff. Moreover, an increase in the sectoral price level also implies higher revenue and employment for surviving (incumbent) firms. Hence, there is a direct relationship between survival cutoffs and employment in surviving firms. This is captured in the following proposition.

Proposition 2. *When country 1 reduces its inward MP friction in the manufacturing sector* g_{21m}*, each incumbent manufacturing affiliate in country 1 expands its employment. However, each surviving domestic plant that is a part of an MNC in country 2 reduces its employment. Hence, the share of manufacturing (services) employment at the MNC parent decreases (increases). Finally, firms in the service sector of both countries are unaffected.*

Proof. See Appendix C. □

The opposite employment effects on MNC affiliates in country 1 and their parent firms in country 2 operate through different margins. The unilateral FDI liberalization in country 1 affects MNC affiliates in country 1 through both an indirect general equilibrium effect (i.e., the opposite of the home market effect), and a direct partial equilibrium effect from the lower g_{21m}. By contrast, the liberalization affects MNC parent firms in country 2 only through an indirect general equilibrium effect (i.e., the home market effect).

In Appendix C, we also derive the implications for the mass of entrants. The changes in the mass of manufacturing entrants are triggered by the home market effect discussed above. We show that when g_{21m} declines, the mass of manufacturing entrants in country 1 (2) decreases (increases), and the mass of services entrants is unchanged in both countries. We use these implications to prove the propositions in the next sub-section.

3.2 Implications for Structural Transformation and Trade

Following country 1's inward FDI liberalization in the manufacturing sector, manufacturing exports from country 1 to country 2 declines, because both the number of entrants in country 1, as well as the fraction of firms that export among entrants (and active firms), decline. Total exports by country 1 and country 2 are:

$$EX_{12m} \equiv M_{1m}^{e} \sigma f_{12m} \int_{z_{12m}^{*}}^{\infty} \left(\frac{z}{z_{12m}^{*}} \right)^{\sigma-1} dG(z), \tag{3.1}$$

$$EX_{21m} \equiv M_{2m}^{e} \sigma f_{21m} \int_{z_{21m}^{*}}^{z_{21m}^{*M}} \left(\frac{z}{z_{21m}^{*}} \right)^{\sigma-1} dG(z), \tag{3.2}$$

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

$$L_{1m} = M_{1m}^e \sigma \left[f_{11m} \int_{z_{11m}^*}^{\infty} \left(\frac{z}{z_{11m}^*} \right)^{\sigma-1} dG(z) + f_{12m} \int_{z_{12m}^*}^{\infty} \left(\frac{z}{z_{12m}^*} \right)^{\sigma-1} dG(z) \right] + M_{2m}^e (\sigma - 1) f_{21m} \int_{z_{21m}^{*M}}^{\infty} \left(\frac{\tau_m z}{g_{21m} z_{21m}^*} \right)^{\sigma-1} dG(z) \tag{3.3}$$

where the last term is the labor used in the variable cost of country 2's MNC affiliates in country 1.[14] Note that total sales (of either domestic or exporting firms) equal the firm's wage payments to labor used in the variable, fixed, and entry costs.

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

$$L_{2m} = M_{2m}^e \sigma \left[f_{22m} \int_{z_{22m}^*}^{\infty} \left(\frac{z}{z_{22m}^*} \right)^{\sigma-1} dG(z) + f_{21m} \int_{z_{21m}^*}^{z_{21m}^{*M}} \left(\frac{z}{z_{21m}^*} \right)^{\sigma-1} dG(z) \right] + M_{2m}^e f_{21m} \int_{z_{21m}^{*M}}^{\infty} \left(\frac{\tau_m z}{g_{21m} z_{21m}^*} \right)^{\sigma-1} dG(z) \tag{3.4}$$

where the last term comes from country 2's MNC affiliates in China and is used to pay for the fixed MNC cost and the entry cost in country 2. Note that exporters from country 2 to country 1 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 defined analogously:

$$L_{is} = M_{is}^e \sigma \left[f_{iis} \int_{z_{iis}^*}^{\infty} \left(\frac{z}{z_{iis}^*} \right)^{\sigma-1} dG(z) + f_{ijs} \int_{z_{ijs}^*}^{\infty} \left(\frac{z}{z_{ijs}^*} \right)^{\sigma-1} dG(z) \right], \tag{3.5}$$

There is an important distinction between the number of workers working in the manufacturing sector and the number of manufacturing workers (i.e., jobs), because the fixed MP cost, f_{ijm}^M is in terms of services employment. This is relevant for country 2, because there are MNCs in country 2 that conduct outward manufacturing FDI in country 1. Specifically, the number of workers who have manufacturing jobs in country 2 is:

$$L_{2m}^m = L_{2m} - M_{2m}^e \left[1 - G(z_{21m}^{*M}) \right] f_{21m}^M, \tag{3.6}$$

where the second term on the right hand side is the number of services jobs created by MNC parent

[14] Operating profits of MNC affiliates operating in country 1 are sent back to country 2.

firms in country 2. Accordingly, the number of service jobs in country 2 is:[15]

$$L_{2s}^{s} = L_{2s} + M_{2m}^{e} \left[1 - G(z_{21m}^{*M})\right] f_{21m}^{M}. \tag{3.7}$$

In order to derive analytical results for sectoral employment, we specify the distribution of productivities z as Pareto with a shape coefficient of k, and we normalize the minimum productivity to one:

$$G(z) = 1 - z^{-k}, \tag{3.8}$$

where a larger k implies a smaller variance of the productivity distribution. Despite the simplifying assumptions, the derivations are algebra-intensive and are provided in Appendix C.

Proposition 3. *Suppose country 1 reduces its inward MP friction in the manufacturing sector, g_{21m}, by a sufficiently small amount from τ_m (i.e., a prohibitively high level). Then, a necessary and sufficient condition for the results below is that the slope parameter of the Pareto distribution $k < 2\sigma - 1$: 1) Manufacturing employment of country 1 increases, while it decreases in country 2. 2) Trade is balanced in the service sector between the two countries both before and after the unilateral FDI liberalization. 3) Services employment of country 2 increases. 4) Country 1 exports manufacturing goods (on net) and imports the homogeneous good, while country 2 imports manufacturing goods (on net) and exports the homogeneous good.*

Proof. See Appendix C. □

Importantly, Proposition 3 says that under certain conditions, a unilateral decrease in the inward manufacturing MP friction leads to an increase in the manufacturing employment share. Why do we need the condition that $k < 2\sigma - 1$, i.e., the Pareto slope parameter is not too large, in order to generate the result that manufacturing employment increases in country 1? When the inward MP friction decreases (from a prohibitively high level), there are two offsetting effects on manufacturing employment of country 1. The first effect is positive owing to the new manufacturing jobs created by MNC affiliates in country 1 (i.e., the MNC effect). The second effect is negative, because the mass of domestic (and exporting) manufacturing firms of country 1 declines (i.e., the home market effect in reverse). For country 2, the two effects work in the opposite way as well.[16] The difference is that country 2's MNC affiliates in country 1 (which inherit (partially) the productivity from their parent firms) are more productive than domestic and exporting firms of country 1 on average. This

[15] For country 1, the number of workers working in the manufacturing (or service) sector is the same as the number of manufacturing (or services) workers:

$$L_{1m}^{m} = L_{1m}; \quad L_{1s}^{s} = L_{1s}.$$

[16] Specifically, the MNC effect reduces the manufacturing employment share in country 2, as MNCs switch from exporting to conducting MP production. Offsetting this is the home market effect, which leads to an increase in the manufacturing employment share in country 2, as more firms enter into the manufacturing sector.

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 1 increases.[17]

The result that the service employment share increases in country 2 is a by-product of the increasing number of manufacturing MNCs of country 2 following country 1's unilateral FDI liberalization. On the one hand, as the service sector is symmetric between the two countries and preferences over sector-specific composite goods are Cobb-Douglas, sales and total wage payments to workers *working* in the service sector are unchanged in both countries after the FDI liberalization. On the other hand, as more manufacturing firms in country 2 become MNCs, the total fixed MP cost paid by them, and, as a result, services jobs (i.e., workers) generated by the aggregate fixed MP cost, increase. Thus, in country 2, although the share of workers in the services sector is unchanged, there is an overall increase in the share of services workers.[18]

Proposition 3 involves a small reduction in the manufacturing MP friction, g_{21m}, from a prohibitively high level (i.e., the no-MNC case). We now consider a scenario in which g_{21m} continues to decline and show that under certain conditions, country 1's manufacturing employment share will be below its initial level, hence, generating a hump-shaped pattern.

Proposition 4. *In the manufacturing sector, if the ratio of multinational fixed costs to exporting fixed costs is sufficiently large relative to the elasticity of substitution between varieties, σ, then when g_{21m} is small enough so that country 2's exporting and multinational cutoffs coincide, and there are no exporting firms, country 1's manufacturing employment share will be less than when g_{21m} is prohibitively high, i.e., as g_{21m} declines from the prohibitively high value, country 1's manufacturing employment share follows a hump pattern.*

Proof. See Appendix C. □

As discussed above,there are two opposing forces that affect country 1's manufacturing employment share when g_{21m} declines, the MNC effect, which raises country 1's manufacturing employment, and the home market effect in country 2, which lowers country 1's manufacturing employment. The MNC effect in country 1 is stronger when the MP friction is higher, while the home market effect in country 2 becomes stronger when the MP friction is lower.[19] Therefore, we must start with a

[17] Simulation results are available upon request.

[18] In the Appendix, we also show that under the above conditions, the mass of domestic active firms decreases in country 1 and increases in country 2.

[19] As g_{21m} declines, less productive firms in country 2 start conducting MP in country 1. As g_{21m} continues to decline, the job creation effect from the MNC entry becomes weaker. Also, as g_{21m} declines, the mass of entering manufacturing firms in country 1 declines, which lowers the mass of producing firms and manufacturing employment. This effect becomes larger as g_{21m} becomes smaller.

sufficiently large g_{21m} and end with a sufficiently small g_{21m} in order to obtain the hump pattern. If the ratio of the MP fixed cost to the exporting fixed cost is not sufficiently large, country 2 enters the no-exporter outcome even while g_{21m} is still large. Then, country 1's manufacturing employment is still relatively high. Thus, we need a sufficiently large $\frac{f^M_{21m}}{f_{21m}}$ to obtain the hump pattern.[20]

We provide more intuition from national income accounting, which implies that total revenue of manufacturing firms located in country 1 is given by:

$$R_{1,m} = \beta_m L_1 + EX_{12m} - EX_{21m}$$

When g_{21m} is sufficiently low so that the MP cutoff and export cutoff for country 2 coincide, we have $EX_{21m} = 0$. Moreover, when g_{21m} is sufficiently small, the home market effect in country 2 is strong; hence, $EX_{12m} > 0$, it is small. As a result, $\frac{R_{1,m}}{L_1}$ is close to β_m, which is the manufacturing employment share when g_{21m} is prohibitively high. Moreover, when g_{21m} is sufficiently low, country 1's manufacturing employment share is lower than its manufacturing revenue share. This is because the profits of manufacturing MNC affiliates in country 1 are sent back to MNC parents in country 2 (i.e., not used to pay manufacturing workers in country 1). Therefore, the manufacturing employment share in country 1 when g_{21m} is sufficiently small is lower than when g_{21m} is prohibitively high. This result combined with Proposition 3 implies that the manufacturing employment share of country 1 eventually declines when g_{21m} is sufficiently low (and vice versa for country 2). To summarize, we have established that country 1's manufacturing employment share will follow a hump with respect to g_{21m}.[21]

We now provide a numerical exercise to illustrate this proposition.[22] Figure 1 presents the results. The upper panel of Figure 1 shows that as the MP manufacturing friction decreases, the manufacturing employment share of country 1 follows a hump-shaped pattern, i.e., a pattern consistent with structural change in manufacturing. As discussed above, when the manufacturing MP friction declines from a high level, the positive MNC effect dominates the home market effect and results in an overall increase in the manufacturing employment share of country 1. However, as the manufacturing MP friction continues to decline, eventually, the negative home market effect dominates the positive MNC effect.[23]

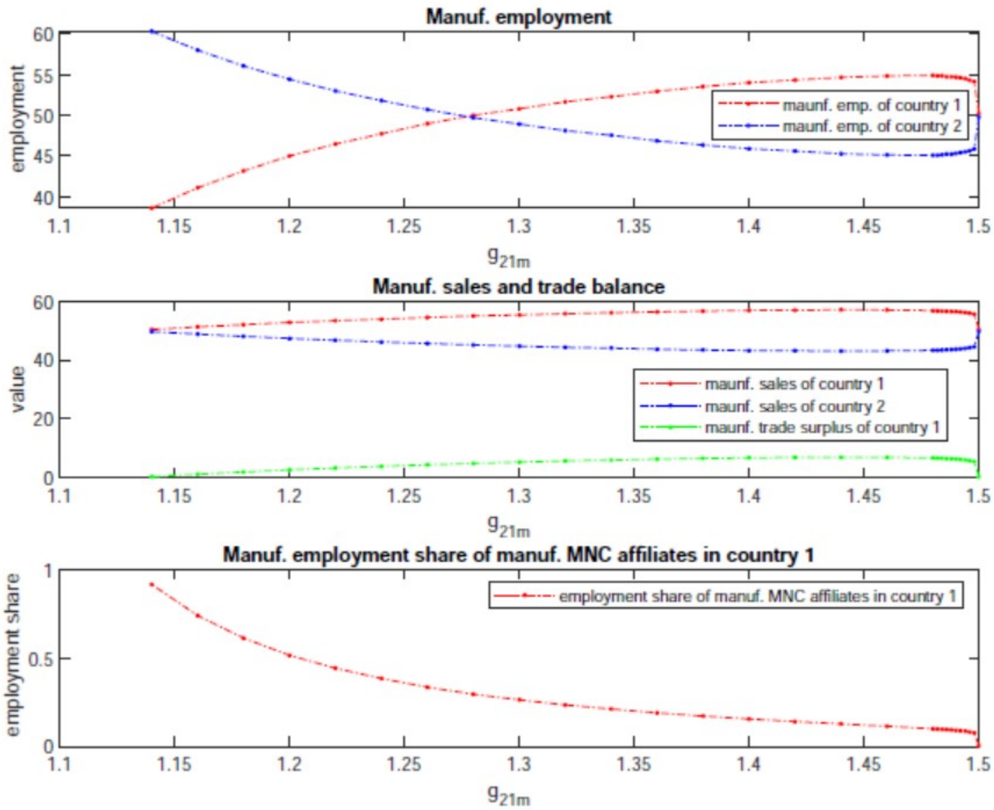
[20] A higher σ gives the most productive firms (MNCs) a greater advantage in the manufacturing sector; thus, the MNC entry effect is larger, which delays the onset of the decreasing part of the hump. As a result, we need a larger $\frac{f^M_{21m}}{f_{21m}}$, which facilitates a lower g_{21m} before the no-exporter outcome in country 2 occurs.

[21] In addition, as g_{21m} declines, country 1's real wage and per capita income decrease. This is a result of our assumption of the homogeneous good. But, there will be a hump with respect to per capita income, i.e., the typical way it is illustrated in the structural change literature.

[22] The parameter values for this simulation are $f_{11m} = f_{22m} = 1$, $f_{12m} = f_{21m} = 2$, $f^M_{12m} = \infty$, $f^M_{21m} = 4.6$, $f_{1mE} = f_{2mE} = 1.5$, $\tau_m = 1.5$, $\sigma = 4$, $k = 3.3$, $\beta_m = 0.5$ and $L_1 = L_2 = 100$.

[23] For country 2, the opposite happens and leads to an overall "U"-shaped pattern for the change of the manufacturing employment share.

Figure 1: Effect of Unilateral FDI Liberalization in Country 1 on Manufacturing Employment, Sales and Trade Balance



The green line in the middle panel of Figure 1 shows that country 1 runs a trade surplus in manufacturing throughout, even when manufacturing employment in country 1 falls below manufacturing employment in country 2. As a reminder, the (post-entry) operating profits from country 2's MNC affiliates in country 1 are shifted back to country 2. When the MP friction is sufficiently low, these operating profits are used to hire workers in country 2 (to pay for the fixed MP cost and the entry cost). Therefore, the overall payment to workers in the manufacturing sector of country 1 is less than the total sales of manufacturing goods made in country 1. This leads to both a trade surplus in the manufacturing sector of country 1 and a reduction of the manufacturing employment share in that country (compared to the no-MNC case). Finally, taken together, the bottom and top panels of Figure 1 shows that when the share of MNC affiliates in manufacturing sector employment is around 15 percent, the manufacturing employment share of country 1 peaks.

Our hump result is robust to the assumption that the fixed costs of manufacturing MP are with service workers. We can assume (1) both the entry cost and the fixed MP cost use service workers in the manufacturing sector or, (2) the entry cost and all fixed costs (domestic, exporting and MP) use manufacturing workers in the manufacturing sector, and we get the same hump result.

This section has established both firm-level and aggregate implications of our model. The main aggregate implication is that MP can deliver structural change – specifically, the hump-pattern in manufacturing – in the inward MP country. We also generate implications for firm-level structural change. In particular, we establish several testable propositions for the effects of an inward FDI liberalization on MNC affiliates and parents. In the next section, we provide identified evidence for most of Proposition 2. We show that following an inward FDI liberalization by country 1, incumbent MNC affiliates in country 1 expand, while surviving domestic firms in country 2 decrease in size. Moreover, we show that the manufacturing (and services) employment share within incumbent MNC parent firms of country 2 declines (and increases) following the unilateral FDI liberalization, respectively.

4 Employment Effects of FDI Liberalization: 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 empirical 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.

4.1 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 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.[24] 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

[24]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.

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 in December 2001, 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.[25] 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.[26]

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, both because of some uncertainty about the precise timing of China's accession to WTO (December 2001), and more importantly about when the FDI policy – part of China's commitments when joining the WTO– would be implemented.[27] Additionally, this policy change was arguably exogenous for Japanese MNCs that have manufacturing affiliates in China. The Chinese government might have made industry-specific FDI policies based on the productivity growth trends in each industry.[28] However, it is unlikely that the Chinese government takes into account the economic conditions of Japanese local affiliates and their parent industries in Japan when making the its own FDI policies. In short, while the FDI policy change might be endogenous for analyses based on Chinese firms, this is 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.

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

[26]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.

[27]Since 1986, the negotiations for China's WTO accession lasted 15 years. We check for anticipation effects by examining pretrends and find no evidence for them.

[28]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.

4.2 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.[29] 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 industry level in the Annual Survey of Industrial Firms (ASIF). 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. 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.[30]

4.3 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 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.[31] In the matched dataset, we identify parent firms that have had at least one

[29] 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.

[30] 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.

[31] 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.

manufacturing affiliate in China before 2007.[32] 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 60% 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
$log(sales)$	15,470	6.756	1.756	0	13.379
$treatment$	15,470	0.306	0.252	0	1
$post02$	15,470	0.729	0.445	0	1
		Panel B: Parent firm			
$log(empl.)$	14,175	6.365	1.317	3.912	11.300
$log(manuf.\ empl.)$	14,175	5.051	2.333	0	10.836
$manuf.\ share$	14,175	0.511	0.286	0	1
R&D empl. share	14,175	0.074	0.099	0	0.912
IB unit empl. share	14,175	0.009	0.021	0	0.749
$treatment$	14,175	0.292	0.237	0	1
$post02$	14,175	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 personnel 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 (English) company and province names of each Japanese manufacturing affiliate in China that appears in BSOBA into Chinese.[33] 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 treat-

[32]Many observations of BSOBA between 1998 and 2007 were established before 1998.
[33]ASIF data we have access to are in Chinese.

ment 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 $5,700$ 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	0.288	0.453	0	1
$post02$	5,991	0.722	0.448	0	1
		Panel B: Parent firm			
$log(empl.)$	5,687	6.518	1.323	3.932	11.300
$log(manuf.\ empl.)$	5,687	5.335	2.253	0	10.836
$manuf.\ share$	5,687	0.529	0.273	0	1
R&D empl. share	5,687	0.0833	0.107	0	0.912
IB unit empl. share	5,687	0.010	0.0230	0	0.749
$treatment$	5,687	0.279	0.447	0	1
$post02$	5,687	0.611	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 personnel in parent employment.

As 60% observations from BSOBA cannot be matched to ASIF, we also use the entire sample to implement our analysis as the robustness checks. When utilizing the entire 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 entire sample to implement analysis. Regression results based on the entire sample are reported in Appendix E.1 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). We choose the status of the first manufacturing affiliate as the baseline for defining treatment as these affiliates are often uniquely important to multinational firms (see also Garetto, Oldenski, and Ramondo (2021) for evidence that first affiliates are systematically different for multinationals around the world). In our data, they are 60% larger than other affiliates, on average. Additionally, since a substantial fraction of the first manufacturing affiliates entered China much earlier than 2002, using them to define the treatment also helps alleviate the potential concern that the FDI policy change in 2002 affected parent firms' entry decisions into China after 2002.[34] The affiliate is treated in affiliate-level regressions if it belongs to a treated industry.

4.4 Estimating Equations

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

$$y_{it} = \beta_0 + \beta_1 * treatment_i * post02_t + \delta_i + \delta_{rt} + \epsilon_{it}, \tag{4.1}$$

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 δ_{rt} 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.[35] $treatment_i$ 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).[36] 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:

$$y_{it} = \beta_0 + \beta_1 * treatment_i * post02_t + \delta_i + \delta_{rt} + \epsilon_{it}, \tag{4.2}$$

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 share of R&D personnel in parent's employment, and (5) employment share of the international business unit in parent' employment. δ_i and δ_{rt} 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 the FDI encouraged industries. Note that we always search for the

[34] For robustness we also consider an alternative definition of treatment based on whether the largest manufacturing affiliate (prior to 2002) is treated. The results (in Appendix E.2) are very similar. Results (in Appendix E.2) are also similar if we broaden the definition of treatment to include any affiliate (prior to 2002) being in a treated industry, however with this definition they are unsurprisingly noisier, as this can include firms being "treated" even if a small affiliate is the only affiliate in a treated industry.

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

[36] Note that the year defined in the Japanese datasets starts from April 1st of the current year to March 31st of the subsequent 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.

first manufacturing affiliate within a parent firm in the *entire sample*, irrespective of whether it is matched to ASIF. Thus, it is possible that the first manufacturing affiliate identified in the Japanese data is unmatched to the Chinese data. In such cases, the parent-year observations are automatically dropped from the parent-level regressions.[37] 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.

4.5 Regression Results

Table 3: China's FDI liberalization and Japanese affiliates

	(1)	(2)	(3)	(4)
	log(tot. empl.)		log(tot. sales)	
$treatment_i * post02_t$	0.186***	0.203**	0.141	0.172*
	(0.0685)	(0.0764)	(0.113)	(0.0959)
affiliate fixed effects	Yes	Yes	Yes	Yes
year fixed effects	Yes	No	Yes	No
city-year fixed effects	No	Yes	No	Yes
N	5717	5461	5777	5517
R^2	0.928	0.935	0.855	0.870

Regression results from estimating equation 4.1 on the matched sample with treatment defined at the 4-digit level. Standard errors are clustered at (affiliate) industry level and included in parentheses. * 0.10 ** 0.05 *** 0.01

Table 3 presents the regression results from estimating (4.1) 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 17% 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 (4.2). 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.[38] 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, al-

[37]We choose this approach as the truly first affiliate of a parent is often significantly larger or important in other ways to the parent's activities (see eg Garetto, Oldenski, and Ramondo (2021)). This is regardless of whether or not we are able to match that affiliate to the Chinese data. Choosing the oldest affiliate from the set of matched affiliates might lead to identifying small or otherwise less-important affiliates of the parent firm. However, we exhaustively assess the robustness of these results in Appendix E.2 and Appendix E.2. Note we apply the same rule when identifying the largest/any manufacturing affiliate in our robustness checks. Therefore, the sample sizes differ between different specifications when we use the matched sample.

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

though the estimates for log manufacturing employment are noisy. What is interesting is that the magnitudes of such reductions are substantial (a 11.1% reduction in manufacturing employment and a reduction of 2.8 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 (at two-digit level) 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.[39]

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 MNC-driven structural transformation coming from a decrease in MP frictions, as in our theory.[40]

We argue that this is not an issue for two reasons. First, our hypothesis is that MNCs are an important driver of structural transformation. What we need to illustrate this in the data is an exogenous shock that encourages FDI inflows. A simple extension of our theory would show that a decrease in trade barriers will also increase vertical MNC inflows, as the cost of shipping inputs back to Japan would decline. In that sense, even if China's trade and other reforms in 2002 were in the same set of industries, it would not affect the interpretation of our results in the context of the broader narrative in this paper.

Second, we illustrate that controlling for trade shares for the parent firms does not affect our results. Specifically, we include import/export shares (in total sales) at the parent firm level into our regressions.[41] 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.

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

[39] 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.

[40] 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. For instance, affiliates in treated industries might also be differentially affected by trade liberalizations in those industries in the same period, and so parent firms might increase FDI and see increased imports from China as a result.

[41] 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.

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.	
$treatment_i * post02_t$	-0.0840***	-0.0837***	-0.111	-0.115	-0.0282**	-0.0282**
	(0.0170)	(0.0173)	(0.103)	(0.102)	(0.0113)	(0.0113)
import share		0.00153		0.284		0.00307
		(0.0552)		(0.281)		(0.0527)
export share		0.0632		0.219		0.00639
		(0.0523)		(0.269)		(0.0346)
firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
prefecture-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
(parent) ind-yr fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	5326	5326	5326	5326	5326	5326
R^2	0.986	0.986	0.920	0.920	0.901	0.901

Regression results from estimating equation 4.2 on the matched sample with treatment defined at the 4-digit level. Standard errors are clustered at (affiliate) industry level and included in parentheses. * 0.10 ** 0.05 *** 0.01

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.[42] Results presented in Table 5 show that after China's FDI policy change the employment of $R\&D$ employees and of international business unit employees increases by about 1.26 and 0.29 percentage points respectively. As the average shares of these two types of employment are 8.3% and 1.0% respectively, these changes are quantitatively substantial.[43]

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 were 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:

$$y_{it} = \beta_0 + \sum_{t=1999,2000,....,2007} \beta_t * treatment_i * year_t + \delta_i + \delta_{rt} + \epsilon_{it}. \tag{4.3}$$

[42] Non-manufacturing employment at headquarters falls into several categories: business planning, IT, R&D, international business, human resources, finance, sales, catering and inventory. We use employment in R&D and in the international business unit to most accurately capture the notion of services employment in the theory.

[43] 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 access to lower cost inputs can increase a firm's scale (see e.g. (Boehm, Flaaen, and Pandalai-Nayar, 2019)). 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.

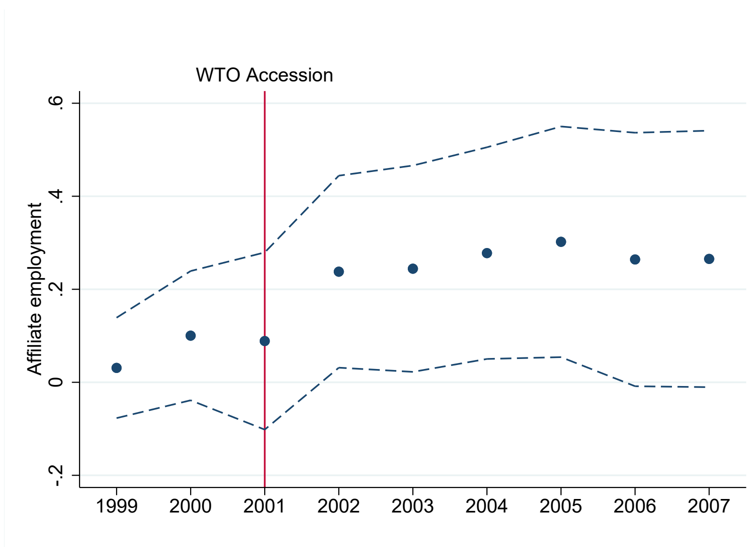
Table 5: China's FDI liberalization and domestic employment of Japanese MNCs' headquarters

	(1)	(2)	(3)	(4)
	share of R&D empl. at parent		share of IB empl. at parent	
$treatment_i * post02_t$	0.0127*	0.0126*	0.00277**	0.00294**
	(0.00657)	(0.00662)	(0.00111)	(0.00125)
import share		0.00406		-0.00897
		(0.0215)		(0.0111)
export share		-0.0165		0.00607
		(0.0139)		(0.00526)
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	5326	5326	5326	5326
R^2	0.872	0.872	0.499	0.500

Regression results from estimating equation 4.2 on the matched sample with treatment defined at the 4-digit level. Standard errors 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

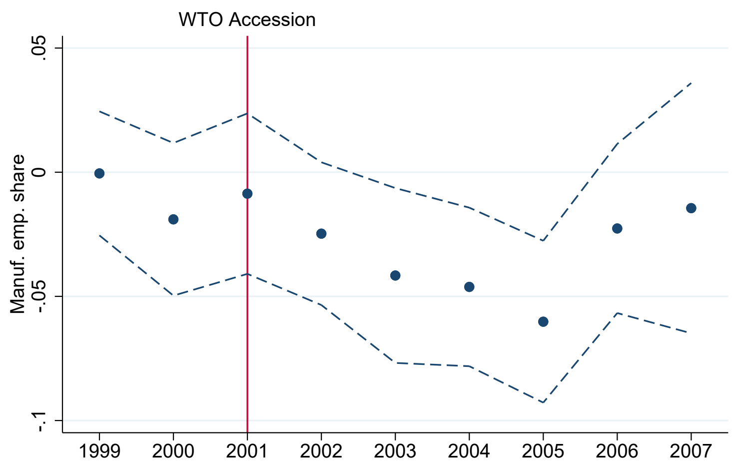
where $year_t$ a year dummy. We then plot the estimated coefficients of β_{1999}-β_{2007} for three key variables of our regressions: affiliate's log total employment, MNC parent firm's manufacturing employment share at home, and shares of $R\&D$ jobs at the MNC's parent firm. Figures 2-4 show that the parallel trends assumption holds well for the three key variables we are interested in, although some estimates after 2002 are noisy (due to small variations in the independent variables).[44]

Figure 2: Parallel trends assumption: total employment of affiliates



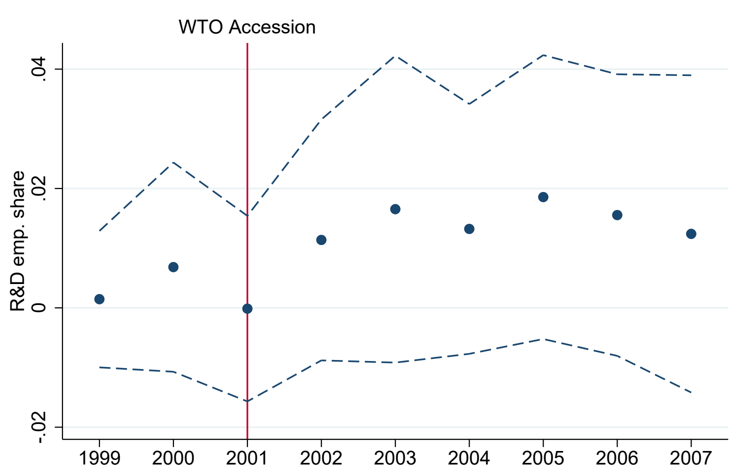
Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

Figure 3: 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 4: 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.

Although the above analysis shows that the parallel trends assumption is reasonable 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 accurately and thus entered into those (FDI) encouraged industries before 2002, we would have not found the 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 also implemented its 10th Five-Year Plan during 2001-2005, which specified certain industries that were 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 increase after 2002, which is consistent with our model's prediction at the extensive margin. However, the increases are very modest.[45]

5 Decomposition of the Change in Manufacturing Employment Share

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? And what is the quantitative

[44] Figures in Section E.3 show that the parallel trends assumption holds well for the three key variables we are interested in, when we use the entire sample and define the treatment at the three-digit industry level.

[45] One caveat here is that our sample does not include every manufacturing FDI entrant into China, as the response rate 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 first shows 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. Regardless, we might still not capture the full extent of entry in treated and control industries.

Table 6: Number of new manufacturing affiliates entering into China

Founding year	Non-encouraged industries	Encouraged industries	Total	Share of encouraged industries
pre-2002 mean	199	176.7	375.7	47.0%
post-2002 mean	296	281	577	48.7%

Time span: 1995-2007. 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 descending order) and categorize industries of the upper half as the encouraged industries (and the bottom half as the non-encouraged industries).

relevance of our findings in aggregate? Direct aggregation from the partial equilibrium estimated results is problematic, as it ignores GE forces such as entry in response to shocks. The estimated effect is also the average effect of treatment, and the data is not large enough to estimate heterogeneity in effects of treatment across firm sizes, for instance. Models to quantify the aggregate impact of these forces would also rapidly be intractable.

In this section, we therefore 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.

These types of decomposition exercises, presented initially in Foster, Haltiwanger, and Krizan (2006) and Melitz and Polanec (2015), have been extensively used in the literature on firm dynamics. Our application is to use it to study the role of multinationals in structural change.

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.[46] 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.

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

5.1 FHK Decomposition

The FHK decomposition method separates the aggregate change in manufacturing employment in five components indicated in the right-hand side of equation (5.1):

$$
\begin{aligned}
\Delta \frac{L_{m,t}}{L_t} = & \underbrace{\sum_{i \in C} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}}}_{\text{within effect}} + \underbrace{\sum_{i \in C} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it}}_{\text{between effect}} + \underbrace{\sum_{i \in C} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}}}_{\text{covariance}} \\
& + \underbrace{\sum_{i \in N} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right)}_{\text{entry}} - \underbrace{\sum_{i \in X} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right)}_{\text{exit}}
\end{aligned}
\tag{5.1}
$$

where $L_{m,t}$ and L_t denote aggregate manufacturing employment and aggregate total employment in period t; $L_{i,m,t}$ and $L_{i,t}$ denote firm i's manufacturing employment and firm i's total employment in period t, with $\frac{L_{i,m,t}}{L_{i,t}}$ representing the share of manufacturing in firm's i's total employment. Further, w_{it} represents firm i's employment share in period t aggregate total employment, $\frac{L_{it}}{L_t}$. Finally, $l_{m,t-1} = \frac{L_{m,t-1}}{L_{t-1}}$ is the aggregate manufacturing employment share at the beginning of the period. Subscripts C, N, and X denote continuing, new, and exiting firms.

The first three terms in the right-hand side of equation (5.1) 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 effects.

The final two terms of equation 5.1 capture entry and exit. The effect of entry is the weighted sum of the manufacturing employment share of all those firms that started operations in period t less the aggregate manufacturing employment share in the previous period, $t-1$. 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 same period. 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 those firms that exit the market. Notice that the decomposition below also captures the employment dynamics of "services" firms, which here are defined as firms with zero manufacturing employment.[47]

[47] 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 $\sum_{i \in C} (0 - l_{m,t-1}) \Delta w_{it}$, respectively.

While implementing equation (5.1) 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 that can be attributed to changes in the manufacturing employment of MNCs and non-MNCs.

5.1.1 FHK Decomposition with Multinationals and a Service Sector

We begin with the decomposition in equation (5.1) and then separate the firms into MNCs and non-MNCs groups:

$$
\begin{aligned}
\Delta \frac{L_{m,t}}{L_t} = & \underbrace{\sum_{i \in C_{MNC}} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C_{MNC}} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C_{MNC}} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}}}_{\text{MNC effect}} \\
& + \underbrace{\sum_{i \in N_{MNC}} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X_{MNC}} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right)}_{\text{MNC effect (cont.)}} \\
& + \underbrace{\sum_{i \in C_{Non-MNC}} w_{it-1} \Delta \frac{L_{i,m,t}}{L_{i,t}} + \sum_{i \in C_{Non-MNC}} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right) \Delta w_{it} + \sum_{i \in C_{Non-MNC}} \Delta w_{it} \Delta \frac{L_{i,m,t}}{L_{i,t}}}_{\text{Non-MNC effect}} \\
& + \underbrace{\sum_{i \in N_{Non-MNC}} w_{it} \left(\frac{L_{i,m,t}}{L_{i,t}} - l_{m,t-1} \right) - \sum_{i \in X_{Non-MNC}} w_{it-1} \left(\frac{L_{i,m,t-1}}{L_{i,t-1}} - l_{m,t-1} \right)}_{\text{Non-MNC effect (cont.)}} + \underbrace{l_{m,t-1}(w_{mt} - w_{mt-1})}_{\text{service effect}}
\end{aligned}
\tag{5.2}
$$

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 or more employees in a manufacturing sector, and is consider a service firm otherwise. As before, w_{it} captures firm i's employment share in aggregate total employment in period t.

While the terms capturing MNCs and non-MNCs are similar to those in equation (5.1) this decomposition differs from (5.1) 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 aggregate category. Conveniently, in the decomposition presented in equation (5.2) the net contribution of services firms to the observed changes in the share of

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	0.27	2013	0.31
Japan	1995	0.16	2016	0.16
France	1999	0.34	2016	0.35

Note: MNCs in China and Hungary correspond to affiliates of foreign parents operating in China and Hungary, respectively. MNCs in Japan, France and the U.S. correspond to domestic parent companies with operations across borders. In each case, Non-MNCs correspond to the remaining firms with some production in manufacturing.

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.[48]

China's decomposition: the Manufacturing Survey and the Census of Manufactures in China does not breakdown firm employment in their manufacturing and services components. Therefore, to implement the FHK decomposition exercise for China we modify equation (5.2) and assume that all jobs in firms classified as manufacturing firms are manufacturing jobs.[49]

Under this assumption there is no within-group change in the manufacturing employment share, since $\frac{L_{i,m,t}}{L_{i,t}} = \frac{L_{i,m,t-1}}{L_{i,t-1}} = 1$ and thus $\Delta \frac{L_{i,m,t}}{L_{i,t}} = 0$. Substituting in equation (5.2) the decomposition for China becomes:

$$\Delta \frac{L_{m,t}}{L_t} = \underbrace{(1 - l_{m,t-1}) \left(\sum_{i \in C_{non-MNC}} \Delta w_{it} + \sum_{i \in N_{non-MNC}} w_{it} - \sum_{i \in X_{non-MNC}} w_{it-1} \right)}_{\text{manuf Non-MNCs}}$$
$$+ \underbrace{(1 - l_{m,t-1}) \left(\sum_{i \in C_{MNC}} \Delta w_{it} + \sum_{i \in N_{MNC}} w_{it} - \sum_{i \in X_{MNC}} w_{it-1} \right)}_{\text{manuf MNCs}} + \underbrace{l_{m,t-1}(w_{mt} - w_{mt-1})}_{\text{services}}. \tag{5.3}$$

5.2 Data

We describe the five microdata sources used in the analysis in great detail in Appendix B. Table 7 below 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.

[48] Appendix A present the details of the derivation of the service term in equation 5.2.

[49] 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.

Notice that for the U.S., Japan and France, MNCs are defined as parent companies from these countries that also operate overseas; whereas for China and Hungary, MNCs correspond to affiliates of foreign parents operating in these countries.[50] We made this distinction in order to separate the relative importance and role of MNCs in economies with different levels of development. Large multinationals from the U.S., Japan and France have started and increased their level of operations in countries like China and Hungary after they have reduced their barriers to foreign investment in the last decades.[51]

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 stayed stable (Japan and France) or experienced only a small increase (the U.S.). 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.

5.3 Results

Table 8 presents the results of the decomposition in equation (5.2), and equation (5.3) 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. [52] For some countries in our sample, the analogous breakdown for non-MNCs and the service component (the remaining terms in the decomposition) are contained in Appendix B.

The table makes clear that multinational parents accounted for about a third of the decline in manufacturing employment in the US in the 2000's (and about one-fifth in the 1990's), and foreign affiliates in China account for the majority of the manufacturing employment 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.[53]

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

[50] For further details see Appendix B.

[51] Notice that for the U.S., Japan, and France, non-MNCs include domestic companies that only operate at home as well as foreign affiliates operating in these countries. For China and Hungry, non-MNCs include domestic companies that only operate at home, and domestic companies that also operate abroad.

[52] Notice that in panel A, the the MNC and Non-MNC components do not sum the Total (first column). This is because Total also includes the contribution of services to the observed change in manufacturing employment.

[53] 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.	-0.045	-0.009	-0.029	-0.009	-0.012	0.003	0.000
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.	-0.029	-0.010	-0.015	-0.010	-0.008	0.003	-0.005
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: MNCs in China and Hungary correspond to affiliates of foreign parents operating in these countries. MNCs in Japan, France and the U.S. correspond to domestic parent companies with operations at home and also across borders. In each case, Non-MNCs correspond to the remaining firms with some production in manufacturing. * and † correspond to France decomposition results for 2000's and 2010's decades, respectively. For the U.S. the 1990's and the 2000's corresponds to the period (2003-1993) and (2013-2003) respectively.

MNCs. The picture is different, when we focus on the 2000s. In France, while the net effect of MNCs 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 entering MNCs offset the negative effect of MNCs exiting the market, and continuing MNCs stop reducing the share of manufacturing employment.[54] 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.

Relationship to model and empirical estimates: We emphasize that the accounting decomposition presented in this sector is a first pass at understanding quantitatively the role of MNCs in changes in manufacturing employment in economies at different stages of their structural transformation process. The effects here are *not* all due to within-firm responses to decreases in MP costs, as shown in our theory and as captured by our estimates. These effects contain other forces at work during these periods, including potentially offsetting general equilibrium effects and responses to other shocks. As a result, they should be viewed as supportive evidence that MNCs are likely a quantitatively important component driving changes in manufacturing employment and facilitat-

[54] 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 are manufacturing goods, the exporting boom in the 2000s helps explain why continuing MNCs had stopped reducing manufacturing employment in 2000s.

ing structural change. In other words, the results from the decomposition exercise should not be interpreted as simply an aggregation of the empirical estimates following the China FDI-shock.

6 Conclusion

Our paper makes three contributions. Theoretically, we build a simple model to show that, following a decrease in inward MP frictions by one country, both firm-level and aggregate structural change can occur. Second, in our main contribution, we test the firm-level implications 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 plausibly 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 employment for the treated parent firms in Japan, and an increase in their services and R&D shares. These results demonstrate structural change at the firm-level both in the parent companies and in their foreign affiliates. In addition, because our results are consistent with our theoretical model, it suggests that changes in multinational activity are also facilitating structural change at the country-level.

Third, to provide a first pass at understanding how important the channel we identify 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 also suggest that the MNC channel for structural change is quantitatively important for those countries, and understanding the forces that generate changes in MNC employment are important for understanding structural change.

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, and others that lead to changes in MNC employment, for a larger set of countries, while outside the scope of this paper, would be useful in future research.

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ONLINE APPENDIX

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 of equation A.1. Then, we have:

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

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.

Thus far we have assumed 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

We use the Annual Survey of Industrial Firms (ASIF) complied by the National Bureau of Statistics (NBS) of China, a production firm-level dataset of Chinese manufacturing firms covering the period (1998-2013). All state-owned enterprises and "above-scale" non-state-owned enterprises (i.e., private firms) are included in the dataset.[55] This dataset is commonly used in the literature and uses a unique numerical identifiers to link firms over time. (Brandt, Van Biesebroeck, and Zhang (2012), and Yu (2015)).

Admittedly, the ASIF dataset is a survey, and as such, it does not cover the entire population of manufacturing firms in the economy and it is bias towards relatively large firms. However, Brandt, Van Biesebroeck, and Zhang (2012) showed that, in 2004, ASIF accounted for more than 80% of the total output and 60% of the total employment reported in the Chinese Census data that year. In addition, we repeat our decomposition exercise using China's manufacturing Census in 2004 and 2008, and show that it yields similar results as the one obtained from using the manufacturing survey for the period (1998-2013).

[55] The "above-scale" firms are defined as firms with annual sales above RMB 5 million before 2010 and above RMB 20 million thereafter.

The ASIF dataset reports firm's total employment, but does not provide information on the breakdown of total firm employment into manufacturing and services. As explained in section 5.1.1, we have modify our FHK decomposition to account for this feature of the data. The ASIF 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), and 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). We use the same definition as the official definition of FIEs in China to define foreign MNCs with operations in China. Table A1 reports the average employment of all firms in the economy as well as the average employment of foreign MNCs during our sample period. On average, 20% of our observations are foreign MNCs, and the average employment is higher for foreign MNCs than for domestic firms. Table A2 shows information on employment by all firms and by foreign MNCs for each year of the period (1998-2013). Two patterns arise from this table. First, the number of foreign affiliates in China had increased substantially during our sample period, while their share in the total number of firms had increased from 1998 to 2004, and flattened afterwards. Second, the average employment for foreign MNCs was lower than for the average firm in the economy 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
Employment by MNCs	800,961	385.1	1108.6	182
MNC status	4,042,217	0.20	0.40	0

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

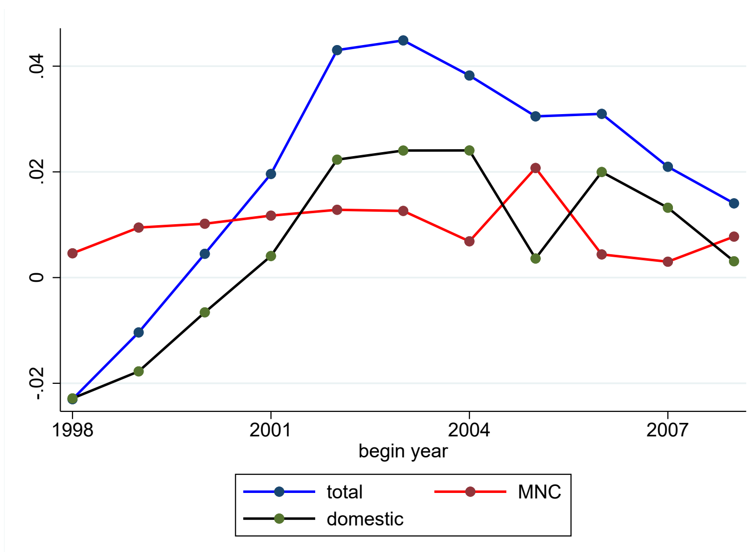
Table A2: Summary Statistics for Employment and Number of firms by year

	All firms			Foreign MNCs		
year	Mean	Median	Number of firms	Mean	Median	Number of firms
1998	341	133	148,683	294	148	26,045
1999	324	129	146,079	296	150	26,376
2000	311	125	147,207	301	150	27,950
2001	289	120	155,572	299	150	30,860
2002	277	116	165,668	306	150	33,889
2003	270	113	180,940	327	153	37,997
2004	221	93	256,201	308	143	56,209
2005	238	100	247,798	339	152	55,009
2006	228	95	278,346	349	153	59,807
2007	219	90	311,981	350	153	66,264
2008	193	80	385,594	333	140	74,809
2009	190	79	404,314	326	135	74,344
2010	356	123	321,604	518	220	75,434
2011	326	194	265,098	504	265	50,320
2012	320	200	289,879	499	269	52,652
2013	417	325	321,165	616	401	52,996

Since ASIF has no information on the breakdown of firm's employment into manufacturing and service jobs, we use equation (5.3) to implement the decomposition exercise. For this We obtain information on overall employment and manufacturing employment share from the China's Bureau of Statistics (i.e., China Statistical Yearbook). Based on these aggregate statistics, we calculate the total change in the share of manufacturing employment and employment shift from other sectors into manufacturing. We utilize observations of MNC affiliates in ASIF and the aggregate statistics from the Yearbook to calculate the three terms in the decomposition that are related to MNCs, as well as the last term in equation (5.3). We then calculate the the three terms related to Non-MNCs firms in equation (5.3) by subtracting the MNC terms and the service 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 substantially to the manufacturing employment share increase in China for the period 1998-2013.[56] Figure A2 decompose the overall contribution by MNC affiliates into contributions by entering, continuing and exiting MNC affiliates for each 5-year interval. It is apparent that the driving force of the MNCs contribution to manufacturing employment is lead by MNC affiliates entering the market during the period of 1998-2013.

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

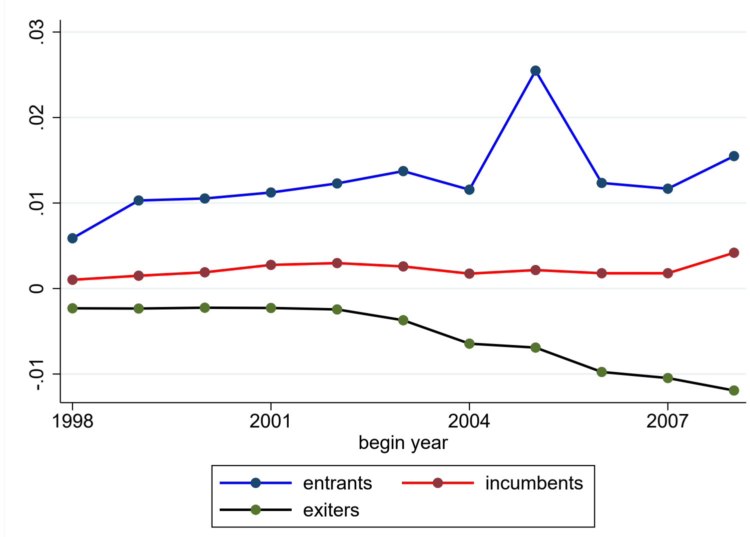


Note: The change in the manufacturing employment share is decomposed between foreign MNCs and domestic firms. The difference between the total change and the sum of the contributions made by domestic firms and MNC foreign affiliates is the employment shift from other sectors to the manufacturing sector.

Finally, we repeat the decomposition exercise, but this time using the Census data in 2004 and 2008 instead of teh Survey data. The result show that MNC affiliates contributed by

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

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



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

0.61%, of the 2.42% overall change experience by the manufacturing employment during this period.

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.[57] We restrict our sample to manufacturing firm which account for roughly 45% of all observations. In the survey, firms also report the number of its domestic and foreign affiliate(s) in manufacturing and non-manufacturing sectors. Based on this information, we can identify whether the firm is a MNC parent with manufacturing affiliate(s) abroad. Finally, BSJBSA report employment on 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 also for the period (1995-2016). This survey contains information about overseas subsidiaries of Japanese MNCs and covers two types of overseas subsidiaries: (1) direct subsidiaries with ratios of investment by Japanese enterprises' being 10% or higher by end of the year, and (2) second-generation subsidiaries with a ratio of investment by Japanese subsidiaries of 50% or higher. Tracing the identification codes over time, we are able to construct a panel of

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

affiliates and parent firms from 1995 to 2016. The matched dataset contains on average 2,300 parent firms and 15,000 foreign 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 reports, the MNCs status of the firm, the average employment of all firms, as well as the average employment of MNC parents during our sample period. On average, there are 13,000 manufacturing firms in BSJBSA each year, 11% of which are MNCs. The mean and the median employment of MNCs is about 2.5-3 times higher than for non-MNCs. Since there is information on the breakdown of total employment into manufacturing and services jobs in BSJBSA, we use equation (5.2) 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 into the manufacturing sector.

Table A3: Summary Statistics of Japanese Manufacturing Firms

	Obs.	Mean	Std. dev.	Median
Employment	288,977	399.5	1646.7	140
Employment by MNCs	32,025	1572.6	4530.0	435
MNC status	288,979	.11	.31	0

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

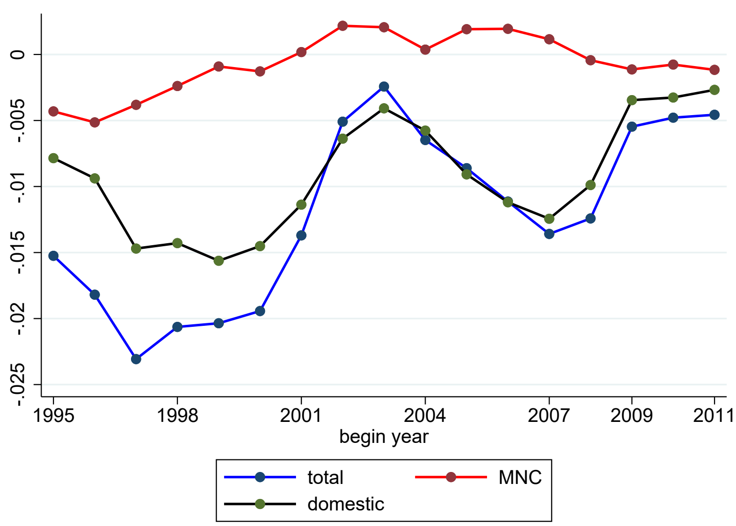
Figure A3 presents the decomposition result for each 5-year interval starting from 1995 and ending in 2011. Overall, it is clear that MNC parent firms had contributed substantially to the overall decline of manufacturing employment share in Japan during the first half of our sample period (i.e., 1995-2005). However, the contribution of MNC 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 the continuing MNC parent firms are the ones driving these results. Specifically, continuing MNCs parents have 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, a 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 is a panel dataset that allows to track the evolution of firms over time.

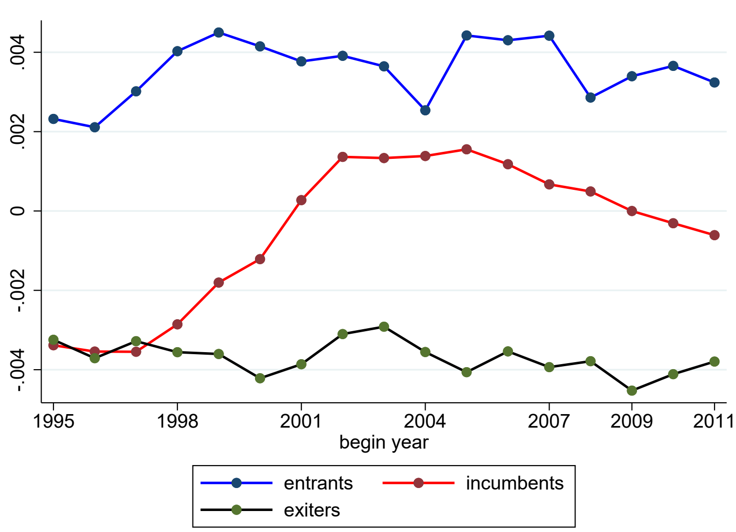
The database reports information on firms' value added, sales, output, stock of capital, employment, wages and materials. Additionally, the dataset reports a firm's ownership status, which we use to construct a variable for multinational firms. Following the standard literature, we define a firm as foreign MNC if more than 10% of their shares belong to foreign owners. Firm size varies significantly in the database, spanning from single-employee

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



Note: the figure shows the decomposition of the change in the manufacturing employment MNCs and domestic firms starting from 1995. The difference between 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 A4: Contributions by Multinational Parent Firms in Japan (5-year window)



Note: the figure depicts the contributions of entering, continuing and exiting MNC parent firms for each 5-year interval. The sum of these three components equals the overall contribution by MNC parents.

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 three employees or more 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 when compared to EU-KLEMS data.

Table A4 presents the 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 at the end of the year to construct 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*. This data provide information regarding the firm's sector of operation (NAF classification) and total employment.[58]

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

[58] 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 belonging to the EPs.

including the country of origin and the relation concerning the head of the group.[59] 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.

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.[60] 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 parent MNC. For example, Peugeot HQ is located in France but has some affiliates outside the French territory. Then we classify Pegeout as a parent 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. In the analysis we consider a MNCs a parent company HQ in France with cross-border operations.

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), the Linked/Longitudinal Firm Trade Transaction Database (LFTTD), and the Orbis dataset linked to the U.S. Census.

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

[59]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. 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.

[60]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.

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.

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.[61]

To classify firms as MNCs and Non-MNCs we rely on ORBIS, a worldwide dataset maintained by Bureau van Dijk. The main advantage of ORBIS is the scope and accuracy of its ownership information: it details the full list of direct and indirect subsidiaries and shareholders of each company in the dataset, along with a company's global ultimate owner and other companies in the same corporate family. This information allows us to build ownership links between affiliates of the same MNE, which identifies the nationality of the parent company, as well as the location of its network of foreign affiliates. ORBIS allow us to distinguish US parent companies in the U.S. from affiliates of foreign parents operating in the U.S. (which is not possible by using the related party trade indicator from the LFTTD Census data). In our analysis of U.S we define a MNCs as a parent company in the U.S. that also have operations overseas.

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

Appendix C Proofs of Propositions, and other Derivations, in Section 3

Proposition 1 *When country 1 reduces its inward MP friction in the manufacturing sector g_{21m}, country 1's survival cutoff in the manufacturing sector decreases, while country 2's survival cutoff in the manufacturing sector increases. In addition, the exporting cutoff from country 1 to country 2 increases, while the exporting cutoff from country 2 to country 1 decreases. Third, the MNC cutoff from country 2 to country 1 decreases. Finally, the cutoffs in the service sector are unchanged in both countries.*

Proof. First, we analyze the slopes of the two curves represented by equations (2.19) and (2.20), when they intersect. For equation (2.19), 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 (2.20), we have

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

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

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

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

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

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

which equals

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

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 (2.19) has a smaller slope than the one

represented by equation (2.20) in absolute value.
Next, note that a reduction in g_{21m} does not move the curve represented by equation (2.19). To the contrary, a reduction in g_{21m} shifts the curve represented by equation (2.20) to the right. That is, form a given z^*_{11m}, z^*_{22m} implied by equation (2.20) increases when $g_{21m} = g_{31m}$ go down. Therefore, we must have the following result after country 1 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 1 reduces its inward MP friction in the manufacturing sector g_{21m}, each incumbent (manufacturing) MNC affiliate in country 1 expands its employment. Each surviving domestic plant that is a part of an MNC in country 2 reduces its employment. Hence, the share of manufacturing (services) employment at the MNC parent decreases (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[62]

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

In other words, market competition becomes less tough in the manufacturing sector of country 1, while it becomes tougher in the manufacturing sector of country 2 (due to more entries). Since the MNC cutoff from country 2 to country 1 declines, more (new) MNCs from country 2 start doing MP in country 1. As P_{m1} goes up and g_{21m} goes down, employment, revenue and profits of incumbent MNC affiliates in country 1 increase. As P_{m2} goes down, both surviving domestic firms and surviving domestic plants that are parts of MNCs in country 2 decrease in terms of sales and the number of (manufacturing) workers used in the variable cost and the fixed production cost. Because the fixed MP cost (f^M_{21m}) which consists of services jobs is unchanged in the manufacturing sector, the share of manufacturing (services) employment drops (and increases) in MNC parent firms in country 2.
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. □

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

We now show how to solve 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 is given by:

$$P_{im} = \left(\frac{\beta_m L}{\sigma f_{iim}}\right)^{\frac{1}{1-\sigma}} \frac{1}{\rho z_{iim}^{*}} \tag{C.2}$$

As firms from country 1 cannot implement MP in country 2, the ideal price index of the manufacturing sector in country 2 can be expressed as

$$(\rho z_{22m}^{*} P_{2m})^{1-\sigma} = \left[M_{1m}^{e} \int_{z_{12m}^{*}}^{\infty} \left(\frac{z}{z_{22m}^{*}\tau_m}\right)^{\sigma-1} dG(z) + M_{2m}^{e} \int_{z_{22m}^{*}}^{\infty} \left(\frac{z}{z_{22m}^{*}}\right)^{\sigma-1} dG(z)\right]. \tag{C.3}$$

The ideal price index of the manufacturing sector in country 1 is more complicated and can be expressed as

$$(\rho z_{11m}^{*} P_{1m})^{1-\sigma} = M_{1m}^{e} \int_{z_{11m}^{*}}^{\infty} \left(\frac{z}{z_{11m}^{*}}\right)^{\sigma-1} dG(z) +$$
$$M_{2m}^{e} \left(\int_{z_{21m}^{*}}^{z_{21m}^{*M}} \left(\frac{z}{z_{11m}^{*}\tau_m}\right)^{\sigma-1} dG(z) + \int_{z_{21m}^{*M}}^{\infty} \left(\frac{z}{g_{21m} z_{11m}^{*}}\right)^{\sigma-1} dG(z)\right) \tag{C.4}$$

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

$$(\rho z_{iis}^{*} P_{is})^{1-\sigma} = \frac{\beta_s L_i}{\sigma f_{iis}} = M_{js}^{e} \int_{z_{jis}^{*}}^{\infty} \left(\frac{z}{z_{iis}^{*}\tau_s}\right)^{\sigma-1} dG(z) + M_{is}^{e} \int_{z_{iis}^{*}}^{\infty} \left(\frac{z}{z_{iis}^{*}}\right)^{\sigma-1} dG(z), \tag{C.5}$$

where $i \in \{1, 2\}$ and $j \neq i$. With the above equations, we can now prove the following: *When country 1 reduces its inward MP friction in the manufacturing sector, g_{21m}, the mass of manufacturing entrants in country 1 decreases, while the mass of manufacturing entrants in country 2 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_{1m}^{e} and M_{2m}^{e}. The slope of two curves are

$$\left|\frac{dM_{1m}^{e}}{dM_{2m}^{e}}\right|_{country\ 2} = \frac{\tau_m^{\sigma-1}\int_{z_{22m}^{*}}^{\infty} z^{\sigma-1} dG(z)}{\int_{z_{12m}^{*}}^{\infty} z^{\sigma-1} dG(z)}$$

and

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

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

$$\left|\frac{dM_{1m}^e}{dM_{2m}^e}\right|_{country\ 2} > \tau_m^{\sigma-1} > 1 > \left|\frac{dM_{1m}^e}{dM_{2m}^e}\right|_{country\ 1},$$

when the two downward sloping lines intersect. Therefore, the slope of the line implied by equation (C.4) is smaller than the slope of the line implied by equation (C.3) in absolute term. Note that when g_{21m} goes down, z_{11m}^* goes down. As a result, the line implied by equation (C.4) moves inward. To the contrary, the line implied by equation (C.3) moves outward as z_{22m}^* goes up. Therefore, the mass of entrants in the manufacturing sector of country 1 must decrease, while the mass of entrants in the manufacturing sector of country 2 must increase. Finally, as the cutoffs and the trade costs are unchanged when country 1 reduces its inward MP friction in the manufacturing sector, the mass of entrants in the service sector is unchanged in both countries. □

Derivations Leading to Proposition 3 Under the Pareto productivity distribution assumption, the free entry conditions can be simplified to:

$$\frac{(\sigma-1) f_{11m}}{k-(\sigma-1)} (z_{11m}^*)^{-k} + \frac{(\sigma-1) f_{12m}}{k-(\sigma-1)} (A_{12} z_{22m}^*)^{-k} = f_{1mE}, \tag{C.6}$$

and

$$\frac{(\sigma-1) f_{22m} (z_{22m}^*)^{-k}}{k-(\sigma-1)} + \frac{k f_{21m} (A_{21} z_{11m}^*)^{-k}}{k-(\sigma-1)} \left[1 - (B_{21})^{-k+(\sigma-1)}\right] - f_{21m} (A_{21} z_{11m}^*)^{-k} \left[1 - (B_{21})^{-k}\right]$$
$$+ f_{21m} (A_{21} B_{21} z_{11m}^*)^{-k} \left[\frac{k \left(\frac{\tau_m B_{21}}{g_{21m}}\right)^{\sigma-1}}{k-(\sigma-1)} - \frac{f_{21m}^M}{f_{21m}}\right] = f_{2mE}, \tag{C.7}$$

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

$$\frac{\beta_m L}{\sigma f_{22m}} = \left[M_{2m}^e \frac{k (z_{22m}^*)^{-k}}{k-(\sigma-1)} + M_{1m}^e \frac{k (z_{12m}^*)^{-k}}{k-(\sigma-1)} \left(\frac{A_{12}}{\tau_m}\right)^{\sigma-1}\right], \tag{C.8}$$

and

$$\frac{\beta_m L}{\sigma f_{11m}} = \left[M_{1m}^e \frac{k(z_{11m}^*)^{-k}}{k-(\sigma-1)} + M_{2m}^e \frac{k\left(z_{21m}^*\right)^{-k}}{[k-(\sigma-1)]} \left(B_{21}^{-k} (A_{21}B_{21})^{\sigma-1} \left(\frac{1}{g_{21m}^{\sigma-1}} - \frac{1}{\tau_m^{\sigma-1}} \right) + \frac{A_{21}^{\sigma-1}}{\tau_m^{\sigma-1}} \right) \right]. \tag{C.9}$$

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

$$L_{1m} = M_{1m}^e \left[\frac{\sigma f_{11m} k(z_{11m}^*)^{-k}}{k-(\sigma-1)} + \frac{\sigma f_{12m} k(z_{12m}^*)^{-k}}{k-(\sigma-1)} \right] + M_{2m}^e \frac{(\sigma-1) f_{21m} k \left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} \left(z_{21m}^{*M}\right)^{-k}}{k-(\sigma-1)} B_{21}^{\sigma-1}, \tag{C.10}$$

and

$$L_{2m} = M_{2m}^e \left[\frac{\sigma f_{22m} k(z_{22m}^*)^{-k}}{k-(\sigma-1)} + \frac{\sigma f_{21m} k(z_{21m}^*)^{-k}}{k-(\sigma-1)} \left[1 - (B_{21})^{-k+(\sigma-1)}\right] \right] + M_{2m}^e \frac{f_{21m} k \left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} \left(z_{21m}^{*M}\right)^{-k}}{k-(\sigma-1)} B_{21}^{\sigma-1}. \tag{C.11}$$

We also assume the two countries are initially symmetric (in terms of production technologies, preferences and all trade/MP costs) before the unilateral FDI liberalization. This implies that the initial MP friction from country 2 to country 1 is prohibitively high. Our goal is to investigate how a small change in the MP friction (from country 2 to country 1) 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 (C.6) and (C.7) imply that:

$$-frac_{dom} \frac{dz_{11m}^*}{z_{11m}^*} - (1 - frac_{dom}) \frac{dz_{22m}^*}{z_{22m}^*} = 0, \tag{C.12}$$

and

$$-frac_{dom} \frac{dz_{22m}^*}{z_{22m}^*} - (1 - frac_{dom}) \left[\frac{dz_{11m}^*}{z_{11m}^*} \left[1 - \left(1 - \left(\frac{\tau_m}{g_{21m}} \right)^{\sigma-1} \right) B_{21}^{-k+(\sigma-1)} \right] + \frac{dg_{21m}}{g_{21m}} \left(\frac{\tau_m}{g_{21m}} \right)^{\sigma-1} B_{21}^{-k+(\sigma-1)} \right] = 0, \tag{C.13}$$

where:

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

under the assumption that the two countries are symmetric initially. As B_{21} goes 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:

$$-frac_{dom} \frac{dz_{22m}^*}{z_{22m}^*} - (1 - frac_{dom}) \left(\frac{dz_{11m}^*}{z_{11m}^*} + \frac{dg_{21m}}{g_{21m}} B_{21}^{-k+(\sigma-1)} \right) = 0. \tag{C.14}$$

As a result, we have:

$$\frac{dz^*_{22m}}{z^*_{22m}} = -\frac{frac_{dom}(1-frac_{dom})\frac{dg_{21m}}{g_{21m}}B_{21}^{-k+(\sigma-1)}}{frac_{dom}^2-(1-frac_{dom})^2} > 0, \tag{C.15}$$

and

$$\frac{dz^*_{11m}}{z^*_{11m}} = \frac{(1-frac_{dom})^2\frac{dg_{21m}}{g_{21m}}B_{21}^{-k+(\sigma-1)}}{frac_{dom}^2-(1-frac_{dom})^2} < 0. \tag{C.16}$$

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 (C.8) implies that:

$$frac_{price}\left(\frac{dM^e_{2m}}{M^e_{2m}} - k\frac{dz^*_{22m}}{z^*_{22m}}\right) + (1-frac_{price})\left(\frac{dM^e_{1m}}{M^e_{1m}} - k\frac{dz^*_{11m}}{z^*_{11m}}\right) = 0, \tag{C.17}$$

where:

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

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 (C.9) leads to:

$$frac_{price}\left(\frac{dM^e_{1m}}{M^e_{1m}} - k\frac{dz^*_{11m}}{z^*_{11m}}\right) + (1-frac_{price})\left[\left(\frac{dM^e_{2m}}{M^e_{2m}} - k\frac{dz^*_{22m}}{z^*_{22m}}\right) - \tau_m^{\sigma-1}g_{21m}^{1-\sigma}(\sigma-1)B_{21}^{-k+(\sigma-1)}\frac{dg_{21m}}{g_{21m}}\right] = 0, \tag{C.18}$$

which can be simplified to:

$$frac_{price}\left(\frac{dM^e_{1m}}{M^e_{1m}}\right) + (1-frac_{price})\left[\left(\frac{dM^e_{2m}}{M^e_{2m}}\right) - \tau_m^{\sigma-1}g_{21m}^{1-\sigma}(\sigma-1)B_{21}^{-k+(\sigma-1)}\frac{dg_{21m}}{g_{21m}}\right] = 0, \tag{C.19}$$

thanks to equation (C.12). Similarly, we can rewrite equation (C.17) as:

$$frac_{price}\left(\frac{dM^e_{2m}}{M^e_{2m}}\right) + (1-frac_{price})\left[\left(\frac{dM^e_{1m}}{M^e_{1m}}\right) + kB_{21}^{-k+(\sigma-1)}\frac{dg_{21m}}{g_{21m}}\right] = 0, \tag{C.20}$$

thanks to equation (C.14). In total, we can solve for the percentage change in the mass of entrants as:

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

and

$$\frac{dM^e_{2m}}{M^e_{2m}} = -(1-frac_{pirce})B_{21}^{-k+(\sigma-1)}\left[\frac{(\sigma-1)\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}(1-frac_{price})+kfrac_{price}}{frac^2_{price}-(1-frac_{pirce})^2}\right]\frac{dg_{21m}}{g_{21m}} > 0, \tag{C.22}$$

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 only need to know 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 1 to achieve this goal. Under the two above simplifying assumptions, labor demand in country 1 is:

$$\frac{k-(\sigma-1)}{k\sigma}L_{1m} = M^e_{1m}\left(f_{11m}(z^*_{11m})^{-k}+f_{12m}(z^*_{12m})^{-k}\right)+M^e_{2m}\frac{\sigma-1}{\sigma}f_{21m}\left(z^{*M}_{21m}\right)^{-k}B_{21}^{\sigma-1}. \tag{C.23}$$

Recall that:

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

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

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

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

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 (C.23) 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:

$$\frac{dL_{1m}}{L_{1m}}\approx C\left[\frac{\left[(\sigma-1)frac^2+(1-frac)(k+(\sigma-1)frac)\right]}{1+(1-frac)\frac{\sigma-1}{\sigma}B_{21}^{-k+(\sigma-1)}}-\frac{\left[(1-frac)\frac{\sigma-1}{\sigma}B_{21}^{-k+(\sigma-1)}\right][k-(\sigma-1)]\left(\frac{B_{21}^{\sigma}}{\frac{f_{21m}^M}{f_{21m}}-1}\right)}{1+(1-frac)\frac{\sigma-1}{\sigma}B_{21}^{-k+(\sigma-1)}}\right]\frac{dg_{21m}}{g_{21m}}\qquad\text{(C.24)}$$

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

$$\frac{dL_{1m}}{L_{1m}}>0,$$

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

Proposition 3 *Suppose country 1 reduces its inward MP friction in the manufacturing sector g_{21m} by a sufficiently small amount from τ_m (i.e., a prohibitively high level). Then, a necessary and sufficient condition for the results below is that the slope parameter of the*

Pareto distribution $k < 2\sigma - 1$: 1) Manufacturing employment of country 1 increases, while it decreases in country 2. 2) Trade is balanced in the service sector between the two countries both before and after the unilateral FDI liberalization. 3) Services employment of country 2 increases after the unilateral FDI liberalization in country 1. 4) country 1 exports manufacturing goods (on net) and imports the homogeneous good, while country 2 imports manufacturing goods (on net) and exports the homogeneous good.

Proof. Equation (C.24) shows that when B_{21} is extremely big (and also relative to other terms in the equation),

$$\frac{dL_{1m}}{L_{1m}} > 0.$$

Thus, the manufacturing employment share increases in country 1. 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 2 (and the total wage payment to them), $L_{2m} = \beta(L_1 + L_2) - L_{1m}$ decreases. Furthermore, as the number of manufacturing entrants in country 2 and the MNC cutoff for country 2 increases and decreases respectively, $L_{2m}^m = L_{2m} - M_{2m}^e \left[1 - G(z_{21m}^{*M})\right]$ declines even more than L_{2m}. In total, manufacturing employment share declines in country 2. This completes the proof for the first part.
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 (3.5) are unchanged in both countries. Moreover, as all the parameters used in equation (3.5) are the same between the two countries, trade is always balanced in the service sector. The service employment share of country 1 is unchanged after the unilateral FDI liberalization as $L_{1m}^s = L_{1s}$. However, the service employment share of country 2 increases after the unilateral FDI liberalization as

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

where L_{2s} is unchanged while M_{2m}^e and $G(z_{21m}^{*M}$ increases and declines respectively. This completes the proof for the second and third parts.
Third, we discuss trade patterns in the manufacturing sector and in the service sector. Note that there is a *difference* between the net exports of manufacturing goods from country 1 to country 2 and the change in manufacturing employment starting from the world without MP, as a fraction of country 2's MNC affiliates' sales in country 1 is repatriated to country 2 (as the payment of fixed MP cost and the profits). Specifically, the total sales of manufacturing goods made by country 1 equals

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

which differs from the payment to manufacturing workers in country 1 (i.e., equation (C.10)) only in the last term. Therefore, Log linearization (up to the first order) of $sales_1$ around

$g_{21m} \approx \tau_m$ leads to

$$\frac{dsales_1}{sales_1} \approx C \left[\frac{\left[(\sigma-1)frac^2 + (1-frac)(k+(\sigma-1)frac)\right]}{1+(1-frac)B_{21}^{-k+(\sigma-1)}} - \frac{\left[(1-frac)B_{21}^{-k+(\sigma-1)}\right][k-(\sigma-1)]\left(\frac{B_{21}^{\sigma}}{\frac{f_{21m}^M}{f_{21m}}-1}\right)}{1+(1-frac)B_{21}^{-k+(\sigma-1)}} \right] \frac{dg_{21m}}{g_{21m}}. \tag{C.25}$$

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

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

when $k < 2\sigma - 1$. Therefore, country 1 exports manufacturing goods (on net) and imports the homogeneous good. This completes the proof for the last part of the proposition.
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 country 1 exports manufacturing goods (on net) and imports the homogeneous good must imply that country 2 imports manufacturing goods (on net) and exports the homogeneous good. This completes the proof.

□

We now show that, following a reduction in country 1's inward MP friction for manufacturing, g_{21m}, the mass of domestic active manufacturing firms decreases (increases) in country 1 (2).

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

$$\frac{dM_{im}^{active}}{M_{im}^{active}} = \frac{dM_{im}^{e}}{M_{im}^{e}} - k\frac{z_{iim}^{*}}{z_{iim}^{*}}. \tag{C.26}$$

Recall that

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

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

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

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

Therefore, equation (C.26) implies

$$\frac{dM_{1m}^{active}}{M_{1m}^{active}} = (1 - frac_{pirce})B_{21}^{-k+(\sigma-1)} \left[\frac{(\sigma - 1)frac_{price}}{frac_{price}^2 - (1 - frac_{pirce})^2} \right] \frac{dg_{21m}}{g_{21m}} < 0, \qquad \text{(C.27)}$$

and

$$\frac{dM_{2m}^{active}}{M_{2m}^{active}} = -(1 - frac_{pirce})B_{21}^{-k+(\sigma-1)} \left[\frac{(\sigma - 1)(1 - frac_{price})}{frac_{price}^2 - (1 - frac_{pirce})^2} \right] \frac{dg_{21m}}{g_{21m}} > 0. \qquad \text{(C.28)}$$

□

Proposition 4 *If the ratio of multinational fixed costs to exporting fixed costs is sufficiently large relative to the elasticity of substitution between varieties, σ, then for a small enough g_{21m}, country 1's manufacturing employment share will be less than its value when g_{21m} is prohibitively high, i.e., as g_{21m} declines from the prohibitively high value, country 1's manufacturing employment share will follow a hump pattern.*

Under a Pareto distribution of productivities, equation (3.1) can be written as:

$$EX_{12m} \equiv M_{1m}^e \sigma f_{12m} \frac{k z_{12m}^{*-k}}{k - (\sigma - 1)} = M_{1m}^e \sigma f_{12m} \frac{k \left(A_{12} z_{22m}^*\right)^{-k}}{k - (\sigma - 1)}. \qquad \text{(C.29)}$$

The last term of equation (3.4) – operating profits of country 2's MNCs – can be written as:

$$Profits_{mnc} \equiv M_{2m}^e f_{21m} \left(\frac{\tau_m}{g_{21m}} \right)^{\sigma-1} \frac{k z_{21m}^{*-k}}{k - (\sigma - 1)}, \qquad \text{(C.30)}$$

because $z_{21m}^{*M} = z_{21m}^*$.

First, we show that when $\frac{f_{12m}^M}{f_{12m}} > \sigma$, it must be the case that

$$Profits_{mnc} > EX_{12m}.$$

The key point to note is that when the exporting and the MNC cutoffs are equalized in country 2, we must have

$$B_{21} \equiv \left[\frac{\frac{f_{21m}^M}{f_{21m}} - 1}{\left(\frac{\tau_m}{g_{21m}} \right)^{\sigma-1} - 1} \right]^{\frac{1}{\sigma-1}} = 1,$$

which implies that

$$\frac{f_{21m}^M}{f_{21m}} = \left(\frac{\tau_m}{g_{21m}} \right)^{\sigma-1}.$$

Therefore, we can rewrite equation (C.30) as

$$Profits_{mnc} \equiv M^e_{2m} f_{21m} \frac{f^M_{21m}}{f_{21m}} \frac{k z^{*-k}_{21m}}{k-(\sigma-1)} = M^e_{2m} f_{21m} \frac{f^M_{21m}}{f_{21m}} \frac{k \left(A_{21} z^*_{11m}\right)^{-k}}{k-(\sigma-1)}. \tag{C.31}$$

Note that $A_{12} = A_{21}$ and $f_{12m} = f_{21m}$ owing to the symmetric setup. Next, we calculate the ratio of $\frac{z^*_{22m}}{z^*_{11m}}$ when there is no exporting from country 2 to country 1 (which is the case when $z^{*M}_{21m} = z^*_{21m}$). Under the Pareto assumption, the two free entry conditions can be written as

$$\frac{(\sigma-1)}{k-(\sigma-1)} \left[f_{11m} \left(z^*_{11m}\right)^{-k} + f_{12m} \left(A_{12} z^*_{22m}\right)^{-k} \right] = f_{1mE},$$

and

$$\frac{(\sigma-1)}{k-(\sigma-1)} \left[f_{22m} \left(z^*_{22m}\right)^{-k} + f^M_{21m} \left(A_{21} z^*_{11m}\right)^{-k} \right] = f_{2mE}.$$

Again, owing tot he symmetric setup, all parameters are the same between the two countries except for the MP fixed cost, f^M_{21m}, and the MP friction, g_{21m}. Defining:

$$T = \frac{[k-(\sigma-1)] f_{2mE}}{f_{22m}(\sigma-1)},$$

and

$$A \equiv A_{12} = A_{21};\ t_1 = \frac{f_{12m}}{f_{11m}} = \frac{f_{21m}}{f_{22m}};\ t_2 = \frac{f^M_{21m}}{f_{22m}},$$

we have:

$$T_0 \equiv \left(\frac{z^*_{22m}}{z^*_{11m}} \right)^k = \frac{1 - A^{-k} t_1}{1 - A^{-k} t_2} > 1,$$

as $f^M_{21m} > f_{21m} > f_{22m}$. Therefore, we have:

$$\frac{Profits_{mnc}}{EX_{12m}} = T_0 \frac{\frac{f^M_{12m}}{f_{12m}}}{\sigma} \frac{M^e_{2m}}{M^e_{1m}},$$

Finally, we provide a lower bound for the ratio of $\frac{M^e_{2m}}{M^e_{1m}}$. The two conditions that pin down the mass of (potential) entrants in the two economies are equations (C.4) and (C.3). When there is no exporting from country 2 to country 1, we can write the two conditions (under the Pareto assumption) as

$$\frac{\beta_m L_1}{\sigma f_{11m}} = \frac{k}{k-(\sigma-1)} \left[M^e_{1m} z^{*-k}_{11m} + M^e_{2m} z^{*-k}_{11m} \frac{A_{21}^{-k+(\sigma-1)}}{g^{\sigma-1}_{21m}} \right],$$

and

$$\frac{\beta_m L_2}{\sigma f_{22m}} = \frac{k}{k-(\sigma-1)}\left[M_{1m}^e z_{22m}^{*-k}\frac{A_{12}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}} + M_{2m}^e z_{22m}^{*-k}\right],$$

as $z_{21m}^{*M} = z_{21m}^*$. We can solve for M_{2m}^e and M_{1m}^e, which leads to

$$\frac{M_{2m}^e}{M_{1m}^e} = \frac{z_{11m}^{*-k} - z_{22m}^{*-k}\frac{A_{12}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}}{z_{22m}^{*-k} - z_{11m}^{*-k}\frac{A_{21}^{-k+(\sigma-1)}}{g_{21m}^{\sigma-1}}} > \frac{T_0 - \frac{A_{12}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}}{1 - T_0\frac{A_{21}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}} > T_0,$$

as $\tau_m > g_{21m}$, $A_{21} = A_{12} > 1$, $T_0 > 1$.[63] In total, we have

$$\frac{Profits_{mnc}}{EX_{12m}} = \frac{M_{2m}^e f_{21m}\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}\frac{kz_{21m}^{*-k}}{k-(\sigma-1)}}{M_{1m}^e \sigma f_{12m}\frac{kz_{12m}^{*-k}}{k-(\sigma-1)}} = \frac{M_{2m}^e z_{22m}^{*-k}}{\sigma M_{1m}^e z_{11m}^{*-k}}\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} > \frac{T_0^2\frac{f_{12m}^M}{f_{12m}}}{\sigma},$$

When the above expression exceeds one, i.e., when g_{21m} is sufficiently low, then the manufacturing employment share in country 1 is less than β_m, which implies that a hump-shaped pattern occurs.

END OF PROOF.

From Proposition 1 and the results derived above about the mass of entrants, we know that starting from the symmetric case without MP, we must have $M_{2m}^e > M_{1m}^e$ and $z_{11m}^* < z_{22m}^*$ after a reduction in g_{21m}. Moreover, $A_{12} = A_{21}$ and $f_{12m} = f_{21m}$ thanks to the symmetry. Therefore, we conclude that as long as $\frac{f_{12m}^M}{f_{12m}} > \sigma$, it must be the case that

$$Profits_{mnc} > EX_{12m}.$$

Not that, the iceberg trade cost τ must be large enough so that there is no exporting while the MP friction, $g_{21m} \geq 1$:

$$\tau_m^{\sigma-1} \geq \sigma.$$

We emphasize that the condition that $\frac{f_{12m}^M}{f_{12m}} > \sigma$ is a sufficient condition, as the numerical example we are going to present does not satisfy this condition. Moreover, we can relax this sufficient condition by calculating the ratio of $\frac{z_{22m}^*}{z_{11m}^*}$ when there is no exporting from country 2 to country 1. Under the Pareto assumption, the two free entry conditions can be written as

$$\frac{(\sigma-1)}{k-(\sigma-1)}\left[f_{11m}\left(z_{11m}^*\right)^{-k} + f_{12m}\left(A_{12}z_{22m}^*\right)^{-k}\right] = f_{1mE},$$

[63] The denominator can be negative in principle. In this case, we would have the complete specialization case in which country 1 does not produce manufacturing goods. We rule out this case.

and

$$\frac{(\sigma-1)}{k-(\sigma-1)}\left[f_{22m}\left(z^*_{22m}\right)^{-k}+f^M_{21m}\left(A_{21}z^*_{11m}\right)^{-k}\right]=f_{2mE}.$$

Note that all parameters are the same between the two countries except for the MP fixed cost, f^M_{21m}, and the MP friction, g_{21m}. Denoting

$$T=\frac{[k-(\sigma-1)]f_{2mE}}{f_{22m}(\sigma-1)},$$

and

$$A\equiv A_{12}=A_{21};\ t_1=\frac{f_{12m}}{f_{11m}}=\frac{f_{21m}}{f_{22m}};\ t_2=\frac{f^M_{21m}}{f_{22m}},$$

we have

$$T_0\equiv\left(\frac{z^*_{22m}}{z^*_{11m}}\right)^k=\frac{1-A^{-k}t_1}{1-A^{-k}t_2}>1,$$

as $f^M_{21m}>f_{21m}>f_{22m}$. Therefore, we have

$$\frac{Profits_{mnc}}{EX_{12m}}=T_0\frac{\frac{f^M_{12m}}{f_{12m}}}{\sigma}\frac{M^e_{2m}}{M^e_{1m}},$$

which is larger than one if

$$T_0\frac{f^M_{12m}}{f_{12m}}\geq\sigma,$$

as we know $M^e_{2m}>M^e_{1m}$. This is another (and looser) sufficient condition for the result of the hump-shape.

We can provide a lower bound for the ratio of $\frac{M^e_{2m}}{M^e_{1m}}$ and loosen the sufficient condition under which the hump-shape relationship arises. The two conditions that pin down the mass of (potential) entrants in the two economies are equations (C.4) and (C.3). When there is no exporting from country 2 to country 1, we can write the two conditions (under the Pareto assumption) as

$$\frac{\beta_m L_1}{\sigma f_{11m}}=\frac{k}{k-(\sigma-1)}\left[M^e_{1m}z^{*-k}_{11m}+M^e_{2m}z^{*-k}_{11m}\frac{A_{21}^{-k+(\sigma-1)}}{g^{\sigma-1}_{21m}}\right],$$

and

$$\frac{\beta_m L_2}{\sigma f_{22m}}=\frac{k}{k-(\sigma-1)}\left[M^e_{1m}z^{*-k}_{22m}\frac{A_{12}^{-k+(\sigma-1)}}{\tau^{\sigma-1}_m}+M^e_{2m}z^{*-k}_{22m}\right],$$

as $z^{*M}_{21m} = z^*_{21m}$. We can solve for M^e_{2m} and M^e_{1m}, which leads to

$$\frac{M^e_{2m}}{M^e_{1m}} = \frac{z^{*-k}_{11m} - z^{*-k}_{22m}\frac{A_{12}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}}{z^{*-k}_{22m} - z^{*-k}_{11m}\frac{A_{21}^{-k+(\sigma-1)}}{g_{21m}^{\sigma-1}}} > \frac{T_0 - \frac{A_{12}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}}{1 - T_0\frac{A_{21}^{-k+(\sigma-1)}}{\tau_m^{\sigma-1}}} > T_0,$$

as $\tau_m > g_{21m}$, $A_{21} = A_{12} > 1$, $T_0 > 1$.[64] In total, we have

$$\frac{Profits_{mnc}}{EX_{12m}} = \frac{M^e_{2m} f_{21m}\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1}\frac{kz^{*-k}_{21m}}{k-(\sigma-1)}}{M^e_{1m}\sigma f_{12m}\frac{kz^{*-k}_{12m}}{k-(\sigma-1)}} = \frac{M^e_{2m} z^{*-k}_{22m}}{\sigma M^e_{1m} z^{*-k}_{11m}}\left(\frac{\tau_m}{g_{21m}}\right)^{\sigma-1} > \frac{T_0^2\frac{f^M_{12m}}{f_{12m}}}{\sigma},$$

which has to be larger than one for the hump-shaped result to hold.

Appendix D Implications of Unilateral Trade Liberalization

In this section, we study the effect of country 2's unilaterally reducing the iceberg trade cost in manufacturing 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

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

and

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

where we define

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

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

Note that τ_{12m} represents the iceberg trade cost from country 1 to country 2 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

$$(\rho z^*_{iik}P_{ik})^{1-\sigma} = \frac{\beta_s L_i}{\sigma f_{iik}} = \left[M^e_{jk}\int_{z^*_{jik}}^{\infty}\left(\frac{z}{z^*_{iik}\tau_k^{ji}}\right)^{\sigma-1} dG(z) + M^e_{ik}\int_{z^*_{iik}}^{\infty}\left(\frac{z}{z^*_{iik}}\right)^{\sigma-1} dG(z)\right], \tag{D.3}$$

[64] The denominator can be negative in principle. In this case, we would have the complete specialization case in which country 1 does not produce manufacturing goods. We rule out this case.

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

Proposition 5. *When the iceberg trade cost from country 1 to country 2 in the manufacturing sector τ_m^{12} falls, country 1's survival cutoff in the manufacturing sector increases, while country 2's survival cutoff in the manufacturing sector decreases. In addition, the exporting cutoff from country 1 to country 2 decreases, while the exporting cutoff from country 2 to country 1 increases. As a result, firms sell in country 1 (domestic firms from country 1 and exporting firms from country 2 to country 1) shrink in size, while they increase size in country 2. Furthermore, the mass of entrants increases and decreases in country 1 and country 2, respectively. Finally, country 1's trade surplus in the manufacturing sector and its manufacturing employment share increase, when the unilateral iceberg trade cost from country 2 to country 1 is reduced.*
There is no change in the service sector concerning all variables discussed above.

Proof. Note 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_{12m} is reduced. In particular, as the two countries are symmetric before the reduction of τ_{12m}, 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 (2.19) has a smaller slope than the one represented by equation (2.20) in absolute value:

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

where $FE1$ refers to equation (D.1) while $FE2$ refers to equation (D.2). A reduction in τ_{12m} 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 $z_{21m}^* = A_{21} z_{11m}^*$ decreases and increases respectively.
Third, as

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

we must have[65]

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

In other words, market competition becomes tougher in the manufacturing sector of country 1 (due to more entries), while it becomes less tougher in the manufacturing sector of country 2. Therefore, sales and operating profits of domestic firms decrease and increase in country 1 and country 2, respectively. For exporting plants that sell from country 2 to country 1, they also shrink in size as P_{m1} decreases. For exporting plants that sell from country 1 to country 2, their sizes (i.e., sales and employment) increase as P_{m2} goes up and τ_{12m} goes down.
Fourth, we have shown that when the two curves intersect, the one represented by equation (D.3) with $i = 1$ and $k = m$ has a smaller slope than the one represented by equation (D.3)

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

with $i = 2$ and $k = m$ in absolute value:

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

where *country* 2 refers to equation (D.3) with $i = 2$ and $k = m$ and where *country* 1 refers to equation (D.3) with $i = 1$ and $k = m$. When τ_{12m} falls, z_{11m}^* and z_{21m}^* go up. As a result, the curve representing country 1 shifts upward. When τ_{12m} falls, z_{22m}^* and z_{12m}^* go down (and τ_{12m} also goes down). Thus, the curve representing country 1 shifts downward. Therefore, we must have the mass of manufacturing entrants increases in country 1 (M_{2m}^e) and decreases in country 2 (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 1, 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 (3.1) and (3.2). Thanks to the Cobb-Douglas preference, total consumption of manufacturing goods by workers in country 1 (i.e., $P_{1m}C_{1m}$) is equal to $\beta_m L_1$ which is not affected by τ_{12m}. Next, as M_{1m}^e increases and z_{12m}^* goes down, total manufacturing exports from country 1 to country 2 EX_{12m} increases. Conversely, as M_{2m}^e decreases and z_{21m}^* goes up, total manufacturing exports from country 2 to country 1 EX_{21m} decreases. In total, revenue of the manufacturing sector in country 1 ($sales_{1m}$) increases, which implies revenue of the manufacturing sector in country 2 ($sales_{2m}$) decreases. As the wage rate is always one, manufacturing employment (and its share in total employment) increases and decreases in country 1 and country 2, respectively. □

The key insight behind the above proposition is again the home market effect. Since market access from country 1 to country 2 becomes easier after the unilateral trade liberalization, more manufacturing firms enter into country 1 which intensifies market competition there. As a result, the survival cutoff increases. The opposite story happens in the manufacturing sector of country 2, which leads to a lower survival cutoff and fewer entrants into the manufacturing sector of country 2. Exactly because of this home market effect, manufacturing exports from country 1 to country 2 increases and vice versa for manufacturing exports from country 2 to country 1. This leads to a higher manufacturing employment share and a smaller employment share of the agricultural sector. For country 2, it has a trade deficit in the manufacturing sector and a smaller 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 induced by the unilateral trade liberalization. Specifically, manufacturing employment share increases in one country, when the trade surplus in its manufacturing sector increases. lateral trade liberalization (done by country 2) increases country 1's manufacturing employment share, as country 1's trade surplus in the manufacturing sector increases. This is similar to the effect of lateral FDI liberalization on sectoral employment. However, there are three key differences between the two types of liberalization.

First, lateral trade liberalization always increases trade surplus of manufacturing goods and the manufacturing employment share in country 1, while lateral FDI liberalization has such an effect 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 episodes of liberalization. For the unilateral trade liberalization, there are more exporters from country 1 and they expand after the liberalization.[66] For the unilateral FDI liberalization, there are actually fewer exporters from country 1 and they shrink (as market competition is intensified in country 2). However, manufacturing exports from country 2 to country 1 shrink more, which drives the increasing trade surplus of manufacturing goods in country 1. Finally, firms are affected in opposite ways between the two liberalization episodes. For the trade liberalization, domestic firms and exporting firms shrink and expand in country 1 respectively, as the manufacturing sector of country 1 (two) becomes more (less) competitive.[67] However, domestic and exporting manufacturing firms of country 1 expand and shrink respectively, when country 1 implements the unilateral FDI liberalization. In total, the two liberalization episodes yield different implications at both the firm level and the aggregate level.

Appendix E Empirical Robustness Checks

In this section of the appendix, we report regression results for robustness checks. Since the results are qualitatively similar to the ones reported in the main text, we do not discuss the results reported here.

E.1 Results using the entire sample (with the treatment defined at three-digit industry level)

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

[66] Declining manufacturing exports from country 2 to country 1 also contribute to the increasing trade surplus of manufacturing goods in country 1.

[67] The opposite story holds for domestic and exporting firms of country 2.

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.	
$treatment_i * post02_t$	-0.0147	-0.0160	-0.0417	-0.0472	-0.0325**	-0.0325**
	(0.0438)	(0.0439)	(0.0960)	(0.0965)	(0.0123)	(0.0122)
import share		0.0381		0.156		-0.00812
		(0.0354)		(0.143)		(0.0213)
export share		0.0540		0.232*		0.00362
		(0.0446)		(0.131)		(0.0227)
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	14293	14293	14293	14293	14293	14293
R^2	0.982	0.982	0.913	0.913	0.889	0.889

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 service employment of Japanese MNCs' headquarters

	(1)	(2)	(3)	(4)
	share of R&D empl. at parent		share of IB empl. at parent	
$treatment_i * post02_t$	0.0109	0.0110	0.000968	0.000937
	(0.00776)	(0.00775)	(0.00256)	(0.00256)
import share		0.00439		-0.000943
		(0.0123)		(0.00469)
export share		-0.00756		0.00207
		(0.0127)		(0.00319)
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	14293	14293	14293	14293
R^2	0.835	0.835	0.536	0.536

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

E.2 Results based on the largest/any manufacturing affiliate in China

Table A9: China's FDI liberalization and domestic employment of Japanese MNCs (largest or any affiliate)

	(1)	(2)	(3)	(4)	(5)	(6)	
	log(tot. empl.)		log(manuf. empl.)		share of manuf. empl.		sample and sample size
$treatment_i * post02_t$	-0.0646***	-0.0652***	-0.0769	-0.0801	-0.0178	-0.0175	largest affiliate
	(0.0197)	(0.0201)	(0.105)	(0.104)	(0.0111)	(0.0111)	5,321 (matched sample)
$treatment_i * post02_t$	-0.0273	-0.0286	-0.0780	-0.0836	-0.0285*	-0.0286*	largest affiliate
	(0.0427)	(0.0428)	(0.0866)	(0.0873)	(0.0158)	(0.0156)	14,293 (entire sample)
$treatment_i * post02_t$	-0.0357	-0.0357	-0.0490	-0.0489	-0.0161*	-0.0161*	any affiliate
	(0.0238)	(0.0239)	(0.0712)	(0.0716)	(0.00815)	(0.00814)	6,063 (matched sample)
export/import shares as controls	No	Yes	No	Yes	No	Yes	
firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	
prefecture-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	
(parent) ind.-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	

In the first four rows, we consider a definition of treatment based on whether the largest manufacturing affiliate of the parent firm (prior to 2002) is treated. If the first entry is after 2002, the treatment is defined based on the first manufacturing affiliate. In the last two rows, we consider a definition of treatment based on whether any of the manufacturing affiliates of the parent firm (prior to 2002) is treated. If the first entry is after 2002, the treatment is defined based on the first manufacturing affiliate. Std. err. are clustered at (affiliate) industry level and included into the parentheses. * 0.10 ** 0.05 *** 0.01

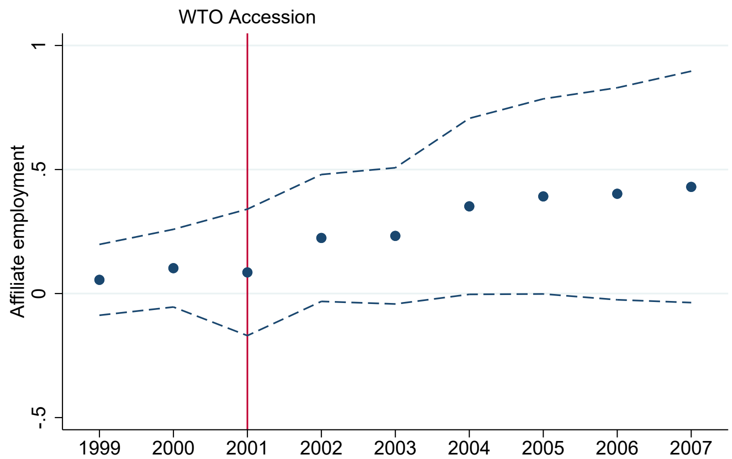
Table A10: China's FDI liberalization and domestic service employment of Japanese MNCs' headquarters

	(1)	(2)	(3)	(4)	
	share of R&D empl. at HQs		share of IB empl. at HQs		sample and sample size
$treatment_i * post02_t$	0.00989	0.00991	-0.00210	-0.00200	largest affiliate
	(0.00706)	(0.00713)	(0.00356)	(0.00340)	5,321 (matched sample)
$treatment_i * post02_t$	0.00983	0.00996	0.00276	0.00272	largest affiliate
	(0.00877)	(0.00875)	(0.00305)	(0.00305)	14,293 (entire sample)
$treatment_i * post02_t$	0.00142	0.00142	0.00142	0.00142	any affiliate
	(0.00430)	(0.00434)	(0.00207)	(0.00207)	6,063 (matched sample)
export/import shares as controls	No	Yes	No	Yes	
firm fixed effects	Yes	Yes	Yes	Yes	
prefecture-year fixed effects	Yes	Yes	Yes	Yes	
parent ind.-year fixed effects	Yes	Yes	Yes	Yes	

In the first four rows, we consider a definition of treatment based on whether the largest manufacturing affiliate of the parent firm (prior to 2002) is treated. If the first entry is after 2002, the treatment is defined based on the first manufacturing affiliate. In the last two rows, we consider a definition of treatment based on whether any of the manufacturing affiliates of the parent firm (prior to 2002) is treated. If the first entry is after 2002, the treatment is defined based on the first manufacturing affiliate. Std. err. are clustered at (affiliate) industry level and included into the parentheses. * 0.10 ** 0.05 *** 0.01

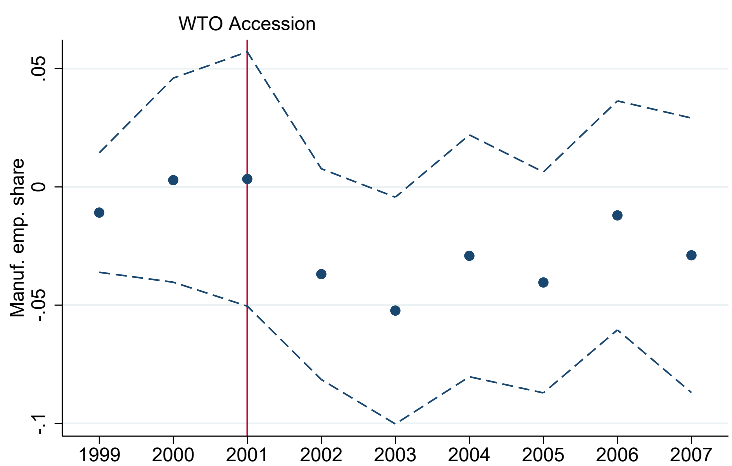
E.3 Parallel-trends Assumptions

Figure A5: Parallel trends assumption: total employment of affiliates



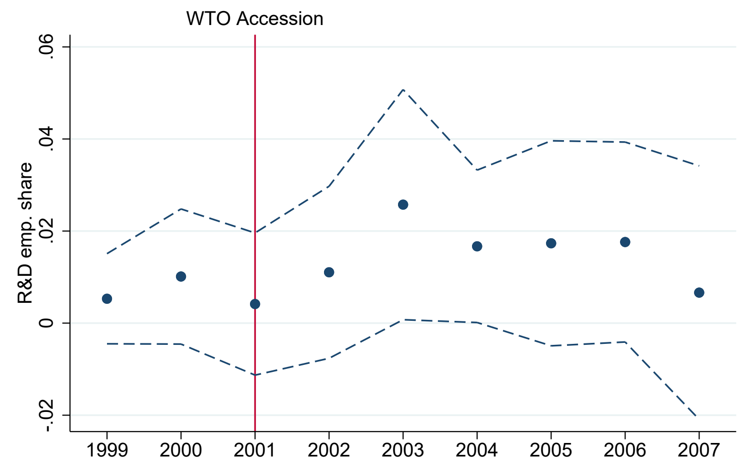
Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

Figure A6: 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 A7: Parallel trends assumption: share of R&D employment at the parent firm

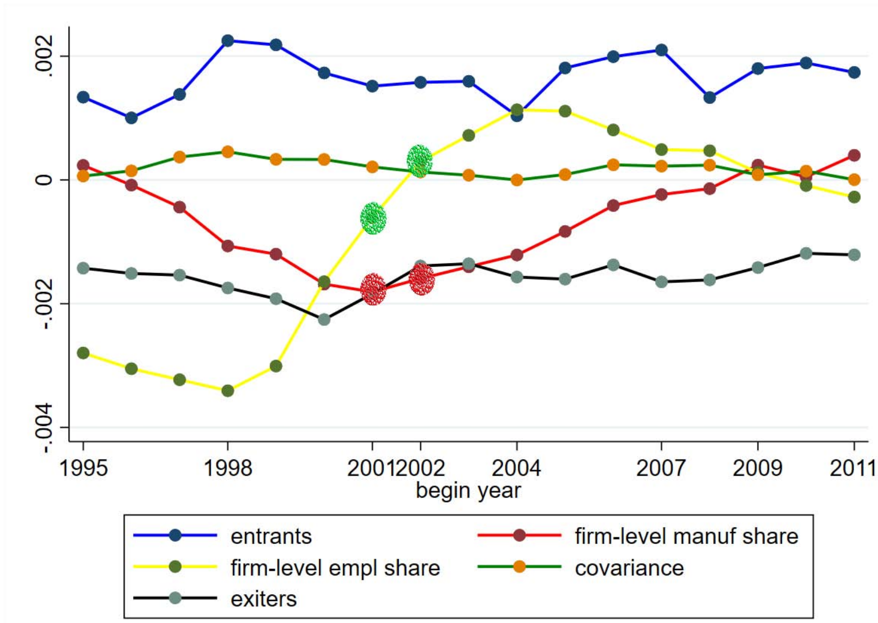


Note: This figure plots estimates of treatment-year dummy variables for 1999-2007. Dotted lines depict the 95% confidence interval.

E.4 Within-firm Decomposition

Figure A8 presents the decomposition result for Japanese MNC parents firms which consists the first five terms in equation (A.1) for (manufacturing) MNC parent firms. Each year represents the contribution to the change from the that year to five years forward. E.g., the point for 1998 represents the contribution from 1998 to 2003. The red curve shows that the manufacturing employment share within MNC parent firms had had negative changes during 2001-2006 (around -0.19%) and 2002-2007 (around -0.18%), which is consistent with our empirical finding in Section 4 that manufacturing employment share of MNC parent firms had decreased in the treatment group for 2002-2007. Moreover, the yellow curve shows that the share of MNC parent firms' overall employment in total employment had had a slightly negative or even no change during 2001-2006 or 2002-2007. This is also consistent with our empirical finding in Section 4 that the overall employment effect of China's FDI policy change on MNC parent firms' domestic employment is small.

Figure A8: Within-firm Employment Decomposition of Multinational Parent Firms in Japan



Note: We present the contributions by entering, continuing (middle three terms) and exiting MNC parent firms for each 5-year interval starting from 1995. The sum of the five terms equals the overall contribution by MNC parents.