Selection and Market Reallocation: Productivity Gains from Multinational Production*

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Abstract

Assessing productivity gains from multinational production has been a vital topic of economic research and policy debate. Positive productivity gains are often attributed to productivity spillovers; however, an alternative, much less emphasized channel is selection and market reallocation whereby competition leads to factor reallocation both within and between domestic firms and exits of the least productive firms. We investigate the roles of these different mechanisms in determining aggregate productivity gains using a unifying framework that explores the mechanisms' distinct predictions on the distributions of domestic firms: Within-firm productivity improvement shifts the productivity distribution rightward while selection and market reallocation shifts the revenue and employment distributions leftward and raises left truncations. Using a rich cross-country firm panel dataset, we find significant evidence of both mechanisms and effects of competition in product, technology and labor space. However, selection and market reallocation account for the majority of aggregate productivity gains, suggesting that ignoring this channel could lead to substantial bias in understanding the nature of productivity gains from multinational production.

JEL Codes: F2, O1, O4

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1 Introduction

Assessing productivity gains from multinational production has been a vital topic of economic research and policy debate. Nations with greater openness to multinational production have been shown to exhibit, on average, higher aggregate productivity and faster economic growth. This stylized fact, presented in numerous macro-level studies,[1] is often attributed to positive productivity spillover from foreign multinational firms.[2] There is, however, a less emphasized, alternative explanation centering on *selection and market reallocation*. Greater openness to multinational production leads to tougher competition in host-country product and factor markets, which can result in a reallocation of resources within each domestic firm, from domestic to multinational firms, and from less productive to more productive firms. These resource reallocations force the least efficient domestic firms to exit the market, increase the market share of the most productive firms, and motivate domestic firms to become more specialized at core advantage goods, all of which raise the host-country aggregate productivity.

Although all of the above channels imply aggregate productivity gains from foreign multinational production, they operate at two distinct margins and represent different sources of productivity gains. Within-firm productivity improvement, which can arise from either productivity spillover or within-firm resource reallocation, operates at an "intensive margin" whereby foreign multinational production raises the productivity of individual continuing domestic firms. Between-firm selection and market reallocation, in contrast, work at an "extensive margin" whereby foreign multinational competition induces exits of the least productive domestic firms and increases the weights of the most productive firms in aggregate output. Their implications for domestic economies are also sharply different: Within-firm productivity improvement implies domestic firm productivity growth whereas selection and market reallocation result in increased market concentration. Distinguishing between these sources is thus essential for improving our understanding of the mechanisms by which an economy responds to foreign multinational competition and setting effective economic policies. While an extensive body of research has assessed the productivity spillover effect of multinational firms, little analysis has investigated the role of selection and reallocation in the aggregate impact of multinational production and how the different channels—distinctively as well as

[1] See, for example, Borensztein et al. (1998) and Alfaro et al. (2004).

[2] See Harrison and Rodríguez-Clare (2011) and Kose et al. (2011) for recent overviews of the literature on the relationship between multinational production, productivity, and economic growth. Evidence suggests that multinational production exerts a positive effect on economic growth conditional on local conditions, such as sufficient human capital stock and relatively developed financial markets. At the macro level, the cross-country correlations between average FDI-to-GDP ratio and average TFP and TFP growth are 0.27 and 0.26, respectively (sources: World Bank World Development Indicators and Penn World Tables; data: 1980-2005).

jointly—influence the potential productivity effects from multinational competition.[3]

This paper disentangles the roles of within-firm productivity improvement and between-firm selection and market reallocation in determining the aggregate productivity gains from multinational production and investigates their relative importance. This cannot be accomplished by simply examining the relationship between multinational production and host-country average productivity, as both channels predict a positive relationship. We therefore utilize an intuitive unifying empirical framework motivated by stylized theories led by Melitz (2003) and Helpman, Melitz and Yeaple (2004) to explore the variations in how the two channels influence the distributions of domestic firms in dimensions including productivity, employment, revenue and survival. Specifically, we hypothesize that within-firm productivity improvement implies a rightward shift of the productivity distribution for surviving domestic firms. In contrast, greater competition from multinational production, in both factor and product markets, reallocate factors from domestic to multinational and from less productive to more productive firms. The between-firm factor reallocation will be reflected as a leftward shift in the employment distribution of domestic firms. Further, when within-firm productivity improvement is limited, greater competition in factor and product markets will erode the revenue of domestic firms and shift the revenue distribution leftward, while raising the cutoff productivity for survival and forcing the least efficient domestic firms to exit.

These hypotheses are evaluated empirically using a rich cross-country firm panel dataset, drawn from Orbis, that contains comprehensive financial, operation, and ownership information for public and private manufacturing companies in over 30 developed and developing countries for the 2002-2007 period. To account for the endogenous entry decision of multinational firms, we adopt a first-stage specification motivated by the existing literature examining the entry decision of multinationals as a function of not only all time-variant country-pair industry factors but also multinationals' ex-ante productivity and their host-country specific fixed-cost shifter reflecting, for example, changes in multinationals' real financial constraints to enter host countries. An extensive number of studies including, for example, Froot and Stein (1991), Blonigen (1997), Klein, Peek, and Rosengren (2002), Desai, Foley, and Hines (2004), Baker, Foley and Wurgler (2009), and Bilir, Chor and Manova (2015) show that firm financial constraints and shocks play an important role in their ability to engage in new FDI.

[3] Although the role of selection and reallocation is underemphasized in evaluating productivity gains from multinational production, its role has been examined when assessing productivity gains from trade liberalization (see Melitz, 2003). An important empirical study in this area, Pavcnik (2002), finds that of the 19.3 percent manufacturing productivity growth from trade liberalization in Chile during 1979-1986, 12.7 percent is attributable to reallocation of resources from less to more efficient producers and 6.6 percent to increased productivity within plants. See Melitz and Redding (2014) for a recent overview.

Motivated by this literature, we incorporate an interaction between changes in multinational headquarters' cash flow measured in the host-country PPP value and host-country entry cost into multinationals' investment decisions; multinationals that experience a positive financial shock due to, for example, increased investment returns in headquarters or an appreciation of headquarter-country currency are expected to have a reduced financial constraint in foreign investments and thus more likely to make new entry especially in host countries where the marginal value of the financial shock is large. But such idiosyncratic financial shocks, unlike other firm characteristics such as productivity or the level of cash flow, are not likely to be directly correlated with the future productivity growth of host-country domestic firms, thereby offering an exclusion restriction for identifying the causal effects of multinational production.

We find that within-firm productivity improvement and between-firm selection and reallocation are two significant but distinct sources of productivity gains from multinational production. The productivity distribution of domestic firms is shown to shift rightward after foreign multinational entry, suggesting within-firm productivity improvement among surviving domestic firms. In contrast, the revenue and employment distributions of domestic firms are found to shift leftward especially at the left tail, as anticipated by the effects of increased competition and reallocation in factor and product markets. The least productive domestic firms are most likely to exit and get crowded out of the market, as a result of tougher selection on domestic firms which leads to higher cutoff productivity for survival and more left-truncated distributions. Consistent with the labor market competition hypothesis, the average wage of domestic firms is found to rise after foreign multinational entry.

When exploring potential sources of within-firm productivity improvement, we find that foreign multinational competition can influence both innovation and product composition decisions. Following Bloom, Draca and Van Reenen (2015) who use patent applications as a proxy for innovation, we use a cross-country patent application panel dataset obtained from Orbis and show that new multinational entry leads to a significant increase in domestic firms' patenting activities, especially for the lowest productivity groups. Further, we examine the product composition of domestic firms using Dun & Bradstreet's WorldBase Database which reports detailed information on the primary and secondary products of establishments around the world and find that domestic firms, especially those with the lowest productivity, are more likely to drop products after facing foreign multinational entry. This result is consistent with recent theories in the trade literature (e.g., Bernard, Redding and Schott, 2010; Eckel and Neary, 2010; Nocke and Yeaple, 2014; Mayer, Melitz and Ottaviano, 2014) which suggest that increased foreign competition can motivate domestic firms to reallocate resources towards

their core-advantage goods and this within-firm reallocation can constitute an important mechanism of productivity upgrading.

It is worth noting that within-firm productivity response and between-firm reallocation could be interdependent. The extent of productivity upgrading by surviving firms can determine the extent of the reallocation effect. Similarly, the competition impact of multinationals can influence the incentives of domestic firms to innovate or enhance their capacity to absorb technology spillover from foreign firms. This is confirmed in our analysis which shows that domestic firms experiencing greater productivity upgrading witness smaller declines in revenue shares. To further disentangle the channels and their interactions, we also adopt an alternative approach that differentiates foreign multinational competition in a domestic firm's product space, technology space, and labor space, represented, respectively, by the extent of foreign multinational entry in the product space a domestic firm operates, in the technologically linked industries, and in the labor market facing the domestic firm given its industry's occupational labor structure. We find that foreign multinational entry in a domestic firm's product space exerts a negative effect on the domestic firm's revenue and employment but an insignificant effect on productivity, suggesting that foreign rivalry in product space leads to primarily a negative market reallocation effect. In contrast, foreign multinational entry in the technology space raises productivity as well as employment and revenue, implying an overwhelming productivity upgrading effect. Finally, foreign multinational entry in domestic firms' labor space leads to an increase in productivity suggesting productivity spillover via labor linkages, a decrease in the employment share as expected from labor reallocation, and overall a positive effect on revenue. These findings offer strong further support to the different mechanisms through which foreign multinational firms could influence domestic firms' performance.

Whe quantifying and decomposing the aggregate productivity impact of multinational production, we find based on our preferred estimations that between-firm selection and reallocation alone account for two thirds of aggregate productivity gains from foreign multinational entry, while within-firm productivity improvement by itself accounts for one third. These results highlight that a substantial share of productivity gains are channeled through between-firm selection and reallocation. Further, since the analysis suggests that within-firm productivity gain could also occur through within-firm selection and reallocation whereby domestic firms respond to foreign multinational competition by reallocating resources to focus on competitive products, the overall importance of selection and market reallocation can be even greater when the within-firm margin is also accounted for. Ignoring the selection and

market reallocation channel could therefore drastically bias our understanding of the origin and the magnitude of productivity gains from multinational production.

We perform a series of additional exercises, including re-examining the hypotheses using alternative TFP estimates, using different data samples such as industries with relatively homogeneous products (to address potential markup issues in productivity measures), industries with different levels of skill intensity, and countries with better data coverage, and considering the role of trade. In all the exercises, we find consistent evidence of between-firm selection and market reallocation.

Our study is closely related to several strands of the literature. First, as mentioned above, we build on an extensive empirical literature that assesses the existence of productivity spillover from multinational to domestic firms.[4] One of the earliest contributions to this literature is Aitken and Harrison (1999) who find evidence of negative spillover in a panel of Venezuelan manufacturing enterprises for the period 1975-1989. The authors attribute the result to a market-stealing effect whereby foreign multinational firms steal market share from domestic firms. That paper soon spawned a large series of empirical studies. Keller and Yeaple (2009), for example, find significant evidence of within-industry positive spillover from foreign multinational to domestic firms in the United States. Similar results are found in Aghion et al. (2015) for a panel of medium-sized and large-sized Chinese enterprises for the period 1998-2007. Javorcik (2004), exploring spillover through vertical production linkages in Lithuania between 1996 and 2000, shows that multinational production generates positive externalities via backward production linkages from multinational affiliates to local intermediate input suppliers. Carluccio and Fally (2013) examine how productivity spillover via backward linkages depends on technological incompatibilities between foreign and domestic technologies and show that a decrease in the cost of inputs compatible with the foreign technology has heterogeneous effects on domestic firms. Studies by Arnold and Javorcik (2009) and Guadalupe et al. (2012), which account for the endogenous acquisition decisions of foreign multinational firms, find that foreign ownership leads to significant productivity spillover in acquired plants even after addressing the acquisition decisions. Fons-Rosen et al. (2013), exploiting the difference in the amount of foreign investment by financial and industrial investors, examine the direct effect of foreign ownership on acquired firms and the spillover effects on domestic firms and find the productivity impact of FDI to be small, mostly between related industries within the same sector.

In contrast to the ample literature on productivity spillover, evidence on the selection and

[4] The academic literature of foreign direct investment is vast. See Hanson (2001), Caves (2007), and Harrison and Rodríguez-Clare (2010) for surveys on the effects of FDI.

reallocation effect of multinational production is scarce. A number of studies offer related insights by evaluating the effects of multinational production on domestic wage rates and financial constraints. Aitken, Harrison, and Lipsey (1996) investigate the impact of foreign-owned plants on the wages of domestically owned establishments in Mexico and Venezuela and report an increase in industry wages due to foreign multinational production. Similarly, Feenstra and Hanson (1997) find a higher level of maquiladora activity to lead to a higher share of total wages going to skilled (nonproduction) workers in Mexico, interpreting their result as increased demand for skilled labor from foreign multinational firms. Exploring the effect of multinational production on domestic financial markets, Harrison and McMillan (2003) find that domestic firms are more credit-constrained than foreign firms and borrowing by foreign firms exacerbates domestic firms' credit constraints.[5] Ramondo (2009), using a panel of Chilean manufacturing plants, finds entry by foreign plants to be associated negatively with the market shares of domestic firms and positively with the productivity of domestic incumbents. Kosova (2012), analyzing exit and growth sales of domestic firms in the Czech Republic, finds evidence consistent with crowding out and technology spillover.

Our paper contributes to the above literature by evaluating jointly the distinct roles of within-firm productivity improvement and between-firm reallocation in determining the aggregate productivity gains from multinational production. The existing empirical literature has traditionally focused on productivity spillovers from foreign multinational to domestic firms while the effect of selection and market reallocation—either within or between firms—has been much less studied. The main contribution of the paper is to account for the different mechanisms of productivity gains from foreign multinational competition and, importantly, quantify their relative importance. Our approach, utilizing intuitive and novel empirical strategies that explore the distributions of domestic firms and differentiate competition in product, factor and technology space, offers a unifying framework for assessing and quantifying the aggregate and the decomposed productivity gains. The paper shows that the bulk of productivity gains result from selection and market reallocation. The result provides an important new insight into a central topic of empirical literature which has mostly centered on the relationships between multinational activity and domestic productivity without systematically searching for the mechanisms and forces driving those relationships.

The findings of the paper also deliver important implications for policy debates on FDI,

[5] In contrast to Harrison and McMillian (2003), Harrison, Love, and McMillian (2004), using Worldscope data on 7,079 firms in 28 countries, find FDI inflows to be associated with a reduction in firms' financing constraints. Harrison and Rodríguez-Clare (2011) note that these contrasting results point to policy complementarities like those between FDI and local financial markets (see Alfaro et al., 2004, 2010).

as understanding the sources of potential gains from multinational production is critical to designing economic policies (Harrison and Rodríguez-Clare, 2010). If productivity spillover is the primary source of productivity gains, special treatment to foreign firms, often provided by host countries in the form of tax breaks and financial incentives, might be justifiable. But if productivity gains arise primarily from selection and reallocation as shown in the paper, it would be important to also improve domestic market conditions, including labor mobility and credit access, to facilitate the gains from competition and resource reallocation.

More broadly, the roles of spillover, selection, and reallocation from tougher competition is an important subject of inquiry in many fields of economics. In addition to trade (e.g. Pavcnik, 2002; Melitz, 2003), Combes et al. (2012), for example, study the role of agglomeration forces (externalities) versus selection in explaining the productivity advantage of large cities,[6] Bloom et al. (2015) analyze the effects of technology spillover versus market rivalry in R&D, and Acemoglu et al. (2013) examine how reallocation affects the implications of subsidies for growth and welfare in a model of firm innovation with endogenous entry and exit. Our work also connects to the growing literature that emphasizes the productivity effect of resource misallocation across establishments (see Hsieh and Klenow, 2009; Alfaro et al., 2009; Bartelsman, Haltiwanger, and Scarpetta, 2013). Echoing these studies, our paper suggests that the reallocation of capital and labor as a result of increased multinational production could lead to important productivity gains.

The rest of the paper is organized as follows. Section 2 presents theoretical hypotheses that will guide the empirical analysis. Section 3 describes the data and key variables. Sections 4 and 5 report the estimation results and robustness analyses, respectively. Section 6 quantifies and decomposes the productivity gains from increased multinational production. Section 7 concludes.

2 Theoretical Hypotheses: The Impacts of Multinational Production

In this section, we present theoretical hypotheses describing the different mechanisms through which multinational production affects aggregate domestic-firm productivity in host countries.

[6] Both Combes et al (2012) and our paper are motivated by stylized models in the firm heterogeneity literature. Incorporating Melitz and Ottaviano (2008) with urban economics models, Combes et al. (2012) develop a new quantile regression approach to compare the distribution of establishment productivity for each sector across French areas of different density. Our paper, built on Helpman, Melitz and Yeaple (2004) and Melitz (2003), examines the productivity gains from multinational production by exploring its effects on the productivity, revenue and employment distributions of domestic firms.

Gains in aggregate domestic-firm productivity can arise from two main sources: (i) within-firm productivity improvement among domestic firms due to, for example, productivity spillover from foreign multinational firms and self upgrading; and (ii) between-firm selection and market reallocation whereby the least productive domestic firms exit the market and factor resources are reallocated from less productive to more productive domestic firms. Examining the relationship between multinational production and aggregate domestic productivity alone would not allow us to distinguish between these two sources of productivity gains. We therefore proceed below by exploring the distinctive implications of each mechanism for the distributions of domestic firms in dimensions including productivity, revenue, employment, and survival probability.[7]

2.1 Within-Firm Productivity Gain

First, the productivity of each individual domestic firm can be influenced by foreign multinational firms through productivity spillover. As discussed earlier, a large volume of empirical literature has investigated the issue in the contexts of various developed and developing countries and found evidence of positive spillover which could occur through, for example, production linkage, sharing common inputs, and labor mobility.

Intuitively, when there is positive productivity spillover from foreign multinationals to domestic firms, individual domestic firms will experience a within-firm productivity improvement, leading to a rightward shift of the domestic firms' productivity distribution. This hypothesis is outlined below:

Hypothesis 1 (Within-firm productivity gain): *When foreign multinational entry leads to within-firm productivity improvement among domestic firms, it shifts the domestic productivity distribution rightward.*

Note that there may be other sources of within-firm productivity improvements. For example, domestic firms may upgrade their productivity through resource reallocation within the firm. Domestic firms can react to foreign multinational competition by changing product composition and reallocating resources to focus on core-advantage goods. The work by Bernard, Redding and Schott (2010), Eckel and Neary (2010), Mayer, Melitz and Ottaviano (2014, 2015), and Nocke and Yeaple (2014) shows that firms may choose to drop the least

[7] In an earlier working paper version, we present a stylized analytical framework adapted from Melitz (2003) and Helpman, Melitz and Yeaple (2004) to incorporate the different mechanisms. In Section 5, we consider various empirical extensions and alternative strategies to further disentangle the effects and examine robustness.

competitive products and specialize in their most competitive products following trade liberalization. This reallocation of resources within firms towards their most efficient use could similarly happen as a result of foreign multinational competition and contribute to within-firm productivity gains. We explore this possibility in Section 5.3 by examining domestic firms' product composition decisions.

2.2 Between-Firm Selection and Market Reallocation

The entry of foreign multinational firms can also raise competition in both product and factor markets. Melitz (2003) and Melitz and Ottaviano (2008) show that foreign competition due to trade liberalization results in factor and product market reallocation and tougher selection among domestic firms. These implications are similarly applicable to foreign multinational competition as we discuss below.

Between-Firm Selection Multinational firms, by self selection, tend to be the most productive firms in each industry as highlighted in Helpman, Melitz and Yeaple (2004). It can be shown in the same theoretical framework that the entry of foreign multinationals will increase demand in factor—particularly labor—markets and bid up factor costs. Such entry could also raise competition in product markets and, in a context of variable markups such as Melitz and Ottaviano (2008), lower domestic firms' product price. Both of these effects will consequently raise the productivity threshold required for domestic firms' survival, forcing the least productive domestic firms to exit and making the productivity distribution of domestic firms more left-truncated. We refer to this effect as a *between-firm selection* effect and summarize it below:

Hypothesis 2 (Between-firm selection): *Foreign multinational entry raises the cutoff productivity for survival and reduces survival rates especially for the least productive domestic firms.*

Between-Firm Factor and Product Market Reallocation The increased competition in the labor market as a result of greater foreign multinational competition will also reallocate labor from domestic to foreign multinational firms and from less productive to more productive domestic firms. This should lead to a leftward shift in the employment distribution of domestic firms, especially at the left tail of the distribution, and an increase in the wage rate.[8] We

[8] In the capital market, if foreign firms obtain a share of capital needed in foreign investment at home and the rest in host countries, competition for domestic capital could lead to similar effects. Graham and Krugman

refer to this effect as a *between-firm factor reallocation* effect and summarize it below:

Hypothesis 3 (Between-firm factor reallocation): *The increased labor demand after foreign multinational entry shifts the employment distribution of domestic firms leftward especially at the left tail and bids up the wage rate.*

Taking into account all the effects discussed above, increased multinational competition will affect domestic firm revenue in three ways. First, within-firm productivity improvement, when present, exerts a positive effect on domestic firms' revenue. Second, the tougher firm selection and the exits of the least productive domestic firms induce an increase in average productivity and a decrease in aggregate price, which in turn exert a negative effect on domestic firm revenue. Third, the reallocation of factor resources further erodes the revenue of individual domestic firms. These effects together imply that, when the extent of within-firm productivity improvement is relatively small, domestic firms, especially the least productive domestic firms, will incur a loss in domestic sales and the revenue distribution of surviving firms will shift leftward especially at the left tail. We refer to this effect as the between-firm *revenue reallocation* effect and summarize it below:

Hypothesis 4 (Between-firm revenue reallocation): *When there is insufficient within-firm productivity improvement, foreign multinational entry shifts the revenue distribution of domestic firms leftward, especially at the left tail.*

It is worth noting that the above hypotheses are not conditional on specific theoretical contexts. Specifically, within-firm productivity improvement from increased multinational production should imply a rightward shift of the productivity distribution even though the degree of improvement could be conditional on the productivities of domestic and foreign multinational firms. Between-firm selection and reallocation due to greater multinational competition should result in exits of the least productive domestic firms in a variety of competition structures. Further, the within- and between-firm effects of foreign multinational competition could be interdependent. The extent of within-firm productivity improvement among surviving firms may affect the extent of the market reallocation effect. Similarly, multinationals' effects on factor and product prices will influence domestic firm's incentives

(1991), and Harrison and McMillian (2003) show that investors often fail to fully transfer capital upon taking control of a foreign company. Instead, they tend to finance an important share of their investment in the local market. This is confirmed in Bilir, Chor and Manova (2014) who show that host countries with more developed financial markets attract more multinational entry. If multinationals borrow heavily from host-country local banks rather than bringing capital from abroad, they may exacerbate domestic firms' financing constraints by crowding them out of domestic capital markets.

to upgrade productivity or adapt product composition. We explore these interdependences in Section 5.4.

2.3 Aggregate Productivity

Next consider the impact of greater foreign multinational production on aggregate productivity. To evaluate the aggregate productivity impact, we take into account both domestic and foreign multinational firms. As discussed above, domestic firms' aggregate productivity will be affected at two distinct margins. At an intensive margin, domestic firms could experience within-firm productivity gain as a result of positive productivity spillover from foreign multinational firms as well as self-upgrading through within-firm adjustments and resource reallocations. At an extensive margin, the tougher selection on domestic firms raises the productivity threshold for survival and reallocates markets and resources towards more productive domestic firms. Both of these mechanisms will increase the aggregate productivity of domestic firms.

When accounting for the productivity of foreign multinational firms, the aggregate productivity effect will further increase. As Helpman, Melitz and Yeaple (2004) show, firms with greater productivity are more likely to overcome the fixed cost of foreign investment and engage in multinational production overseas. Consequently, multinational firms tend to be, by selection, more productive than average domestic firms. In Section 6, we will evaluate the relative importance of each of the above sources in the aggregate productivity impact of foreign multinational production.

3 Cross-Country Firm Financial and Ownership Data

We use a cross-country manufacturing firm-level panel dataset, drawn from Orbis published by Bureau van Dijk, that contains comprehensive financial, operation, and ownership information for public and private companies in over 30 developed and developing countries. Bureau van Dijk is a leading source of company information and business intelligence and is extensively used by empirical firm-level studies in international trade, foreign direct investment, and other fields. Orbis combines information from around 100 sources and information providers. Primary sources include Tax Authorities, Ministry of Statistics, Provincial Bureau of Legal Entities, Securities and Investments Commissions, National Banks, Municipal Chambers of Commerce, and State Register of Accounts. Over 99 percent of the companies included in Orbis are private. For each company, the dataset reports: a) detailed 10-year financial in-

formation including 26 balance sheet and 25 income sheet items, b) industries and activities including primary and secondary industry codes in both local and international classifications, c) corporate structure including board members and management, and d) ownership information, including shareholders and subsidiaries, direct and indirect ownership, ultimate owner, independence indicator, corporate group, and all companies with the same ultimate owner as the subject company.

Orbis provides several advantages that are central to our analysis. First, a notable strength of Orbis is its ownership information, which covers over 30 million shareholder/subsidiary links and is known for its scope and accuracy. The information is collected from a variety of sources. The data show full lists of direct and indirect subsidiaries and shareholders, a company's degree of independence, its ultimate owner, and other companies in the same corporate family. We explore the shareholder, ultimate owner, and subsidiary information to identify (majority- and wholly-owned) MNC activities across countries. Second, the financial data in Orbis consist of a rich array of time-series information enabling us to measure and compare a firm's total factor productivity over time. Third, Orbis provides broad country coverage, including a wide range of both industrial and emerging economies.

We use four categories of information for each firm: (a) industry information including the 4-digit NAICS code of the primary industry in which each establishment operates, (b) ownership information including each firm's domestic and global parents and domestic and foreign subsidiaries, (c) location information, and (d) non-consolidated financial information including revenue, employment, assets, investment, and material cost.[9] A firm is considered foreign-owned if it is majority- or wholly-owned by a foreign multinational firm. There are about 36,000 foreign-owned subsidiaries in the final sample.[10]

While we believe that Orbis is a very informative and useful data source for answering the question raised in our paper, we are aware of its limitations. Like most other datasets that rely on public registries and proprietary sources, Orbis does not cover the population of businesses across countries. An ideal alternative would be national census data that include

[9] We imposed a number of requirements in cleaning the data. First, we dropped all records that lack revenue, employment, asset, and industry information. Second, we focused on manufacturing industries only. Third, we excluded countries with fewer than 100 observations. Last, we restricted the final sample to countries with relatively good coverage of firm financials that are required to estimate productivity. The main countries in the final sample include Argentina, Australia, Austria, Bosnia and Herzegovina, Belgium, Bulgaria, China, Colombia, Croatia, Czech Republic, Germany, Estonia, Finland, France, Greece, Hungary, Indonesia, Italy, Japan, South Korea, Spain, Lithuania, Malaysia, Poland, Portugal, Romania, Russia, Sweden, Slovenia, Slovakia, Taiwan, and Ukraine.

[10] The subsidiary data used in our paper do not distinguish between greenfield foreign investment and mergers and acquisitions. However, our primary theoretical hypotheses and empirical approach are not dependent on the mode of multinational entry.

the entire population of firms. However, such census data are hard to obtain (usually subject to location and nationality restrictions and requirements) and nonexistent in many developing countries. The reason for the lack of data is simple: high costs and institutional restrictions prevent frequent collections of economic census for all the businesses existing in a country.

To assess the extent of coverage, in particular, with respect to small businesses, we compare the data against several benchmarks including, for example, the Structural and Demographic Business Statistics (SDBS) from the OECD. We find Orbis provides satisfactory coverage in many of the countries considered. For France, for example, the SDBS dataset reports that 84 and 91 percent of the enterprises have fewer than 10 and 20 employees, respectively, in 2007. Orbis reports 80 and 86 percent. The coverage for some countries seems highly satisfactory. For Sweden, SDBS reports close to 93 percent of the enterprises with fewer than 20 employees while Orbis shows 95 percent. For some other countries, Orbis tends to have a lower percentage of small firms. For Spain and Portugal, for example, the percentage of enterprises with fewer than 20 employees is 91 and 89 percent, respectively, in SDBS and 88 and 77 percent, respectively, in Orbis. The SDBS data does not include data for developing countries, but the numbers in Orbis seem comparable for some of the countries. For Argentina, for example, the share of enterprises with fewer than 20 employees was close to 90 percent (with INDEC showing 82 percent for Buenos Aires). For Latvia, it was close to 78 percent in Orbis while Eurostat reports 85 percent.

In Section 5, we further address potential issues with the data and data sampling in a number of ways, including, in particular, repeating our analysis for subsamples of countries with better data coverage.

Productivity: Estimation Methodology We use revenue, employment, asset, and material cost information to estimate each firm's total factor productivity, a primary variable of the paper. In particular, we use firms' financial data in the 2002-2007 period to derive estimates of production function and productivity.[11]

A key challenge in the measurement and identification of productivity relates to the endogeneity of the firm's optimal choice of inputs. Different estimation measures exhibit different advantages and limitations. As shown by Ackerberg, Caves, and Frazer (2015), the use of instruments based on lagged input decisions as the source of identification in structural estimation methods such as Olley and Pakes (1996) and Levinsohn and Petrin (2003) may be

[11] Revenue, asset, and material cost are deflated in the data. We obtained industry-level revenue, asset, and material cost deflators from the EU KLEMS, the OECD STAN database, and some other national data sources. For countries without industry-level deflators, we used national income and capital deflators. See Section 5.2 for discussions on the implications of unobserved price information and the robustness analysis.

associated with collinearity problems.[12]

We considered a variety of productivity estimation methodologies.[13] Ghandi et al. (2012), one of the most recent studies, use a transformation of the firm's first order condition for flexible inputs that does not require finding instruments for the flexible inputs or subtracting them from output. The transformation enables a nonparametric regression of the flexible input revenue share against all observed inputs to non-parametrically identify the flexible input's production elasticity and the ex-post shocks. We report our primary results based on these productivity estimates, but also show in Section 5.2 that the findings are qualitatively similar when other estimation methods such as Ackerberg, Caves, and Frazer (2015) are used.

We estimate production functions separately for each country group and industry and obtain the productivity of each firm based on country group-industry specific production function estimates. Four country groups, namely, high income, upper middle, lower middle, and low income, classified following the World Bank's income group definition are considered. In Figure 1, we show that multinational affiliate sales and host-country industry TFP exhibit a positive and significant relationship in both absolute levels and growth rates. Specifically, countries with greater growth rates of multinational activity experience, on average, greater TFP growth. In the empirical analysis, we divide the 6-year period into two sub-periods, 2002-2004 and 2005-2007, and investigate how new multinational entry affects host-country TFP growth.[14]

In addition to the productivity effect, we examine as well the effects of foreign multinational competition on domestic firms' revenue, employment, and survival. We also complement the analysis with two additional datasets in Section 5 to investigate how foreign multinational competition might influence domestic firms' innovation and product composition decisions. First, we use a cross-country patent application panel dataset obtained from Orbis which reports information such as patent name, international patent classification (IPC) code, patent application date, citing document, cited document, application outcome, current owner country code, and inventor country code. Following previous studies such as Aghion et al. (2009), Bloom et al. (2013) and Bloom, Draca and Van Reenen (2015), we use the number of patent applications filed by a domestic firm as a proxy for innovation. Second, we match the main

[12] Ghandi et al (2012) show that the methods suggested by Ackerberg, Caves, and Frazer (2006), and Wooldrige (2009), which are based on a quasi-fixed assumption on the inputs included in the production function, mantain the same identification problems.

[13] Van Biesebroeck (2008) and Syverson (2011) provide a comparison of several different productivity estimation methods and show them to produce similar productivity estimates.

[14] Table A.1 reports the summary statistics of the main variables. Compared to entry, we observe relatively few exits of multinational firms in the data. In the empirical analysis, we therefore focus on the effect of new entry.

data with another worldwide establishment-level database, Dun & Bradstreet's WorldBase, which reports, for each establishment, detailed location, 4-digit SIC codes of primary and up to five secondary products, global ultimate owner and headquarters, start year, and basic information such as employment and sales. Exploring over-time variations in establishments' product composition, we examine how domestic firms might undertake within-firm selection and reallocation by adjusting their product mix after facing foreign multinational entry.

4 Empirical Strategy and Evidence

In this section, we evaluate the hypotheses outlined in Section 2 and assess empirically the effects of increased multinational production. Following Section 2, our empirical strategy investigates the productivity effects of foreign multinational competition at both the within-firm margin and the between-firm margin. To account for the endogenous entry decision of multinational firms, the analysis proceeds in two steps. First, motivated by stylized theories and evidence on the role of firm productivity and financial shocks in foreign investment decisions, we examine the entry decision as a function of not only all time-variant country-pair industry factors but also multinationals' ex-ante productivity and changes in their real financial constraints to enter host countries. Multinationals that experience a positive financial shock due to, for example, increased investment returns in headquarters or an appreciation of headquarter-country currency are expected to have a reduced financial constraint in foreign investments—especially in host countries where entry cost had inhibited entry and the marginal value of the shock is large—and thus more likely to make new entry. But such idiosyncratic financial shocks, unlike other firm characteristics such as productivity or the level of cash flow, are unlikely to be directly correlated with the future productivity growth of host-country domestic firms, thereby offering an exclusion restriction for identifying the causal effects of multinational production. After accounting for the endogeneity of multinational entry, we explore the over-time changes in domestic firms' distributions to identify the distinct effects of greater multinational production.

4.1 The Entry Decision of Multinational Firms

We begin our empirical analysis by examining the entry of foreign multinational firms in the specification given below:

$$\Pr\left[entry_{mij}=1\right]=\Phi[\beta_1 \ln TFP_{mi}+ \tag{1}$$
$$\beta_2 \ln financial\ shock_{mi}+\beta_3 \ln financial\ shock_{mi}\cdot entry\ cost_j+\lambda_{ijs}+\varepsilon_{mij}],$$

where $entry_{mij}$ represents the binary decision of a multinational firm m headquartered in country i to invest in a given host country j, TFP_{mi} is the lagged productivity of the multinational firm estimated on the basis of headquarters activities in 2002-2004, $financial\ shock_{mi}$ is the change in the multinational firm headquarters' cash flow measured in the host-country PPP value, $entry\ cost_j$ is a measure of entry cost in the host country, and λ_{ijs} is a vector of country-pair-industry dummies that control for all country-pair-industry factors that could affect multinationals' entry decisions including the possibility that multinationals are attracted to host countries with higher productivity growth. Because we examine the entry decision in a single period, the time dimension is suppressed in the fixed effect. In addition, firm-level clustering is used to allow for correlations of errors within each firm. We also consider an alternative specification which includes in addition a firm fixed effect λ'_{mi} to control for all firm characteristics including TFP and financial shock.

As shown in Helpman, Melitz and Yeaple (2004), firms with a large productivity draw should be more likely to enter new host countries. Moreover, firms' financial shock at their headquarters will influence their financial constraints to invest abroad and is also expected to affect multinationals' entry decisions. Multinationals that experience idiosyncratic positive cash flow shocks at headquarters, due to, for example, increased investment returns or an appreciation of headquarter-country currency, see a decrease of financial constraints in foreign investments and are thus more likely to enter new host countries. But these idiosyncratic cash flow shocks of multinational firms, in contrast to other multinational characteristics such as productivity and size, are unlikely to be directly correlated with the future productivity growth of individual host-country domestic firms, thereby serving as a suitable exclusion restriction in the second stage to identify the causal effects of multinational production.

The role of financial shocks in multinationals' ability to overcome financial constraints and engage in new FDI has been shown in an extensive empirical literature. Froot and Stein (1991) find that a devaluation of a host-country's currency will increase the volume of M&As by otherwise financially-constrained foreign multinational firms, a finding that is similarly shown in

Blonigen (1997). Klein, Peek, and Rosengren (2002) examine how FDI can be constrained by weak conditions in the source-country banking sector and show that Japanese multinational firms that are tied to less healthy banks were less likely to invest abroad during the banking sector crises in Japan in the 1990s. Desai, Foley, and Hines (2004) investigate how poor financial institutions restrict multinationals' access to external capital in some jurisdictions and lead them to rely more on internal capital markets. Exploring multinationals' source-country stock market performance, Baker, Foley and Wurgler (2009) find that FDI flows increase substantially with source-country stock market valuations and suggest that FDI flows reflect, in part, increases in low-cost capital available to multinational firms in the source country. Erel, Liao and Wisbach (2012) similarly find that firms in countries whose stock market has increased in value or currency has recently appreciated and firms that have a relatively high market-to-book value tend to engage in FDI while firms from weaker-performing economies tend to be targets. Bilir, Chor and Manova (2014) evaluates the role of host-country financial development in the operations of multinational firms and show that host-country financial development increases entry by multinational affiliates, due to a financing effect that encourages multinational entry and activity in the host country through improved access to external capital. The above evidence offers strong support to the importance of financial constraints and shocks in multinationals' foreign investment decisions.[15]

The effect of positive financial shocks on entry may, however, vary across host countries depending on the level of entry cost multinational firms face. We thus interact the firm-level financial shock variable with a country-specific entry cost variable.[16] As as in Helpman, Melitz and Rubinstein (2008), we use country-level data on the regulation costs of firm entry by Djankov et al. (2002) measured as the number of legal procedures required to legally start operating a business.

Table 1 reports the estimation results.[17] We find that, as expected in Section 2, more productive firms exhibit a greater likelihood of entering foreign countries, a result consistent with, among many others, Helpman, Melitz and Yeaple (2004), Yeaple (2009), and Chen and Moore (2010). Further, firms that experience a positive financial shock are more likely to enter new host countries, especially new countries where the marginal value of the financial shock is sufficiently large for overcoming entry cost. These findings are robust to the inclusion of host-country-industry, country-pair-industry, and firm fixed effects, which control for all

[15] See Froot and Dabore (1999) and Foley and Manova (2015) for overviews of the evidence.

[16] We thank a referee for this suggestion.

[17] We use a linear probability model to avoid the incidental parameter problem that arises in fixed-effect maximum likelihood estimators.

time-variant and time-invariant country-industry and country-pair-industry factors and all time-invariant multinational firm characteristics. We also assess the predictive ability of the instrument by performing weak identification tests and rejected the null hypothesis of weak identification.[18] Based on the estimates, we then obtain the predicted probability of entry for each multinational firm in a given host country and the expected number of new multinational firms in each host country, the latter to be used in the following analysis.

Now we move on to evaluate the effect of multinational production on host-country domestic firms, taking into account the endogenous entry of multinational firms.[19] We first estimate the net effect of new multinational entry on the average productivity of domestic firms. Table 2 shows that multinational production exerts, on average, a positive and significant effect on the average productivity of domestic firms, taking into account the endogeneity of multinational entry.

There are, however, two important considerations behind these estimates. First, comparing the OLS and the instrumented results, we find that failure to account for the endogenous entry of multinational firms can lead to an over-estimation of the effect of multinational production. According to column (2), a one-standard-deviation increase in the probability of new multinational entry is associated with a 0.03-standard-deviation increase in average domestic productivity, as opposed to a 0.05-standard-deviation increase according to the OLS results.[20] Second, as described in Section 2, increases in average domestic productivity can arise from both within-firm productivity improvement and between-firm selection and reallocation. Looking at the relationship between multinational production and average domestic productivity alone does not allow us to distinguish between the two sources of productivity gains. We therefore proceed below to assess their relative importance by examining the impact of multinational entry on the distributions of domestic firms in dimensions including productivity, revenue, employment, and survival probability.

4.2 Within-Firm Productivity Improvement

First, consider the potential within-firm productivity effect of foreign multinationals, which would shift the productivity distribution of surviving domestic firms rightward as discussed in

[18] See Staiger and Stock (1997) and Stock and Yogo (2005) for references on the weak identification tests and the critical values for F statistics.

[19] Given that firm productivity and MNC entry are both obtained from first-stage estimations, we bootstrap the standard errors in all the estimations.

[20] We also performed the Hausman test on the second-stage regressions and found presence of endogeneity in the OLS results.

Hypothesis 1. Given that the effects of foreign multinational competition could vary along the distribution of domestic firms as discussed in Section 2, we estimate the following equation by either using a pooled sample of domestic firms or dividing domestic firms into four bins based on quartiles of the distribution of initial productivity:[21]

$$\Delta \ln TFP_{kj}(q) = \gamma_{TFP}(q)\widehat{entry}_j + \delta_{TFP}X_{kj} + \lambda_j + \lambda_s + \epsilon_{kj} \tag{2}$$

where $\Delta \ln TFP_{kj}$ is the log productivity change of domestic firms k in the qth bin of country j between 2002-2004 and 2005-2007, $entry_j$ is an indicator of multinational entry in country j (in a given industry), and X_{kj} represent firm characteristics including lagged firm revenue and age. Note that, in the above as well as the following equations, we control for all time-invariant country-industry factors by essentially taking the first difference and exploring the changes in each outcome variable. In addition, we include separate fixed effects in the first-differenced equations to control for all time-variant country and industry characteristics including macroeconomic factors like economic growth, domestic policies, and exchange rates and industry factors like factor intensities. Country-industry clustering is also used to allow for correlations of errors within each cluster. In the above and all the following estimating equations, we account for the endogeneity of $entry_j$ with an instrumented number of multinational entry $\widehat{entry}_j$ obtained from the first stage.

Table 3 reports the results. The estimates suggest that a higher probability of new multinational firms, on average, increases the within-firm productivity of domestic firms. An increase in the probability of new multinational entry by 100 percentage points is associated with an average 1.5-percent rightward shift of the productivity distribution. This effect is witnessed throughout the productivity distribution for domestic firms with different levels of initial productivity, but stronger at the left tail of the productivity distribution. Domestic firms with the lowest productivity are shown to experience the greatest productivity improvement.

4.3 Between-Firm Selection

Next, we examine the between-firm selection and reallocation effects. Section 2 suggests that the productivity cutoff for domestic firm survival rises after the entry of new multinational firms. Consequently, the probability of survival diminishes especially for firms with low initial

[21] Lileeva and Trefler (2010) similarly assign domestic firms to four different bins based on their initial productivity and document heterogeneous firm responses to export market access.

productivities. We examine this hypothesis in the following specification:

$$\Pr\left[survival_{kj}(q)=1\right]=\Phi\left[\gamma_s(q)\widehat{entry}_j+\delta_s X_{kj}+\lambda_j+\lambda_s+\epsilon_{kj}\right], \tag{3}$$

where the dependent variable $survival_{kj}$ indicates whether a domestic firm k in the qth bin survived in the domestic market j in the second sub-period 2005-2007. Again, we include lagged firm characteristics, vectors of country and industry dummies, and country-industry clustering to allow for correlations of errors within each cluster.

Table 4 reports the results. We find that a greater probability of new multinational production exerts a negative and significant effect on the survival probability of domestic firms. Domestic firms are more likely to exit the market in the presence of new multinational entry. The tougher selection effect is, as anticipated in Hypothesis 2, particularly strong at the left tail of the productivity distribution and insignificant at the right tail of the productivity distribution. The least productive domestic firms are most likely to exit after new multinational entry while the survival rate of the most productive domestic firms are shown to be unaffected.

We also consider an alternative specification to examine the between-firm selection hypothesis by estimating:

$$\ln TFP_{kj}=\alpha_s survival_{kj}+\alpha_s' survival_{kj}\cdot\widehat{entry}_j+\lambda_j+\lambda_s+\epsilon_{kj}, \tag{4}$$

where TFP_{kj} is the ex-ante 2002-2004 productivity of firm k in country j and $survival_{kj}$ is a binary indicator of whether firm k survived in the domestic market j in 2005-2007. If multinational entry leads to tougher selection on domestic firms, α_s' is expected to be positive.

As shown in Table 5, we find again significant evidence of a tougher selection from multinational entry. Not only are surviving domestic firms, on average, more productive than exiting domestic firms, the ex-ante productivity difference between the two groups is 19.7 percent greater when there is a 100-percentage-point higher probability of a new multinational entry. The selection effect is also reflected in terms of the ex-ante revenue difference between surviving and exiting firms. Surviving firms are, on average, greater than exiting firms ex ante, especially in cases of multinational entry.[22]

[22] Given the expectation that foreign multinational entry will raise the left truncations of the domestic firm distributions, we also examined how foreign multinational entry affects the cutoff productivity and cutoff revenue in a given country and industry. There are a number of ways to define cutoff productivity (and similarly cutoff revenue) in a country and industry, including the minimum productivity of surviving firms, the maximum productivity of exiting firms, or less strict measures such as the productivity of the bottom 10th-percentile of surviving firms and the mean productivity of the bottom 10 percent of surviving firms. We considered all the above definitions and found that a higher probability of multinational entry leads to a significant increase in the cutoff productivity as well as cutoff revenue of surviving domestic firms. This result

4.4 Between-Firm Factor and Product Market Reallocation

Now we evaluate the between-firm market reallocation effects. Hypothesis 3 in Section 2 suggests that the increased labor demand by foreign multinational firms will shift leftward the employment distribution of domestic firms especially at the left tail and bid up the wage rate. We examine this hypothesis by estimating the following equation

$$\Delta labor_{kj}(q) = \gamma_l(q)\widehat{entry}_j + \delta_l X_{kj} + \lambda_j + \lambda_s + \epsilon_{kj} \tag{5}$$

where $\Delta labor_{kj}(q)$ is the change in the employment share of a domestic firm k in the qth bin.

As shown in Table 6, we find that new multinational entry leads to a decrease in the average employment share of domestic firms and shifts the distribution leftward. This effect, again especially strong for the least productive domestic firms and insignificant for the most productive domestic firms, lends direct support to the prediction on labor market reallocation. The least productive domestic firms suffer the greatest declines in employment after the entry of foreign multinational firms, while the employment in medium-productivity domestic firms also falls, albeit not as drastically. A 100-percentage-point increase in the probability of a new multinational entry is associated with a 4.6-percent decrease in the employment share of the lowest-productivity group. In sharp contrast, the most productive domestic firms see a positive, though statistically insignificant, effect on employment shares.

We also consider the average wage rate of domestic firms. Section 2 predicts an increase in wage rate as a result of increased labor demand by foreign multinational firms. To examine this hypothesis, we compute the average unit labor cost for domestic firms in each country and industry. As shown in Table 7, we find that a 100-percentage-point increase in the probability of new multinational entry leads to a 2.9-percent increase in average wage rate.

Now consider the revenue reallocation effect of foreign multinational competition. Hypothesis 4 in Section 2 suggests that when there is insufficient within-firm productivity improvement, greater multinational production will shift the revenue distribution of domestic firms leftward, especially at the left tail. We therefore consider the following specification:

$$\Delta revenue_{kj}(q) = \gamma_r(q)\widehat{entry}_j + \delta_r X_{kj} + \lambda_j + \lambda_s + \epsilon_{kj} \tag{6}$$

where $\Delta revenue_{kj}(q)$ is the change in the revenue share of a domestic firm k in the qth bin.

Table 8 shows that new multinational entry leads to a decrease in the average revenue share of domestic firms, especially for the least productive firms. A 100-percentage-point

offers further evidence on the between-firm selection effect of foreign multinational competition.

increase in the probability of new multinational entry is associated with a 2-percent decrease in domestic firms' average revenue share and a 3.6-percent decrease in revenue share for the lowest-productivity group. The revenue share of the most productive domestic firms, again, is not significantly affected. This result suggests that the positive within-firm TFP effect of multinational entry is more than offset by the negative factor market reallocation effect, resulting in a reallocation of product market share from domestic to multinational and from the less productive to the more productive domestic firms. Table 9 summarizes the above estimated effects of multinational entry on the various distributions of domestic firms.

5 Discussion and Sensitivity Analysis

5.1 Data Coverage

The dataset used in our empirical analysis spans over 30 developed and developing countries. While this enables us to evaluate the productivity gains from multinational production based on a broad set of countries, the estimates can be affected by the data coverage across countries. For example, national public registries, an important source of our data, vary in their data reporting criteria. Some registries impose certain minimum-size criteria on, for example, revenue, censoring the data on the left tail. Such data censoring issues would make it difficult to identify the selection and market reallocation effect at the left tails of the productivity, revenue and employment distributions where there is likely little change over time.

In this subsection, we address possible data sampling issues by focusing on countries with arguably relatively comprehensive data coverage. We restrict the analysis to the top 5 countries with the largest number of domestic firms, namely, China, Spain, France, Italy and Romania. Our earlier results remain qualitatively robust. For example, the productivity distribution of domestic firms shifts rightward by 2.1 percent when there is a 100-percentage-point increase in the probability of multinational entry (the first panel of Table 10).

5.2 Measure of Productivity

In our main analysis, we estimate firm productivity using a new methodology developed by Ghandi et al. (2012). We have also compared our results using other productivity estimates. Recent literature on production function estimations suggests that the use of instruments based on lagged input decisions as the source of identification in structural estimation methods such as Olley and Pakes (1996) and Levinsohn and Petrin (2003) may be associated with collinearity and functional dependence problems. Ackerberg, Caves and Frazer (2015) suggest

an alternative approach that does not suffer from the functional dependence problems and produces consistent estimates under alternative data generating processes. In the second panel of Table 10, we report our results on the productivity distribution using their methodology and find qualitatively similar results. In fact, the findings call for an upward adjustment in the relative importance of between-firm selection and market reallocation.

As in most empirical work that exploits productivity estimates, we do not observe firm-level physical output quantities and prices. This information is especially difficult to obtain for the large cross-section of countries considered in this paper. We therefore estimate firm productivity based on the output value (instead of physical output) produced by each firm, given its inputs.[23]

It is important to note, however, the central, broader point we emphasize in this paper—that between-firm selection and reallocation could be an important source of gains from multinational production—is established by exploring various other characteristics—such as revenue, employment, wage rate, and survival—of domestic firms and thus does not depend on the measures of productivity. Considering within-firm productivity improvement as the only mechanism by which countries realize productivity gains from multinational production would lead to a biased understanding of both the nature and the magnitude of the gains, even if physical output or true productivity were observed.

Next, we discuss the empirical implications when the productivity measure is systematically correlated with firm prices and markups. Melitz and Ottaviano (2008) show that in a variable-markup setup increased competition should induce a downward shift in the distribution of markups across firms (even in the absence of labor reallocation). They find that, although only relatively more productive firms survive (with higher markups than the less productive firms that exit), the surviving firms' distributions of markups and prices should shift downward. This prediction suggests that the estimates of within-firm productivity improvement in our paper, derived on the basis of the shift of the revenue-based productivity distribution, could be biased downward if the distribution of productivity partly reflects the distribution of markups.

Given the difficulty of obtaining the data required for measuring output-based productivity, one of the solutions suggested in the literature is to focus on homogeneous goods. In industries with relatively homogeneous products, the concern that revenue-based productivity

[23] Note that even if price or physical output information were observed, the relationship between prices and markups would still be unclear. Higher prices can reflect higher quality, instead of higher markups. De Loecker (2011) introduces a methodology that uses detailed product-level information to recover the markups and the output-based productivity of firms. However, this approach requires specific assumptions regarding the mechanisms through which demand shocks affect prices and productivity.

is systematically correlated with prices or markups is mitigated. The shift of the productivity distribution is more likely to reflect changes in productivity. We hence re-estimate the within-firm productivity effect for industries that are classified as relatively homogeneous by Rauch (1999). We find the results to remain qualitatively similar (the third panel of Table 10). The within-firm productivity of domestic firms improves, on average, by 2.1 percent when the probability of new multinational entry increases by 100 percentage points in these industries. The productivity distribution shifts rightward especially for the least productive domestic firms.

5.3 Sources of Within-Firm Productivity Improvement

Our analysis so far suggests that domestic firms tend to experience, on average, a within-firm productivity upgrading. However, this within-firm productivity upgrading could arise from various channels. As described earlier, a large volume of empirical literature emphasizes one particular source, that is, positive productivity spillover from foreign multinational to domestic firms. However, there may exist other plausible channels such as domestic firms' self upgrading through within-firm resource reallocation. While the latter possibility has been explored in the context of trade liberalization, there exists relatively little evidence in the context of foreign multinational competition.

In this subsection, we illustrate two possible mechanisms by examining specifically the impacts of foreign multinational production on domestic firms' innovation and product composition. First, we use a cross-country patent application panel dataset obtained from Orbis which reports information such as patent name, international patent classification (IPC) code, patent application date, citing document, cited document, application outcome, current owner country code, and inventor country code. We compute the number of patent applications filed by each domestic firm in a given year and use it as a proxy for innovation as in many previous studies such as Aghion et al. (2009), Bloom et al. (2013) and Bloom, Draca and Van Reenen (2015). The first panel of Table 11 shows that new multinational entry leads to an increase in patenting activities; a 100-percentage-point increase in the probability of multinational entry is associated with a 0.4-percent increase in the number of patent applications.[24] This effect is especially strong for the lowest two bins of domestic firms.[25]

[24] Similar to our findings, Bloom, Draca and Van Reenen (2015) document prompt patenting responses to import competition from China. An alternative interpretation of the result is that firms may simply be applying for more patents to protect their existing knowledge in response to greater foreign competition. If that is the case, the average quality of patents is likely to fall. To examine this effect, we followed Bloom, Draca and Van Reenen (2015) by looking at average citations per patent and did not find that is the case.

[25] The documented increase in patenting could be attributed to either productivity spillover or self-upgrading

Second, we examine how domestic firms might respond to foreign multinational competition by adjusting product composition, using rich establishment-level product data from Dun & Bradstreet's WorldBase Database which reports detailed information on the primary and secondary products of establishments across countries. As shown in the second panel of Table 11, we find that domestic firms are, on average, 0.2 percent more likely to drop products after facing a 100-percentage-point higher probability of foreign multinational entry. This result, similar to the effect on the productivity distribution, is again strongest for the least productive domestic firms and consistent with theories in the trade literature (e.g., Bernard, Redding and Schott, 2010; Eckel and Neary, 2010; Bloom et al., 2013; Nocke and Yeaple, 2014; Mayer, Melitz and Ottaviano, 2014), suggesting that foreign multinational competition motivates domestic firms, especially those of the lowest productivity, to drop products and reallocate resources towards more efficient products.

5.4 The Interdependence of Productivity and Reallocation Effects

It is worth noting that the within-firm productivity upgrading and between-firm reallocation effects could be interdependent. The extent of productivity upgrading by surviving firms can determine the extent of the reallocation effect. Similarly, the competition impact of multinationals in factor and product markets can influence the incentives of domestic firms to innovate or enhance capacity to absorb technology spillover from the presence of foreign MNCs.

In this section, we perform several exercises to explore the potential interdependence between the productivity and reallocation effects of foreign multinational competition. First, we re-group domestic firms to four bins according to the extent of within-firm productivity upgrading instead of initial productivity levels and examine how the revenue effect might differ across the bins. As shown in Table 12, we find that domestic firms experiencing the least productivity upgrading witness the greatest declines in revenue shares while domestic firms with the greatest productivity upgrading see insignificant revenue effects.

Second, we re-group domestic firms based on their industries' R&D and skilled-labor intensities. It is plausible that domestic firms in R&D intensive and skilled-labor intensive

in response to competition threats. The latter response has received growing attention in the context of trade liberalization. Lileeva and Trefler (2010) investigate the effect of U.S. tariff cuts on Canadian plants' export and productivity growth and find lower-productivity Canadian plants that were induced to export by the tariff cuts tend to increase labor productivity and product innovation. Examining the impact of MERCOSUR, Bustos (2011) shows that Argentinean firms in industries facing higher reductions in Brazil's tariffs upgrade technology faster. Bloom, Draca and Van Reenen (2015) investigate the impact of Chinese import competition and find that productivity increases among European firms that are most affected by Chinese imports.

industries have a greater scope for productivity upgrading and are hence more likely to have a smaller, partly offset reallocation effect. Table 13 shows consistent evidence. The negative market reallocation effect is significantly weaker in industries whose R&D intensity and skilled-labor intensity are above the median.

While the above exercises offer illustrative evidence, we also adopt an alternative approach to further disentangle the different mechanisms and their interactions by differentiating foreign multinational activity in a domestic firm's product space, technology space, and labor space. The first measure, foreign multinational entry in product space, is aimed to capture the degree of foreign multinational competition present in the product space where a domestic firm operates, measured by the average probability of new foreign multinational entry across a domestic firm's product mix.

The second measure, foreign multinational entry in technology space, seeks to capture the degree of foreign multinational entry that has the greatest potential to influence domestic firms' productivity upgrading and offset the market reallocation effect. To construct this measure, we compute a proxy of technology linkage across industries frequently considered in the productivity spillover literature (see, for example, Jaffe et al., 2000; Ellison, Glaeser and Kerr, 2010), using patent citation flow data taken from the NBER Patent Database. The data, compiled by Hall et al. (2001), includes detailed records for all patents granted by the United States Patent and Trademark Office (USPTO) from January 1975 to December 1999. Each patent record provides information about the invention (such as technology classification and citations of prior art) and about the inventors submitting the application (such as name and city). We construct a technology linkage variable, that is, $technology_{s\widetilde{s}}$, by measuring the extent to which technologies in industry s cite technologies in industry $\widetilde{s}$.[26] We then compute, for each domestic firm, the sum of foreign multinational entry in a domestic firm's technology-linked industries, i.e., industries cited by the domestic firm's own industry, weighted by the share of citations.

The third measure, foreign multinational entry in labor space, captures the degree of foreign multinational entry most plausible to influence a domestic firm's labor market and includes foreign multinational activities in industries that share similar labor demand as a given domestic firm. Foreign multinational activity in related labor space, on the one hand, is most likely to exert a labor market reallocation effect on domestic firms, while, on the other hand, constituting a possible source of knowledge spillover given the similar labor skill requirements. We compute a measure of an industry-pair's similarity in occupational labor requirements,

[26] The concordance between the USPTO classification scheme and SIC3 industries is adopted in the construction of the variable.

Labor similarity$_{ss'}$. Industries with greater similarity in occupational labor structure are expected to share greater reallocation as well as externality effects in labor markets. We use the Bureau of Labor Statistics 2006 National Industry-Occupation Employment Matrix (NIOEM), which reports industry-level employment across detailed occupations. As in Ellison et al. (2010), we convert occupational employment counts into occupational percentages for each industry and measure the correlation of each industry pair s and s' in occupational percentages. We then calculate the weighted sum of foreign multinational entry in industries that share similar labor demand to the domestic firm using industry-pair correlations in occupation structure as weights.[27]

Table 14 examines how foreign multinational entry in the above three types of space affects, respectively, the productivity, employment, and revenue of domestic firms. We find that foreign multinational entry in domestic firms' product space exerts a negative and significant effect on domestic firms' average revenue share and average employment share, but an insignificant effect on domestic firms' within-firm productivity. This result suggests that foreign rivalry in product space leads to primarily a negative market reallocation effect on domestic firms. In contrast, foreign multinational entry in domestic firms' technology space positively and significantly affects domestic firms' productivity as well as employment and revenue, implying that productivity upgrading via technology linkages with new foreign multinationals can offset the reallocation effect. Finally, foreign multinational entry in domestic firms' labor space leads to a positive effect on domestic firm productivity, consistent with the knowledge spillover hypothesis, a negative effect on domestic firm employment share, as expected from the labor reallocation hypothesis, and overall a positive effect on domestic firm revenue share. These findings offer strong further support to the three different mechanisms through which foreign multinational firms could influence domestic firms' market performance.[28]

[27] Constructing the industry-relatedness measures using U.S. industry account data is motivated by two considerations. First, the measures reflect standardized production technologies and are relatively stable over time. Second, the measures require detailed factor demand information and the U.S. industry account data are more disaggregated than those of most other countries.

[28] We also explored how foreign multinational entry in industries with input-output linkages might affect domestic firms' within-firm productivity upgrading. Numerous studies led by Javorcik (2004) find evidence of productivity spillover from foreign firms to domestic firms through vertical production linkages. Following Javorcik (2004), we constructed two variables, *backward linkage* and $forward\ linkage$, to measure, respectively, the share of a downstream industry's inputs from an upstream industry and the share of an upstream industry's output used in a downstream industry using the 2002 Benchmark Input-Output Accounts published by the Bureau of Economic Analysis. We then interacted the two variables with predicted multinational production in each industry and compute the weighted sum of multinational production in downstream and upstream industries, respectively. Our results, consistent with existing studies, suggest significant productivity spillovers from downstream foreign multinational firms to upstream domestic firms and vice versa.

5.5 The Role of Trade

Our empirical analysis so far controls for all time-invariant country-industry factors by taking first differences of the key firm performance measures (for example, productivity and revenue) between the two sub-periods and all time-variant country factors as well as time-variant industry characteristics through the use of fixed effects. Still, a possible concern that could arise is that observed changes in domestic productivity and revenue distributions might be driven by other factors such as export and import growth. For example, greater import competition could similarly lead to a leftward shift of the revenue distribution. Increases in export activity, on the other hand, could shift both productivity and revenue distributions rightward when there is significant learning by exporting.

We adopted two strategies to address this concern. First, we accounted for the endogeneity of multinational entry in the first stage by instrumenting with multinationals' ex-ante cash flow shock. Our analysis shows that foreign multinational entry exerts significant within-firm productivity and between-firm reallocation effects even when we take into account the potential endogeneity issue. Second, we explicitly controlled for export and import growth in host-country industries. We obtained cross-country industry-level export and import data from the UN COMTRADE and computed the export and import growth rates between 2002-2004 and 2005-2007. We found that controlling for the role of trade slightly lowers the estimated effect of multinational entry on the productivity distribution.

On a related note, one may consider that differences across horizontal, vertical, and export-platform FDI might affect the productivity impact of multinational production through the role of trade. As market reallocation can result from all types of FDI, our main qualitative point—that market reallocation constitutes an important source of productivity gains from multinational production—should remain valid. However, we acknowledge that the degree of product market competition, relationships with domestic upstream and downstream industries, and productivity spillover might depend on the final market of foreign multinationals (see, among others, Markusen and Venables, 1999; Markusen, 2002, for related theoretical work). As in the case of most cross-country firm-level datasets, Orbis does not report intra-firm trade data to differentiate between the different types of FDI. One alternative is to use input-output tables and industry codes to identify potential production linkages between MNC headquarters and subsidiaries (as in Alfaro and Charlton, 2009). However, this would not be able to distinguish export-platform FDI from the rest. Assessing the gains from different types of FDI thus remains an important topic of research that could be advanced by availability of cross-country intra-firm trade data.

6 Quantifying and Decomposing Aggregate Productivity Impact

In this section, we quantify the aggregate as well as the decomposed productivity effects of greater multinational production. Specifically, we follow Pavcnik (2002) by decomposing domestic firms' weighted aggregate productivity measure $\widetilde{TFP}_t^D$ into two parts: the unweighted aggregate productivity measure $\overline{TFP}_t^D$ and the total covariance between a firm's share of the industry output s_{kt} and its productivity TFP_{kt}:

$$\widetilde{TFP}_t^D = \sum_k^D s_{kt} TFP_{kt} = \overline{TFP}_t^D + \sum_k^D (s_{kt} - \overline{s}_t)(TFP_{kt} - \overline{TFP}_t^D). \tag{7}$$

Comparing domestic firms' weighted aggregate productivity measure $\widetilde{TFP}_t^D$ in two periods yields:

$$\Delta\widetilde{TFP}_t^D = \Delta\overline{TFP}_t^D + \Delta\sum_k^D (s_{kt} - \overline{s}_t)(TFP_{kt} - \overline{TFP}_t^D).$$

Given that we abstract from new entering firms in the analysis, the above equation can be further written as:

$$\begin{aligned}\Delta\widetilde{TFP}_t^D \;=\; & \underbrace{\left(\overline{TFP}_t^{D,surviving} - \overline{TFP}_{t-1}^{D,surviving}\right)}_{within-firm} + \underbrace{\left(\overline{TFP}_{t-1}^{D,surviving} - \overline{TFP}_{t-1}^{D}\right)}_{between-firm\ selection} \\ & + \underbrace{\Delta\sum_k^D (s_{kt} - \overline{s}_t)(TFP_{kt} - \overline{TFP}_t^D)}_{between-firm\ reallocation}.\end{aligned} \tag{8}$$

The first component on the right hand side, $\overline{TFP}_t^{D,surviving} - \overline{TFP}_{t-1}^{D,surviving}$, represents the contribution of within-firm productivity improvement (among surviving domestic firms) to the aggregate domestic productivity and is positive as we show in Section 4.2 that multinational entry induces significant within-firm productivity improvement. In particular, we find that a 100-percentage-point higher probability of multinational entry leads to, on average, 1.5 percent increase in within-firm productivity. The second component, $\overline{TFP}_{t-1}^{D,surviving} - \overline{TFP}_{t-1}^{D}$, represents the contribution of the selection effect to the aggregate domestic productivity. Given that in Section 4.3 we find that more productive domestic firms are more likely to survive after multinational entry and, in particular, the average productivity of surviving firms is 19.7 percent higher than that of exiting firms when the probability of a multinational entry is 100 percentage points higher, this second term is positive as well. The third component, $\Delta\sum_k^D (s_{kt} - \overline{s}_t)(TFP_{kt} - \overline{TFP}_t^D)$, represents the contribution of the market reallocation effect to the aggregate domestic productivity. In Section 4.4, we find significant

evidence of market reallocation as the least productive domestic firms experience the sharpest decline in revenue share. To evaluate the magnitude of the reallocation effect, we compute $\Delta \sum_k^D (s_{kt} - \overline{s}_t)(TFP_{kt} - \overline{TFP}_t^D)$ at the country-industry level and find the covariance to be, on average, 2 percent greater when there is a 100-percentage-point higher probability of multinational entry.

The above analysis shows that between-firm selection and reallocation alone account for two thirds of aggregate productivity gains from foreign multinational entry, while within-firm productivity improvement by itself accounts for one third. These results highlight that a substantial share of productivity gains are channeled through between-firm selection and reallocation. Further, since the analysis also suggests that within-firm productivity upgrading could similarly occur through within-firm selection and reallocation whereby domestic firms respond to foreign multinational competition by reallocating resources to focus on competitive products, the overall importance of selection and market reallocation can be even greater when the within-firm margin is also accounted for. Ignoring this channel could therefore drastically bias our understanding of the origin and the magnitude of the productivity gains from multinational production.

Finally, we account for the productivity of foreign multinational firms i.e., $\widetilde{TFP}_t^M$ and assess its direct contribution to a host country's aggregate productivity. By comparing the productivity of multinational firms with that of domestic firms, we find that multinational firms exhibit, on average, a 23-percent productivity premium compared to domestic firms. This, combined with the average market share extracted by foreign multinational firms after entry, leads to a 3-percent contribution to the aggregate productivity.

7 Conclusion

Assessing productivity gains from greater openness to multinational production has been a fundamental topic of economic research. A primary challenge in empirical investigations is to distinguish the sources of productivity gains, including gains from within-firm productivity improvement and gains from between-firm selection and reallocation. However, this task cannot be accomplished by simply examining the relationship between multinational production and host-country average productivity, as both channels predict a positive relationship. We therefore utilize an intuitive empirical framework motivated by stylized theories from Melitz (2003) and Helpman, Melitz and Yeaple (2004) which explores the variations in how the two channels influence the distributions of domestic firms in dimensions including productivity,

employment, revenue and survival.

Using a rich cross-country firm panel dataset, we find that within-firm productivity improvement and between-firm selection and reallocation are two significant but distinctly different sources of productivity gains from multinational production. The productivity distribution of domestic firms is shown to shift rightward after foreign multinational entry, suggesting within-firm productivity improvement among surviving domestic firms. In contrast, the revenue and employment distributions of domestic firms are found to shift leftward especially at the left tail, as anticipated by the effects of increased competition and reallocation in factor and product markets. The least productive domestic firms are most likely to exit and be crowded out of the market, indicating a tougher selection on domestic firms. Consistent with the labor market competition hypothesis, the average wage of domestic firms is found to rise after foreign multinational entry. Further, we find that domestic firms, especially, those with the lowest productivity, are more likely to drop products after facing foreign multinational entry, suggesting that increased foreign competition can also lead to within-firm selection and reallocation. Our analysis also shows that within-firm productivity response and between-firm reallocation could be interdependent. Domestic firms experiencing greater productivity upgrading tend to witness smaller declines in revenue shares. When constructing alternative measures to directly capture foreign multinational entry in a domestic firm's product space, technology space, and labor space, we find consistent effects of foreign multinational competition channeled through product rivalry, technology linkage, and labor market.

In quantifying the productivity gains from multinational production, we find based on our preferred estimations that between-firm selection and reallocation alone account for two thirds of aggregate productivity gains from foreign multinational entry, while within-firm productivity improvement by itself accounts for one third. Since the analysis suggests that within-firm productivity gain could also occur through within-firm selection and reallocation whereby domestic firms respond to foreign multinational competition by reallocating resources to focus on competitive products, the overall importance of selection and market reallocation becomes even greater when the within-firm margin is also accounted for. These results suggest that it is critical to take into account the role of selection and reallocation when assessing the productivity gains from multinational production. Ignoring this source can lead to a biased understanding of the nature and the magnitude of the productivity gains, with consequent biases in the design of FDI and industrial policies.

Two potential extensions of our analysis are worthy of particular attention. First, the effects of multinational production might take a longer term to fully realize in domestic

economies. Our estimates thus capture the lower bound of the total productivity gains from multinational production due to the time length of the available data. It would be useful to investigate the long-run impact of multinational competition when longer time-series data are available. Second, future work could explore the heterogeneous gains from multinational production across countries. For example, how might domestic labor-market rigidities and financial markets affect the extent of factor market reallocation and the subsequent productivity effects of multinational production? How might the different levels of domestic human capital and technology stock across host countries influence the degree of gains from productivity spillover? Such analysis on the role of economic and institutional characteristics in determining countries' gains from multinational production will provide additional research and policy insights.

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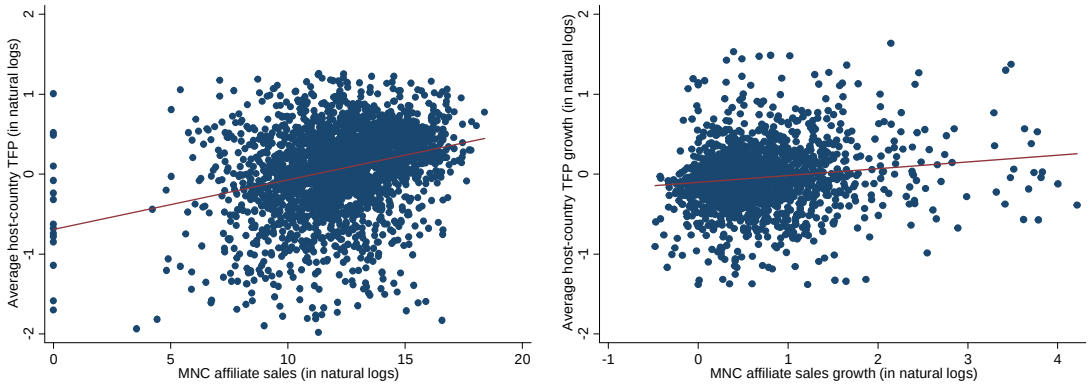

Figure 1: The relationship between multinational production and host-country TFP

Table 1: The Entry Decision of Multinational Firms (Firm-Country Level)

Dependent variable:	(1) MNC entry	(2) MNC entry	(3) MNC entry
HQ TFP	0.002***	0.002***	–
	(0.001)	(0.001)	
Financial shock	0.001***	0.001***	–
	(0.0004)	(0.0004)	
Financial shock x	-0.0003***	-0.0003***	-0.0004***
Entry Cost	(0.0001)	(0.0001)	(0.0002)
Host-country-ind FE	Yes	Yes	Yes
Country-pair-ind FE	No	Yes	Yes
Firm FE	No	No	Yes
Obs	372,274	372,274	372,274
R square	0.04	0.05	0.06
F Statistic	28.97	35.23	50.41
Prob>F	0.00	0.00	0.00

Notes: (i) Linear probability (LP) estimates are reported; (ii) standard errors clustered at the firm level are reported in the parentheses; (iii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 2: Multinational Entry and Change in Average Productivity (Country-Industry Level)

Dependent variable:	(1) Change in ave TFP	(2) Change in ave TFP
MNC entry	0.010***	
	(0.003)	
MNC entry (predicted)		0.026**
		(0.015)
Beta coefficients	0.05	0.03
Host-country FE	Yes	Yes
Industry FE	Yes	Yes
Obs	3,751	3,751
R square	0.52	0.52

Notes: (i) Columns (1) and (2) report OLS and instrumented estimates, respectively; (ii) bootstrapped standard errors are reported in the parentheses; (iii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 3: The Shift of Domestic Productivity Distribution

Depdendent var.:	(1)	(2)	(3)	(4)	(5)
Change in TFP	All	Bin 1 (<25%)	Bin 2 (25-50%)	Bin 3 (50-75%)	Bin 4 (>75%)
MNC entry (predicted)	0.015***	0.021***	0.014***	0.015***	0.010***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Lagged revenue	-0.016***	-0.072***	0.019***	0.011***	0.002***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Age	-0.082***	-0.181***	-0.073***	-0.048***	-0.027***
	(0.001)	(0.004)	(0.003)	(0.002)	(0.002)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	388,006	98,183	96,955	97,716	95,152
R square	0.06	0.12	0.07	0.06	0.05

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 4: The Survival of Domestic Firms

Depdendent var.:	(1)	(2)	(3)	(4)	(5)
Survival	All	Bin 1 (<25%)	Bin 2 (25-50%)	Bin 3 (50-75%)	Bin 4 (>75%)
MNC entry (predicted)	-0.0005***	-0.0012**	-0.0009***	-0.0007***	0.0003
	(0.002)	(0.000)	(0.003)	(0.000)	(0.000)
Lagged revenue	0.005***	0.015***	0.005***	0.003***	-0.0004*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.004***	-0.009***	-0.003***	-0.002***	-0.03***
	(0.000)	(0.001)	(0.000)	(0.002)	(0.005)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	407,145	103,233	101,245	102,181	100,486
R square	0.06	0.10	0.09	0.08	0.04

Notes: (i) Linear probability estimates are reported; (ii) bootstrapped standard errors are reported in the parentheses; (iii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 5: The Ex-ante Productivity Difference of Surviving and Exiting Firms

Dependent variable:	(1) Firm TFP (lagged)	(2) Firm revenue (lagged)
Survival	0.636***	3.364***
	(0.022)	(0.018)
Survival * MNC entry (predicted)	0.197***	0.243***
	(0.022)	(0.016)
Host-country-industry FE	Yes	Yes
Obs	387,496	500,797
R square	0.82	0.51

Notes: (i) bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 6: The Shift of Domestic Employment Distribution

Depdendent var.: Change in employment share	(1) All	(2) Bin 1 (<25%)	(3) Bin 2 (25-50%)	(4) Bin 3 (50-75%)	(5) Bin 4 (>75%)
MNC entry (predicted)	-0.023***	-0.046***	-0.012**	-0.024***	0.003
	(0.005)	(0.015)	(0.006)	(0.009)	(0.005)
Lagged revenue	-0.028***	-0.063***	-0.037***	-0.030***	-0.029***
	(0.002)	(0.006)	(0.002)	(0.004)	(0.002)
Age	-0.026***	0.010	-0.019***	-0.042***	-0.025***
	(0.005)	(0.014)	(0.006)	(0.009)	(0.005)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	388,702	98,497	97,088	97,839	95,278
R square	0.22	0.29	0.19	0.22	0.16

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 7: Changes in the Average Wage Rate of Domestic Firms (Country-Industry Level)

	(1)
Dependent var.	Change in ave wage
MNC entry (predicted)	0.029**
	(0.013)
Host-country FE	Yes
Industry FE	Yes
Obs	3,268
R square	0.42

Notes: (i) Weighted least square estimates are reported; (ii) bootstrapped standard errors are reported in the parentheses; (iii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 8: The Shift of Domestic Revenue Distribution

Depdendent var.:	(1)	(2)	(3)	(4)	(5)
Change in revenue share	All	Bin 1 (<25%)	Bin 2 (25-50%)	Bin 3 (50-75%)	Bin 4 (>75%)
MNC entry (predicted)	-0.020***	-0.036***	-0.011***	-0.022***	-0.006
	(0.004)	(0.012)	(0.004)	(0.007)	(0.006)
Lagged revenue	-0.044***	-0.036***	-0.039***	-0.042***	-0.069***
	(0.001)	(0.004)	(0.001)	(0.003)	(0.002)
Age	-0.025***	-0.028***	-0.011***	-0.028***	-0.026***
	(0.004)	(0.010)	(0.004)	(0.007)	(0.005)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	407,145	103,233	101,245	102,181	100,486
R square	0.20	0.24	0.11	0.26	0.15

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 9: Estimated Effects of Multinational Entry

Variable	Est. parameter
Within-firm productivity (bin 1)	0.021
Within-firm productivity (bin 2)	0.014
Within-firm productivity (bin 3)	0.015
Within-firm productivity (bin 4)	0.01
Survival (bin 1)	-0.0012
Survival (bin 2)	-0.0009
Survival (bin 3)	-0.0007
Survival (bin 4)	0.0003
Productivity diff b/w surviving and exiting firms	0.197
Employment share (bin 1)	-0.046
Employment share (bin 2)	-0.012
Employment share (bin 3)	-0.024
Employment share (bin 4)	0.003
Revenue share (bin 1)	-0.036
Revenue share (bin 2)	-0.011
Revenue share (bin 3)	-0.022
Revenue share (bin 4)	-0.006

Notes: The table summarizes the estimated effects of multinational entry.

Table 10: Robustness: The Shift of Domestic Productivity Distribution

Depdendent var.:	(1)	(2)	(3)	(4)	(5)
Change in TFP	All	Bin 1 (<25%)	Bin 2 (25-50%)	Bin 3 (50-75%)	Bin 4 (>75%)
Robustness 1: Top Countries					
MNC entry (predicted)	0.013***	0.025***	0.007***	0.006***	0.010***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Lagged revenue	-0.011***	-0.038***	0.034***	0.022***	0.016***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Age	-0.080***	-0.181***	-0.104***	-0.060***	0.000
	(0.002)	(0.004)	(0.003)	(0.003)	(0.002)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	228,829	57,435	57,666	57,648	56,080
R square	0.09	0.17	0.13	0.08	0.06
Robustness 2: Alternative TFP Estimates					
MNC entry (predicted)	0.008***	0.018***	0.004*	0.004	0.002*
	(0.002)	(0.006)	(0.002)	(0.004)	(0.001)
Lagged revenue	-0.019***	-0.039***	0.016***	0.008***	0.007***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Age	-0.061***	-0.174***	-0.078***	-0.038***	-0.019***
	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	379,985	95,832	95,335	96,109	92,709
R square	0.05	0.12	0.09	0.07	0.06
Robustness 3: Homogenous Industries					
MNC entry (predicted)	0.021***	0.107***	0.007***	-0.004	-0.002
	(0.006)	(0.016)	(0.003)	(0.009)	(0.003)
Lagged revenue	-0.034***	-0.115***	0.012***	0.012***	0.0003
	(0.002)	(0.006)	(0.004)	(0.003)	(0.004)
Age	-0.098***	-0.219***	-0.083***	-0.062***	-0.042
	(0.002)	(0.012)	(0.008)	(0.007)	(0.008)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	43,170	10,855	10,799	10,874	10,642
R square	0.08	0.19	0.09	0.08	0.07

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 11: Sources of Within-Firm Productivity Improvement

	(1) All	(2) Bin 1 (<25%)	(3) Bin 2 (25-50%)	(4) Bin 3 (50-75%)	(5) Bin 4 (>75%)
Dependent var.: Patenting					
MNC entry (predicted)	0.004***	0.002***	0.0017***	0.0003	-0.0005
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Lagged revenue	0.002***	-0.0003**	0.003***	0.018***	0.010***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)
Age	0.006***	0.001***	0.002***	0.007***	0.012***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	1,539,080	367,848	388,641	387,630	394,961
R square	0.05	0.08	0.04	0.05	0.05
Dependent var.: Dropping products					
MNC entry (predicted)	0.002***	0.003***	0.002***	0.002***	0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Lagged revenue	-0.001***	0.005***	-0.002	-0.002	-0.007***
	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)
Age	0.000	0.001***	0.001*	0.001*	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Host-country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs	836,400	160,244	190,784	213,490	271,882
R square	0.08	0.14	0.07	0.05	0.09

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 12: The Interdependence of Productivity and Reallocation Effects

	(1)	(2)	(3)	(4)
Depdendent var.:	TFP Growth			
Change in revenue share	Bin 1 (<25%)	Bin 2 (25-50%)	Bin 3 (50-75%)	Bin 4 (>75%)
MNC entry (predicted)	-0.023***	-0.021***	-0.003	-0.009
	(0.000)	(0.000)	(0.008)	(0.007)
Lagged revenue	-0.088***	-0.058***	-0.035***	0.011***
	(0.003)	(0.003)	(0.003)	(0.003)
Age	-0.026***	-0.008	-0.012*	-0.043***
	(0.008)	(0.008)	(0.007)	(0.008)
Host-country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Obs	95,224	93,502	97,088	94,171
R square	0.26	0.21	0.31	0.15

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 13: Robustness: Technology Intensity and Market Reallocation Effects

Depdendent var.:	(1)	(2)	(3)	(4)
Change in revenue share	Low RD	Medium and High RD	Low Skill	Medium and High Skill
MNC entry (predicted)	-0.108***	-0.020***	-0.121***	-0.016***
	(0.025)	(0.004)	(0.055)	(0.004)
Lagged revenue	-0.044***	-0.042***	-0.049***	-0.042***
	(0.003)	(0.002)	(0.004)	(0.002)
Age	-0.027***	-0.027***	-0.028***	-0.025***
	(0.007)	(0.004)	(0.012)	(0.004)
Host-country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Obs	88,713	313,075	57,153	349,820
R square	0.16	0.24	0.24	0.21

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table 14: Robustness: Foreign Multinational Entry in Product, Technology and Labor Space

Dependent var.	(1) TFP	(2) Change in emp. share	(3) rev. share	(4) TFP	(5) Change in emp. share	(6) rev. share
MNC entry (predicted)						
– product space	0.0004	-0.042***	-0.032***	-0.003	-0.018***	-0.011*
	(0.002)	(0.006)	(0.005)	(0.002)	(0.008)	(0.006)
– technology space	3.642***	17.223***	10.700***	3.544***	17.901***	11.310***
	(0.939)	(3.482)	(2.823)	(0.944)	(3.485)	(2.826)
– labor space				0.001***	-0.005***	-0.004***
				(0.000)	(0.001)	(0.000)
Lagged revenue	-0.019***	-0.028***	-0.044***	-0.019***	-0.028***	-0.044***
	(0.005)	(0.002)	(0.001)	(0.005)	(0.002)	(0.001)
Age	-0.061	-0.026***	-0.025***	-0.061	-0.026***	-0.025***
	(0.001)	(0.005)	(0.004)	(0.001)	(0.005)	(0.004)
Host-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	379,818	388,535	406,972	379,818	388,535	406,973
R square	0.07	0.21	0.20	0.07	0.21	0.20

Notes: (i) Bootstrapped standard errors are reported in the parentheses; (ii) ***, **, and * represent statistical significance at 1, 5, and 10 percent, respectively.

Table A.1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
entry dummy	0.18	0.39	0	1
entry sum	0.48	1.84	0	42
survival	0.99	0.04	0	1
TFP change	0.08	0.48	-9.28	14.15
revenue share change	-0.001	0.02	-0.99	0.97
employment share change	-0.002	0.02	-0.99	0.99