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Selection and Market Reallocation: Productivity Gains from Multinational Production†

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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 and revenue reallocation 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 rightward or reshapes the productivity distribution, while selection and market reallocation move the revenue and employment distributions leftward and raise left truncations. Using a rich cross-country firm-level 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 ignoring this channel could lead to substantial bias in understanding the nature of productivity gains from multinational production. (*JEL* D22, D24, F14, F23, G32, O47)

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

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macro-level studies, is often attributed to positive productivity spillover from foreign multinational firms.[1] 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 foreign 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 host-country aggregate productivity.

Although all of the previously mentioned channels imply aggregate-productivity gains from multinational production, they operate at two distinct margins and represent different sources of productivity gains. Within-firm productivity improvement, which can arise from productivity spillover, technology upgrading, 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 jointly—influence the potential productivity effects from multinational competition.[2]

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

[1] See, for example, Borensztein, De Gregorio, and Lee (1998) and Alfaro et al. (2004) for macro-level studies, and Harrison and Rodríguez-Clare (2010) and Kose et al. (2010) 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).

[2] 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 the 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.

channels predict a positive relationship. We therefore utilize a unifying empirical framework motivated 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. In this framework, we hypothesize that within-firm productivity improvement will shift and even reshape the productivity distribution of surviving domestic firms. The extent to which each domestic firm responds to foreign multinational competition through productivity spillover, technology adoption, or within-firm reallocation could depend on their initial productivity draws, leading to potentially heterogeneous productivity effects. Greater competition from multinational production, in both factor and product markets, reallocates factors from domestic to multinational firms and from less productive to more productive firms, thereby resulting in a leftward shift in the employment distribution of domestic firms. Further, when the adverse effects of greater competition dominate, the revenue distribution of domestic firms will shift leftward and become more left truncated with a greater cutoff productivity for survival.

Note that the within- and between-firm effects of foreign multinational competition could also interact with each other. 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 firms' abilities to absorb productivity spillover and innovate as well as their incentives to upgrade productivity.

These hypotheses are evaluated empirically using a rich cross-country firm-level 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 (2014) shows that firm financial constraints and shocks play an important role in their ability to engage in new FDI. 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 are 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 get crowded out of the market and exit 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; and 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.

The evidence also suggests an interdependence between within-firm productivity response and between-firm reallocation. We find 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.

When 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 reexamining 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.[3] First, as mentioned previously, we build on an extensive empirical literature that assesses the existence of productivity spillover from multinational to domestic firms. One of the earliest contributions is Aitken and Harrison (1999) who find evidence of negative spillover in a panel of Venezuelan manufacturing enterprises for the period 1975–1989 and attribute the result to a market-stealing effect. That paper soon spawned a large series of empirical studies. Keller and Yeaple (2009), for example, find significant evidence of within-industry positive spillover in the United States. Similar results are found in Aghion et al. (2015) for a panel of Chinese enterprises in 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) find that productivity spillover via backward linkages can depend on technological incompatibilities between foreign and domestic technologies. Taking into account endogenous acquisition decisions, studies by Arnold and Javorcik (2009) and Guadalupe, Kuzmina, and Thomas (2012) find that foreign ownership leads to significant productivity spillover in acquired plants while Fons-Rosen et al. (2013), exploiting the difference in the amount of foreign investment by financial and industrial investors, find the productivity impact of FDI to be small, mostly between related industries within the same sector.

[3] 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.

In contrast to the ample literature on productivity spillover, evidence on the selection and reallocation effect of multinational production is scarce. A number of studies offers 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 (non-production) 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.[4] 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. Kosová (2010), 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 previously mentioned 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 results 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, 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

[4] 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 (2010) note that these contrasting results point to policy complementarities, like those between FDI and local financial markets (see Alfaro et al. 2004, 2010).

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.[5]

The rest of the paper is organized as follows. Section I presents theoretical hypotheses that will guide the empirical analysis. Section II describes the data and key variables. Sections III and IV report the estimation results and robustness analyses, respectively. Section V quantifies and decomposes the productivity gains from increased multinational production. Section VI concludes.

I. The Impact of Multinational Production: Hypotheses

In this section, we present testable hypotheses describing the different mechanisms through which multinational production could affect aggregate domestic-firm productivity in host countries. Gains in aggregate domestic-firm productivity can arise from two main sources: within-firm productivity improvement among domestic firms due to, for example, productivity spillover from foreign multinational firms, innovation, and technology upgrading; and 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 the different sources of productivity gains. We discuss later how to disentangle the different channels by exploring the implications of each channel for the distributions of domestic firms in stylized theoretical frameworks.

A. *Framework and Assumption*

The impact of multinational production on host-country domestic firms can be established in a stylized theoretical framework of heterogeneous firms and multinational production as seen in Helpman, Melitz, and Yeaple (2004); Melitz (2003); and Melitz and Ottaviano (2008).[6]

In this realm of models, consumers may exhibit various types of utility functions (e.g., a utility function with a constant elasticity of substitution), and there is a spectrum of heterogeneous firms within a sector, each drawing a level of productivity from a given distribution. To produce the good, firms incur a marginal cost that diminishes with a higher productivity draw. In addition to serving the home

[5] More broadly, the roles of spillover, selection, and reallocation from tougher competition are an important subject of inquiry in many fields of economics. In addition to trade (e.g., Pavcnik 2002, and 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, Bloom, Draca, and Van Reenen (2016) 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, Charlton, and Kanczuk 2009; and 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.

[6] In an earlier working paper version (Alfaro and Chen 2015), we present a stylized analytical framework adapted from Melitz (2003) and Helpman, Melitz, and Yeaple (2004) to illustrate the different mechanisms.

country, firms may supply a foreign country via either exports or local production and subsidiary sales. Firms incur an iceberg trade cost and a fixed export cost, such as the cost to set up and manage a distribution network, when exporting to a foreign market. If firms choose to engage in multinational production abroad, they incur a fixed cost, such as the cost of owning or renting a production facility in addition to the cost of a distribution network, at each foreign production location. The fixed costs of exporting and multinational production can be country as well as firm specific. For example, countries with more regulations may impose greater fixed costs for setting up distribution networks and production facilities. The fixed costs may also conceivably vary across firms, reflecting cross-firm variations in, for example, financial constraints and business networks.[7] Firms with, for instance, existing business networks in a foreign country might face lower fixed costs of exporting and multinational production.

Several general assumptions are noteworthy for drawing hypotheses on how foreign multinational competition may affect domestic firms. First, we assume, as in Helpman, Melitz, and Yeaple (2004), that exporting involves higher variable costs (due to iceberg trade costs) while multinational production involves higher fixed costs (due to, for example, the need to operate additional production facilities). Based on this assumption, only the most productive firms are able to offset the higher fixed costs and find it more profitable to invest in local production than to export. Thus, multinational firms, by self-selection, are more productive than other types of firms.

Second, we assume that the price elasticity of the aggregate industry demand is no less than one. This assumption ensures that an increase in aggregate productivity, which leads to a lower aggregate price, does not lower the industry's aggregate sales. In Section IC, we also discuss the possibility that aggregate industry demand has a price elasticity of less than one and its implications for the hypotheses.

Third, we assume that each firm's productivity can be influenced by both its productivity draw at birth and ex post factors, such as innovation and technology adoption decisions, within-firm resource allocations, and productivity spillover from other firms. The entry of foreign multinational firms can thus affect the productivity level of domestic firms not only through productivity spillover to domestic firms, but also by motivating the firms to raise R&D, adopt better technologies, and alter product composition.

Fourth, related to the previous assumption, the extent to which domestic firms respond to foreign multinational competition through each channel could depend on their initial productivity draws. For example, the magnitude of productivity spillover could be heterogeneous across firms depending on the firms' initial productivity and absorptive capacity. Similarly, the incentives to raise innovation or alter product composition in response to foreign competition could vary systematically across the distribution of domestic firms.

Based on the previously mentioned framework, we next outline an array of testable hypotheses that are generalizable to a broad class of theoretical contexts on how

[7] In theoretical modeling, a firm-specific fixed cost shifter also allows two firms with identical productivity to differ in their export and multinational production choices, a possibility often observed in the data.

the entry of foreign multinational firms could affect the productivity, employment, and revenue distributions of domestic firms.

B. *Within-Firm Productivity Gain*

First, we hypothesize that foreign multinational entry could lead to within-firm productivity improvement for domestic firms. As the extent of productivity improvement could be heterogeneous across firms depending on their initial productivity levels, the domestic-productivity distribution could shift rightward or change shape. This hypothesis is outlined next.

HYPOTHESIS 1 (Within-Firm Productivity Gain): *Foreign multinational entry can lead to (heterogeneous) within-firm productivity improvement among domestic firms, whereby domestic firms' new productivity distribution stochastically dominates the previous one.*

As discussed in the subsection, the productivity of each individual domestic firm can be influenced by foreign multinational firms through a variety of mechanisms. As shown in a large volume of empirical literature, foreign multinational entry could generate positive productivity spillover to domestic firms through production linkage, sharing common inputs, and labor mobility.

But there may also be other sources of within-firm productivity improvements. For example, domestic firms may raise innovation or adopt better technologies to increase their competitiveness against new foreign multinational competition. This effect could vary significantly across domestic firms depending on their position in the productivity distribution and distance to the productivity frontier. As shown in Aghion et al. (2015), the entry of a technologically advanced competitor could encourage innovation by incumbents initially close to the frontier, while exerting no or negative innovation effects on incumbents behind the frontier that have little hope to win against the entrant.

Domestic incumbents may also respond to foreign multinational competition through resource reallocation within the firm 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); and Nocke and Yeaple (2014) shows that firms may choose to drop the least 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 these possibilities in Section IVC by examining domestic firms' innovation and product composition decisions.

C. *Between-Firm Selection and Market Reallocation*

The entry of foreign multinational firms can also raise competition in both product and factor markets. As shown in Melitz (2003) and Melitz and Ottaviano (2008), 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 next.

Between-Firm Selection.—As discussed in Section IA and highlighted in Helpman, Melitz, and Yeaple (2004), multinational firms, by self-selection, tend to be the most productive firms in each industry. 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 next.

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. We refer to this effect as a *between-firm factor reallocation* effect and summarize it next.

HYPOTHESIS 3 (Between-Firm Factor Reallocation): *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 previously discussed, increased multinational competition will affect domestic-firm revenue in three different ways. First, within-firm productivity improvement could affect domestic-firm revenue. When the price elasticity of aggregate demand is higher than one, an improvement in domestic-firm productivity can increase both the industry's aggregate sales and individual domestic firms' revenue.[8] When the price elasticity of aggregate demand is equal to one, the industry's aggregate sales do not change, but domestic firms whose productivity improves more than the aggregate productivity can experience an increase in revenue while the rest see a decline. Second, as new foreign multinational entry leads to tougher competition in product markets, domestic firms' demand and

[8] Conversely, when the price elasticity of aggregate demand is lower than one, within-firm productivity improvement, which lowers aggregate price, will contract aggregate sales and hurt total domestic-firm revenue even though the impact can be asymmetric across domestic firms.

revenue could be crowded out by more competitive foreign multinational firms. Third, increased competition in factor markets and an increase in factor prices could force domestic firms to raise prices and see a decline in demand and revenue.

These complex and often opposing effects together imply that the net effect of foreign multinational entry on domestic firms' revenue is ambiguous. In the absence of within-firm productivity improvement, domestic firms, especially the least productive domestic firms, will likely 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 next.

HYPOTHESIS 4 (Between-Firm Revenue Reallocation): *Increased factor and product competition after foreign multinational entry shift the revenue distribution of domestic firms leftward, especially at the left tail.*

Interdependence of Within- and Between-Firms Effects.—It is worth noting that the effects of foreign multinational competition, both within and between firms, could be interdependent. For example, firms receiving a greater productivity spillover could have greater capacities to innovate and upgrade technology. The extent of within-firm productivity improvement among surviving firms may also affect the extent of the market reallocation effect by allowing firms to cut prices and raise demand to mitigate the market reallocation effect.[9] Similarly, multinationals' effects on factor and product prices can influence domestic firms' ability to absorb productivity spillover as well as their incentives to upgrade productivity or adapt product composition. Some domestic firms may be pushed by foreign multinational entry to innovate or adjust product mix to raise productivity and escape competition, while for some other firms the increased competition weakens their anticipated return and raises the costs of innovation. We empirically explore these interdependences in Section IVD.

D. *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 previously described, 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

[9] Note, however, that when the aggregate demand for the industry has a price elasticity lower than unity, within-productivity improvement could also lead to lower sales and exits among the least efficient firms, which constitute another source of between-firm adjustments.

firms, the aggregate-productivity effect will further increase due to the productivity premium of new foreign multinational firms. In Section V, we will evaluate the relative importance of each of the previous sources in the aggregate-productivity impact of foreign multinational production.

II. 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: detailed ten-year financial information, including 26 balance sheet and 25 income sheet items; industries and activities, including primary and secondary industry codes in both local and international classifications; corporate structure, including board members and management; and 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: industry information, including the four-digit NAICS code of the primary industry in which each establishment operates; ownership information, including each firm's domestic and global parents and domestic and foreign subsidiaries; location information; and non-consolidated financial information, including revenue, employment, assets, investment, and material cost.[10] A firm is considered foreign-owned if it is majority- or wholly-owned by

[10] 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,

a foreign multinational firm. There are about 36,000 foreign-owned subsidiaries in the final sample.[11]

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 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 do 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 IV, 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.[12]

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.

[11] 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.

[12] Revenue, asset, and material costs are deflated in the data. We obtained industry-level revenue, asset, and material cost deflators from the European Commission's KLEMS Productivity and Growth Accounts, the OECD STAN database, and European Commission and national data sources. For countries without industry-level deflators, we used national income and capital deflators. See Section IVB for discussions on the implications of unobserved price information and the robustness analysis.

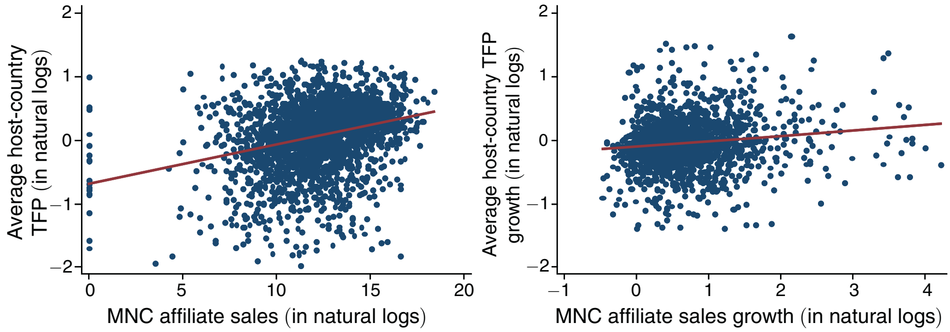

Figure 1. The Relationship between Multinational Production and Host-Country TFP

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 associated with collinearity problems.[13]

We considered a variety of productivity-estimation methodologies.[14] Ghandi, Navarro, and Rivers (2013), one of the most recent studies, use a transformation of the firm's first-order condition for flexible inputs that do 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 IVB 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 six-year period into two

[13] Ghandi, Navarro, and Rivers (2013) show that the methods suggested by Ackerberg, Caves, and Frazer (2015); and Wooldrige (2009), which are based on a quasi-fixed assumption on the inputs included in the production function, maintain the same identification problems.

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

subperiods, 2002–2004 and 2005–2007, and investigate how new multinational entry affects host-country TFP growth.[15]

In addition to the productivity effect, we examine the effects of foreign multinational competition on domestic firms' revenue, employment, and survival. We also complement the analysis with two additional datasets in Section IV 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, Schankerman, and Van Reenen (2013); and Bloom, Draca, and Van Reenen (2016), we use the number of patent applications filed by a domestic firm as a proxy for innovation. Second, we match the main data with another worldwide establishment-level database, Dun & Bradstreet's WorldBase, which reports, for each establishment, detailed location, four-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.

III. Empirical Strategy and Evidence

In this section, we evaluate the hypotheses outlined in Section I and assess empirically the effects of increased multinational production. Following Section I, 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.

[15] Appendix 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.

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.

A. *The Entry Decision of Multinational Firms*

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

$$(1)\quad \Pr\left[entry_{mij} = 1\right] = \Phi\big[\beta_1 \ln TFP_{mi} + \beta_2 \ln \mathit{financial\ shock}_{mi} + \beta_3 \ln \mathit{financial\ shock}_{mi} \cdot \mathit{entry\ cost}_j + \lambda_{ijs} + \varepsilon_{mij}\big],$$

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, $\mathit{financial\ shock}_{mi}$ is the change in the multinational firm headquarters' cash flow measured in the host-country PPP value, $\mathit{entry\ cost}_j$ 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 have 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) evaluate 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 previously mentioned evidence offers strong support to the importance of financial constraints and shocks in multinationals' foreign investment decisions.[16]

The effect of positive financial shocks on entry may, however, vary across host countries depending on the level of entry cost that multinational firms face. We thus interact the firm-level financial shock variable with a country-specific entry cost variable.[17] 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.[18] We find that, as expected in Section I, 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 time-variant and time-invariant country-industry and country-pair-industry factors, and all time-invariant multinational firm characteristics. We also assessed the predictive ability of the instrument by performing weak identification tests and rejected the null hypothesis of weak identification.[19] 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.

[16] See Froot and Dabora (1999) and Foley and Manova (2015) for overviews of the evidence.
[17] We thank a referee for this suggestion.
[18] We use a linear probability model to avoid the incidental parameter problem that arises in fixed-effect maximum likelihood estimators.
[19] See Staiger and Stock (1997) and Stock and Yogo (2005) for references on the weak identification tests and the critical values for *F*-statistics.

Table 1—The Entry Decision of Multinational Firms (*firm-country level*)

Dependent variable:	MNC entry (1)	MNC entry (2)	MNC entry (3)
HQ TFP	0.002	0.002	—
	(0.001)	(0.001)	
Financial shock	0.001	0.001	—
	(0.0004)	(0.0004)	
Financial shock × Entry cost	−0.0003	−0.0003	−0.0004
	(0.0001)	(0.0001)	(0.0002)
Host-country-ind fixed effects	Yes	Yes	Yes
Country-pair-ind fixed effects	No	Yes	Yes
Firm fixed effects	No	No	Yes
Observations	372,274	372,274	372,274
R^2	0.04	0.05	0.06
F-statistic	28.97	35.23	50.41
Prob > F	0.00	0.00	0.00

Note: Linear probability (LP) estimates are reported; standard errors clustered at the firm level are reported in the parentheses.

Table 2—Multinational Entry and Change in Average Productivity (*country-industry level*)

Dependent variable	Change in average TFP (1)	Change in average TFP (2)
MNC entry	0.010	
	(0.003)	
MNC entry (predicted)		0.026
		(0.015)
Beta coefficients	0.05	0.03
Host-country fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	3,751	3,751
R^2	0.52	0.52

Note: Columns 1 and 2 report OLS and instrumented estimates, respectively; bootstrapped standard errors are reported in the parentheses.

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.[20] 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

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

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.[21] Second, as described in Section I, 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 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.

B. *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 Hypothesis 1. Given that the effects of foreign multinational competition could vary along the distribution of domestic firms as discussed in Section I, 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:[22]

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

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} represents firm characteristics, including lagged firm revenue and age. Note that, in the previous 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 previous 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

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

[22] 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.

Table 3—The Shift of Domestic-Productivity Distribution

Dependent variable: Change in TFP	All (1)	Bin 1 (<25%) (2)	Bin 2 (25–50%) (3)	Bin 3 (50–75%) (4)	Bin 4 (>75%) (5)
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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	388,006	98,183	96,955	97,716	95,152
R^2	0.06	0.12	0.07	0.06	0.05

Note: Bootstrapped standard errors are reported in the parentheses.

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.

C. *Between-Firm Selection*

Next, we examine the between-firm selection and reallocation effects. Section I 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 productivity. We examine this hypothesis in the following specification:

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

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 subperiod 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

$$(4) \qquad \ln TFP_{kj} = \alpha_s survival_{kj} + \alpha'_s survival_{kj} \cdot \widehat{entry}_j + \lambda_j + \lambda_s + \epsilon_{kj},$$

Table 4—The Survival of Domestic Firms

Dependent variable: Survival	All (1)	Bin 1 (<25%) (2)	Bin 2 (25–50%) (3)	Bin 3 (50–75%) (4)	Bin 4 (>75%) (5)
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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	407,145	103,233	101,245	102,181	100,486
R^2	0.06	0.10	0.09	0.08	0.04

Note: Linear probability estimates are reported; bootstrapped standard errors are reported in the parentheses.

Table 5—The Ex Ante Productivity Difference of Surviving and Exiting Firms

Dependent variable:	Firm TFP (lagged) (1)	Firm revenue (lagged) (2)
Survival	0.636	3.364
	(0.022)	(0.018)
Survival × MNC entry (predicted)	0.197	0.243
	(0.022)	(0.016)
Host-country-industry fixed effects	Yes	Yes
Observations	387,496	500,797
R^2	0.82	0.51

Note: Bootstrapped standard errors are reported in the parentheses.

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.[23]

[23] 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 tenth-percentile of surviving firms and the mean productivity of the bottom 10 percent of surviving firms. We considered all the above definitions and

Table 6—The Shift of Domestic-Employment Distribution

Dependent variable: Change in employment share	All (1)	Bin 1 (<25%) (2)	Bin 2 (25–50%) (3)	Bin 3 (50–75%) (4)	Bin 4 (>75%) (5)
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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	388,702	98,497	97,088	97,839	95,278
R^2	0.22	0.29	0.19	0.22	0.16

Note: Bootstrapped standard errors are reported in the parentheses.

D. *Between-Firm Factor and Product Market Reallocation*

Now, we evaluate the between-firm market reallocation effects. Hypothesis 3 in Section I 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 I 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

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

Table 7—Changes in the Average Wage Rate of Domestic Firms
(*country-industry level*)

Dependent variable	Change in average wage (1)
MNC entry (predicted)	0.029
	(0.013)
Host-country fixed effects	Yes
Industry fixed effects	Yes
Observations	3,268
R^2	0.42

Note: Weighted least square estimates are reported; bootstrapped standard errors are reported in the parentheses.

Table 8—The Shift of Domestic-Revenue Distribution

Dependent variable: Change in revenue share	All (1)	Bin 1 (<25%) (2)	Bin 2 (25−50%) (3)	Bin 3 (50−75%) (4)	Bin 4 (>75%) (5)
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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	407,145	103,233	101,245	102,181	100,486
R^2	0.20	0.24	0.11	0.26	0.15

Note: Bootstrapped standard errors are reported in the parentheses.

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 I 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 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

TABLE 9—ESTIMATED EFFECTS OF MULTINATIONAL ENTRY

Variable	Estimated 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 difference between 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

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

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 previous estimated effects of multinational entry on the various distributions of domestic firms.

IV. Discussion and Sensitivity Analysis

A. *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 five 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).

Table 10—Robustness: The Shift of Domestic-Productivity Distribution

Dependent variable: Change in TFP	All (1)	Bin 1 (<25%) (2)	Bin 2 (25–50%) (3)	Bin 3 (50–75%) (4)	Bin 4 (>75%) (5)
Panel A. 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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	228,829	57,435	57,666	57,648	56,080
R^2	0.09	0.17	0.13	0.08	0.06
Panel B. 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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	379,985	95,832	95,335	96,109	92,709
R^2	0.05	0.12	0.09	0.07	0.06
Panel C. 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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	43,170	10,855	10,799	10,874	10,642
R^2	0.08	0.19	0.09	0.08	0.07

Note: Bootstrapped standard errors are reported in the parentheses.

B. *Measure of Productivity*

In our main analysis, we estimate firm productivity using a new methodology developed by Ghandi, Navarro, and Rivers (2013). 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.[24]

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 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

[24] Note that even if price or physical output information was 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.

in these industries. The productivity distribution shifts rightward, especially for the least productive domestic firms.

C. *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, Schankerman, and Van Reenen (2013); and Bloom, Draca, and Van Reenen (2016).[25] 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.[26] This effect is especially strong for the lowest two bins of domestic firms.[27]

[25] Although widely used in the literature, patents are arguably a lower-bound measure of innovation. There can be other forms of innovation and other mechanisms of productivity upgrading that are not captured in the patent data. We also considered ISO certification data as an alternative measure, which were available only at the country-sector level for 2009 and onward. Examining the relationship between foreign multinational entry and host countries' ISO certifications in both total and different ISO categories, we found suggestive evidence broadly consistent with our main findings. For example, a 100 percentage point increase in the probability of new multinational entry was found to be associated with 29.3 percent more total ISO certifications and 32.7 percent more ISO 9001 certifications. The results are available upon request.

[26] Similar to our findings, Bloom, Draca, and Van Reenen (2016) 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 (2016) by looking at average citations per patent and did not find that is the case.

[27] The documented increase in patenting could be attributed to either productivity spillover or self upgrading 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 US 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 (2016) investigate the impact of Chinese import competition and find that productivity increases among European firms that are most affected by Chinese imports.

Table 11—Sources of Within-Firm Productivity Improvement

	All (1)	Bin 1 (<25%) (2)	Bin 2 (25–50%) (3)	Bin 3 (50–75%) (4)	Bin 4 (>75%) (5)
Panel A. Dependent variable: 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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,539,080	367,848	388,641	387,630	394,961
R^2	0.05	0.08	0.04	0.05	0.05
Panel B. Dependent variable: 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 fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	836,400	160,244	190,784	213,490	271,882
R^2	0.08	0.14	0.07	0.05	0.09

Note: Bootstrapped standard errors are reported in the parentheses.

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, Schankerman, and Van Reenen 2013; Nocke and Yeaple 2014; and 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.

D. *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

TABLE 12—THE INTERDEPENDENCE OF PRODUCTIVITY AND REALLOCATION EFFECTS

	TFP Growth			
Dependent variable: Change in revenue share	Bin 1 (<25%) (1)	Bin 2 (25–50%) (2)	Bin 3 (50–75%) (3)	Bin 4 (>75%) (4)
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 fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	95,224	93,502	97,088	94,171
R^2	0.26	0.21	0.31	0.15

Note: Bootstrapped standard errors are reported in the parentheses.

TABLE 13—ROBUSTNESS: TECHNOLOGY INTENSITY AND MARKET REALLOCATION EFFECTS

Dependent variable: Change in revenue share	Low R&D (1)	Medium and high R&D (2)	Low skill (3)	Medium and high skill (4)
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 fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	88,713	313,075	57,153	349,820
R^2	0.16	0.24	0.24	0.21

Note: Bootstrapped standard errors are reported in the parentheses.

the incentives of domestic firms to innovate or enhance capacity to absorb technology spillover from 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 regroup 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 regroup 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 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 previous 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, Trajtenberg, and Fogarty 2000; and Ellison, Glaeser, and Kerr 2010), using patent citation flow data taken from the NBER Patent Database. The data, compiled by Hall, Jaffe, and Trajtenberg (2001), include detailed records for all patents granted by the US 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, $technology_{s\tilde{s}}$, by measuring the extent to which technologies in industry s cite technologies in industry $\tilde{s}$.[28] 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, $Labor\ similarity_{ss'}$. 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

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

TABLE 14—ROBUSTNESS: FOREIGN MULTINATIONAL ENTRY IN PRODUCT, TECHNOLOGY, AND LABOR SPACE

Dependent variable	Change in TFP (1)	Change in emp. share (2)	Change in revenue share (3)	Change in TFP (4)	Change in emp. share (5)	Change in revenue share (6)
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 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	379,818	388,535	406,972	379,818	388,535	406,973
R^2	0.07	0.21	0.20	0.07	0.21	0.20

Note: Bootstrapped standard errors are reported in the parentheses.

of foreign multinational entry in industries that share similar labor demand to the domestic firm using industry-pair correlations in occupation structure as weights.[29]

Table 14 examines how foreign multinational entry in the previously mentioned 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.[30]

[29] Constructing the industry-relatedness measures using US 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 US industry account data are more disaggregated than those of most other countries.

[30] 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

E. *The Role of Trade*

Our empirical analysis so far controls for all time-invariant country-industry factors by taking the first differences of the key firm performance measures (for example, productivity and revenue) between the two subperiods 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, however, 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; and 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.

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.

V. 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}:

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

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

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

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

$$(8) \qquad \Delta \widetilde{TFP}_t^D = \underbrace{\Big(\overline{TFP}_t^{D,\,surviving} - \overline{TFP}_{t-1}^{D,\,surviving}\Big)}_{within\text{-}firm} + \underbrace{\Big(\overline{TFP}_{t-1}^{D,\,surviving} - \overline{TFP}_{t-1}^{D}\Big)}_{between\text{-}firm\ selection}$$

$$+ \underbrace{\Delta \sum_k^D (s_{kt} - \bar{s}_t)\big(TFP_{kt} - \overline{TFP}_t^D\big)}_{between\text{-}firm\ reallocation}.$$

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 IIIB 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, a 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 IIIC, 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, $\Delta \sum_k^D (s_{kt} - \bar{s}_t)(TFP_{kt} - \overline{TFP}_t^D)$, represents the contribution of the market reallocation effect to the aggregate domestic productivity. In Section IIID, 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 $\Delta \sum_k^D (s_{kt} - \bar{s}_t)(TFP_{kt} - \overline{TFP}_t^D)$

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 previous 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 is 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.

VI. 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-level 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, it might take a longer period to fully realize the effects of multinational production 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.

Appendix

Table A.1—Summary Statistics

Variable	Mean	Standard deviation	Minimum	Maximum
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

REFERENCES

Acemoglu, Daron, Ufuk Akcigit, Harun Alp, Nicholas Bloom, and William R. Kerr. 2013. "Innovation, Reallocation and Growth." National Bureau of Economic Research (NBER) Working Paper 18993.

Ackerberg, Daniel A., Kevin Caves, and Garth Frazer. 2015. "Identification Properties of Recent Production Function Estimators." *Econometrica* 83 (6): 2411–51.

Aghion, Philippe, Jing Cai, Mathias Dewatripont, Luosha Du, Ann Harrison, and Patrick Legros. 2015. "Industrial Policy and Competition." *American Economic Journal: Macroeconomics* 7 (4): 1–32.

Aitken, Brian J., and Ann E. Harrison. 1999. "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela." *American Economic Review* 89 (3): 605–18.

Aitken, Brian, Ann Harrison, and Richard E. Lipsey. 1996. "Wages and foreign ownership: A comparative study of Mexico, Venezuela and the Unites States." *Journal of International Economics* 40 (3–4): 345–71.

Alfaro, Laura, and Andrew Charlton. 2009. "Intra-Industry Foreign Direct Investment." *American Economic Review* 99 (5): 2096–2119.

Alfaro, Laura, Areendam Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek. 2004. "FDI and economic growth: The role of local financial markets." *Journal of International Economics* 64 (1): 89–112.

Alfaro, Laura, Areendam Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek. 2010. "Does foreign direct investment promote growth? Exploring the role of financial markets on linkages." *Journal of Development Economics* 91 (2): 242–56.

Alfaro, Laura, Andrew Charlton, and Fabio Kanczuk. 2009. "Plant Size Distribution and Cross-Country Income Differences." In *NBER International Seminar on Macroeconomics 2008*, edited by Jeffrey A. Frankel and Christopher Pissarides, 243–72. Chicago: University of Chicago Press.

Alfaro, Laura, and Maggie X. Chen. 2015. "Selection and Market Reallocation: Productivity Gains from Multinational Production." Harvard Business School Working Paper 12–111.

Alfaro, Laura, and Maggie X. Chen. 2018. "Selection and Market Reallocation: Productivity Gains from Multinational Production: Dataset." *American Economic Journal: Economic Policy*. https://doi.org.10.1257/pol.20150437.

Arnold, Jens Matthias, and Beata S. Javorcik. 2009. "Gifted kids or pushy parents? Foreign direct investment and plant productivity in Indonesia." *Journal of International Economics* 79 (1): 42–53.

Baker, Malcolm, C. Fritz Foley, and Jeffrey Wurgler. 2009. "Multinationals as Arbitrageurs? The Effects of Stock Market Valuations on Foreign Direct Investment." *Review of Financial Studies* 22 (1): 337–69.

Bartelsman, Eric, John Haltiwanger, and Stefano Scarpetta. 2013. "Cross-Country Differences in Productivity: The Role of Allocation and Selection." *American Economic Review* 103 (1): 305–34.

Bernard, Andrew B., Stephen J. Redding, and Peter K. Schott. 2010. "Multiple-Product Firms and Product Switching." *American Economic Review* 100 (1): 70–97.

Bilir, Kamran, Davin Chor, and Kalina Manova. 2014. "Host-Country Financial Development and Multinational Activity." National Bureau of Economic Research (NBER) Working Paper 20046.

Blonigen, Bruce A. 1997. "Firm-Specific Assets and the Link between Exchange Rates and Foreign Direct Investment." *American Economic Review* 87 (3): 447–65.

Bloom, Nicholas, Mirko Draca, and John Van Reenen. 2016. "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity." *Review of Economic Studies* 83 (1): 87–117.

Bloom, Nicholas, Mark Schankerman, and John van Reenen. 2013. "Identifying Technology Spillovers and Product Market Rivalry." *Econometrica* 81 (4): 1347–93.

Borensztein, E., J. De Gregorio, and J.-W. Lee. 1998. "How does foreign direct investment affect economic growth?" *Journal of International Economics* 45 (1): 115–35.

Bustos, Paula. 2011. "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms." *American Economic Review* 101 (1): 304–40.

Carluccio, Juan, and Thibault Fally. 2013. "Foreign entry and spillovers with technological incompatibilities in the supply chain." *Journal of International Economics* 90 (1): 123–35.

Caves, Richard E. 2007. *Multinational Enterprise and Economic Analysis*. 3rd ed. Cambridge: Cambridge University Press.

Chen, Maggie Xiaoyang, and Michael O. Moore. 2010. "Location decision of heterogeneous multinational firms." *Journal of International Economics* 80 (2): 188–99.

Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon, Diego Puga, and Sébastien Roux. 2012. "The Productivity Advantages of Large Cities: Distinguishing Agglomeration From Firm Selection." *Econometrica* 80 (6): 2543–94.

De Loecker, Jan. 2011. "Product Differentiation, Multiproduct Firms, and Estimating the Impact of Trade Liberalization on Productivity." *Econometrica* 79 (5): 1407–51.

Desai, Mihir A., C. Fritz Foley, and James R. Hines, Jr. 2004. "A Multinational Perspective on Capital Structure Choice and Internal Capital Markets." *Journal of Finance* 59 (6): 2451–87.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer. 2002. "The Regulation of Entry." *Quarterly Journal of Economics* 117 (1): 1–37.

Eckel, Carsten, and J. Peter Neary. 2010. "Multi-Product Firms and Flexible Manufacturing in the Global Economy." *Review of Economic Studies* 77 (1): 188–217.

Ellison, Glenn, Edward L. Glaeser, and William R. Kerr. 2010. "What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns." *American Economic Review* 100 (3): 1195–1213.

Erel, Isil, Rose C. Liao, and Michael S. Weisbach. 2012. "Determinants of Cross-Border Mergers and Acquisitions." *Journal of Finance* 67 (3): 1045–82.

Feenstra, Robert C., and Gordon H. Hanson. 1997. "Foreign direct investment and relative wages: Evidence from Mexico's maquiladoras." *Journal of International Economics* 42 (3–4): 371–93.

Foley, C. Fritz, and Kalina Manova. 2015. "International Trade, Multinational Activity, and Corporate Finance." *Annual Review of Economics* 7: 119–46.

Fons-Rosen, Christian, Sebnem Kalemli-Ozcan, Bent E. Sørensen, Carolina Villegas-Sanchez, and Vadym Volosovych. 2013. "Quantifying Productivity Gains from Foreign Investment." National Bureau of Economic Research (NBER) Working Paper 18920.

Froot, Kenneth A., and Emil M. Dabora. 1999. "How are stock prices affected by the location of trade?" *Journal of Financial Economics* 53 (2): 189–216.

Froot, Kenneth A., and Jeremy C. Stein. 1991. "Exchange Rates and Foreign Direct Investment: An Imperfect Capital Market Approach." *Quarterly Journal of Economics* 106 (4): 1191–1217.

Ghandi, Amit, Salvador Navarro, and David Rivers. 2013. "On the Identification of Production Functions: How Heterogeneous is Productivity?" https://www.ssc.wisc.edu/~agandhi/homepage/Amit_Gandhi_files/production_9_25_13_FULL.pdf.

Graham, Edward M., and Paul R. Krugman. 1991. *Foreign Direct Investment in the United States*. 2nd ed. Washington, DC: Institute for International Economics.

Guadalupe, Maria, Olga Kuzmina, and Catherine Thomas. 2012. "Innovation and Foreign Ownership." *American Economic Review* 102 (7): 3594–3627.

Hall, Bronwyn H., Adam B. Jaffe, and Manuel Trajtenberg. 2001. "The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools." National Bureau of Economic Research (NBER) Working Paper 8498.

Hanson, Gordon H. 2001. "Should Countries Promote Foreign Direct Investment?" United Nations Conference on Trade and Development (UNCTAD) G-24 Discussion Paper Series 9.

Harrison, Ann E., and Margaret S. McMillian. 2003. "Does direct foreign investment affect domestic credit constraints?" *Journal of International Economics* 61 (1): 73–100.

Harrison, Ann E., Inessa Love, and Margaret S. McMillian. 2004. "Global capital flows and financing constraints." *Journal of Development Economics* 75 (1): 269–301.

Harrison, Ann, and Andrés Rodríguez-Clare. 2010. "Trade, Foreign Investment, and Industrial Policy." In *Handbook of Development Economics*, Vol. 5, edited by Dani Rodrik and Mark Rosenzweig, 4039–4214. Amsterdam: North-Holland.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein. 2008. "Estimating Trade Flows: Trading Partners and Trading Volumes." *Quarterly Journal of Economics* 123 (2): 441–87.

Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple. 2004. "Export versus FDI with Heterogeneous Firms." *American Economic Review* 94 (1): 300–316.

Hsieh, Chang-Tai, and Peter J. Klenow. 2009. "Misallocation and Manufacturing TFP in China and India." *Quarterly Journal of Economics* 124 (4): 1403–48.

Jaffe, Adam B., Manuel Trajtenberg, and Michael S. Fogarty. 2000. "Knowledge Spillovers and Patent Citations: Evidence from a Survey of Inventors." *American Economic Review* 90 (2): 215–18.

Javorcik, Beata Smarzynska. 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages." *American Economic Review* 94 (3): 605–27.

Keller, Wolfgang, and Stephen R. Yeaple. 2009. "Multinational Enterprises, International Trade, and Productivity Growth: Firm-Level Evidence from the United States." *Review of Economics and Statistics* 91 (4): 821–31.

Klein, Michael W., Joe Peek, and Eric S. Rosengren. 2002. "Troubled Banks, Impaired Foreign Direct Investment: The Role of Relative Access to Credit." *American Economic Review* 92 (3): 664–82.

Kose, M. Ayhan, Eswar Prasad, Kenneth Rogoff, and Shang-Jin Wei. 2010. "Financial Globalization and Economic Policies." In *Handbook of Development Economics*, Vol. 5, edited by Dani Rodrik and Mark Rosenzweig, 4283–4359. Amsterdam: North-Holland.

Kosová, Renáta. 2010. "Do Foreign Firms Crowd Out Domestic Firms? Evidence from the Czech Republic." *Review of Economics and Statistics* 92 (4): 861–81.

Levinsohn, James, and Amil Petrin. 2003. "Estimating Production Functions Using Inputs to Control for Unobservables." *Review of Economic Studies* 70 (2): 317–41.

Lileeva, Alla, and Daniel Trefler. 2010. "Improved Access to Foreign Markets Raises Plant-Level Productivity…For Some Plants." *Quarterly Journal of Economics* 125 (3): 1051–99.

Markusen, James R. 2002. *Multinational Firms and the Theory of International Trade*. Cambridge: MIT Press.

Markusen, James R., and Anthony J. Venables. 1999. "Foreign direct investment as a catalyst for industrial development." *European Economic Review* 43 (2): 335–56.

Mayer, Thierry, Marc J. Melitz, and Gianmarco I. P. Ottaviano. 2014. "Market Size, Competition, and the Product Mix of Exporters." *American Economic Review* 104 (2): 495–536.

Melitz, Marc J. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71 (6): 1695–1725.

Melitz, Marc J., and Gianmarco I. P. Ottaviano. 2008. "Market Size, Trade, and Productivity." *Review of Economic Studies* 75 (1): 295–316.

Melitz, Marc J., and Stephen J. Redding. 2014. "Heterogeneous Firms and Trade." In *Handbook of International Economics*, Vol. 4, edited by Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, 1–54. Amsterdam: North-Holland.

Nocke, Volker, and Stephen Yeaple. 2014. "Globalization and Multiproduct Firms." *International Economic Review* 55 (4): 993–1018.

Olley, G. Steven, and Ariel Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica* 64 (6): 1263–97.

Pavcnik, Nina. 2002. "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *Review of Economic Studies* 69 (1): 245–76.

Ramondo, Natalia. 2009. "Foreign Plants and Industry Productivity: Evidence from Chile." *Scandinavian Journal of Economics* 111 (4): 789–809.

Rauch, James E. 1999. "Networks versus markets in international trade." *Journal of International Economics* 48 (1): 7–35.

Staiger, Douglas, and James H. Stock. 1997. "Instrumental Variables Regression with Weak Instruments." *Econometrica* 65 (3): 557–86.

Stock, James H., and Motohiro Yogo. 2005. "Testing for Weak Instruments in Linear IV Regression." In *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, edited by Donald W. K. Andrews and James H. Stock, 80–108. Cambridge: Cambridge University Press.

Syverson, Chad. 2011. "What Determines Productivity?" *Journal of Economic Literature* 49 (2): 326–65.

Van Biesebroeck, Johannes. 2008. "The Sensitivity of Productivity Estimates: Revisiting Three Important Debates." *Journal of Business and Economic Statistics* 26 (3): 321–38.

Wooldridge, Jeffrey M. 2009. "On estimating firm-level production functions using proxy variables to control for unobservables." *Economics Letters* 104 (3): 112–14.

Yeaple, Stephen Ross. 2009. "Firm heterogeneity and the structure of U.S. multinational activity." *Journal of International Economics* 78 (2): 206–15.