Which Boats are lifted by a Foreign Tide? Direct and Indirect Wage Effects of Foreign Ownership

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Abstract

The attraction of foreign direct investment (FDI) is considered to be of particular importance for emerging economies because it represents a channel through which international convergence in standards of living may be achieved. One important effect of FDI is its impact on wages, both within the targeted firm (direct) and the local firms within the same geographic region and sector (indirect). In this paper we investigate the question whether multinational enterprises (MNEs) raise or lower wages directly and indirectly, both theoretically and empirically. Importantly, the magnitude of these changes may depend on how many firms in the sector are already foreign-owned. Generally, the effect of MNEs on wages has not been studied as intensively in the international business (IB) literature as other aspects of FDI, and ours is the first article to specifically investigate the moderating effect of variation in foreign employment shares across industry-province cells (clusters). Using Chinese data on 146,199 firms we estimate the direct wage effect of foreign ownership to be positive and to increase with the employment share of foreign

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owned firms. We also find that the indirect effect on domestic wages varies with the foreign share and may even turn negative.

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1 Introduction

Over the last two decades, a large literature has emerged that investigates performance differentials between MNEs and local firms, and possible productivity spillovers to host country firms (e.g., Chang, Chung & Moon, 2013a; Arnold and Javorcik, 2009; Liu, Siler, Wang & Wei, 2000; Buckley, Clegg & Wang, 2002; Javorcik, 2004). The evidence shows that MNEs are generally more productive than comparable domestic firms, in line with the idea of MNEs possessing ownership advantages that allow them to overcome the additional costs of investing abroad (Hymer, 1976, Dunning and Lundan, 2008). As the existence of such ownership advantages implies that there is a potential for productivity spillovers to domestic firms, a large literature has developed to look for such effects. The evidence, however, is mixed but suggests that such spillovers may happen especially in customer-supplier linkages (e.g., Meyer, 2004; Görg & Greenaway, 2004).

In contrast to the extensive work on productivity effects, the implications of MNEs for wages in host countries have drawn relatively little academic attention in the IB literature so far (a notable exception being Clougherty, Gugler, Sørgard & Szücs, 2014). This is in spite of scholars pointing to the importance of research on the effect of MNE presence on host country working conditions in general and wages in particular (Wells, 1998; Meyer 2004; Haskel, Lawrence, Leamer & Slaughter, 2012; Kobrin 2017). They emphasize the importance of understanding *all* the consequences of an increased MNE presence especially in developing and emerging economies that hope for a rapid ascension of the technology ladder.

In this paper, we focus on the effects of foreign owned MNEs on wages in the host country economy. Importantly, we consider not only wages in the individual firm that may or may not be foreign owned (what we term a *direct effect*), but also all of the remaining local firms that may be indirectly affected through the presence of foreign MNEs (an *indirect effect* or *spillover*). Providing a joint empirical framework for estimating these two effects is novel in the literature and an important contribution of our paper. While a number of studies provide evidence suggesting that foreign-owned firms pay higher wages than local firms (Conyon, Girma, Thompson & Wright, 2002; Girma & Görg, 2007; Heyman, Sjöholm & Tingvall, 2007; Hijzen, Martins, Schank & Upward, 2013) they are not concerned with estimating effects on wages of

other local firms. On the other hand, studies like Clougherty, Gugler, Sørgard & Szücs (2014) and Driffield and Girma (2003) look at the impact of the presence of MNEs on wages in locally owned firms that are only indirectly impacted by the MNE's activity, though they neglect what happens to wages in firms that experience an influx of foreign ownership. Providing a framework for estimating these two aspects of MNE presence jointly follows the call by Clougherty et al. (2014) for empirical work on wage effects that moves beyond the focus on spillovers to consider direct effects as well. In order to guide our empirical work, we construct a theoretical framework that captures inherent differences between locally and foreign owned firms and features clusters that include firms of both types.[1]

Standard theories of wage spillovers from MNEs generally consider two aspects (Görg & Greenaway, 2004): Firstly, they assume that MNEs transfer technology to local firms (voluntarily or involuntarily, cf. Inkpen, Minbaeva & Tsang, 2019) which raises their productivity and also wages. Secondly, if MNEs are in competition with local firms, market-stealing-effects lead to lower output and productivity in domestic firms, yielding also lower wages as result. However, critics may argue that MNEs, in particular when locating in transition or developing economies, actively *prevent* the leakage of technology to local firms, thus reducing the potential for spillovers; or may question whether MNEs and local firms are in direct competition on local or foreign markets. One of the novelties of our theoretical model is that is shows that even in the absence of such interactions (technology transfer or competition), we may still expect direct as well as spillover effects to materialise, as an influx of MNEs changes the composition of the stock of firms in an economy. We use the model and the complementary existing literature to derive predictions for the direct and indirect wage effects. The direct wage effect, or foreign wage premium, is expected to be positive, matching the findings of previous work (e.g. Lipsey & Sjöholm, 2004). Our model features a human resources-specific advantage enjoyed by MNEs, which results in more effective screening, better job matches between MNEs and workers, and thus higher wages for workers. Another frequently given explanation for positive foreign wage premia is the effort by an MNE to actively *prevent* spill-overs, that is they choose to pay higher

[1] A cluster in the empirical part of our paper is defined purely as an industry-region combination (e.g., the food industry in the province of Shanghai) and is therefore somewhat different from the notion of business clusters (as, e.g., espoused by Porter, 1990) where a cluster is a geographic combination of firms that are interconnected.

wages in order to prevent workers from leaving the firm and taking valuable know-how with them (Fosfuri, Motta & Rønde, 2001, Glass & Saggi, 1999, 2002).

The indirect effect relates to the literature on spill-overs: the presence of positive productivity spill-overs to local firms in the same sector would indicate a positive indirect wage effect, as well. Notwithstanding this argument, our model emphasizes a point of selection combined with the composition of the targeted sector: As it is always the most productive local firms that become foreign-owned (Chang at al., 2013a), the relative average productivity of the firms that remain locally owned falls. If this mechanism outweighs potential positive effects due to spillovers, the indirect wage effect could in fact be negative. Due to considerable ambiguity regarding empirical evidence on the magnitude and direction of spill-over effects (Görg & Greenaway, 2004, Meyer, 2004), we follow our model and indeed hypothesize the indirect wage effect to be negative. Another novel aspect of our theoretical framework is that it allows us to consider an additional aspect that has recently been shown to be important (Girma, Gong, Görg & Lancheros, 2015a): all wage effects are likely to be mediated by the magnitude of foreign presence in the relevant industry and region. In other words, the direct and indirect wage effects on local firms are different in clusters that have a lower share of foreign presence compared to those with higher shares.

In our empirical analysis we therefore go beyond the mere estimation of direct and indirect (spillover) effects, and consider this empirically relevant source of heterogeneity that has not yet been examined by the IB literature. The extent to which a sector is already subject to the presence of foreign firms is likely to influence the way in which wage effects are transmitted. Our model emphasizes the composition effect: the first firms becoming foreign-owned will not be very different from their locally owned peers, so effects are modest. As the share of foreign ownership increases, the differences become more marked and both wage effects increase in magnitude (the direct effect turning more positive, the indirect effect more negative). We draw on theories from the IB literature in addition to our model's prediction to develop a set of hypotheses regarding this contingency and how it modifies the wage effects.

Our empirical analysis uses manufacturing firm-level data from China. Our dataset is based on the Annual Reports of Industrial Enterprise Statistics, compiled by the China National Bureau of Statistics. We use information on 146,199 firms over the period 2003-2006. China

is a highly relevant case to study given the importance of inward FDI to the economy. Since its accession to the WTO in 2001, China has substantially liberalized policy towards direct investment inflows in order to attract foreign investors (Chen, 2011; Long, 2005). In 2014, the Chinese economy was host to about 10 percent of the global stock of foreign direct investment and received 19 percent of world-wide FDI inflows (United Nations, 2015). Due to the high number of geographic regions and industries covered, our Chinese data is particularly suitable for investigating the moderating effect of differences in foreign presence.

Our empirical work needs to take selection on two levels into account: MNEs target firms that are relatively more productive even before the influx of foreign capital, as well as locate in advantageous areas (Meyer, 2004; Chang et al., 2013a; Girma et al., 2015a). Ignoring these tendencies would expose our empirical estimation to endogeneity bias. The estimation method is a multi-level application of propensity score matching methods (Hirano, Imbens & Ridder, 2003). It involves computing propensity scores and subsequently employing them as inverse weights (Girma et al., 2015a). As a result, we can identify the causal effects of i) foreign ownership (by comparing a foreign-owned firm in a given cluster with an otherwise identical locally owned firm in the same cluster) and ii) overall foreign presence in a cluster (by, for example, comparing the average wage of a locally-owned firm in a cluster with zero foreign presence with the average wage of an identical locally-owned firm in an otherwise identical cluster with 50 percent foreign-owned firms). We estimate differing direct or indirect (spillover) effects depending (possibly non-linearly) on the level of foreign presence in a well-defined industry-region cluster. Furthermore, combining the estimated direct and indirect effects we can calculate a total effect of MNEs on wages in the host country.

While our empirical approach is similar to that of Girma et al. (2015a), our analysis is novel in that we focus on wage effects, while Girma et al. consider productivity spillovers. Also, our theoretical framework is very different in that we highlight that wage effects may materialize even in the absence of technology transfers due to compositional differences across clusters. Our approach is therefore novel in both the IB and the economics literature on FDI wage effects.

In the next two sections we review the existing literature, present our theoretical framework and derive our hypotheses using both existing IB theory as well as our own theoretical derivations. Section 4 describes the data and method, section 5 presents our results and section 6

contains the concluding discussion of implications, limitations and future research.

2 Literature Review

The notion that MNEs have inherent advantages over their local competitors is well-developed. Dunning's classical eclectic paradigm points out the importance of ownership advantages to allow foreign firms to overcome the liability of foreignness (Hymer, 1976, Dunning, 1977, Dunning and Lundan, 2008). If a foreign MNE has valuable intangible assets or superior quality processes and goods that give rise to such ownership advantages it stands to reason that they will also have measurable advantages vis-à-vis their local competitors (Driffield & Love, 2007; Narula & Driffield, 2012).

This has indeed been confirmed by numerous studies that have investigated systematic differences in a large number of metrics, e.g. productivity, skill intensity, wages, or level of innovation (e.g., Wang & Wang, 2015; Chang et al., 2013a, Arnold & Javorcik, 2009, Bandick & Hansson, 2009; Girma & Görg, 2007; Rugman & Verbeke, 2001). These studies generally conclude that MNEs are superior in their performance compared to local firms.[2]

The logical next step is to investigate the effects of attracting these advantaged MNEs from the perspective of a host country. A multitude of channels by which MNEs can lift up the host economy has been suggested, which can be broadly sorted into the broad categories of knowledge/technology, employment and wages. These indirect benefits from the presence of MNEs are often termed as spillovers, which may be voluntary or involuntary from the perspective of the MNE.

Beginning with knowledge and technology, MNEs may share their advantages with the host country via workers that acquire skills and subsequently leave to work at a locally owned firm or start their own business (Martin & Salomon, 2003; Ben Hamida, 2013; Görg & Strobl, 2005a). Technological know-how is also transmitted via upstream linkages with local suppliers (Giroud 2007, Jindra, Giroud & Scott-Kennel, 2009) or downstream linkages with customers and distributors (Driffield, Munday & Roberts, 2002; Miozzo & Grimshaw, 2008; Godart &

[2]In addition to the positive view that MNEs have intrinsic advantages and subsequently transmit them to their host countries to varying degrees, there are also critical views of their impact. To name just a few, it has been suggested that MNEs damage the natural environment of their host countries, adopt unsafe and exploitative work practices and harm local businesses through crowding out and "unfair" competition (Oetzel & Doh, 2009; Clapp & Dauvergne, 2011; Daly, 1993; De Backer & Sleuwagen, 2003; Haddad & Harrison, 1993).

Görg, 2013; Newman, Rand, Talbot & Tarp, 2015). While these effects can be expected to increase local firms' productivity and technology (Liu et al., 2000; Buckley et al., 2002), MNEs can also harm their local competitors as they take market share away from them, thus reducing productivity (Aitken & Harrison, 1999; Görg & Greenaway, 2004).[3]

In terms of employment, benefits for local firms stem from increased competitiveness due to spillovers, which allows them to expand operations and improve survival chances, while negative competition effects may crowd out domestic employment (Görg & Strobl, 2005b; Sharma, 2018). Improvements in technology would also be expected to raise the skill intensity of local firms (Taylor & Driffield, 2005; Sharma, 2018). Vertical customer-supplier linkages can also boost employment in local firms (Görg & Strobl, 2002). On the negative side, increased competition with MNEs may lead to crowding out of domestic firms, thus reducing employment (DeBacker and Sleuwaegen, 2003). Given the potential for employment generation, incentives provided by host countries to attract MNEs are often computed in 'per-job' terms, for example South Carolina successfully attracted BMW to set up a new production facility in 1994 in part by providing tax and other incentives amounting to around $68,421 per job (Woodward 1994; Schweke, Rist & Dabson 1994, p.23)

Wage effects of MNEs have drawn relatively little academic attention in the IB literature so far. Some recent studies in economics have examined whether foreign firms pay higher wages than domestic firms (e.g., Hijzen et al., 2013, Heyman et al., 2007, Girma & Görg, 2007, Conyon et al., 2002). To be more precise, the research has aimed to tease out a *causal* relationship between foreign ownership and wages that is not driven by observable or unobservable firm characteristics, but by ownership per se. A smaller literature has looked at the implications of the presence of foreign MNEs on wages paid by domestic firms in the same industry (e.g., Aitken, Harrison & Lipsey, 1996, Lipsey & Sjöholm, 2004, Hale & Long, 2011, Clougherty et al., 2014), so-called "wage spillovers" or "indirect wage effects".[4] However, none of these studies consider the potential mediating effect of the overall foreign presence in a given cluster.

[3]Delving deeper into the conditions under which the positive effects are particularly strong, the literature has shown that relevant factors include the absorptive capacity of the local firms (Ben Hamida 2013, Blalock & Simon, 2009; Zanfei, 2012), the corporate culture of the multinational parent (Ha & Giroud, 2015; Jindra et al., 2009) as well as the institutional environment of the host country (Giuliani & Macchi, 2013).

[4]The intuitive idea implicit in the existing studies on wage spillovers is that MNEs influence wages in domestic firms through technology transfer or competition effects within the own industry.

2.1 The moderating effect of established MNE presence

A moderator of the foreign wage premium that has been understudied in the IB literature is the extent to which MNEs are already present in the targeted sector. Foreign investment accumulates over time and, what is more, projects tend to geographically follow each other due to agglomeration advantages (Barry, Görg & Strobl, 2003; Crozet, Mayer & Mucchielli, 2004, Tan & Meyer, 2011). However, it stands to reason that FDI has a differential impact on an industry depending on whether the MNE in question is the very first one to enter a sector previously populated exclusively by locally owned firms or only contributing to a foreign presence that has already been substantial before its arrival. This effect has not yet been investigated, but understanding it is of obvious interest for policy makers interested in formulating a dynamic strategy to attracting foreign investment. Before we turn to the results from our own theoretical framework, we draw on the existing literature to begin hypothesizing on the moderating influence of already established foreign presence.

A large part of the literature considers the foreign wage premium to result from MNEs paying their workforce premium wages to prevent the loss of firm-specific assets (FSA) (Ben Hamida, 2013; Blomström & Kokko, 2002; Meyer, 2004; Sinani & Meyer, 2004). Insofar as more MNEs being present implies that more technological know-how is already in the public knowledge domain within the sector in question, one would expect the foreign wage premium to decline as the share of foreign ownership increases.

An alternative explanation posits that MNEs seek out local employees who can help bridge cultural or legal gaps due to superior knowledge of the business environment and the labor market in the host country (Hashai & Buckley, 2014; Hijzen et al., 2013). There is empirical support for this mechanism provided by Fortanier & Van Wijk (2010). As more MNEs enter, the search for such talent would intensify, leading to a positive link between the foreign wage premium and the share of foreign ownership.

The extant literature considers the link between higher MNE productivity (Dunning, 1988; Rugman & Verbeke, 2001; Javorcik, 2014; Javorcik & Poelhekke, 2017) and higher MNE profits, which, if shared with the work force, automatically imply higher MNE wages (Dunning, 1998; Rugman & Verbeke, 2001; Budd, Konings & Slaughter, 2005; Helpman, Itskhoki & Redding,

2010; Egger & Kreickemeier, 2013; Martins & Yang, 2015). In this case the link between the extent of foreign presence and the wage premium relies on the question of just how much productivity gain foreign ownership causes, and whether this effect is moderated by already established MNEs.

Finally, one may also argue that spillovers depend on the extent of MNEs already established. In terms of technology transfer, one may expect that to be highest when there are only few MNEs established with its importance diminishing as more MNEs are present in an industry or region. As to the negative competition effects due to market stealing, these may be stronger (i.e., more adverse) the more MNEs are already established. This provides a natural segue to our theoretical framework and hypothesis development.

3 Theory and Hypothesis Development

In order to complement the existing literature we present a novel theoretical framework in this section. Its purpose is to provide context and inform our hypotheses regarding the direct and indirect wage effects as well as their potential moderation by the magnitude of foreign presence. While there are a number of theoretical approaches to explaining why foreign firms pay higher wages focusing on very specific channels (e.g., Egger & Kreickemeier, 2013, Malchow-Møller, Markusen & Schjerning, 2013), there is much less formal theory linking domestic firms' wages to the presence of foreign MNEs. An important exception is Clougherty, Gugler, Sørgard & Szücs (2014), who model the impact of cross-border mergers on domestic firms. The two channels they consider are a "standard" positive productivity spillover (which generally raises wages) and a bargaining effect that works through the local union losing negotiating power (which generally lowers wages). Bargaining between the merger firm and unions can offset any positive spillover effects on the outsider firm. However, none of the papers mentioned considers how the foreign wage premium and the indirect wage effect are moderated by the presence of other MNEs in a cluster.

We construct a framework that we regard as complementary to the existing literature, and, indeed to Clougherty et al. The direct effect is fundamentally caused by an exogenous change that is a result of a switch in ownership, as is the case in their model. However, we model clusters to be made up of a large number of heterogeneous, monopolistically competitive firms. A switch

in ownership now involves selection, whereby only the "best" domestic firms switch ownership, which affects the direct wage effect as well as the indirect wage effect. In other words, we show that there may be indirect wage effects of foreign ownership even without specific assumptions regarding the nature of spillovers to local firms, be they productivity gains, cost reductions or changes in union bargaining power. To be clear, we are not claiming that those channels do not matter. We are simply showing that a framework modeling the entire population of firms leads to novel conclusions regarding the impact of cross-cluster differences in the magnitude of foreign ownership on wage effects.

Constructing a tractable model that shines a light on certain aspects and details necessitates abstractions and simplifications elsewhere. For example, our model is populated by firms that are directly competing with each other within a specific sector, so vertical relationships such as 'supplier-MNE parent' linkages are absent. As a result, the model is necessarily silent about vertical spillovers. In addition, the production technology only employs one type of labor, which means that within-firm adjustments to the composition of its labor force are beyond the scope of our analysis, as well.

3.1 Direct wage effect of foreign ownership

We consider the 'direct' effect to be the effect on firms receiving foreign ownership, i.e. the foreign wage premium. The existing literature comes down strongly on the side of a positive foreign wage premium (Almeida, 2007; Heyman et al. 2007; Chen, Ge & Lai 2011; Hijzen et al. 2013), as does our model.

The details of our model are in the appendix. We study a wage ratio which describes the direct effect on the marginal firm and compares the 'after' to the 'before' wage paid by a firm with a **given productivity level** that switches from local to MNE (with the wages denoted by w^M and w^L, respectively). Thus, the foreign wage premium for the marginal firm is given by

$$\frac{w^M}{w^L} = \left(\frac{c_L}{c_M}\right)^a \tag{1}$$

where c^M and c^L denote the cost for MNEs and local firms, respectively, of screening employees as to their suitability for the job on offer. These are assumed to be lower for MNEs. $a > 0$

is a constant that depends on underlying parameters and serves as a kind of elasticity.[5] The interpretation of equation (1) is straightforward: Given that the switch in ownership affects the screening cost in our model, the relative wage is directly related to the relative screening cost. The foreign wage premium in percentage terms is approximately equal to the percentage reduction in screening costs multiplied with the elasticity a. For future reference we call this effect the *screening effect*: a wage premium caused by more extensive job market screening by foreign MNEs.

Next we study the effect on foreign owned firms in general. Mathematically we use the average wage of foreign owned firms relative to the average wage of domestic firms, with averages being denoted by bars. The expression is

$$\begin{aligned} &\frac{\bar{w}^M}{\bar{w}^L} = \left(\frac{c_L}{c_M}\right)^a \frac{\rho^b}{1-\rho^b} \qquad (2) \\ &where \quad b > 0 \\ &and \quad 0 < \rho = \frac{\theta^d}{\theta^*} < 1 \end{aligned}$$

The right hand side now is a product of two terms. The first one is already familiar from expression (1), the screening effect. The second one contains another parameter-based constant, b, which is also strictly positive. ρ is the ratio of the two productivities θ^d and θ^*, where the first is the cut-off productivity at which a firm just enters production but remains locally owned (so it is the lowest possible productivity draw while still allowing a firm positive profits, θ^d), while the second is the cut-off where a firm is just indifferent between paying an extra fixed cost to attract foreign investment or not, θ^*. It is this ratio that generates the result that the extent of foreign ownership already present in the cluster influences the foreign wage premium. See also Figure 1 for a graphical depiction of the firms' entry and investment choices.

[Figure 1 about here]

The closer these two values are together, the smaller the number of operating firms that are locally owned (relative to those that are MNEs). The further they are apart, the more

[5] In detail, the parameters influencing a consist of the shape parameter for the distribution of worker skills (a Pareto distribution is assumed), the elasticity of substitution between varieties of the monopolistically produced goods, the severity of diminishing returns of adding workers to production and the curvature of the screening cost function.

firms there are with a draw that causes them to produce locally only. Consequently, the share of foreign ownership increases in ρ. We call this second term the composition effect because it reflects the change in relative average productivity within the domestically owned and the foreign owned firms caused by the shift in the underlying productivity thresholds. Panels (a) and (b) of Figure 2 depict clusters with high ρ and MNE share and low ρ and MNE share, respectively.[6]

[Figure 2 about here]

It is straightforward to formally check that the foreign wage premium expressed in (2) increases in ρ, which leads us to our first hypothesis.

Hypothesis 1 *All other things equal, the wage effect of foreign ownership on foreign owned firms (the direct effect) is positive, and it increases with the share of firms that are already foreign-owned in the sector.*

As we discussed in Section 2.1. above, a similar hypothesis would emerge from a theoretical framework in which MNEs pay a wage premium to poach local workers from their competitors because of their superior local knowledge. The more MNEs are in the market, the higher the market power of such local talent and, hence, the higher the wage premium. Our model merely makes the point that such an outcome can also come about even in the absence of such interactions between MNEs and local firms.

3.2 Indirect Effect on Locally-Owned Firms

Next, we turn to the impact of an increase in the number of foreign-owned firms on the average wage paid by locally-owned firms, the indirect effect. Recall that our framework does not make assumptions regarding linkages between firms, we do not take a stance regarding the explicit nature of spill-overs. In contrast, Clougherty et al. (2014) model a situation where the acquisition of an insider firm directly reduces the outsider firm's costs. The authors assume

[6]Note that the kind of heterogeneous-firm model we use generally leads a host of firm-specific outcomes to depend solely on the firm's productivity draw (e.g. revenue, wage, job market screening threshold). So while a higher productivity draw does lead to a higher wage, the causal chain is intricate and relies on the firm's choice of screening threshold when hiring its work force. In addition, foreign ownership per se improves the firm's human resources operations: at an identical level of productivity a foreign owned firm will hire a work force with better matches and thus pay higher wages than a domestically owned firm.

the presence of positive per-worker productivity spill-overs, which they convert into reductions in non-wage costs in their framework (Clougherty et al., 2014, p. 454). As a result, they find a positive spillover effect from cross-border mergers and acquisitions on the wage of outsider firms, or a positive indirect effect in our parlance.

Another channel that has been proposed focuses on competition between the firms, either in labor markets (e.g. Aitken et al., 1996, or Hale and Long, 2011) or in goods markets (e.g. Lommerud, Straume & Sørgard, 2006). However, in our model workers are ex-ante identical, so the fact that the average locally owned firm is left with a relatively lower quality work force is not due to having lost all of the higher quality workers to MNEs, but instead due to poorer screening by the firms resulting in lower quality matches.

In our framework, the indirect effect is about composition: As the productivity cut-off that determines the magnitude of foreign presence in the sector falls, relatively more firms become foreign-owned and relatively fewer remain locally owned. However, the underlying productivity of any switching firm is not random: rather, it is always the one that before the switch was the most productive firm among the locally owned ones, so the one that is most similar to the already foreign-owned firms.[7] For that reason, average productivity and thus average wage of the locally owned firms fall. Put simply, if foreign acquisitions are picking cherries, the remaining fruit will be those of ever lower quality. What is more, this effect strengthens as the share of locally owned firms shrinks, which is due to the curvature of the underlying distribution, which is a standard choice matching empirical firm size patterns.[8]

We again refer the reader interested in the mathematical details to the appendix, and progress immediately to our second Hypothesis.

Hypothesis 2 *All other things equal, the wage effect of foreign ownership on locally owned firms (the indirect effect) is negative, and it falls further with the share of firms that are already foreign-owned in the sector.*

Note that this indirect effect is strictly about averages, i.e. a comparison of the two groups

[7]This implication has support in the literature: Almeida (2007) finds that Portuguese firms that are acquired by MNEs generally are very similar to the firms that are already foreign-owned.

[8]The Pareto distribution is widely used in New Trade Theory models in order to describe the distribution of firms. It is chosen not only for its analytical tractability, but also because it has been shown to match empirical patterns of firm size and revenue very well. See Axtell (2001) or Helpman et al. (2004).

of firms with different ownership. The negative sign is caused by changes in composition, but at the firm-level only the marginal firm switches to a higher screening threshold as a result of being acquired. Since we did not model a direct link between a foreign acquisition in the industry and a non-involved firm's production technology or costs, an individual local firm's wage level would be unchanged.

Alternatively, such a hypothesis may also be supported by a model assuming that a larger presence of MNEs leads to stronger competition and market stealing effects. This would reduce productivity and thus wages of domestic firms and the more so the more MNEs are already established.

Our model, by necessity, abstracts from other issues in order to highlight the novel aspect of composition. In the real world many factors affect the influx of foreign capital into a firm, industry or region. Firm characteristics play a role here, as well as institutional set up and industrial policies impacting an industry or region. Moreover, firm characteristics also affect wage determination. While a detailed treatment of these issues would make the theoretical model too complex, we make an attempt at controlling for some of these aspects in our empirical analysis, where we model the influx of FDI into an industry / region and the determinants of firm level wages.

4 Data Description

In order to estimate direct and indirect wage effects empirically, we draw on firm level panel data from the Chinese manufacturing industry. The dataset is based on the Annual Reports of Industrial Enterprise Statistics, compiled by the China National Bureau of Statistics. The dataset covers all firms in China with an annual turnover of more than 5 million Renminbi (about $800,000). These companies account for an estimated 85–90 percent of total output in most industries. For the purpose of this analysis, we have information on 146,199 firms over the period 2003-2006.[9]

We estimate the effect of a firm having received foreign investment in 2005, which we refer to

[9]While this time period reflects data availability it also coincides with important changes in China's FDI liberalization policy following its accession to the WTO in 2001. These changes were implemented in 2002 and substantially increased the number of industries open to foreign investment. They also removed WTO-incompatible requirements on industries such as requiring exporting a stipulated percentage of the goods produced within China (Chen, 2011; Long, 2005).

as our "treatment". A firm is deemed to have foreign ownership if foreign investment accounts for at least 10 percent of firms' paid-up capital. This capital inflow may be due to acquisitions or joint ventures. Unfortunately, our data do not allow us to distinguish these two modes. Of the foreign-owned firms in our data set, 18% are wholly-foreign owned and 57% are majority-foreign owned. Our data does not capture wholly-owned *greenfield* investment. However, this is unlikely to be an important omission because in China investment with a domestic partner is frequently a condition of being granted market entry to foreign firms in many industries and regions (Jiang, Keller, Qiu & Ridley, 2018).

The choice of treatment year is purely pragmatic, as it provides us with information on both pre-treatment (2003-2004) and post-treatment (2006) years. The outcome variable is the average wage measured in 2006 relative to its pre-treatment (i.e. 2004) values. This differencing helps remove bias due to time invariant firm-specific unobservable effects (Girma & Görg, 2007; Arnold & Javorcik, 2009).

The main novelty of our paper is to allow for externalities from foreign ownership within a well-defined cluster. We define $r = 1...R$ sufficiently heterogeneous economic clusters. Our underlying assumption is that interactions between firms in the same cluster are far more important than any potential inter-cluster interaction. This assumption is supported by empirical findings in the literature that spillovers are strongest within particular regions or a broad set of industries (e.g., Driffield & Girma, 2003). Note that in our empirical analysis we only need to assume that this holds in the short run. In other words, in the short run, intra-cluster interaction is more important than inter-cluster interaction. This does not appear unreasonable, especially in China where inter-regional labor mobility is somewhat impeded by the Hokou system (Chan, 2013).

The empirical construction of clusters is not an exact science. Ideally, clusters should be constructed in such a way as to maximize the potential of intra-cluster spillovers, while at the same time minimize possible inter-cluster externalities. In doing so, one would need to strike a balance between having a large enough number of clusters and sufficient observations per cluster. In this paper we classify firms into clusters based on the intersection of 11 geographic areas and 13 industry groupings.[10] We impose the condition that at least 4% of firms in a

[10]In the data set firms are originally grouped in terms of four digit industry codes. Based on these we assign

cluster should be foreign-invested and the total number of firms should not be less than 100. For this reason we have to leave out 16 clusters from the analysis, leaving us with a total of $R = 127$ clusters.[11] We also report below robustness checks using different definitions of clusters.

Table 1 provides the definition and summary statistics of pre-treatment covariates by foreign ownership status. Perhaps not surprisingly, the raw data suggest that foreign firms tend to be larger, more productive and pay higher average wages compared to their domestically-owned counterparts. Hence, it is important to control for these firm level characteristics in our estimation in order to address selection at the firm level and differences in wage setting across firms.

[Table 1 here]

Table 2 provides some summary statistics of the cluster level variables. Average share of foreign firms in 2005 was 21.1% with an interquartile range value of 17.1% suggesting quite substantial inter-cluster heterogeneity.[12] We also see that there are differences across clusters in terms of wage levels and growth, average firm size and age, export activitiy, taxes, benefits to workers and the importance of state-owned enterprises. These may reflect institutional and policy differences across clusters that may also determine foreign capital inflows. These are controlled for in the empirical analysis.

Table 3 shows that the proportion of foreign firms and their employment share have both significant (unconditional) correlations with all of the cluster level variables. This indicates the importance of controlling for cluster level differences in the empirical analysis.

[Tables 2 – 3 here]

them to the 13 industry groupings which roughly correspond to two digit industries. Note that, in 2004, almost 90 percent of firms report that they only produce a single product.

[11] Table A1 in the appendix lists the geographic and industry groups which underpin our cluster formation; while Table A2 gives the employment share of foreign firms and the share of foreign firms s in the top and bottom 10 FDI attracting clusters.

[12] Recall that our dataset covers the universe of large firms but does not include all small firms. This should not bias our measure of foreign presence in a cluster, as foreign owned MNEs are generally large firms which are included in our dataset.

5 Empirical Methodology

The aim of the empirical exercise is to estimate direct and indirect effects of MNEs on wages that potentially differ depending on the level of foreign ownership in a cluster. It is well known that MNEs neither acquire foreign firms nor choose locations randomly. Instead, a cherry-picking pattern has been documented: MNEs target firms that are relatively more productive even before the take-over, as well as locate in advantageous areas (Meyer, 2004; Chang et al., 2013a; Girma, Gong, Görg & Lancheros, 2015b). Note that this poses a potential empirical problem when we strive to measure the firm-specific effect of foreign ownership and the cluster-specific effect of the foreign share per se (Chang, Chung & Moon, 2013b). If, for example, a researcher was to find that a larger foreign presence corresponds to higher wages the result may simply be caused by the fact that foreign investors chose clusters with attractive features (e.g., better-educated work-force, lower taxes), which in turn are correlated with higher wage levels. In that case, foreign presence *per se* may not have any effect on wages at all. Hence, controlling for selection at firm and cluster level is essential, as was also indicated by our descriptives.

In order to deal with these two levels of selection, our empirical approach proceeds in two steps (see Girma et al. 2015a for a more detailed description). We firstly estimate the relationship between foreign ownership and wages separately for each cluster, using data at the firm level. In a second step we take into account the presence of MNEs as treatment, using data at the cluster level.[13]

5.1 First step estimation

We estimate the relationship between foreign ownership and wages *separately for each of the 127 clusters*. We define a binary treatment variable $d_{ir} = 1$ if firm i in cluster r receives foreign investment in 2005 and $d_{ir} = 0$ if not. This treatment variable is then used as independent variable in a wage regression using the firm level data for a given cluster. In order to take into account selection at the firm level, we estimate the outcome equation using inverse propensity-score weighted regression and controlling for the pre-treatment covariates (Bang & Robins,

[13] We also followed a much simpler estimation approach that ignores the multi-level selection problems. Using OLS and interacted variables to explore the effect of foreign presence on the wage premium, we find the results to be qualitatively similar to those reported below. The paper does not contain that analysis for the sake of brevity, but all of the results are available from the authors.

2005, Hirano et al., 2003). Note that the outcome variable, the firm-level wage is defined as the change relative to the treatment period, akin to using a difference-in-differences strategy combined with propensity score matching.[14]

For each cluster, this implies that we firstly generate the firm-specific propensity-scores of being treated via a logistic regression with a rich list of pre-treatment covariates subject to balancing conditions being satisfied. The list and precise definition of the pre-treatment covariates can be found in Table 1. Results are reported in Table A3 in the appendix. As we have 127 propensity score estimations, we report summary statistics for the estimated coefficients. These corroborate the pattern suggested in Table 3 – productivity, wages, size and export activity are positively correlated with foreign ownership. The last column of Table A3 also shows that propensity score conditioning has done a remarkably good job at balancing firm level observable covariates across the two groups of firms.[15]

Using the obtained propensity scores we then estimate the following outcome equation by cluster via inverse probability weighted regression:

$$w_{is} = \alpha + \beta d_{is} + F(X;\delta) + error;\ \ i = 1...N. \tag{3}$$

where w is defined as the change in the firm level wage and $F(.)$ represents a function of pre-treatment covariates vector X.[16] From the regressions we can then calculate the cluster specific potential outcomes for the average treated (1) and non-treated (0) firm in a given cluster with foreign presence s as predicted from the regression

$$\bar{w}_s^1 = \frac{1}{N}\sum_{i=1}^{N}[\hat{\alpha} + \hat{\beta} + F(X;\delta)] \text{ and } \bar{w}_s^0 = \frac{1}{N}\sum_{i=1}^{N}[\hat{\alpha} + F(X;\delta)] \tag{4}$$

[14]The estimator is "doubly robust" as it provides two opportunities to adjust for selection on observables by combining inverse probability reweighting with regression covariates adjustment. Our identifying assumption is, of course, selection on observables. To the extent that there are unobservables that are correlated with both the treatment conditional on observables and the change in wages, our results would potentially be biased.

[15]Cluster-by-cluster estimation allows for complete heterogeneity across clusters. As a robustness check, we also estimate a pooled propensity score, which provides results that are very similar. Furthermore, in another robustness checks, we allow for a further lag of the covariates in the propensity score. Again, this does not change results substantially. Results are not reported here to save space but are available upon request.

[16]In the inverse probability weighting, treated firms receive a weight of $1/p$ and non-treated firms $1/(1-p)$. In Table A4 we present summary statistics of estimated coefficients from the 127 regressions. We impose the common support condition to ensure that the propensity score is balanced across domestic and foreign firms.

The average difference between the two potential outcomes in (4) would be an estimate of the average treatment effect if the cluster-specific level of foreign presence did not matter. In order to investigate whether there is a causal relationship between the cluster specific level of foreign presence and the cluster specific wage effects, we now turn to the second step estimation.

5.2 Second step estimation

In the second step of the analysis we treat $\bar{w}_s^1$ and $\bar{w}_s^0$ estimated in the first step as the "outcome" variables, and consider the cluster level foreign presence as the "treatment" variable. We approximate the cluster level foreign presence using the proportion of foreign firms in the cluster. This is defined as $s_r = \frac{N_r}{N}$, with N_r being the number of MNEs and N being the total cluster level number of firms.

A complication arises from the fact that this cluster level "treatment" variable is continuous between 0 and 1. In order to control for selection at the cluster level, we employ the causal inference approach for continuous treatments (Hirano & Imbens, 2004). A key result from this literature is that causal inference can be conducted by conditioning on the generalized propensity score (GPS), which is essentially the conditional density of the treatment given some pre-treatment balancing covariates.

We generate the GPS conditional on pre-treatment cluster level covariates, $\hat{G}_r$, using the fractional logit model (Papke & Wooldridge, 1996). A full list of these cluster level variables can be found in Table 2. Marginal effects from the fractional logit model and the accompanying covariate balancing tests are reported in Table A5 in the appendix. In line with the correlations in Table 3, we find that the share of foreign firms is higher in clusters with higher average wages, lower average age of firms, lower tax rate and a higher number of foreign owned firms. We also report results from covariate balancing test in this second step estimation in the final two columns.[17] We show the average p-values from these tests, and it is reassuring to see that conditioning on GPS has done a very good job at covariate balancing.

[17] In order to check for covariate balancing conditional on generalized propensity scores (GPS), we adopt the blocking approach proposed by Hirano and Imbens (2004). Accordingly we first divide clusters into 3 discrete groups defined by treatment intensity (i.e., employment share of foreign firms), and then create 5 blocks within each such group based on the estimated GPS quintiles. Within each block, we carry out difference-in-means tests between a treatment intensity group and the other two groups combined by conditioning on the GPS. This process is repeated for each of the 3 treatment intensity groups and 9 covariates, entailing a total of 135 balancing tests.

We then calculate cluster level potential outcomes conditional on $\hat{G}_r$ and s_r using polynomial approximation as suggested by Hirano and Imbens (2004). We use a quadratic approximation over R cluster:[18]

$$\bar{w}_r^d = \frac{1}{R}\sum_{r=1}^{R}(\hat{\beta}_0 + \hat{\beta}_1\hat{G}_r + \hat{\beta}_2 s_r + \hat{\beta}_3\hat{G}_r s_r + \hat{\beta}_4\hat{G}_r^2 + \hat{\beta}_5 s_r^2) \tag{5}$$

Subsequently we calculate the predicted values $\bar{w}_r^d$ for the two firm level treatments d and the continuous cluster-level treatment s_r.

Using these predicted values as potential outcomes, we can then calculate various treatment effects, using insights from the recent statistical literature (e.g. Hudgens & Halloran, 2008). Firstly, we can calculate a *direct wage effect* $\bar{\gamma}_{ss}^{10} = \bar{w}_s^1 - \bar{w}_s^0$ as the difference in wages between foreign-owned (1) and domestic (0) firms for a given level of foreign presence s in a cluster.

The *indirect wage effect* is defined as $\bar{\gamma}_{s0}^{00} = \bar{w}_s^0 - \bar{w}_0^0$, hence, the difference in wages between domestic firms (0) in a cluster with foreign presence level s and in a cluster without any foreign presence. Based on these two treatment effects, we can calculate a so-called *total wage effect* as $\bar{\gamma}_{s0}^{10} = \bar{w}_s^1 - \bar{w}_0^0$, which gives an estimate of the wage premium for a foreign firm in a specific cluster with foreign presence s compared to a domestic firm in a cluster with no foreign presence. Note that the total effect can be directly calculated as the sum of direct and indirect effects.

6 Discussion of Results

The direct and indirect effects can be calculated for any level of foreign presence in a cluster by using equation (5). Since the presentation of all treatment effects in a single table is not practical, we instead plot all estimated direct and indirect wage effects of foreign ownership along with their 95% confidence intervals in Figure 3. We find that the share of MNEs in a cluster matters significantly, both statistically and economically.[19]

[Figure 3 here]

Our first finding is that the direct wage effect, i.e. the wage premium due to being an MNE

[18] Note that individual parameters from such polynomial approximations do not have any behavioral interpretation (Hirano and Imbens, 2004).

[19] The interested reader may find a table with estimates and confidence intervals at select levels of MNE presence in the appendix (Table A6).

compared to a local firm, is always positive. This is in line with the literature on wage premia of MNEs, which also established positive wage differences between MNEs and local firms for a number of countries (e.g., Hijzen et al., 2013; Girma and Görg, 2007; Heyman et al., 2007). A more novel result is that we also find that the premium differs strongly as one varies the share of MNEs in a cluster. The higher is the presence of MNEs in a cluster, the higher is the difference between the wages paid by MNEs compared to domestic firms. This is in line with Hypothesis 1. The finding may be due to the mechanism highlighted in our theoretical model, namely selection of the best local firms as targets, which becomes more important the more foreign MNEs are already present in a cluster. It could also reflect that MNEs hire workers from local firms, leading to a wage premium (Fortanier & van Wijk, 2010). This premium may increase with existing foreign presence, as the search for local talent becomes harder and more costly the more foreign MNEs are already in the market. Unfortunately, our data do not allow us to discriminate between these two hypotheses.

The second panel of Figure 3 depicts the indirect effect, i.e., the impact the presence of MNEs has on wages in domestic firms. We find that this spillover effect is small but positive and statistically significant for low levels of foreign presence in a cluster. Only for clusters with above average foreign presence (which stands at about 21 percent in the data) do they turn significantly negative. This negative effect becomes stronger the larger the foreign presence in the cluster.

Our theoretical model predicts that indirect effects should be negative and more so the higher is the presence of foreign firms in a cluster due to the changing composition of the pool of local firms in a cluster. A similar expectation would emerge from assuming negative competition effects from MNEs on domestic firms (Aitken et al., 1996; Meyer, 2004), which would also become stronger as MNE presence increases in a cluster. Such negative effects only apply, though, when foreign presence is comparatively high in a cluster.

For low levels of MNE presence positive indirect effects prevail, i.e., local firms increase their wages due to increasing presence of MNEs in a cluster. We may interpret this as indicating positive wage spillovers on domestic firms if the presence of foreign firms is not too high. This is in line with evidence for positive wage spillovers in Clougherty et al. (2014) and Driffield & Girma (2003), although these studies do not allow the spillover effect to vary depending on the

level of MNE presence in a cluster.

In line with our hypotheses, we have seen that the direct wage effect of MNEs increases while the indirect effect decreases uniformly with the degree of foreign presence in the cluster. From a policy point of view one may wonder whether there is an "optimal presence" of MNEs in the sense that the economy-wide wage effect of foreign ownership is maximized. By summing the direct and indirect effects we can calculate a total wage effect, which is shown in Figure 4.

[Figure 4 here]

This total wage effect is always positive but has an inverted u-shape in relation to the share of foreign presence, reaching its maximum value when the share of MNEs is around 25 percent. At this level of foreign presence, the total foreign ownership wage effect stands at about 22 percent. In other words, the wage paid by the average MNE in a cluster with an MNE share of around 25 percent is about 22 percent higher than that paid by the average domestic firm in a cluster with no MNEs.

We defined our measure of foreign presence based on the number of MNEs, matching the spirit of our theoretical framework and the measure used by Clougherty et al. (2014). As a robustness check, we also consider the employment share in MNEs as an alternative measure. This is defined as $s_r = \frac{L_r}{L} = \frac{\sum_i^N d_{ir} * emp_{ir}}{L}$, with d_{ir} being the foreign ownership indicator, L being total cluster level employment and emp_{ir} employment in firm i situated in cluster r. This definition is similar to what is usually used in the literature on wage spillovers (e.g. Aitken at al., 1996; Driffield & Girma, 2003). The estimated different wage effects are plotted in Figure 5 and they are consistent with the results discussed earlier.

[Figure 5 here]

As additional robustness checks, we examine the sensitivity of our results to the precise definition of *cluster*. In particular, we re-define clusters to be i) one of 169 towns or ii) one of 145 three-digit SIC industries. While modification i) leaves our main results essentially intact, the removal of the geographic component by defining clusters at a very disaggregated industry-level in ii) leads to a weakening of the effect of foreign presence on the wage premium. We carefully interpret this finding as support for our interpretation that local labour market effects are im-

portant for the impact of foreign presence on wage levels. These results are not reported here to save space, but are available upon request.

7 Conclusion

In this paper we implement an approach which allows us to estimate direct and indirect effects of foreign ownership on wages in a unified framework. Our analysis allows for differences in effects depending on the strength of the presence by foreign firms in a well-defined cluster. It also takes into account selection at both the firm and the cluster level.

Our paper adds to the theoretical understanding of such wage effects with a simple model where we do not assume that MNEs and domestic firms interact through technology transfers or competition. Rather, MNEs differ in terms of having a "better" matching methodology with lower screening costs compared to domestic firms. This can explain why they are able to pay higher wages. In our framework, foreign presence also affects average wages of domestic firms because of selection, whereby only the least productive domestic firms (which pay low wages) remain domestic while other firms get taken over by foreign owners.

The empirical analysis uses firm level data from China. Results show that there are positive direct effects of foreign ownership – foreign firms pay higher wages – and that the estimated effects increase with increasing presence of MNEs in a cluster. We also find that the spillover effect on domestic wages varies with the strength of MNE presence in a cluster. For low levels of foreign presence the estimated effect is low but positive, while it turns increasingly negative once the presence of foreign firms is higher than about 20 percent. Combining the estimated direct and indirect effects, we find that the total effect of foreign ownership on wages is positive and depends non-linearly on the level of foreign presence. Its maximum is at a level of foreign presence of around 25 percent: The wage paid by an MNE in a cluster with a 25 percent level of foreign presence is 22 percent higher than the wage paid by the average domestic firm in a cluster with no foreign presence.

As Oetzel and Doh (2009) point out, managers need to keep an eye on the implications of their activities for economic development, as they "increasingly operate at the will of the local communities" (p. 115) in which they are located. Furthermore, research on corporate social responsibility suggests that consumers in the MNEs' home countries worry about the

treatment of host country workers by the MNE (Boehe & Cruz, 2010). Therefore, managers ought to understand their firm's impact on local labor markets as well as the composition of firms already operating in the markets they enter.

Our empirical results suggest that the presence of MNEs may negatively influence the wages of local firms within the same industry. It stands to reason that this would be concerning for host country governments and thus complicate MNE operations. Competition effects in both output and labor markets may exacerbate negative consequences for local firms. On the other hand, we estimate direct wage effects to be positive and to increase with the strength of MNE presence. This may reflect any of the various MNE advantages discussed in the literature, including the human resources management advantages we model in the present paper. Knowing these opposite effects is helpful for MNE management when negotiating with host country institutions. For the host country government, potential policy implications are two-fold: On the one hand, the attraction of MNEs is beneficial in that it brings better-paying jobs alongside with technological know-how into the country. However, our results suggest that a balance between foreign-owned firms and locally owned firms in a given sector may be optimal. Too low a share and you run danger of leaving benefits arising from better management techniques on the table. Too high a share and you may allow the local stock of firms in the sector to become too picked-over and unproductive.

While our theoretical framework focuses on labor market advantages and industry composition, our empirical analysis cannot disentangle the various theoretical channels which may stand behind the wage effects that we document. Future work should address this issue, thereby providing further valuable information to managers negotiating with host governments and explaining their global impact to stakeholders - as well as government officials who find themselves pondering what type and how many multinationals to encourage (or allow) to take control of local firms.

One limitation of our analysis of spillovers is that we only look at horizontal effects taking place in the same industry. While this is also true for other work in the IB literature on wage effects of FDI, the related literature on productivity spillovers highlights that technology transfer is most likely when there are vertical customer-supplier linkages between industries (Driffield, Munday & Roberts, 2002; Javorcik, 2004; Godart & Görg, 2013). While our empirical

definition of an industry is arguably broad enough to accommodate some customer-supplier industry linkages, a full treatment of vertical linkages is beyond the scope of this paper.

Furthermore, with our data we can only analyse what happens to average wages in the firm. While our theoretical model does not consider a reallocation of workers within or across firms, changes in wages can of course stem from different adjustment processes: firstly, firms pay higher or lower wages to their existing staff, or secondly, firms can hire workers with different skill profiles, adjusting the labour force towards more skilled or unskilled workers. A full treatment of this question would necessitate linked employer-employee data (as in, eg., Hijzen et al., 2013). While Hijzen et al. find that the largest direct wage effects of MNE are due to newly hired workers, we unfortunately do not have such detailed data available and need to leave this question for further research.

The empirical analysis is carried out with firm level data for China only. Still, the results may also give some indicative ideas regarding the wage effect of MNEs for other developing and emerging economies. Direct effects can be expected to be positive in other countries as well, given the global evidence on productivity premia of MNEs (Chang et al., 2013b; Harrison & Scorse, 2010). Recall that at the core of our theoretical mechanism is a built-in human resources advantage by the MNE, which is not host-country specific. However, one would conjecture that this advantage varies with the idiosyncracies of labor markets across host economies, which would directly influence the foreign wage premium. Previous work has estimated productivity spillovers to be negative for a variety of countries, suggesting that the negative indirect wage effects we have documented may also be found elsewhere (Meyer & Sinani, 2009). The compositional effect, which in our model implies that the strength of the effects depend on the level of foreign presence should thus be applicable in other countries, also. An important condition would be the size of the clusters the MNEs invest in. Our mechanism requires a non-neglible mass of both foreign owned and locally owned firms to be present in the market in order for MNE selection to have the demonstrated effect.

Of course, in order to validate these conjectures, one would need further analyses with data for other countries. We hope that our paper highlights the potential insights one could gain from implementing this approach. They may prove very useful for policy makers who aim at maximizing the potential from inward foreign direct investment for their country, as well as for

MNE managers who wish to understand the impact of their investments and involvement on host economies.

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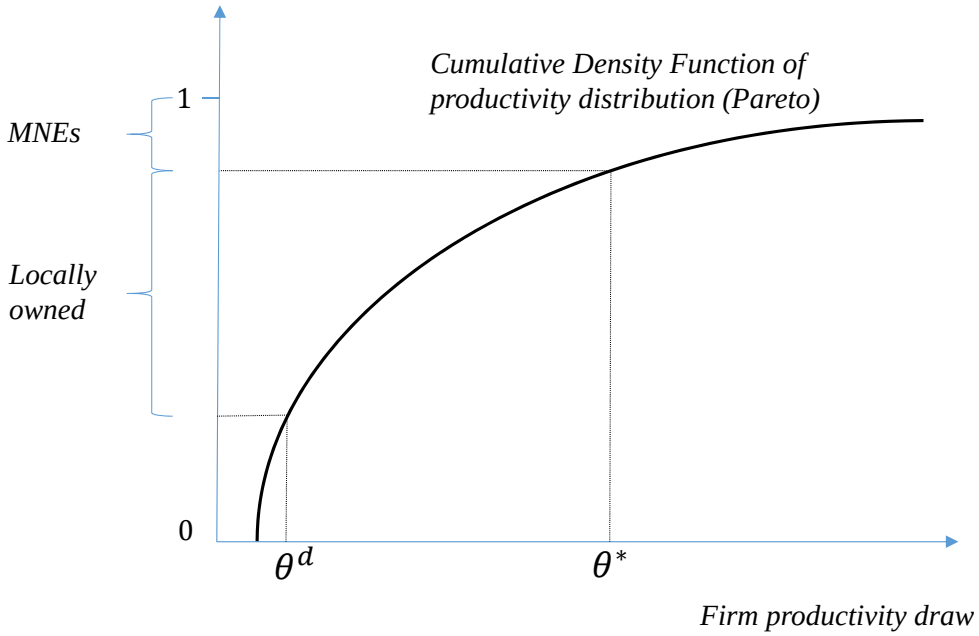

Figure 1: Equilibrium with MNEs and locally owned firms

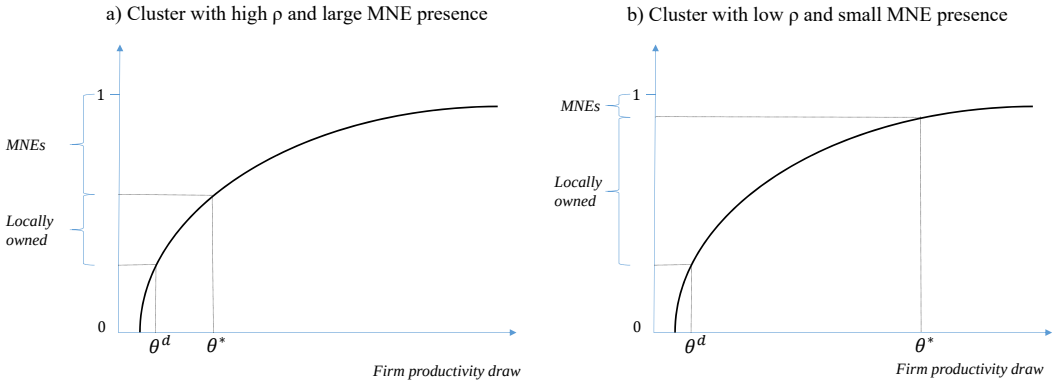

Figure 2: Differences in MNE shares across clusters

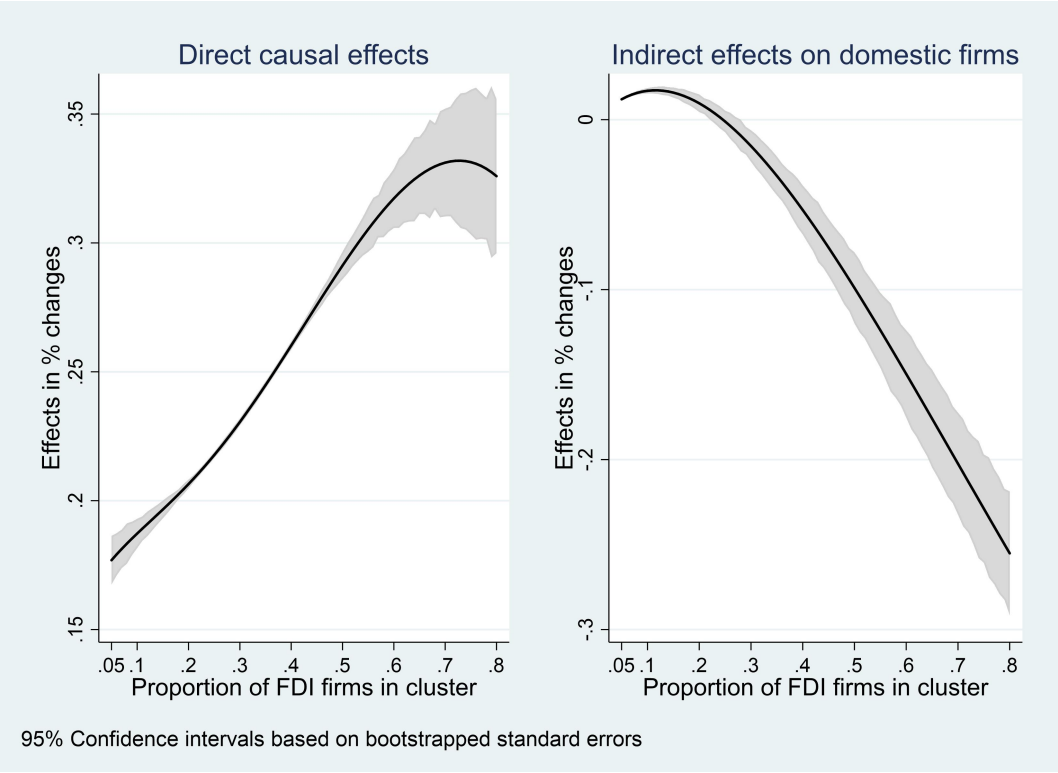

Figure 3: Causal effects of FDI on wages at foreign and domestic firms

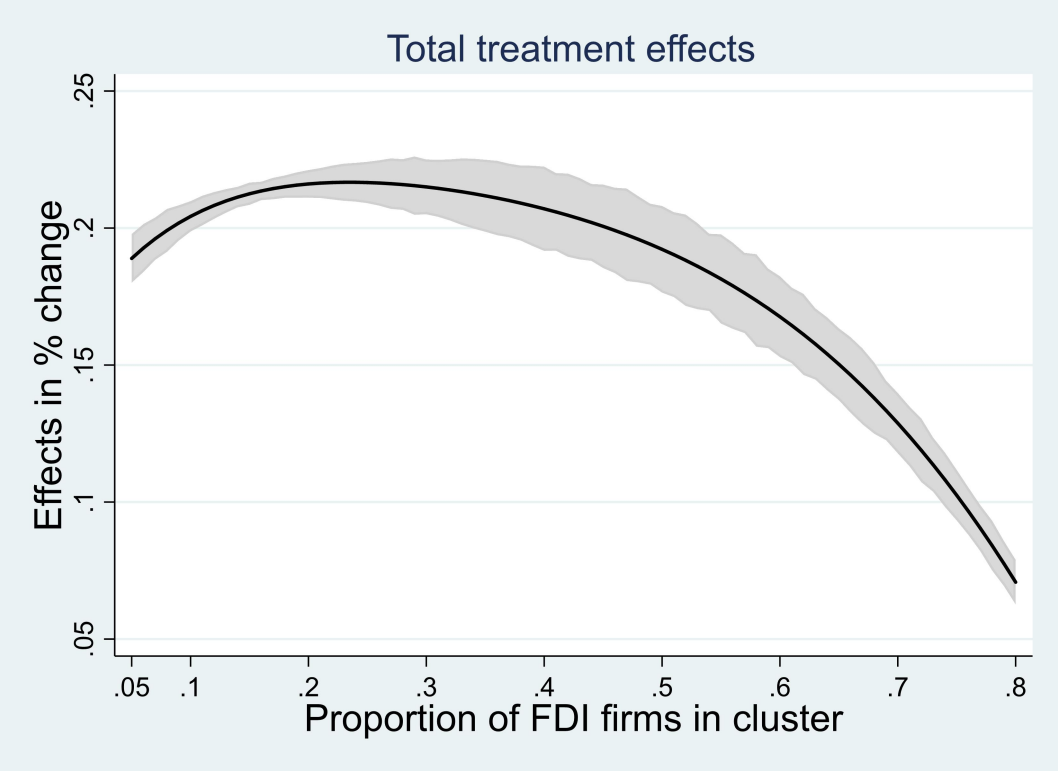

Figure 4: Total treatment effects of FDI on wages

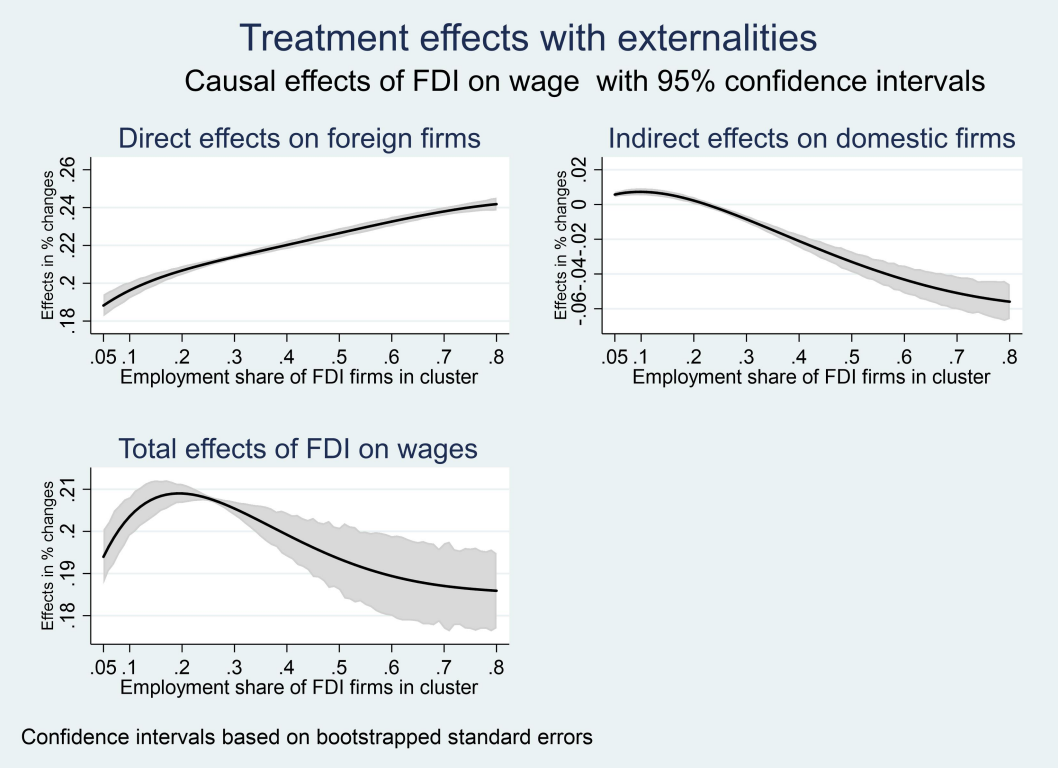

Figure 5: Treatment effects based on employment shares of FDI firms in cluster

Table 1: Variable definition and summary statistics of pre-treatment (2004) covariates

		Domestic Firms				Foreign Firms			
Variable	Definition	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Productivity	Total factor productivity estimated following Levinsohn and Petrin (2003)	4.013	1.271	-6.050	10.948	4.068	1.343	-4.723	11.613
Productivity growth	Productivity growth between 2003 and 2004	0.123	0.729	-8.669	8.375	0.076	0.798	-7.929	9.849
Wages	Log of wages per worker (in constant 2009 USD)	2.421	0.498	-2.020	8.440	2.744	0.611	-0.182	7.140
Wage growth	Growth in wages between 2003 and 2004	0.092	0.427	-4.690	7.286	0.087	0.444	-3.588	7.907
Size	Log of total assets (in constant 2009 USD)	8.224	1.644	-0.026	17.666	9.014	1.718	0.667	16.685
Age	Log of (years since establishment+1)	1.959	0.936	0	4.605	1.844	0.731	0	4.533
Exports	Export sales/total sales	0.121	0.291	0	1	0.454	0.436	0	1
Tax	Tax paid/total sales	0.095	0.378	-5.124	7.666	0.044	0.262	-5.777	5.081
Benefits	Dummy variable if company has incurred expenses towards benefits to workers such as housing or health care	0.841	0.366	0	1	0.650	0.477	0	1
Number of firms		110809				35390			

Note: The approach by Levinsohn and Petrin (2003) allows for the estimation of a production function taking into account simultaneity of input choice. It thus allows TFP estimation avoiding endogeneity bias due to such simultaneity. Recent applications include Driffield, Love & Yang (2016) and Girma et al. (2015).

Table 2: Summary statistics of cluster level variables

Variable	Mean	S.D.	Interquartile range	Min	Max
Proportion of foreign firms	0.211	0.120	0.171	0.045	0.556
Productivity	4.047	0.329	0.453	3.322	4.988
Productivity growth	0.211	0.153	0.135	-0.049	1.429
Wage	2.500	0.280	0.390	1.998	3.271
Wage growth	0.171	0.079	0.101	0.042	0.702
Size	8.520	0.439	0.450	7.788	10.041
Age	2.006	0.175	0.191	1.218	2.510
Exports	0.234	0.128	0.168	0	0.610
Tax	0.225	0.219	0.195	-0.930	0.939
Benefit (log of cluster average benefit)	-4.613	0.582	0.503	-5.691	-1.946
Share of state-owned firms	0.093	0.062	0.096	0.006	0.247
Log of number of foreign firms in province	5.077	1.209	1.648	2.303	8.148
Number of clusters	127				

Note:

(i) All variables except total number of foreign firms in region are defined as cluster-level averages.

(ii) All variables except proportion of foreign firms are measured in the pre-treatment year of 2003.

Table 3: Correlation matrix of cluster level variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Proportion of foreign firms	1											
2. Productivity	0.0691	1										
	(0.440)											
3. Productivity growth	-0.339	0.267	1									
	(0.000)	(0.002)										
4. Wage	0.657	0.267	-0.376	1								
	(0.000)	(0.002)	(0.000)									
5. Wage growth	-0.394	0.0246	0.582	-0.596	1							
	(0.000)	(0.783)	(0.000)	(0.000)								
6. Size	-0.164	0.172	-0.126	-0.0161	-0.0569	1						
	(0.065)	(0.053)	(0.158)	(0.857)	(0.525)							
7. Age	-0.125	-0.196	-0.429	0.197	-0.272	0.486	1					
	(0.162)	(0.027)	(0.000)	(0.026)	(0.002)	(0.000)						
8. Tax	-0.308	-0.118	0.104	-0.310	0.228	-0.0127	0.0279	1				
	(0.000)	(0.188)	(0.244)	(0.000)	(0.010)	(0.887)	(0.755)					
9. Benefit	-0.00806	-0.281	-0.251	0.228	-0.215	0.0234	0.385	-0.00581	1			
	(0.928)	(0.001)	(0.004)	(0.010)	(0.015)	(0.794)	(0.000)	(0.948)				
10. Exports	0.644	-0.221	-0.258	0.306	-0.282	-0.344	-0.263	-0.100	-0.00004	1		
	(0.000)	(0.013)	(0.003)	(0.000)	(0.001)	(0.000)	(0.003)	(0.263)	(1.000)			
11. Share of state-owned firms	-0.416	-0.185	-0.0336	-0.180	0.171	0.402	0.606	0.259	0.428	-0.537	1	
	(0.000)	(0.038)	(0.708)	(0.043)	(0.055)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)		
12. # foreign firms in province	0.631	0.0374	-0.274	0.316	-0.342	-0.409	-0.312	-0.0961	-0.149	0.744	-0.642	1
	(0.000)	(0.677)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.282)	(0.094)	(0.000)	(0.000)	

Notes: p-values in parentheses

A Theoretical Appendix

To illustrate the mechanisms at work we focus on one country with a continuum of risk neutral workers. The standard setup of CES-preferences with monopolistic competition in the final good market yields the following expression for equilibrium revenue of a firm producing variety j.

$$r(j) = Aq(j)^{\beta} \text{ with } 0 < \beta < 1 \tag{A.1}$$

where

$$A = E^{1-\beta} P^{\beta}$$

is a demand factor exogenous to the firm and $1/(1-\beta)$ is the elasticity of substitution between varieties. Total expenditures on differentiated goods are given by E and the price index for differentiated goods is given by P. Furthermore, demand for good j from (A.1) is

$$q(j) = A^{\frac{1}{1-\beta}} p(j)^{\frac{-1}{1-\beta}}$$

There is a fixed entry cost that firms have to pay in order to remain in the market given by f_e. Firm productivity is determined by a draw of the parameter θ, and the distribution is Pareto with the shape parameter given by z. As mentioned above, a second set of fixed costs determines the firm's ownership. Here, the firms face the following choice: either they choose a lower profile which results only in the usual market entry costs of f_d but also implies that the firm will not be able to partner up with an MNE. Or the firm pays f_d plus an additional fixed cost f_m and, as a result, becomes attractive to multinational corporations and is consequently acquired.[20]

A firm's output depends on its productivity θ, a measure of workers hired h and the average ability of those workers $\bar{a}$:

$$y = \theta h^{\gamma} \bar{a}$$

Just as in Helpman et al. (2010), firms begin the hiring process by posting vacancies. The workers that are subsequently matched with the firm are subject to screening. Upon being interviewed, each worker draws a match-specific ability parameter a, which is also assumed to be distributed Pareto with shape parameter k.[21] The firms choose a level of screening effort by setting a threshold a_c . Workers with a match-specific productivity below a_c will be recognized and not hired. Screening costs increase in a_c and also differ depending on whether the firm is part of an MNE or not. Screening costs are given by $\frac{c_L a_c^{\delta}}{\delta}$ and $\frac{c_M a_c^{\delta}}{\delta}$ for locally owned and foreign-

[20] Note that we model the difference between foreign- owned and domestically owned firms only insofar as it relates to the labor market. The firm's decision whether to incur the additional fixed cost f_m will hence solely depend on the benefits it gets from lower screening costs.

[21] Throughout we assume that $0 < \gamma k < 1$ in order to ensure that firms have an incentive to screen (see Helpman et al. (2010) for discussion). Intuitively, firms may find it disadvantageous to screen if i) the importance of number of workers relative to their (average) productivity level in the production function is high (high γ) and ii) there is low dispersion of match-specific productivity levels (high k).

owned firms, respectively, where $c_L > c_M > 0$ and $\delta > 0$. One can show that a firm sampling n workers and choosing screening intensity a_c ends up with a measure of workers given by

$$h = n\left(\frac{a_{min}}{a_c}\right)^k \tag{A.2}$$

and average ability of the hired workers is given by

$$\bar{a} = k\frac{a_c}{k-1}$$

Note that a_{min} is the minimum of the support for the Pareto distribution of the match-specific productivity draws by workers.

The firm maximizes profit given by

$$\pi(\theta) = \max_{n\geq 0, a_c \geq a_{min}, I_m \in \{0,1\}} \frac{1}{1+\gamma\beta} A(\kappa_y \theta n^\gamma a_c^{1-\gamma k})^\beta - bn - (1-I_m)\frac{c_L a^\delta}{\delta} - I_m \frac{c_M a^\delta}{\delta} - f_d - I_m f_m$$

Here $\kappa_y = \frac{k}{k-1} a_{min}^{\gamma k}$ is a constant and b is the cost of sampling one worker. The firm chooses the number of workers to sample n, the screening threshold a_c and whether to invest in being acquired by an MNE or not. Note that the factor $\frac{1}{1+\beta\gamma}$ is a result of bargaining with the workers: it represents the share of revenue that the firm obtains. We continue with the case of the locally owned firm ($I_m = 0$). The first-order conditions are given by

$$\frac{\beta(1-\gamma k)}{1+\beta\gamma} r(\theta) = c_L a_c(\theta)^\delta$$

and

$$\frac{\beta\gamma}{1+\beta\gamma} r(\theta) = bn(\theta).$$

Here we used the fact that the firm's revenue is given by $r(\theta) = A(\kappa_y \theta n^\gamma a_c^{1-\gamma k})^\beta$. The total wage bill $w(\theta)h(\theta)$ is a constant fraction of firm revenue, so we derive

$$w(\theta) = \frac{\beta\gamma}{1+\beta\gamma}\frac{r(\theta)}{h(\theta)} = bn(\theta)/h(\theta) = b\left(\frac{a_c(\theta)}{a_{min}}\right)^k,$$

using the second first-order condition as well as (A.2). In addition, we can solve for the screening threshold and the number of sampled workers:

$$a_c(\theta) = \left(\frac{A\beta}{1+\beta\gamma}\right)^{\frac{1}{\delta\Gamma}} \frac{(1-\gamma k)}{c_L}^{\frac{1-\gamma\beta}{\delta\Gamma}} \frac{\gamma}{b}^{\frac{\gamma\beta}{\delta\Gamma}} (\kappa_y\theta)^{\frac{\beta}{\delta\Gamma}}$$

$$n(\theta) = \left(\frac{A\beta}{1+\beta\gamma}\right)^{\frac{1}{\Gamma}} \frac{(1-\gamma k)}{c_L}^{\frac{\beta(1-\gamma k)}{\delta\Gamma}} \frac{\gamma}{b}^{\frac{\beta\gamma+\Gamma}{\Gamma}} (\kappa_y\theta)^{\frac{\beta}{\Gamma}}.$$

Here $\Gamma \equiv (1-\beta\gamma) - \frac{\beta(1-\gamma k)}{\delta} > 0$. Firms with higher revenue (due to a better productivity draw) choose

a higher screening threshold and sample more workers. This, in turn, raises their wage, because they hire a higher quality workforce. Note that a drop in the screening cost from c_L to c_M indicates a jump upwards in both. All of the firm's decisions depend on its initial productivity draw.

In equilibrium, we define the key productivity cut-offs θ^d and θ^*: Only firms with a productivity draw of θ^d or higher will enter production and only firms with a productivity draw of θ^* or higher will enter production and pay the fixed cost to attract multinational investment and lower their screening costs.

Free entry implies zero expected profit, i.e.

$$\Pi^L(\theta^d) = f_d,$$

where the superscript L denotes a locally owned firm, and Π refers to firm revenue net of variable costs. We implicitly define θ^* as the productivity level at which the firm is indifferent between investing or not:

$$\Pi^L(\theta^*) = \Pi^M(\theta^*) - f_m.$$

The last condition for sectoral equilibrium is the free-entry condition, which (together with the assumption of Pareto distributed productivity draws) also allows us to derive the implicit functional relationship between θ^d and θ^*:

$$f_d \int_{\theta^d}^{\infty} \left[\left(\frac{\theta}{\theta^d} \right)^{\frac{\beta}{\Gamma}} - 1 \right] dG_\theta(\theta) + f_m \int_{\theta^*}^{\infty} \left[\left(\frac{\theta}{\theta^*} \right)^{\frac{\beta}{\Gamma}} - 1 \right] dG_\theta(\theta) = f_e$$

and

$$(\theta^d)^z = \frac{f_d}{\frac{(z-\frac{\beta}{\Gamma})}{\frac{\beta}{\Gamma}} \frac{f_e}{\theta^z_{min}} - \frac{f_m}{\theta^{*z}}}.$$

The two cut-off equations and the free-entry condition are used to solve for θ^d, θ^* and A.

A.1 Direct wage effect

In order to examine the direct treatment effect, we first consider the wage paid by the marginal MNE (that is one with a productivity draw of θ^*) when its ownership changes from domestic to foreign. In this framework this premium is simply a function of the screening cost ratio, which is by definition always positive:

$$\frac{w^m}{w^d} = \left(\frac{c_L}{c_M} \right)^{\frac{k(1-\gamma\beta)}{\delta\Gamma}} \tag{A.3}$$

This is equation (1) in the main text. In addition, we can show that the direct treatment effect differs with the presence of foreign firms by looking at the ratio of the average wage paid by foreign-owned firms $\bar{w}^m$ and by domestically owned firms $\bar{w}^d$.

$$\begin{aligned}\frac{\bar{w}^m}{\bar{w}^d} &= \frac{\int_{\theta^*}^{\infty} w(\theta) dG_\theta(\theta)}{\int_{\theta^d}^{\theta^*} w(\theta) dG_\theta(\theta)} \\ &= \frac{w^{m*}}{w^d} \left(\frac{\theta^d}{\theta^*}\right)^{\frac{\beta k}{\delta \Gamma}} \frac{1}{\left(\frac{\theta^d}{\theta^*}\right)^{\frac{\beta k}{\delta \Gamma} - z} - 1} \\ &= \frac{w^{m*}}{w^d} \frac{1}{\rho^{-z} - \rho^{-\frac{\beta k}{\delta \Gamma}}}\end{aligned}$$

Throughout our analysis we assume $z > \frac{\beta k}{\delta \Gamma}$, ensuring a strictly positive value for the wage ratio. Here w^{m*} is the wage paid by a firm with $\theta = \theta^*$ that chooses to lower its screening costs. Using (A.3) we can simplify the ratio w^{m*}/w^d further:

$$\frac{w^{m*}}{w^d} = \frac{w^{d*}}{w^d} \left(\frac{c_L}{c_M}\right)^{\frac{k(1-\gamma\beta)}{\delta \Gamma}} = \rho^{-\frac{k\beta}{\delta \Gamma}} \left(\frac{c_L}{c_M}\right)^{\frac{k(1-\gamma\beta)}{\delta \Gamma}}$$

Combining the last two expressions we arrive at

$$\frac{\bar{w}^m}{\bar{w}^d} = \left(\frac{c_L}{c_M}\right)^{\frac{k(1-\gamma\beta)}{\delta \Gamma}} \frac{1}{\rho^{\frac{k\beta}{\delta \Gamma} - z} - 1}$$

This is equation (2) in the main text.

B Empirical Appendix

Table A1: Cluster (geographic-industry grouping pair) classification used in this paper

Geographic grouping	Constituent provinces	Industry grouping	Constituent sectors
1	Beijing and Tianjing	1	Food processing, production and beverage
2	Shanghai	2	Textile, leather and garments
3	Liaonign and Shandong	3	Timber, furniture, paper and printing
4	Jiangshu	4	Rubber and plastic
5	Fujian and Zhejiang	5	Ferrous and nonferrous metals
6	Guangdong and Hainan	6	Electric, electronics, telecommunications and instruments
7	Neimenggu, Hebei and Shanxi	7	Chemical materials and chemical products
8	Jilin, Heilongjiang	8	Medical and pharmaceutical products
9	Jiangxi, Anhui	9	Non-metal mineral products
10	Qinghai, Henan, Ganshu, Shanxi, Hunan, Ningxia, Hubei, Guangxi and Xinjiang	10	Metal products
11	Guizhou, Yunnan , Sichuan and Chongqin	11	Machinery
		12	Special purpose equipment
		13	Transport equipment

Table A2: Top and bottom 10 FDI attracting clusters in terms of employment share of foreign firms

Bottom 10 clusters

Geographic grouping	Industry grouping	Employment share of FDI	Share of FDI firms
5	7	0.04	0.08
8	7	0.05	0.07
4	7	0.06	0.06
10	7	0.06	0.08
5	7	0.06	0.04
7	7	0.06	0.06
7	10	0.06	0.05
10	4	0.07	0.08
8	4	0.07	0.03
11	2	0.07	0.08

Top 10 clusters

3	12	0.43	0.54
2	4	0.43	0.61
2	13	0.43	0.63
6	11	0.44	0.47
2	2	0.44	0.51
9	5	0.48	0.71
6	4	0.49	0.70
4	6	0.54	0.72
2	1	0.55	0.69
6	2	0.56	0.72

Table A3: Summary statistics from the first stage cluster-specific logit regressions and balancing tests (N=127)

	Marginal effects from cluster-specific logit regressions					Balancing tests
Pre-treatment covariates (in 2004)	Mean	Median	SD	Min	Max	% of balanced clusters
Productivity	0.063	0.037	0.167	-0.320	0.579	100%
Productivity growth	-0.099	-0.107	0.320	-1.3292	1.957	99.2%
Wages	1.342	1.326	0.565	-0.382	2.982	100%
Wages growth	-0.501	-0.434	0.858	-7.756	0.454	98.4%
Size	0.318	0.319	0.161	-0.062	0.718	100%
Age	-0.308	-0.303	0.253	-1.012	0.288	100%
Exports	2.783	2.648	1.622	-3.626	11.948	97.6%
Tax	-0.769	-0.632	0.924	-6.572	0.671	100%
Benefits	-1.496	-1.447	0.688	-3.283	0.221	100%

Notes: (i) Determinants of foreign ownership are estimated separately for each of the 127 clusters. (ii) The last column gives the results from the covariate balancing test which consists of testing (at 10% level or lower) for difference in the means of the covariates in treatment and control groups, conditional on the estimated propensity score.

Table A4: Summary statistics of estimated coefficients from doubly-robust regressions (Equation (3))

	Mean	Median	SD	Min	Max
Foreign ownership	0.217	0.213	0.056	0.083	0.377
Pre-treatment covariates:					
Productivity	0.019	0.018	0.015	-0.022	0.087
Productivity growth	-0.173	-0.174	0.055	-0.316	-0.036
Wages	-0.017	-0.022	0.072	-0.204	0.539
Wages growth	-0.012	-0.010	0.023	-0.091	0.053
Size	0.004	-0.006	0.142	-0.829	1.041
Age	0.007	0.008	0.012	-0.034	0.037
Exports	-0.008	-0.006	0.021	-0.093	0.072
Tax	0.000	-0.010	0.075	-0.182	0.400
Benefits	-0.008	-0.011	0.040	-0.118	0.099

Notes: (i) The estimated coefficients of the pre-treatment variables do not have any causal interpretation

Table A5: Estimated coefficients and average marginal effects from cluster-level fractional logit model and balancing tests results

Dependent variable: *Proportion of Foreign Firms*	Estimated coefficients	Marginal effects	p-values from balancing tests
Productivity	-0.169	-0.026	0.444
	(0.2983)	(0.2990)	
Productivity growth	-0.271	-0.042	0.10
	(0.5243)	(0.5244)	
Wage	1.535	0.240	0.185
	(0.0000)	(0.0000)	
Wage growth	1.080	0.169	0.496
	(0.1659)	(0.1670)	
Size	0.195	0.031	0.559
	(0.0787)	(0.0797)	
Age	-0.758	-0.118	0.410
	(0.0158)	(0.0165)	
Tax	-0.483	-0.075	0.389
	(0.0016)	(0.0019)	
Benefit	-0.129	-0.020	0.385
	(0.2298)	(0.2287)	
Exports	1.417	0.221	0.948
	(0.0064)	(0.0067)	
Share of state-owned firms	1.559	0.243	0.592
	(0.1570)	(0.1559)	
# of foreign firms in region	0.212	0.033	0.941
	(0.0005)	(0.0004)	
Observations	127		

Notes: p-values in parentheses.

Table A6: Direct, indirect and total causal effects of foreign ownership on wages

	% of MNEs	Causal effects		
Direct effects		Point estimate	95% confidence interval	
	10%	0.187	0.182	0.193
	20%	0.206	0.205	0.208
	30%	0.231	0.229	0.232
	40%	0.260	0.259	0.262
	50%	0.291	0.286	0.296
Indirect effects				
	10%	0.017	0.015	0.019
	20%	0.010	0.005	0.015
	30%	-0.015	-0.024	-0.007
	40%	-0.053	-0.068	-0.039
	50%	-0.099	-0.120	-0.078
Total effects				
	10%	0.204	0.198	0.210
	20%	0.216	0.211	0.221
	30%	0.215	0.205	0.225
	40%	0.207	0.192	0.222
	50%	0.192	0.177	0.207

Notes: This table contains a selection of the estimates used to draw Figures 3 and 4.