Kreckemeier, Udo

Conference Paper

Distance and the Multinational Wage Premium


Provided in Cooperation with:
Verein für Socialpolitik / German Economic Association


This Version is available at:
http://hdl.handle.net/10419/181618

Terms of use:
Documents in EconStor may be saved and copied for your personal and scholarly purposes.
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.
If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.
Distance and the Multinational Wage Premium*

Hartmut Egger†
University of Bayreuth
CESifo, GEP, and IIfW

Elke Jahn
University of Bayreuth
IAB Nuremberg

Udo Kreickemeier
TU Dresden
CESifo and GEP

March 1, 2018

Abstract

Combining administrative data on German workers with commercial data on German producers, we find evidence that German subsidiaries of foreign multinationals, while paying a premium relative to other local producers, offer wages of similar size as German subsidiaries of German multinationals. Zooming in on foreign multinationals gives a more nuanced picture and reveals a so far unexplored distance effect that is prevalent in the data. Foreign multinationals pay lower wages than German multinationals if the ultimate owner is located in close proximity to Germany, whereas the opposite is true if the ultimate owner is located further away. To provide a rationale for this pattern, we develop a theoretical model that allows for firm-specific wages and emphasizes uncertainty about foreign wage payments as an important factor of the foreign investment decision. Due to this uncertainty, firms that have to pay high wages at home are more likely to seek investment abroad. High-wage firms are also more likely to actually produce abroad, once the foreign wage level has been revealed, explaining why multinationals pay higher wages than non-multinationals in the home and the host country of investment. In the model, the empirically observed distance effect on the multinational wage premium occurs since exporting as an alternative means of reaching foreign customers is less attractive for distant locations, and firms are therefore more willing to accept unfavorable (i.e. high wage) draws for foreign production in locations that are further away from their headquarters.

JEL-Classification: F12, F14, F21, F23
Keywords: Multinational Wage Premium, Heterogeneous Firms, Distance Effects

*We are grateful to participants at the Göttingen Workshop in International Economics for helpful comments and discussion.
†Corresponding author: University of Bayreuth, Department of Economics, Universitätsstr. 30, 95447 Bayreuth, Germany; Email:hartmut.egger@uni-bayreuth.de.
1 Introduction

It is a well-established empirical fact that multinational firms pay higher wages than other producers. This wage gap falls drastically, but does not disappear, when controlling for observable differences and restricting the comparison of multinationals and non-multinationals to firms that have the same size, workforce composition, industry affiliation, etc. (Aitken et al., 1996; Balsvik, 2011; Malchow-Møller et al., 2013). The (residual) wage premium conditional on characteristics of the firm and its workforce has sparked a lot of interest in academic research, and the literature has produced a large body of evidence supportive of the conclusion that “multi-nationality – not nationality – is important” (Heyman et al., 2007, p. 356) for its existence. This accords with the widespread view that multinationals are exceptional producers and motivates the specific premise common in the theoretical literature that a superior technology of the parent is instrumental for the wage premium paid by its subsidiaries (see, for instance, Fosfuri et al., 2001; Egger and Kreickemeier, 2013; Gumpert, 2017). Although this reasoning seems plausible, conclusive evidence for it is so far missing.

Using detailed information on the ownership of German producers, we show in this paper that important new insights into nature of the multinational wage premium can be obtained by acknowledging the role of distance between the parent and its subsidiaries. In particular, we find that foreign multinationals pay lower wages in Germany than domestic multinationals if the ultimate owner of the German subsidiary is located nearby, whereas the opposite is true if the ultimate owner comes from a far-off country. To provide a rationale for the role of distance in our data we develop a theoretical model, which features wage differences between firms, allows for exporting and foreign investment as two alternative forms of reaching foreign consumers, and points to uncertainty about foreign wages as a key obstacle to foreign investment for those firms paying low wages at home. To the extent that larger distance makes exporting (relatively) less attractive – as suggested by the evidence supportive of a proximity-concentration trade-off in the foreign investment decision (cf. Brainard, 1997) – this model can not only explain the existence of a multinational wage premium but also the distance effect observed in the data.

In the empirical part of the paper, we introduce a new dataset, which links administrative data on German workers from the Institute for Employment Research (IAB) in Nuremberg with firm-level information from Bureau van Dijk’s commercial database Orbis. To construct the dataset, we rely on the Establishment History Panel (BHP) of IAB, which aggregates worker information to the plant level, and use record linkages provided by the IAB to match German establishments from BHP with German firms from the Orbis database. Since Orbis provides detailed information on ownership structure, we can distinguish non-multinationals and multinationals, and we can
furthermore distinguish multinationals by the location of their ultimate owners. A particular advantage of the linked BHP/Orbis data is that it contains detailed information on parents and their subsidiaries in other countries, and hence it offers a rich set of controls for national and international corporate networks for our empirical analysis.

We employ the linked BHP/Orbis data to collect evidence on the multinational wage premium in Germany and find, in line with previous empirical work, that the premium falls but is not eliminated when controlling for observable differences in plant and workforce characteristics of the German subsidiaries (see Hijzen et al., 2013). We also show that the distinction between domestic multinationals with a German ultimate owner and foreign multinationals with an ultimate owner outside of Germany is important and helps explaining sizable differences in the estimates of multinational wage premia found in the literature. In particular, our results confirm insights from Heyman et al. (2007) that relying on foreign ownership information instead of controlling for whether the subsidiary is part of a multinational corporate network leads to lower estimates of wage premia, because wages in the control group of firms with domestic ownership are inflated by the existence of domestic multinationals. In our dataset, we find only small differences between wage premia paid by subsidiaries of domestic and foreign multinationals, being suggestive for the conclusion that, irrespective of their nationality, multinationals pay higher wages than non-multinationals, because they are exceptional producers.

To shed light on whether such a conclusion is justified, we add a control for the profitability of the ultimate owner – measured by log revenues per employee. Our results indicate that differences in the profitability of parents does not explain a major part of the multinational wage premium. Including controls for job turnover, the type of occupations distinguished by their functions and qualifications needed to perform the required tasks, and a proxy for workplace training still leaves a sizable part of the multinational unexplained. This suggests that existing explanations are only partially successful in explaining why multinationals pay higher wages than non-multinationals. Adding a control for distance between Germany and the location of the ultimate owner provides additional important insights on how firms remunerate their workers and challenges the view that the nationality of the parent is not overly important for explaining multinational wages. Our results point to a negative border effect on the multinational wage premium as well as a positive distance effect which dominates the border effect if the ultimate owner is from a far-off country.

In the theory part of the paper, we construct a model that produces wage patterns in line with three stylized facts from our data. First, multinationals pay higher wages than non-multinationals even after controlling for observable differences in plant and workforce characteristics. Second, subsidiaries of domestic and foreign multinationals pay on average wages of similar size. Third, foreign multinationals pay lower wages than German multinationals if the ultimate owner is located
nearby, whereas the opposite is true if the ultimate owner is located further away. The model we suggest builds on two important ingredients. The first one is a mechanism that explains the existence of firm-specific wages. We take a parsimonious approach and use recent evidence from Wiswall and Zafar (2018) upon the willingness to pay for more attractive workplace attributes as motivation for modeling wage differences as a compensation for exogenous differences of firms in the workplace attributes (amenities, in short).\(^1\) The second ingredient that is important for our analysis is an uncertainty about the perception of workplace attributes by foreign workers and thus an uncertainty of firms about foreign wages when making their decision upon foreign investment.\(^2\) We capture this uncertainty by a lottery that gives investors a single amenity draw for their foreign production plant from a distribution common to all producers, once they have paid the fixed cost of investment as a participation fee.

Assuming that firms can serve foreign consumers either as exporters through the shipment of domestic output or as multinationals through foreign production, and provided that only foreign production costs are subject to an ex ante uncertainty, foreign investment is more attractive ceteris paribus for firms whose amenities are low-valued by domestic workers, because these firms have to pay high compensating wages to attract workers at home and are therefore more likely to benefit from a better amenity draw when choosing to invest abroad. This selection mechanism suffices to explain, why, consistent with the first stylized fact, multinationals pay higher wages than non-multinationals at home and abroad. Regarding the wages multinationals pay at home relative to abroad, there are two counteracting effects. On the one hand, foreign investment offers the chance of obtaining a better amenity for the foreign production plant, which is the main reason for entering the lottery in the first place. On the other hand, the investment is risky and may result in a bad amenity draw, leading to higher wage payments abroad than at home. Whereas foreign investors can opt out of foreign production if the drawn amenity is too bad, they will accept higher foreign labor costs to a certain extent because foreign production bears the additional advantage of saving on trade costs, which is a net gain if the investment cost is sunk. It is a priori not clear which of the two effects dominates, and, depending on the distribution of amenities, our model allows

\(^1\)The idea that non-wage workplace attributes are important determinants of wage dispersion is not new. For instance, Rosen (1986) argues that compensating wage differentials between firms arise *inter alia* because of inter-firm differences in working conditions or work-time schedules. Based on such theoretical insights, a sizable literature has evolved trying to assess the willingness to pay for workplace amenities, and evidence from Gronberg and Reed (1994), Bonhomme and Jolivet (2009), and others suggests that wage differences compensating for differences in workplace amenities can be sizable.

\(^2\)Whereas direct evidence for cross-country differences in the perception of workplace amenities is to the best of our knowledge not available, indirect evidence supportive of such differences can be derived from three different observations. The first one is the finding of Wiswall and Zafar (2018) that preferences for workplace attributes are quite diverse even within groups of similar people. The second one is the finding of Hipólito (2008) that workplace attributes are an important determinant for explaining differences in wage inequality across European countries, suggestive for the conclusion that the willingness to pay for amenities differs between these countries. The third one is the insight from a literature dealing with health effects of job satisfaction that the same workplace attributes have different effects in different countries (see Cottini and Lucifora, 2014).
for wages in the domestic subsidiary to be higher or lower on average than wages in the foreign subsidiary of a multinational firm. This implies multinational wage premia that are consistent with the second stylized fact in our data.

Finally, associating higher trade costs with larger distance, as it is common, for instance, in the gravity literature (cf. Anderson and van Wincoop, 2003; Anderson, 2011), our model also captures the third stylized fact, regarding the role of distance for the relative wage premium paid by the foreign subsidiary. To see this, note that larger distance has two effects. It lowers the return to exporting, and hence increases the incentive for foreign investment, so that the average wage in the domestic subsidiary of firms choosing to invest decreases in distance due to a composition effect. Whereas effect also exists for foreign subsidiaries, it is counteracted by a second selection effect specific to foreign subsidiaries: With larger distance to the foreign market, a larger share of investors accept the amenity draw, therefore leading to higher wages in the group of investors. On net, our model therefore predicts in line with the data that larger distance between two countries increases the wage premium paid by domestic subsidiaries of foreign multinationals relative to the wage premium paid by domestic subsidiaries of local multinationals.

We also consider three possible extensions of our model. In the first extension, we account for endogenous amenity provision, because it is well established that some firms make considerable investments into workplace amenities for improving their reputation as employer among current employees as well as prospective applicants (see Ben, 2016). Provided that firms differ in the costs of amenity provision, our results do not change when allowing for endogenous adjustments in the firm-specific amenity levels. In a second extension, we add productivity differences as a second source of firm heterogeneity. This allows us to narrow down the comparison of multinationals and non-multinationals to producers of equal workforce size and thus the comparison used in the empirical analysis. In a final extension, we allow multinationals to replace domestic by foreign production if the outcome of the amenity lottery is particularly good. This generates a setting in which vertical and horizontal multinationals co-exist, and it shows that the former pay lower wages than the latter, which finds support in the data.

Our analysis is closely related to a large literature that aims at measuring and explaining multinational wage premia. On the empirical side, we complement previous work that documents existence of such a premium for various countries, including developing, newly industrialized, and developed ones (see, for instance, Aitken et al., 1996; Girma et al., 2001; Lipsey and Sjöholm, 2004). There is consensus in the literature that the multinational wage premium shrinks considerably, when controlling for worker and plant characteristics (Hijzen et al., 2013; Malchow-Møller et al., 2013). Recent empirical applications consider detailed information from linked employer-employee panel data and use the time dimension to show that time-invariant and unobserved heterogeneity
of workers and plants are important determinants of the residual, unexplained wage premium that remains after controlling for observables (Heyman et al., 2007; Balsvik, 2011). Whereas our dataset lacks the virtues of linked employer-employee panel data to account for unobserved heterogeneity of plants and workers by using fixed effects, it contains detailed information on corporate networks and, in particular, the ultimate owners of subsidiaries located in Germany. This information is particularly useful for shedding light on the widespread view that multinationals pay higher wages than non-multinationals because the parents are exceptional producers, with the nationality of the investor playing only a minor role.

On the theory side, our paper complements the literature by pointing to a new explanation for multinational wage premia. Most of the existing models build on the premise that the parent has access to a superior technology and that this causes higher wage payments by their subsidiaries to reduce the risk of technology dissipation due to job turnover (Fosfuri et al., 2001; Glass and Saggi, 2002), because of workplace learning (Girma and Görg, 2007; Malchow-Møller et al., 2013), due to (international) rent sharing (Egger and Kreickemeier, 2013; Orefice et al., 2016), or to compensate their workforce because multinationals require the workforce in their subsidiaries to perform tasks more independently (Gumpert, 2017). Whereas these mechanisms seem empirically relevant, they cannot explain the specific role of distance for the size of multinational wage premia in the German data. To provide a rationale for the distance effect, we suggest an alternative approach and assume that firms seek investment abroad if they pay high wages at home, because under uncertainty about foreign wages the expected return on the investment increases in domestic wages. Since exporting as an alternative means of foreign market penetration is not subject to uncertainty, the selection effect put forward by our model can explain the observed distance effects on the wages paid by German subsidiaries of foreign multinationals.

The remainder of the paper is organized as follows. In Section 2 we introduce the dataset and conduct the empirical analysis. Section 3 presents our baseline model and a detailed analysis upon the wage patterns of multinational and non-multinational producers. There, we also discuss how our model can be embedded into a general equilibrium environment. In Section 4, we consider three model extensions and discuss the robustness of our results when abandoning several restrictive assumptions made in the baseline specification to improve analytical tractability. The last section concludes.

---

Scheve and Slaughter (2004) argue that multinationals pay higher wages than non-multinationals to compensate their workers for a higher risk of job loss. Whereas this specific mechanism for generating wage premia is not directly rooted in the technology advantage of parents, lacking a fully-fledged model it is not clear from Scheve and Slaughter (2004) which exogenous differences could be responsible for the higher job turnover of multinationals.
2 Empirical evidence

In this section, we introduce a new dataset on multinational subsidiaries, that merges information on German plants from the Establishment History Panel (BHP) of the Institute for Employment Research (IAB) with information from the commercial firm database Orbis of Bureau van Dijk (BvD). After a detailed discussion about its construction, we use the new dataset to collect evidence on the existence and magnitude of the wage premium multinational firms pay to German workers, analyze to what extent the determinants put forward by the literature can explain the residual, unexplained part of the wage premium that still exists after controlling for observables, and finally investigate whether the distance between the parent’s location and the German subsidiary provides additional insights into its magnitude.

2.1 Data description and sample statistics

For our empirical analysis, we merge data on German plants from BHP with international firm data from Orbis. Plants in BHP are constructed from administrative data on German workforce and refer to local units of a firm that employ at least one worker subject to social security contributions at reference date June 30 of a given year. BHP is available for the period 1975-2014 and contains information on workforce, such as age, gender, education, vocational training, nationality, occupations, and gross mean daily wages, as well as information on size, industry affiliation, location, and job turnover of the plant (see Schmucker et al., 2016, for further details).

Information of the plants’ corporate networks comes from the commercial provider of global business and company information BvD. BvD collects data from almost 160 different sources, which are stored in their global firm database Orbis. The advantages of this database for our purpose is that Orbis provides comprehensive information on corporate hierarchies and ownership structures of companies. Based on the shareholding structure, BvD determines the shareholder with the highest direct or total percentage of ownership, and it classifies this shareholder as ultimate owner (parent) if it ranks highest in the hierarchy of companies. Using the shareholding structure, BvD can therefore provide a comprehensive picture about the networks of firms and, since Orbis also provides information on the country in which a firm is located, one can determine in this database whether a firm is ultimately owned by a domestic or foreign parent, and whether it belongs to a

---

4 Since earnings in the social security notifications have an upper limit, wage information in the source data is rightward censored. To overcome this problem, BHP provides information on imputed wages that are constructed following Card et al. (2013). Furthermore, missing information on worker qualification (education and vocational training) has been imputed, following Fitzenberger et al. (2006) and Kruppe et al. (2014).

5 In our dataset a firm is linked to a shareholder if more than 25 percent of the equity is owned by the parent. Whereas we cannot investigate whether our results are sensitive to this definition, Martins (2004) and Barbosa and Louri (2002) provide evidence that the specific choice of the cut-off level plays a minor role for their estimations. Furthermore, our definition in principle allows for multiple owners of a single firm. However, the problem of inconclusive ownership records does not arise in the dataset.
network of firms or is an independent producer. Aside from the ownership structure, Orbis also contains information on key financial indicators, including revenues and the size of the workforce at the firm level.

Since Orbis and BHP do not provide a common identifier, firm information from the former and plant information from the latter cannot be directly merged. To overcome this problem, IAB has performed a record linkage based on firm and plant names, legal forms, addresses, numbers of employees and the main industrial affiliations. Matching success rate for German firms in BvD with more than five employees is well above 80 percent and increases with the size of the firm. The linked BHP/Orbis data allows us to go beyond the current literature on multinational wage premia in three dimensions. First, due to detailed information on corporate structures, we can not only study the consequences of foreign ownership on the payment of German workers, but also investigate whether German subsidiaries of a foreign multinational pay differently than German subsidiaries of a German multinational. Second, since our dataset provides information on the (domestic or foreign) ultimate owner, we can shed light on how the nationality of the parent and the geographic distance to its subsidiary affects the wage payment of a multinational in Germany. Third, the detailed data on German plants and their parents allows us to discriminate between competing theories explaining the existence of a multinational wage premium.

For now, record linkages between Orbis and BHP are available for just a single year, and we therefore use a cross section of firms from Orbis (subject firms) which were active and located in Germany at the end of January 2014 and meet the following criteria. First, the data file must provide valid information on the ultimate owner and the country in which the parent and its subsidiaries are located. Second, the data file must provide valid information on the number of employees, the operating revenues, and industry classification codes for the subject firm and its ultimate owner for the previous business year. Third, we keep only subject firms, for which we find at least one active plant in BHP for 2013. Applying the three criteria gives a final dataset with 5,791 unique parents, 10,218 subject firms, and 26,711 plant observations.

Making use of the ownership structure in our dataset, we can distinguish between three different types of subject firms in the subsequent analysis. The first one are firms owned by a foreign multinational parent, which is a company outside of Germany that is ultimate owner of at least one German subsidiary. The second one are firms owned by a local multinational parent, which is a German company that is ultimate owner of at least one foreign subsidiary. The third one are non-multinational firms, which either belong to a German ultimate owner with no foreign

---

6Matching success rates drop to 55 percent for small firms with less than 5 employees. For details on the crosswalk between BHP and Orbis, see (Schild, 2016; Antoni et al., 2018).

7As it takes some time until financial information is integrated into the Orbis database, we use an update of the Orbis dataset drawn in June 2016 to improve financial information for 2013.
subsidiary or are independent producers that do not belong to another company. Beyond that, our dataset also provides information about the size of the corporate network and the share of subsidiaries located in countries different from the parent’s location, and hence gives a nuanced picture about the ownership structure of multinational producers.

Table 1: Descriptives of firm-plant linkages

<table>
<thead>
<tr>
<th>No. of parents</th>
<th>Mean no. of plants</th>
<th>Total number of plants</th>
<th>Network size</th>
<th>Mean share foreign subsidiaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign multinational parent</td>
<td>2,007</td>
<td>4.90</td>
<td>9,841</td>
<td>280.07</td>
</tr>
<tr>
<td>Distance ≤ 2,000 miles</td>
<td>1,249</td>
<td>5.14</td>
<td>6,416</td>
<td>237.52</td>
</tr>
<tr>
<td>Distance 2,001 − 6,000 miles</td>
<td>462</td>
<td>5.47</td>
<td>2,529</td>
<td>336.30</td>
</tr>
<tr>
<td>Distance &gt; 6,000 miles</td>
<td>296</td>
<td>3.03</td>
<td>896</td>
<td>371.82</td>
</tr>
<tr>
<td>Local multinational parent</td>
<td>1,012</td>
<td>12.00</td>
<td>12,147</td>
<td>133.87</td>
</tr>
<tr>
<td>Non-multinational parent</td>
<td>2,773</td>
<td>1.70</td>
<td>4,713</td>
<td>5.17</td>
</tr>
</tbody>
</table>

Notes: Data sources are BvD and BHP, 2013. Distance to Berlin in miles is measured using the ‘great circle’ formula: \( D_{ij} = 3962.6 \arccos(\sin(Y_i) \cdot \sin(Y_j) + \cos(Y_i) \cdot \cos(Y_j) \cdot \cos(X_i - X_j)) \), where \( X \) is longitude in degrees multiplied by 57.3 to convert it to radians and \( Y \) is latitude multiplied by \(-57.3\) (assuming it is measured in degrees West). Parent firms maintain at least 25 percent of controlling interest.

Table 1 shows descriptives of firm-plant linkages in our dataset. The first column displays the number of parents for the three different firm types outlined above. About one third of the ultimate owners of German plants have their headquarters outside of Germany and almost 50 percent of the parents are classified as non-multinationals. \(^8\)\(^(2)\) and \(^3\) inform about the mean and total number of German plants by firm type. As can be expected, multinational firms are bigger and therefore own more German plants than non-multinationals. However, there is also evidence in our data that local multinationals own more German plants than foreign multinationals. This is suggestive of a home bias, in particular when noting from column \(4\) that the network size of foreign multinationals is bigger on average than the network size of German multinationals. From column \(5\), we can furthermore conclude that corporate networks of foreign multinationals are more international than corporate networks of German multinationals. Finally, the descriptives in Table 1 are supportive of the idea that the costs of foreign investment increase in distance, because fewer firms from distant locations choose to invest in Germany and because remote investors operate with larger corporate networks.\(^9\)

Table 2 presents further descriptives and points to important differences in plant and workforce characteristics of multinationals and non-multinationals. Similar to other studies, multinationals

\(^8\) For non-multinationals, the difference between mean number of plants and network size reflects that we cannot match all firms from Orbis with plants from BHP (with a lower success rate for smaller firms) and that we have dropped plants from BHP because of missing controls.

\(^9\) This finding accords with the observation that larger distance has a negative effect on the absolute level of both exporting and foreign investment (see Bergstrand and Egger, 2007), and it is not in contradiction to the well-established proximity-concentration trade-off (see Brainard, 1997), which suggests that higher trade costs increase the attractiveness of (horizontal) foreign investment relative to exporting.
in our dataset are larger and pay higher wages than their non-multinational competitors (see, for instance, Malchow-Møller et al., 2013). Furthermore, Eastern Germany hosts fewer multinationals than Western Germany, suggesting that even 25 years after the reunification there are persistent differences in the economic conditions of new and old federal states. Log local population density is a proxy for the local labor market conditions and constructed using information on the location of plants to assign them to 141 local labor markets identified by Kosfeld and Werner (2012), based on commuter links. There is almost no difference between non-multinationals and multinationals in this variable, and hence no evidence in our data for selection of the latter into regions promising more favorable labor market conditions.

**Table 2: Descriptives of plant and workforce characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Non-multinationals</th>
<th></th>
<th>Multinationals</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>sd</td>
<td>mean</td>
<td>sd</td>
</tr>
<tr>
<td><strong>Plant characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log (imputed) mean wage</td>
<td>4.586</td>
<td>0.395</td>
<td>4.810</td>
<td>0.425</td>
</tr>
<tr>
<td>Plantsize (in 1,000 employees)</td>
<td>0.069</td>
<td>0.232</td>
<td>0.109</td>
<td>0.605</td>
</tr>
<tr>
<td>Eastern Germany</td>
<td>0.231</td>
<td>0.422</td>
<td>0.179</td>
<td>0.383</td>
</tr>
<tr>
<td>Log local population density</td>
<td>7.542</td>
<td>1.197</td>
<td>7.679</td>
<td>1.148</td>
</tr>
<tr>
<td><strong>Workforce characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share low-skilled</td>
<td>0.096</td>
<td>0.127</td>
<td>0.089</td>
<td>0.130</td>
</tr>
<tr>
<td>Share medium-skilled</td>
<td>0.711</td>
<td>0.245</td>
<td>0.706</td>
<td>0.266</td>
</tr>
<tr>
<td>Share high-skilled</td>
<td>0.192</td>
<td>0.239</td>
<td>0.205</td>
<td>0.269</td>
</tr>
<tr>
<td>Age structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share aged 15-24</td>
<td>0.100</td>
<td>0.120</td>
<td>0.092</td>
<td>0.133</td>
</tr>
<tr>
<td>Share aged 25-34</td>
<td>0.202</td>
<td>0.174</td>
<td>0.198</td>
<td>0.179</td>
</tr>
<tr>
<td>Share aged 35-44</td>
<td>0.220</td>
<td>0.161</td>
<td>0.235</td>
<td>0.176</td>
</tr>
<tr>
<td>Share aged 45-54</td>
<td>0.288</td>
<td>0.185</td>
<td>0.309</td>
<td>0.209</td>
</tr>
<tr>
<td>Share aged 55 +</td>
<td>0.190</td>
<td>0.175</td>
<td>0.166</td>
<td>0.179</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share full-time</td>
<td>0.687</td>
<td>0.249</td>
<td>0.730</td>
<td>0.270</td>
</tr>
<tr>
<td>Share female</td>
<td>0.411</td>
<td>0.283</td>
<td>0.428</td>
<td>0.316</td>
</tr>
<tr>
<td>Share foreigner</td>
<td>0.073</td>
<td>0.147</td>
<td>0.065</td>
<td>0.116</td>
</tr>
</tbody>
</table>

*Notes:* Data sources are BvD and BHP, 2013. In the appendix, we provide further descriptives on occupations and industry affiliations. Parent firms maintain at least 25 percent of controlling interest.

Regarding the workforce composition, BHP distinguishes workers by their skill level and assigns them to three distinct groups. The first one is the group of low-skilled workers, which are employees with a secondary school-leaving certificate but no vocational training. The group of medium-skilled workers comprises employees with a secondary school-leaving certificate and vocational training. Finally, employees with a degree from a university of applied sciences or a university
are classified as highly skilled. Table 2 accords with the finding from previous studies that the workforce of multinationals is better skilled (see Heyman et al., 2007; Balsvik, 2011). We do not find considerable differences between multinationals and non-multinationals in the age structure of workforce, while the descriptives indicate that multinationals offer a larger share of full-time jobs and employ more females and fewer foreigners than non-multinationals.

2.2 Empirical results on multinational wages

We employ a linear specification akin to the baseline specification of Malchow-Møller et al. (2013), and estimate an equation of the following form, using OLS:

\[
\ln w_i = \alpha + m_i \beta + x_i' \gamma + z_i' \delta + \varepsilon_i,
\]

(1)

where \( w_i \) is the mean gross daily wage in plant \( i \), \( m_i \) is a dummy variable for multinationals (with coefficient \( \beta \)) that takes a value of 1 if at least 25 percent of the equity is owned by a multinational parent and 0 otherwise, \( x_i \), \( z_i \) are vectors of plant and parent controls, respectively, with \( \gamma \) and \( \delta \) denoting the corresponding vectors of coefficients, and \( \varepsilon_i \) is an error term.\(^{10}\)

In the parsimonious specification reported in column (1) of Table 3, we set dummy \( m_i \) equal to one for plants whose ultimate owner is a foreign multinational and estimate the effect of foreign ownership on domestic wages without conditioning on other controls. This gives a sizable wage premium of 11.3 percent. However, it is well-known from previous empirical work that this premium is inflated by neglecting observable differences between multinationals and non-multinationals in their workforce and plant characteristics. We therefore use the variables listed in Table 2 as well as 10 dummies for the occupations of workforce and 24 dummies for broad sector categories, which are constructed as aggregates of the 88 two-digit NACE Rev.2 industry divisions (see the appendix), to control for these differences. In column (2) of Table 3, we see that adding these controls reduces the wage premium of foreign ownership by more than 50 percent.

In column (3) of Table 3, we additionally consider information on the size of the corporate network, because we cannot exclude that wages are higher in firms belonging to large (domestic or foreign) conglomerates of producers than in independent firms. This further reduces but does not eliminate the premium from foreign ownership. In column (4), we consider the same controls as above, but now account for subsidiaries of foreign multinationals and local (German) multinationals. This has a sizable effect and almost quadruples our estimate for the foreign ownership premium to 15.4 percent, with an even somewhat larger average wage premium (16.3 percent).

\(^{10}\)Relying on cross-section data, we cannot apply a difference-in-difference matching approach to estimate the wage effects of ownership change, as suggested by Girna and Görg (2007) and Hijzen et al. (2013). Furthermore, lacking information on individual workers, we cannot estimate the multinational premium based on individual wages as in Heyman et al. (2007), Balsvik (2011), and Malchow-Møller et al. (2013).
Table 3: Wages and multinational ownership

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign multinational parent</td>
<td>0.113*</td>
<td>0.048*</td>
<td>0.042*</td>
<td>0.154**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
<td>(0.018)</td>
<td>(0.017)</td>
<td>(0.020)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local multinational parent</td>
<td></td>
<td>0.163**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.013)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multinational parent</td>
<td></td>
<td>0.159**</td>
<td>0.158**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.016)</td>
<td>(0.017)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal multinational</td>
<td></td>
<td></td>
<td></td>
<td>0.190**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.043)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical multinational</td>
<td></td>
<td></td>
<td></td>
<td>0.151**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.013)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>4.728**</td>
<td>4.064**</td>
<td>4.071**</td>
<td>4.059**</td>
<td>4.062**</td>
<td>4.065**</td>
<td>4.047**</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.099)</td>
<td>(0.099)</td>
<td>(0.101)</td>
<td>(0.103)</td>
<td>(0.103)</td>
<td>(0.089)</td>
</tr>
</tbody>
</table>

Other controls

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and workforce</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Network size</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Ind. countries only</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Observations</td>
<td>26,701</td>
<td>26,701</td>
<td>26,701</td>
<td>26,701</td>
<td>26,701</td>
<td>26,406</td>
<td>26,701</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.016</td>
<td>0.536</td>
<td>0.539</td>
<td>0.553</td>
<td>0.5553</td>
<td>0.552</td>
<td>0.554</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the log of the plant’s gross mean daily wage. Plant and workforce controls are plant size, the shares of full-time, female, non-German, medium skilled, high skilled workers among the plant’s workforce, the share of workers aged 25–34, 35–44, 45–54, above 55 as well as groups of dummies for the share by occupation and one-digit industries. We further add the log of local labor market density, and a dummy indicating whether the plant is located in former East Germany. Parent firms maintain at least 25 percent of controlling interest. Standard errors in parentheses are clustered at the parent country level: **p < 0.01, *p < 0.05, and + p < 0.1.

paid by German multinationals. The finding that the two wage premia are of similar size lends support to the conclusion of Heyman et al. (2007) that “multi-nationality – not nationality – is important” (p. 356). This argument is further substantiated by the results in column (5), which rely on a specification with a single dummy for all multinational subsidiaries. By construction, this specification gives an estimate for the multinational wage premium that lies between the respective estimates for domestic and foreign multinational parents reported in column (4).

In column (6), we restrict the country sample for parents to economies that are classified as industrialized by United Nations (2014). This has two reasons. First, there is some evidence in our data that ultimate owners are clustered in tax havens, and we want to make sure that our estimates are not affected by location choices mainly driven by the incentive to lower profit taxes. Second, findings of Aitken et al. (1996) and others suggest that income differences between the source and the host country of investment can help explaining existence of a multinational wage premium. We find that dropping multinationals with an ultimate owner from non-industrialized countries

11Lacking detailed information on individual workers and lacking the information on job changers necessary to control for unobserved heterogeneity of workers, we cannot rule out that our estimates of multinational wage premia are prone to an upward bias. However, the results from Malchow-Møller et al. (2013) encourage us to believe that such biases are not too large.
has only a minor effect on the wage premium – maybe because only few observations are lost in this case. Finally, in column (7) we distinguish between horizontal and vertical multinationals. Thereby, we follow Alfaro and Charlton (2009) and classify parent-plant relationships as horizontal if both producers are from the same three-digit NACE Rev.2 industry and as vertical, otherwise.\textsuperscript{12} Our results indicate that horizontal multinationals pay higher wages than vertical multinationals, in line with the idea that the main motive for vertical investment is cost saving.

**Table 4: Multinational wages and their determinants**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multinational parent</td>
<td>0.127**</td>
<td>0.126**</td>
<td>0.119**</td>
<td>0.124**</td>
<td>0.115**</td>
<td>0.135**</td>
<td>0.126**</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.008)</td>
<td>(0.015)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Parent profitability</td>
<td>0.011+</td>
<td>0.011+</td>
<td>0.011+</td>
<td>0.011+</td>
<td>0.011+</td>
<td>0.011+</td>
<td>0.011+</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Outflow from adv. occ.</td>
<td>-0.029**</td>
<td>-0.023**</td>
<td>-0.032**</td>
<td>-0.032**</td>
<td>-0.032**</td>
<td>-0.033**</td>
<td>-0.033**</td>
</tr>
<tr>
<td>(OA)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Interaction OA x MNP</td>
<td>0.026**</td>
<td>0.022**</td>
<td>0.022**</td>
<td>0.022**</td>
<td>0.022**</td>
<td>0.022**</td>
<td>0.022**</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Outflow from age 25-55</td>
<td>-0.009**</td>
<td>-0.009**</td>
<td>-0.009**</td>
<td>-0.009**</td>
<td>-0.009**</td>
<td>-0.009**</td>
<td>-0.009**</td>
</tr>
<tr>
<td>(OC)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Interaction OC x MNP</td>
<td>0.007*</td>
<td>0.007*</td>
<td>0.007*</td>
<td>0.007*</td>
<td>0.007*</td>
<td>0.007*</td>
<td>0.007*</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Inflow into adv. occ.</td>
<td>-0.159**</td>
<td>-0.140**</td>
<td>-0.140**</td>
<td>-0.140**</td>
<td>-0.140**</td>
<td>-0.140**</td>
<td>-0.140**</td>
</tr>
<tr>
<td>(IA)</td>
<td>(0.013)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Interaction IA x MNP</td>
<td>0.041</td>
<td>0.041</td>
<td>0.041</td>
<td>0.041</td>
<td>0.041</td>
<td>0.041</td>
<td>0.041</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>Share simple occ. (SO)</td>
<td>-0.198*</td>
<td>-0.213*</td>
<td>-0.213*</td>
<td>-0.213*</td>
<td>-0.213*</td>
<td>-0.213*</td>
<td>-0.213*</td>
</tr>
<tr>
<td></td>
<td>(0.097)</td>
<td>(0.091)</td>
<td>(0.091)</td>
<td>(0.091)</td>
<td>(0.091)</td>
<td>(0.091)</td>
<td>(0.091)</td>
</tr>
<tr>
<td>Interaction SO x MNP</td>
<td>-0.025</td>
<td>-0.031</td>
<td>-0.031</td>
<td>-0.031</td>
<td>-0.031</td>
<td>-0.031</td>
<td>-0.031</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>Constant</td>
<td>4.027**</td>
<td>3.974**</td>
<td>3.975**</td>
<td>3.975**</td>
<td>4.003**</td>
<td>4.175**</td>
<td>4.219**</td>
</tr>
<tr>
<td></td>
<td>(0.151)</td>
<td>(0.136)</td>
<td>(0.134)</td>
<td>(0.134)</td>
<td>(0.133)</td>
<td>(0.222)</td>
<td>(0.213)</td>
</tr>
</tbody>
</table>

**Notes:** The dependent variable is the log of the plant’s gross mean daily wage. Plant and workforce controls are plant size, the shares of full-time, female, non-German, medium skilled, high skilled workers among the plant’s workforce, the share of workers aged 25–34, 35–44, 45–54, above 55 as well as groups of dummies for the share by occupation and one-digit industries. We further add the log of local labor market density, and a dummy indicating whether the plant is located in former East Germany. Parent firms maintain at least 25 percent of controlling interest. Standard errors in parentheses are clustered at the parent country level: ** p < 0.01, * p < 0.05, and + p < 0.1.

In Table 4 we add, step by step, further controls for determinants of multinational wage premia put forward in the theoretical literature. As a benchmark, column (1) repeats the estimation from \textsuperscript{12}Alfaro and Charlton (2009) consider a narrower definition of vertical multinationals using information from input-output tables at a disaggregated industry level. We do not follow their approach, because we can capture vertical linkages only for a low fraction of industries, and hence would end up with an unrealistically small number of vertical multinationals in our dataset when using the classification suggested by Alfaro and Charlton (2009).
Table 3, column (5), for the now smaller establishment sample for which the additional controls used in this table are available. In column (2) of Table 4, we add log revenues per employee in the parent firm as a proxy for its profitability, to account for the fact that most existing theoretical explanations build on the premise that multinationals are exceptional producers, paying higher wages because they use a superior technology, which should also be reflected in higher profits. The small effect of parent profitability does not support the conclusion that access to a superior technology of the parent can explain a major part of the wage premium paid by their subsidiaries in Germany.\footnote{Using network size as an additional explanatory variable, it is possible that we underestimate the effect of parent profitability on wages if more profitable parents build up larger firm networks – in particular because the coefficient of network size is positive and significant.}

In columns (3) and (4) we use information on the outflow of workers to investigate the negative link between turnover and multinational wage premia proposed by Fosfuri et al. (2001), Glass and Saggi (2002), and Scheve and Slaughter (2004). The former two papers argue that multinationals pay higher wages to reduce voluntary termination of employment by workers and thus the risk of technology dissipation. We can address this channel by adding a plant control for worker outflow from occupations classified as advanced according to Blossfeld (1987) relative to the total number of workers in such occupations. The negative effect of this turnover variable in column (2) suggests that the incentive to pay higher wages in order to avoid technology dissipation can explain higher wage payments. However, the observation from our data that multinationals experience on average higher turnover of workers from advanced occupations than non-multinationals (see the descriptives in the appendix) indicates that paying higher wages is not a particularly successful strategy to avoid worker fluctuations. And the positive coefficient of the interaction term with the multinational dummy seems to be at odds with the reasoning of Fosfuri et al. (2001) and Glass and Saggi (2002). Scheve and Slaughter (2004) point to an alternative explanation for a negative link between job turnover and wages. They argue that multinationals pay higher wages to compensate workers for a higher risk of job loss. Using information on outflow of workers in the core age group 25-55 relative to the total employment of workers from this group as further plant control allows us to address this channel. The negative effect of this variable and the observation that multinationals have higher turnover of workers in the relevant age group lends support to the channel highlighted by Scheve and Slaughter (2004). However, the positive interaction term with the multinational dummy seems in conflict with their reasoning.\footnote{Since the two outflow variables are highly collinear, we cannot add these controls simultaneously and rely on the outflow of workers from advanced occupations as our preferred proxy for job turnover in the subsequent analysis.}

In column (5) we add a control that is motivated by Girma and Görg (2007) who claim that multinationals have to train their workforce and pay a wage premium later on to compensate workers for the wage loss in the training period. Whereas our dataset lacks direct information
on on-the-job training, we can expect, following the reasoning in Girma and Görg (2007), that a larger inflow of workers into advanced occupations relative to the employment in these occupations lowers a plant’s wage payments. This is in line with the direct negative effect of this variable reported in column (5). However, Girma and Görg (2007) also argue that this effect should be more pronounced for multinationals than non-multinationals, which cannot explain the positive, insignificant effect of the interaction term with the multinational dummy. In column (6) we analyze to what extent the wage premium reflects a compensation because workers in the subsidiaries of multinationals receive less support from the headquarters and therefore have to solve workplace problems more independently than non-multinationals (see Gumpert, 2017). Whereas our dataset does not provide a direct measure for the independence of workers in the execution of tasks, we can use information on the share of workers in occupations that are classified as simple by Blossfeld (1987) as a proxy for the share of jobs, which do not require input from headquarters. A lower share of workforce in simple occupations should then be associated with higher wages with the effect more pronounced for multinationals. This is in line with the estimates reported in column (6).

In column (7) we report the results obtained when using the various controls outlined in columns (2) to (6) simultaneously. There, we see that accounting for the determinants put forward in the literature lowers the (residual) multinational wage premium but does not eliminate it. Acknowledging the interaction terms, we compute a residual, unexplained multinational wage premium of 12.8 percent, which is almost identical to the estimate from the baseline specification in column (1).

Whereas there is consensus in the literature that multinationals pay higher wages than non-multinationals because they are exceptional producers, evidence of Girma and Görg (2007) on wage payments of foreign multinationals in the UK challenge the conclusion of Heyman et al. (2007) that the nationality of the multinational plays just a minor role. To provide a more systematic view on the role of nationality, we build on a sizable literature pointing to the elimination of shipment costs as an important motive for firms choosing (horizontal) foreign investment instead of exporting (cf. Markusen, 2002; Barba Navaretti and Venables, 2004) and analyze the role of geographic distance between the ultimate owner and its subsidiary for explaining the wage premium paid in Germany. Thereby, we follow the common approach and compute ‘greater circle’ distances between Berlin and the capital of the country the parent is located in, using the formula described in Table 1.

The results in columns (1) of Table 5 are supportive of a distance effect and show that subsidiaries whose ultimate owner is located further away pay higher wages to German workers. Column (2) shows that the distance effect remains unaffected, when controlling for the network size in addition to plant and workforce characteristics. In column (3) we add the square of distance to control for
non-monotonicities. Whereas the point estimates indicate that such non-monotonicities of the distance effect may exist, we are not able to estimate the negative effect of the square of distance significantly.

Table 5: Multinational wages and distance

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multinational parent</td>
<td>0.156**</td>
<td>0.150**</td>
<td>0.146**</td>
<td>0.166**</td>
<td>0.120**</td>
<td>0.119**</td>
<td>0.136**</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.020)</td>
<td>(0.023)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.014)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Distance in 1,000 miles</td>
<td>0.008**</td>
<td>0.008**</td>
<td>0.014**</td>
<td>0.004**</td>
<td>0.007</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.005)</td>
<td>(0.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance in 1,000 miles squared</td>
<td>-0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance 1-2,000 miles</td>
<td>-0.037*</td>
<td>-0.043**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.016)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance 2,000-6,000 miles</td>
<td>0.045**</td>
<td>0.018**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.006)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance &gt; 6,000 miles</td>
<td>0.045*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.022)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>4.070**</td>
<td>4.072**</td>
<td>4.073**</td>
<td>4.060**</td>
<td>4.213**</td>
<td>4.211**</td>
<td>4.203**</td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td>(0.101)</td>
<td>(0.101)</td>
<td>(0.105)</td>
<td>(0.218)</td>
<td>(0.223)</td>
<td>(0.227)</td>
</tr>
<tr>
<td>Plant and workforce</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Network size</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Table 4 controls</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Observations</td>
<td>26,701</td>
<td>26,701</td>
<td>26,701</td>
<td>26,701</td>
<td>16,402</td>
<td>16,402</td>
<td>16,402</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.554</td>
<td>0.554</td>
<td>0.554</td>
<td>0.556</td>
<td>0.648</td>
<td>0.648</td>
<td>0.650</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the log of the plant’s gross mean daily wage. Plant and workforce controls are plant size, the shares of full-time, female, non-German, medium skilled, high skilled workers among the plant’s workforce, the share of workers aged 25–34, 35–44, 45–54, above 55 as well as groups of dummies for the share by occupation and one-digit industries. We further add the log of local labor market density, and a dummy indicating whether the plant is located in former East Germany. Parent firms maintain at least 25 percent of controlling interest. Table 4 controls are those from column (7). Standard errors in parentheses are clustered at the parent country level: ** p < 0.01, * p < 0.05, and + p < 0.1.

In column (4) of Table 5 we distinguish three distance groups as outlined in Table 1 and thereby allow for more flexible forms of the distance effect. The respective estimation results show that foreign multinationals with an ultimate owner in close proximity (less than 2,000 miles away) pay lower wages in their German subsidiaries than local multinationals with a German ultimate owner. This changes if the ultimate owner of the foreign multinational comes from a far-off location (more than 2,000 miles away), which is well in line with the finding of Girma and Görg (2007) that a foreign ownership premium in UK exists if the multinational is from the US, but does not exist if the multinational is from the EU. Our results indicate that such observations are not coincidental but can be explained by a non-monotonic distance effect. In columns (5) to (7), we repeat the estimations from columns (2) to (4), but add the plant variables from Table 4 as additional controls. This reduces the sample of German establishments considerably and therefore

---

15Since all ultimate owners with a distance larger than one mile to Berlin are foreign multinationals by construction, we cannot use the interaction term of distance and the MNP dummy as an additional control.
has quite strong quantitative effects. However, it does not change our results qualitatively.

From the analysis above, we can take away three regularities that are characteristic of the way multinationals remunerate workers in their German subsidiaries. First, multinationals pay higher wages than non-multinationals and there is empirical support for a multinational wage premium even after controlling for observable differences in plant and workforce characteristics. Second, subsidiaries of domestic and foreign multinationals pay wages of similar size. Third, distance between the location of the ultimate owner and the location of the subsidiary is an important determinant of the size of the premium paid by foreign multinationals in their German subsidiaries.

To be more specific, our results suggest a negative border and a positive distance effect, with the latter dominating if the ultimate owner of the German subsidiary is from a far-off country. In the next section, we present a theoretical model that accords with all three observations and can, in contrast to previous theoretical approaches, provide a rationale why distance plays a prominent role for explaining the size of multinational wage premia.

3 A model of the multinational wage premium

3.1 The model: basics

We consider a model of two symmetric countries, each populated by an exogenous mass of homogeneous workers $L$ and an exogenous mass of entrepreneurs $H$. Entrepreneurs can choose between two occupations. They can either become self-employed and supply one unit of services in a perfectly competitive service sector, which pays a remuneration of $s$; or they can become owner-manager of a firm, earning its profit as personal income. As firm owners, entrepreneurs supply a variant of an industrial good $v$ under monopolistic competition, facing iso-elastic demand:

$$q(v) = Ap(v)^{-\sigma},$$

where $p(v)$ is the price of $v$, $A$ is a market size term, determined in general equilibrium but treated parametrically by each firm, and $\sigma > 1$ is the constant price elasticity of demand. Assuming that firms can produce one unit of output with one unit of labor input ($\hat{=} $ one worker), profit maximization establishes the following revenues from domestic sales

$$r(v) = A \left( \frac{\sigma w(v)}{\sigma - 1} \right)^{1-\sigma},$$

16In the appendix, we show that these important insights are robust to the exclusion of outliers or vertical multinationals, the use of additional controls or a non-binary variable for measuring multinational activity, and changes in the thresholds for defining the distance groups.
where wages $w(v)$ are firm-specific and compensate for differences in workplace attributes (amenities), $x(v)$, provided by the employer. Amenity differences are exogenous and originate from an ex ante heterogeneity of entrepreneurs. In the spirit of Rosen (1986), we assume that amenities affect worker utility according to $u = xw/P$, where $P$ is a price index that is common to all consumers. To hire the required labor input and to avoid overpaying their workers, firms offer a wage that makes applicants indifferent between accepting their job offer or being employed elsewhere. As a consequence, heterogeneity of two firms in all endogenous variables is the result of these firms’ heterogeneity in their amenities, and we can therefore drop index $v$ from now on and use amenity $x$ as firm index in the subsequent analysis. Relative domestic wages and relative domestic revenues of two firms featuring amenities $x'$ and $x''$, respectively, can then be expressed as

$$
\frac{w(x')}{w(x'')} = \left( \frac{x'}{x''} \right)^{-1}, \quad \frac{r(x')}{r(x'')} = \left( \frac{x'}{x''} \right)^{\sigma - 1}. \tag{4}
$$

Operating profits are a constant fraction $1/\sigma$ of revenues, and therefore they are also increasing in amenities with elasticity $\sigma - 1$. Entrepreneurs endowed with low amenities choose to become self-employed, and there is an endogenous cutoff $x > 1$ below which this happens.

Firms can serve consumers in the other country either through exports or through local production. An exporter hires additional domestic workers to satisfy foreign demand, respecting the wage it has to pay according to Eq. (4) and respecting the iceberg trade costs for transporting their goods to foreign consumers, which imply that $\tau > 1$ units of output must be shipped in order for one unit to arrive in the foreign market. As multinationals, firms can save on trade costs but have to make an investment of $f$ units of services (at a cost of $s$ per service unit) in order to set up a local production facility abroad. The foreign investment gives the firm a new $x$-draw for the foreign market, and its realization is unknown prior to the (irreversible) payment of $sf$. Provided that the support of $x$ includes sufficiently low amenities, there is a positive probability of an unsuccessful investment, which is associated with a low $x$-realization and foreign labor costs that are too high to make foreign production attractive for the firm.

In the interest of analytical tractability, we assume that amenities have a Pareto distribution of the form $G(x) = 1 - x^{-g}$, with $g > 0$. Taking into account the cutoff $x$ resulting from occupational choice, the conditional distribution of amenities among domestic producers (exporters and local multinationals) equals $G(x|x \geq x) = 1 - (x/x)^{-g}$. The investment of $sf$ buys an $x$-draw from $G(x|x \geq \alpha x)$ for the foreign production facility, where $\alpha \tau > 1 \geq \alpha$ is assumed. The parameter constraint ensures that on the one hand foreign investment is sufficiently attractive for some firms, but on the other hand there is a positive probability for all firms – including those with the least favorable domestic workplace attributes – to end up with an amenity draw in the foreign country.
that is lower than the domestic level.

Once a firm has paid investment cost \( sf \), the decision to start foreign production (or not) depends on the relative size of its foreign amenity draw \( x_a \) and its export-effective domestic amenity level \( x/\tau \). If and only if the former exceeds the latter it is worthwhile to actually start foreign production, conditional on having paid \( sf \). This implies that a foreign investor accepts all foreign amenity draws if \( x/\tau < \alpha x \), the lower bound of the foreign amenity distribution, while she rejects some of the draws otherwise. This captures in a simple way the intuitive idea that the lottery – while unbiased – leads to a positive correlation of domestic and foreign amenities. The expected total revenue of a firm with domestic amenity \( x \) choosing to invest abroad is therefore given by

\[
E[rt(x)|inv] = \int_0^\infty [r(x) + r(x_a)] \frac{dG(x_a)}{1 - G(\alpha x)},
\]

if \( x/\tau < \alpha x \), and it is given by

\[
E[rt(x)|inv] = \int_{x/\tau}^{\infty} \left(1 + \tau^{1-\sigma} \right) r(x) \frac{dG(x_a)}{1 - G(\alpha x)} + \int_0^{x/\tau} \left(1 + \tau^{g-1} \right) r(x) \frac{dG(x_a)}{1 - G(\alpha x)},
\]

otherwise.\(^{17}\) Solving the integrals in Eqs. (5) and (6) establishes

\[
E[rt(x)|inv] = \begin{cases} 
  r(x) \left[1 + \frac{g^{1-\sigma}}{g - \sigma + 1} \left(\frac{x_a}{\alpha x}\right)^{1-\sigma}\right] & \text{if } x/\tau < \alpha x \\
  (1 + \tau^{g-1}) r(x) + \frac{\sigma - 1}{g - \sigma + 1} \left(\frac{x}{\alpha x}\right)^{\sigma-1-\sigma} & \text{if } x/\tau \geq \alpha x 
\end{cases},
\]

where \( \sigma < g \) is assumed to ensure finite, positive means of revenues, wages, and firm-level employment.

Firms choose to invest abroad if the expected gain in operating profits compared to the alternative of serving the foreign market by exports, \( E[\Delta \pi_{op}(x)] \), is larger than the fixed cost of foreign investment, \( sf \). Using Eqs. (4) and (7), we get

\[
sf \leq E[\Delta \pi_{op}(x)] = \begin{cases} 
  \frac{r(x)}{\sigma} \left[\frac{g^{1-\sigma}}{g - \sigma + 1} - \tau^{1-\sigma} \left(\frac{x_a}{\alpha x}\right)^{1-\sigma}\right] & \text{if } x/\tau < \alpha x \\
  \frac{r(x)}{\sigma} \left(\sigma - 1\right) \frac{\sigma^g}{g - \sigma + 1} \left(\frac{x}{\alpha x}\right)^{\sigma-1-g} & \text{if } x/\tau \geq \alpha x 
\end{cases}.
\]

and it is easily checked that \( E[\Delta \pi_{op}(x)] \) is decreasing in \( x \), which implies that foreign investors are negatively selected on domestic amenities. Compared to the literature emphasizing a proximity-

\(^{17}\)Eqs. (5) and (6) exclude the possibility of imports of goods produced by the foreign affiliate, for instance because the foreign subsidiary requires an additional, prohibitively high investment of service input. We consider imports from foreign subsidiaries in an extension of our model presented in Section 4.
concentration trade-off for explaining the costs and benefits of horizontal multinational activity (cf. Brainard, 1997), our model points to costs and benefits that are rooted in the amenity draw under uncertainty. Due to a common amenity floor, the expected gain from this draw is higher for firms with a less favorable domestic amenity level, and hence the selection of firms into foreign investment following from Eq. (8) differs from the one described by Helpman et al. (2004), who show that the proximity-concentration trade-off makes investment more attractive for firms producing at the same lower cost at home and abroad, because these firms can more easily cover the fixed cost involved in foreign investment.

In order to have at least some firm choose to invest abroad, irrespective of the level of trade cost, it must be the case, according to Eq. (8), that the marginal firm with an amenity level of \( x \) is better off with multinational production than with exporting even if \( \tau \) is at its lower bound of \( 1/\alpha \). Eq. (8) in this case becomes

\[
sf < \frac{r(x)}{\sigma} - \frac{g\alpha^{\sigma-1}}{g - \sigma + 1} - \alpha^{\sigma-1}.
\]  

(8')

Endogenous remuneration \( s \) must satisfy the indifference condition of the marginal entrepreneur between occupations. Using Eq. (7), this condition is given by

\[
s = \frac{r(x)}{\sigma} \left[ 1 + \frac{g\alpha^{\sigma-1}}{g - \sigma + 1} - sf \right].
\]

(9)

Solving for \( s \) and substituting into Eq. (8'), we find the sufficient condition for the marginal firm to be better off with foreign investment:

\[
f < \frac{\sigma - 1}{g - \sigma + 1} \frac{\alpha^{\sigma-1}}{1 + \alpha^{\sigma-1}}.
\]

(10)

Furthermore, the firm with amenity \( x = \alpha \tau \bar{x} \) is also better off with foreign investment in this case, and hence there exists a second amenity cutoff \( \hat{x} > \alpha \tau \bar{x} \), separating firms that are better off (in expectation) with investment \( (x < \hat{x}) \) from firms that are better off without investment \( (x > \hat{x}) \). According to Eqs. (8) and (9), this amenity cutoff is given by

\[
\hat{x} \equiv \alpha \tau \bar{x} \Phi, \quad \Phi \equiv \left( \frac{1 + f}{f} \frac{(\sigma - 1)\alpha^{\sigma-1}}{g[1 + \alpha^{\sigma-1}] + \sigma + 1} \right)^{\frac{1}{g - \sigma + 1}} > 1.
\]

(11)

Figure 1 illustrates the selection of firms as a function of their domestic amenities.

With these insights at hand, we can compute the share of multinational producers, which is lower than the share of firms making the foreign investment, because firms with domestic amenity \( x \geq \alpha \tau \bar{x} \) start multinational production only if the amenity drawn abroad is larger than or equal
to \( x/\tau \) and export, otherwise. The ex ante probability to draw an amenity larger than \( x/\tau \) is given by \( \frac{x}{(\alpha \tau x)} \), and hence the share of multinationals can be computed according to

\[
\chi = \int_x^{\alpha \tau x} \frac{dG(x)}{1 - G(x)} + (\alpha \tau)^g \int_x^{\hat{x}} \frac{x}{2} \left( \frac{x}{2} \right)^{-g} \frac{dG(x)}{1 - G(x)} = 1 - \frac{(\alpha \tau)^{-g}}{2} \left( 1 + \Phi^{-2g} \right),
\]

which establishes the intuitive result that the share of multinationals increases in \( \tau \) from a low level of \( \chi = (1 - \Phi^{-2g})/2 \) if \( \tau = 1/\alpha \) to a high level of \( \chi = 1 \) if \( \tau \to \infty \).

### 3.2 The multinational wage premium

Equipped with the insights from the analysis above, we now investigate how foreign investment affects wage payments and to what extent our model is capable to accord with the evidence outlined in Section 2. For this purpose, we first compute average wages of domestic and foreign subsidiaries of multinationals as well as the average wage paid by exporters. For the domestic subsidiary of a multinational, this gives

\[
\mathbb{E}[w \mid \text{MNE}, d] = \frac{1}{\chi} \left\{ \int_x^{\alpha \tau x} w(x) \frac{dG(x)}{1 - G(x)} + (\alpha \tau)^g \int_x^{\hat{x}} w(x) \left( \frac{x}{2} \right)^{-g} \frac{dG(x)}{1 - G(x)} \right\}
\]

\[
= w(x) \frac{g}{g+1} \left\{ 1 - (\alpha \tau)^{-g} \left[ 1 - \frac{g}{2g+1} \left( 1 - \Phi^{-2g-1} \right) \right] \right\},
\]

where the second line uses \( w(x)/w(x) = (x/x)^{-1} \) from Eq. (4).

In a similar vein, we can compute the average wage paid by a multinational firm in its foreign subsidiary according to

\[
\mathbb{E}[w_a \mid \text{MNE}, a] = \frac{1}{\alpha \chi} \left\{ \int_x^{\alpha \tau x} \mathbb{E}[w_a \mid x_a \geq \alpha x] \frac{dG(x)}{1 - G(x)} + \alpha \tau \int_x^{\hat{x}} \mathbb{E}[w_a \mid x_a \geq \frac{x}{\tau}] \left( \frac{x}{2} \right)^{-g} \frac{dG(x)}{1 - G(x)} \right\}
\]

\[
= \frac{w_a(x)}{\alpha \chi} \frac{g}{g+1} \left\{ 1 - (\alpha \tau)^{-g} \left[ 1 - \frac{g}{2g+1} \left( 1 - \Phi^{-2g-1} \right) \right] \right\},
\]

where

\[
\mathbb{E}[w_a \mid x_a \geq x_b] = w_a(x_b) \int_{x_b}^{\infty} \left( \frac{x_a}{x_b} \right)^{-1} \frac{dG(x_a)}{1 - G(x_a)} = w_a(x_b) \frac{g}{g+1}
\]
is the average wage of foreign subsidiaries with amenity levels $x \geq x_b$. In a next step, we compute the average wage paid by exporters according to

$$E[w|\text{EXP}] = \frac{1}{1-\chi} \left\{ \int_{\alpha x}^{\hat{x}} \left[ 1 - (\alpha \tau)^g \left( \frac{x}{\hat{x}} \right)^{\gamma} \right] w(x) \frac{dG(x)}{1 - G(x)} + \int_{\hat{x}}^{\infty} w(x) \frac{dG(x)}{1 - G(x)} \right\}.$$

From Eqs. (13), (14), and (15), we can compute the ratio of average wages paid by exporters on the one hand and domestic or foreign subsidiaries of multinationals on the other hand as

$$\omega_{ed} \equiv \frac{E[w|\text{EXP}]}{E[w|\text{MNE}, d]} = \frac{\chi}{1-\chi} \frac{(\alpha \tau)^{-g-1} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1}) \right]}{1 - (\alpha \tau)^{-g-1} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1}) \right]}.$$

and

$$\omega_{ea} \equiv \frac{E[w|\text{EXP}]}{E[w|\text{MNE}, a]} = \frac{\alpha \chi}{1-\chi} \frac{(\alpha \tau)^{-g-1} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1}) \right]}{1 - (\alpha \tau)^{-g-1} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1}) \right]}.$$

respectively. The following proposition summarizes the properties of $\omega_{ed}$ and $\omega_{ea}$.

**Proposition 1** Domestic and foreign subsidiaries of multinationals pay higher wages (on average) than domestic non-multinationals, i.e. $\omega_{ed}, \omega_{ea} < 1$.

**Proof** See the Appendix.

The existence of multinational wage premia in our model is very intuitive. Two factors play a role. First, firms choosing investment abroad have domestic amenities below $\hat{x}$ and are therefore high wage firms, hoping to find lower wages abroad. And second, within the group of investors, high-wage firms are more likely to accept the amenity draw and actually become MNEs. Therefore, both selection effects work in favor of a multinational wage premium.

Regarding the relative wage paid by foreign and domestic multinationals, we note that the symmetry of countries establishes $w_a(x) = w(x)$, and therefore the ratio of average wages is given by

$$\omega_{ad} \equiv \frac{E[w|\text{MNE}, a]}{E[w|\text{MNE}, d]} = \frac{1 - (\alpha \tau)^{-g} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1}) \right]}{1 - (\alpha \tau)^{-g-1} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1}) \right]} \frac{1}{\alpha}.$$

The following proposition summarizes the key properties of $\omega_{ad}$.

**Proposition 2** The wage ratio $\omega_{ad}$ increases monotonically in trade cost parameter $\tau$ from a low level of $\alpha^{-1}g/(g + 1)$ if $\tau = \alpha^{-1}$ to a high level $\alpha^{-1}$ if $\tau \to \infty$. If $\alpha = 1$, multinational firms
pay higher wages (on average) in their domestic than their foreign affiliate, i.e. \( \omega_{ad} < 1 \), for all possible \( \tau \). If \( \alpha < 1 \), \( \omega_{ad} > 1 \) holds for high levels of \( \tau \), and \( \omega_{ad} > 1 \) extends to all possible \( \tau \) if \( \alpha < \frac{g}{g+1} \).

**Proof** See the appendix.

In the limiting case of \( \tau \to \infty \) there is no exporting alternative, implying that all firms make the investment and choose multinational activity irrespective of the outcome of the amenity lottery. Due to our assumption of \( \alpha \leq 1 \), the amenity distribution among foreign subsidiaries can therefore not be better than the respective distribution among domestic subsidiaries, establishing \( \omega_{ad} \geq 1 \) in this case. Lower trade costs make foreign investment less attractive ceteris paribus and therefore confine the set of firms choosing to invest abroad to producers with less favorable domestic amenities. This composition effect increases the relative wage paid by domestic subsidiaries. Furthermore, lower trade costs increase for investors with domestic amenity \( x \geq \alpha \tau x \) the threshold \( x/\tau \) that must be passed in order to make foreign production attractive. All other things equal, this implies that for a given set of investors, multinationals feature on average better foreign amenities after a decline in trade costs, and this reduces the relative wage paid by foreign subsidiaries. As a consequence, \( \omega_{ad} \) increases with trade costs and, provided that \( \alpha > \frac{g}{g+1} \), it reaches a level lower than one for sufficiently small \( \tau \).

The results in Propositions 1 and 2 are well in line with the evidence on multinational wages reported in Section 2. In particular, associating higher trade costs with larger distance, as it is common, for instance, in the gravity literature, the model outlined above can not only explain the observation from our data that German subsidiaries of domestic and foreign multinationals pay wages of similar size but pointing to the important role of composition effects it also provides a rationale for the negative border effect and the positive distance effect found in our data.

To round off the analysis, we illustrate that the model outlined above can be embedded into a general equilibrium environment in a fairly simple way. For instance, in a one-sector economy, in which varieties \( v \) are assembled to a homogeneous consumption good by perfectly competitive producers, using a linear-homogeneous technology that features constant elasticity of substitution \( \sigma > 1 \) between the respective varieties (cf. Ethier, 1982; Matusz, 1996), market size parameter \( A \) corresponds to aggregate real expenditures for intermediates, \( R/P \), where \( R \) equals total revenues of domestic producers and \( P \) is a CES price index of the form: \( P = \left[ \int_{v \in V} p(v)^{1-\sigma} \right]^{1/(1-\sigma)} \) with \( V \) capturing the set of available consumer goods. In this setting, the general equilibrium outcome can be determined, combining the market clearing conditions for workers and entrepreneurs with constant markup pricing and the indifference conditions between firm ownership and self-employment as well as for investment and non-investment outlined above. Since the respective outcome is not
relevant for our analysis, we leave the computations to the interested reader.

4 Extensions

Based on the insight from the previous section that a model featuring ex ante uncertainty about foreign labor costs can provide a rationale for the empirical findings on multinational wages reported in Section 2, we now discuss three possible extensions of our model. In the first extension, we give up the somewhat restrictive assumption that amenities are exogenous and consider their optimal choice as a function of firm-specific costs for providing them. In a second extension, we add productivity differences as a further source of firm heterogeneity. A second source of heterogeneity allows us to account for national producers along with exporters and multinationals, and hence to discuss exporter and multinational wage premia in a single model. Furthermore, productivity differences generate wage differences in our model even if we control for firm size, a feature that helps us narrow the gap between our stylised theoretical model and the wage premia from the empirical analysis. In a final extension, we allow multinationals to replace domestic production by imports from the foreign country, establishing a new form of multinationals, which are vertical in nature as they shift their whole production abroad (cf. Helpman, 1984). We use this extension to illustrate that the endogenous investment decision under wage uncertainty highlighted in our model can also explain the observation from our data that horizontal multinationals pay higher wages than vertical ones.

4.1 Endogenous amenities

In the parsimonious model outlined in the main text, we have assumed that amenities are exogenous to the firm. This stands in contrast to the well established fact that some (in particular, large) firms make significant investment in their workplace amenities. For instance, Ben (2016) notes that the list of workplace amenities offered by SAS include “a gymnasium, billiard hall, sauna, massages, hair salon, Olympic-size pool, and many other perks” (p. 166), whose provision is, of course, associated with costs. In our setting, amenity provision helps reducing firm-specific wages and thus the marginal costs the producer faces in the production process, complementing work by Helpman et al. (2010) and Bustos (2011) who assume that firms can make an investment to improve the productivity of their workforce.

To keep things simple, we assume that the fixed cost of amenity provision is increasing in the level of amenities with constant elasticity: \( scx^\mu / \mu, \mu > 0 \). Furthermore, we assume that cost parameter \( c \) is firm-specific and (for domestic producers) distributed over the unit interval.
according to $G(c) = c^g$, \( g > 0 \).\(^{18}\) The amenity decision is made after the foreign investment decision but before workers are hired. Crucially for our analysis, foreign investment gives a new \( c \)-draw for the foreign production facility and is made under uncertainty of the outcome of this draw. Under the sufficient condition of \( \mu > \sigma - 1 \) all active firms choose to invest in their amenities and, from standard profit maximization, the amenity ratio of two firms sharing the same strategy of foreign market penetration (two exporters or two multinationals) is decreasing with constant elasticity in these firms relative cost parameters:

$$\frac{x'}{x''} = \left( \frac{c'}{c''} \right)^{\frac{\xi}{\mu - \sigma + 1}}, \quad \xi \equiv \frac{\sigma - 1}{\mu - \sigma + 1}. \quad (19)$$

The relative difference in the amenity provision of an exporter and non-exporter, sharing the same level of \( c \) equals \( (1 + \tau^{1-\sigma})^\xi \), and \( g > \xi\sigma/(\sigma - 1) \) is assumed to ensure positive finite means of revenues, wages, and firm-level employment.

With these insights at hand, we can compute the expected (total) revenues from foreign investment according to

$$\mathbb{E}[r_t(c)|\text{inv}] = \int_{c/\alpha}^{\bar{c}/\alpha} (1 + \tau^{1-\sigma})^\frac{c}{\alpha} r(c) \frac{dG(c)}{G(\bar{c}/\alpha)} + r(\bar{c}) \int_0^{\bar{c}/\alpha} \left[ 1 + \left( \frac{\bar{c}}{c} \right)^{-\xi} \right] \frac{dG(c)}{G(\bar{c})}, \quad (20)$$

where \( \alpha \leq 1 \) has a similar interpretation as in the baseline model, \( r(c) \) denotes domestic revenues of a firm featuring cost parameter \( c \), provided that this firms does not export, \( \bar{c} \) is the highest (cutoff) cost of amenity provision among active producers in their home country, and \( \bar{c}_a = \min\{\bar{c}/\alpha, \hat{t}c\} \), with

$$\hat{t} \equiv \left[ (1 + \tau^{1-\sigma})^\frac{\alpha}{\bar{c}/\alpha} - 1 \right]^{-\frac{\xi}{\mu - \sigma + 1}}, \quad (21)$$

is the cost threshold separating firms choosing multinational production \( (\leq \bar{c}_a) \) from firms choosing to export \( (c > \bar{c}_a) \) after the outcome of the foreign cost lottery has been revealed. Solving the integrals establishes

$$\mathbb{E}[r_t(x)|\text{inv}] = \begin{cases} r(c) \left[ 1 + \frac{\alpha^{\xi} x^{\xi}}{g-\xi} \left( \frac{\bar{c}}{c} \right)^\xi \right] & \text{if} \quad c > \tau/(\alpha\hat{t}) \\ (1 + \hat{t}^{-\xi})r(c) + r(c)\frac{\alpha^{\xi}}{g-\xi} \hat{t}^{\xi} \left( \frac{\bar{c}}{c} \right)^k & \text{if} \quad c \leq \tau/(\alpha\hat{t}) \end{cases}. \quad (22)$$

Provided that the marginal firm with a cost parameter \( \tau \) chooses to invest, the indifference

\(^{18}\)Using \( g \) for the shape parameter of the \( x \) and the \( c \) distribution is a slight abuse of notation. However, it is useful for showing the similarity between the exogenous and endogenous amenity model afterwards.
condition for the marginal entrepreneur establishes

\[ s = \frac{r(\sigma) \sigma - 1}{\sigma \mu \xi} g [1 + \alpha^\xi] - \xi \]  

(23)

where term \((\sigma - 1)(\mu \xi)^{-1} < 1\) corrects operating profits for the cost of amenity provision. Then, under the sufficient condition \(f < [\xi/(k - \xi)]\alpha^\xi/(1 + \alpha^\xi)\), there exists a unique cost cutoff

\[ \hat{c} \equiv \tau (\alpha \hat{t} \Phi)^{-1}, \quad \Phi \equiv \left(1 + \frac{f \alpha^\xi}{1 + \alpha^\xi}\right)^{\frac{1}{\alpha}}, \]  

(24)

separating firms that invest abroad \((c \geq \hat{c})\) from firms that do not invest abroad \((c < \hat{c})\). Following the derivation steps in the baseline scenario, we can furthermore express the share of multinationals, \(\chi\), and the average wage of foreign subsidiaries relative to the average wage of domestic subsidiaries, \(\omega_{ad}\), according to

\[ \chi = 1 - \frac{\alpha \hat{t}}{2} (1 + \Phi^{-2g}) \]  

(25)

and

\[ \omega_{ad} = \frac{1 - \frac{(\alpha \hat{t})^{-g}}{1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)}}{1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)} \]  

\[ \chi \left[ 1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)\right], \]  

(26)

respectively. This reveals that the solutions for \(\chi\) and \(\omega_{ad}\) from the baseline scenario with exogenous amenities are structurally equivalent to their solutions in the model variant with endogenous amenities, with \(\hat{t}\) taking the role of \(\tau\) and \(\xi\) taking the role of \(\sigma - 1\). Therefore, the findings in Proposition 2 remain valid in the more sophisticated model considered here. A similar conclusion can be drawn for relative wages \(\omega_{ed}\) and \(\omega_{ea}\), which in the case of endogenous amenities are given by

\[ \omega_{ed} = \frac{\chi \left(\alpha \hat{t}\right)^{-g-\xi/(\sigma-1)} \left[1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)\right]}{1 - \chi \left[1 - \left(\alpha \hat{t}\right)^{-g-\xi/(\sigma-1)} \left[1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)\right]\right]}, \]  

(27)

and

\[ \omega_{ea} = \frac{\alpha \chi \left(\alpha \hat{t}\right)^{-g-\xi/(\sigma-1)} \left[1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)\right]}{1 - \chi \left[1 - \left(\alpha \hat{t}\right)^{-g} \left[1 - \frac{g + \xi/(\sigma - 1)}{2g + \xi/(\sigma - 1)} \left(1 - \Phi^{-2g-\xi/(\sigma-1)}\right)\right]\right]}, \]  

(28)

respectively. Hence, the findings from Proposition 1 extend to the model variant with endogenous amenities, and we can therefore complete our analysis by noting that qualitatively the findings upon multinational wages do not depend on the assumption of exogenous amenities.
4.2 Productivity differences

In this extension, we introduce two types of producers, differing by their labor productivity. The first type of firms are low-productivity producers, using one unit of labor to produce a (perishable) non-tradable good that can only be produced in the domestic market. These low-productivity firms are called national producers in the subsequent analysis. The second type of firms are high-productivity, international producers, which use $1/\varphi$ units of labor to produce one unit of a tradable good that can be shipped abroad, subject to iceberg trade costs captured by parameter $\tau > 1$ (see above). Low-productivity national firms offer homogeneous amenities $x_n$, whereas high-productivity firms have heterogeneous amenities that are distributed according to $G(x) = 1 - (x/x_n)^{-g}$. Provided that $\varphi > x_n/x$ (assumed from now on), it is guaranteed that entrepreneurs with high productivity will not choose to become self-employed in the service sector, irrespective of their amenity level. Aside from productivity differences in domestic production, we also allow for productivity differences in the two subsidiaries of a multinational firm, and assume that production of one unit of labor unit produces $\delta > 0$ units of output in the foreign subsidiary. For instance, $\delta \leq 1$ may reflect higher communication costs with the firm’s headquarters, as put forward by Gumpert (2017). Then, the expected revenues from foreign investment are given by

$$E[r_t(x)|\text{inv}] = \begin{cases} r(x) \left[ 1 + \frac{g(\alpha \delta)^{\frac{1}{\varphi}}}{g - \sigma + 1} \left( \frac{x}{x_n} \right)^{1-\sigma} \right] & \text{if } x < \alpha \delta \tau x_n \\ (1 + \tau^{1-\sigma})r(x) + r(x) \frac{(\sigma - 1)(\alpha \delta)^{\frac{1}{\varphi}}}{g - \sigma + 1} \tau^{\frac{g}{g - \sigma + 1} + 1} \left( \frac{x}{x_n} \right)^{-g} & \text{if } x \geq \alpha \delta \tau x_n \end{cases}$$

(29)

where $\alpha \leq 1$ has the same interpretation as in the main text, and $\alpha \delta \tau \geq 1$ is assumed in the subsequent analysis. Provided that $f < (\alpha \delta \varphi x_n/(x_n))^{\frac{1}{g + 1}} (\sigma - 1)/(g - \sigma + 1)$, there exists a unique cutoff productivity $\hat{x} = \alpha \delta \tau \Phi$, with

$$\Phi = \left[ \frac{1}{f} \left( \frac{\varphi}{x_n} \right)^{\frac{1}{g + 1}} \frac{1}{g - \sigma + 1} \right] > 1$$

(30)

that separates high-productivity firms choosing to invest abroad ($x \leq \hat{x}$) from high-productivity firms choosing not to do so ($x > \hat{x}$).

The share of multinationals in this extended model can be derived in analogy to Eq. (12) and measures the ratio of multinationals to all high-productivity firms. Furthermore, relative wages in Eqs. (16), (17), and (18) do not change, and hence the results presented in Propositions 2 and 1 are robust to the distinction between high- and low-productivity firms. However, there is now a fourth wage ratio worthwhile to look at, namely the ratio of the average wage of national firms relative to the average wage of exporters, which, noting that $E[w|\text{NAT}] = w(x_n)g/(g + 1)$, is given
by

\[ \omega_{nc} \equiv \frac{\mathbb{E}[w|\text{NAT}]}{\mathbb{E}[w|\text{EXP}]} = \frac{\alpha \delta \tau x}{x_n} \frac{1 - \frac{1}{2^g} (1 + \Phi^{-2g})}{1 - \frac{g+1}{2g+1} (1 - \Phi^{-2g-1})}. \] (31)

For sufficiently high levels of \( x_n \) our model accords with the empirical finding that exporters pay higher wages than non-exporters (cf. Bernard and Jensen, 1999).

Finally, with the more sophisticated model variant considered here, we can condition on endogenous differences in firm size – which themselves are the result of unobservable differences in amenities – when determining the wage premia of multinationals. Contrasting domestic and foreign subsidiaries with equal size shows that domestic and foreign subsidiaries pay wages of similar size if \( \delta = 1 \). In contrast, multinationals pay higher (lower) wages in their domestic than their foreign subsidiaries if \( \delta > (<)1 \) because in this case the productivity disadvantage of the foreign (domestic) subsidiary must be compensated by an amenity disadvantage and thus a wage premium of the domestic (foreign) subsidiary to establish similarity of the two plants in their sales levels.

The model outlined here also allows for a comparison of wages paid by multinationals and national producers with equal plant size. Because multinationals have a higher productivity – which is true for domestic as well as foreign subsidiaries provided that \( \delta > 1/\varphi \) – lower wages paid by national firms must compensate for their productivity disadvantage in order to achieve the same plant size as multinational firms. This requires that the amenity level of low-productivity national producers is higher than the lower bound of amenities of high-productivity multinational firms. To be more specific, \( x_n/x \geq \varphi \) must hold in order to explain that domestic and foreign subsidiaries of multinationals pay higher wages than national producers of equal size, as suggested by the empirical findings in Section 2.\(^{19}\)

4.3 Vertical multinationals

In this subsection, we allow firms that have chosen foreign investment to replace domestic production by imports. Abstracting from further investment requirements of multinationals to make such imports accessible and setting \( \alpha = 1 \) to facilitate our analysis, we can determine a second cutoff, denoted \( \pi_a^2 \equiv \tau x \) that separates horizontal multinationals with amenity draw \( x_a \in (\pi_a, \pi_a^2) \) from vertical multinationals with amenity draw \( x_a \geq \pi_a^2 \). Following the computation steps from

\(^{19}\)Of course, in our data we cannot distinguish non-multinationals by their export status. However, it is easily seen that the ranking established here does not change when using all non-multinationals as reference group, provided that the there are sufficiently many non-exporters in this group.
the main text, the expected total revenue from investing abroad can be expressed as

\[
E [r_t(x)|\text{inv}] = \begin{cases} 
1 + \frac{g}{g - \sigma + 1} \left( \frac{x}{\bar{x}} \right)^{1 - \sigma} + \frac{\sigma - 1}{g - \sigma + 1} \tau^{-g} \left( \frac{x}{\bar{x}} \right)^{-g} & \text{if } x < \tau \bar{x}, \\
(1 + \tau^{1 - \sigma}) r(x) + r(x) \frac{\sigma - 1}{g - \sigma + 1} \left[ \tau^{g - \sigma + 1} + \tau^{-g} \right] \left( \frac{x}{\bar{x}} \right)^{-g} & \text{if } x \geq \tau \bar{x},
\end{cases}
\]

(32)

where \( r(x) \frac{\sigma - 1}{g - \sigma + 1} \left( \frac{x}{\bar{x}} \right)^{-g} \) is the expected revenue gain that exists, because firms with \( x \geq \bar{x}^2 \) switch from horizontal to vertical multinational status and replace domestic output with cheaper foreign production.

Under parameter constraint (10) – here applied for the limiting case of \( \alpha = \delta = 1 \) – the least productive firms choose to invest abroad and similar to the baseline model, we can determine a cutoff amenity level

\[
\hat{x} \equiv \tau \bar{x} \Phi(\tau), \quad \Phi(\tau) \equiv \left( \frac{1 + f (g - \sigma + 1) \left[ 1 + \tau^{-2g + \sigma - 1} \right]}{2g - (\sigma - 1)(1 - \tau^{-g})} \right)^{\frac{g - \sigma + 1}{g - \sigma + 1}} > 1,
\]

(33)

where \( \Phi(\tau) \) is non-monotonic in \( \tau \). To be more specific, there exists a unique \( \hat{\tau} > 1 \), such that \( \Phi'(\tau) > = < 0 \) if \( \tau > = < \hat{\tau} \), and we consider a parameter domain establishing \( \Phi(\hat{\tau}) > 1 \). A higher \( \tau \) lowers the additional gains from vertical multinational production and the non-monotonicity captures two opposing effects this has on the foreign investment decision. Lower revenues from vertical multinational production reduce the expected profits from foreign investment and therefore the incentive to make the investment. This direct effect is counteracted, however, by an indirect effect that is rooted in the occupation choice of entrepreneurs. Since higher trade costs reduce profits of the marginal producer with amenity \( \bar{x} \), who chooses to invest abroad and opts for multinational production, and since the marginal producer is indifferent between becoming owner manager of a firm or becoming self-employed in the service sector, lower revenues from vertical multinational activity lead to lower service costs of foreign investment, making the investment more attractive ceteris paribus.

The total share of multinationals can then be computed following the steps described in the main text,

\[
\chi = \int_{\bar{x}}^{\tau \bar{x}} \frac{dG(x)}{1 - G(x)} + \tau \int_{\bar{x}}^{\hat{x}} \left( \frac{x}{\bar{x}} \right)^{-g} \frac{dG(x)}{1 - G(x)} = 1 - \frac{\tau^{-g}}{2} \left( 1 + \Phi(\tau)^{-2g} \right),
\]

(34)

whereas the share of vertical and horizontal multinational firms are given by

\[
\chi_v \equiv \int_{\bar{x}}^{\hat{x}} \frac{\tau x^{-g} \ dG(x)}{\bar{x} - G(\bar{x})} = \frac{\tau^{-g}}{2} \left( 1 - \tau^{-2g} \Phi(\tau)^{-2g} \right)
\]

(35)
and

$$\chi_h \equiv \chi - \chi_v = 1 - \tau^{-g} \left[ 1 + (1 - \tau^{-2g}) \frac{\Phi(\tau)^{-2g}}{2} \right],$$  \hfill (36)

respectively. Since vertical multinationals do not produce at home, we can distinguish wages paid by horizontal multinational domestically \((d)\) and abroad \((a)\) from wages paid by vertical multinationals in their foreign production facilities \((v)\). It suffices to compute two wage averages in order to pin down the relative wages paid by the various types of production facilities. As shown in the appendix, the average wage paid by the domestic subsidiary of a horizontal multinational relative to the average wage paid by the foreign subsidiary of a horizontal multinational is given by

$$\omega_{ad} = \frac{1 - \tau^{-g} \left[ 1 - \frac{g}{2g+1} (1 - \Phi(\tau)^{-2g-1}) \right] - \frac{g}{2g+1} \tau^{-g-1} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right]}{1 - \tau^{-g-1} \left[ 1 - \frac{g+1}{2g+1} (1 - \Phi(\tau)^{-2g-1}) \right] - \frac{g+1}{2g+1} \tau^{-g} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right]}.$$  \hfill (37)

As in the baseline model with \(\alpha = 1\), the wage ratio is smaller than one for all finite values of \(\tau\) and equal to one if \(\tau \to \infty\). In a similar vein, we can compute the average wage paid by the foreign subsidiary of a vertical multinational relative to the average wage paid by the foreign subsidiary of a horizontal multinational according to

$$\omega_{va} = \frac{\chi_h}{\chi_v} \frac{\tau^{-g-1} \frac{g}{2g+1} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right]}{1 - \tau^{-g} \left[ 1 - \frac{g}{2g+1} (1 - \Phi(\tau)^{-2g-1}) \right] - \frac{g}{2g+1} \tau^{-g-1} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right]}.$$  \hfill (38)

In the appendix, we show that \(\omega_{va} < 1\) for all possible \(\tau\), reaching a minimum value of \(\omega_{va} = 0\) if \(\tau \to \infty\). Together, Eqs. (37) and (38) establish the result that vertical multinationals pay lower wages on average than domestic and foreign subsidiaries of horizontal multinationals. This is intuitive, because firms in our model choose to become a vertical multinational only if their foreign amenity draw is sufficiently good, capturing the widespread view that vertical multinationals are low-cost seeking. However, in contrast to other papers dealing with the decision between vertical and horizontal activity, domestic-foreign wage differences are firm-specific, so that vertical multinational activity is not confined to countries that differ in their economic fundamentals (cf. Markusen, 2002). Rather, similar to horizontal foreign investment it is two-way and exists in our model even though countries are symmetric (see Alfaro and Charlton, 2009, for evidence supportive of vertical foreign investment between similar economies). Furthermore, the ranking of wages in our model provides a rationale for the positive effect of the horizontal multinational dummy in the empirical analysis in Section 2.
Using a new dataset that links information on German establishments with information on national and international ownership structure from a global firm database, we provide evidence on the existence of a residual wage premium of multinational producers that exists even after controlling for observable differences to other plants. With the new dataset, we analyze determinants of residual wage premia of multinationals put forward by existing theoretical work and show that they are only partially successful in explaining their existence. We furthermore show that important new insights can be obtained when acknowledging the role of distance between the foreign parent and the local subsidiary. The empirical results from our analysis point to a negative border effect and to a positive distance effect on the multinational wage premium, with the latter dominating if the parent is based in a far-away country, explaining why (only) in this case wages paid by foreign multinationals are higher than those paid by domestic multinationals.

Based on the empirical results, we set up a theoretical model that acknowledges the role of distance for explaining existence and magnitude of multinational wage premia. The model features firm-specific wages and points to uncertainty about foreign wage payments as an important obstacle to foreign investment for firms with low domestic wage payments, because these firms benefit from their favorable domestic labor costs when serving foreign consumers through exports. This generates a multinational wage premium since firms choosing to invest abroad are firms with high domestic wages and will therefore accept even comparatively high foreign wages in order to avoid the unfavorable labor costs in their domestic production facility. Associating lower distance with lower export costs, the model can produce a negative border effect on the multinational wage premium, because in the case of zero trade costs firms that choose to invest abroad will opt out of foreign investment and start exporting if their foreign labor costs are too high. The model also produces a positive distance effect on the multinational wage premium, because the incentive to opt out of foreign investment decreases with trade costs and firms will accept less favorable wage realizations in their foreign plant. Overall, the model is therefore well in line with the patterns of multinational wage premia observed in our data, and in three extensions we show that the results do not change when abandoning restrictive assumptions that are imposed by the baseline model to facilitate analytical tractability.

This paper relies on detailed information on ownership structure of international production networks to shed new light on the determinants of multinational wage premia. Using information on nationality and financial indicators of ultimate owners, we draw a nuanced picture about the premium paid by multinational producers to German workers, with a particular emphasis on the role of distance between the parent and its subsidiary. Whereas the analysis in this paper is a first
attempt to put the network structure of multinationals into the focus of analysis of multinational wages, important aspects of these networks, such as the location of other subsidiaries, the role of layers of ownership, or the issue of joint ownership, and their effect on the remuneration of workers, have not been considered in this paper and are left for future research.

References


A Theoretical appendix

A.1 Proof of Proposition 1

We first consider the properties of $\omega_{ed}$. From Eqs. (12) and (16), we have $\omega_{ed} = \hat{\omega}_{ed}(\tau) \equiv a A(\tau)$, with

$$a \equiv \frac{1 - \frac{g+1}{2g+1}(1 - \Phi^{-2g-1})}{1 - \frac{g}{2g+1}(1 - \Phi^{-2g})}, \quad \text{and} \quad A(\tau) \equiv \frac{1 - (\alpha \tau)^{-g} \bigg[ 1 - \frac{g}{2g+1}(1 - \Phi^{-2g}) \bigg]}{(\alpha \tau) - (\alpha \tau)^{1-g} \bigg[ 1 - \frac{g+1}{2g+1}(1 - \Phi^{-2g-1}) \bigg]}.$$  \hspace{1cm} (A.1)

To determine the size of constant $a$, we can look at the properties of $\hat{a}(\alpha) \equiv [(g+\alpha)/(2g+\alpha)](1 - \Phi^{-2g-\alpha})$, where $\alpha \geq 0$ and $a = [1 - \hat{a}(1)]/[1 - \hat{a}(0)]$ follows by definition. Hence, $a \geq 0$ and $\hat{a}(0) > 0$. Differentiating $\hat{a}(\cdot)$ gives $\hat{a}'(\alpha) = [g/(2g + \alpha)^2](1 - \Phi^{-2g-\alpha}) + [(g + \alpha)/(2g + \alpha)]\Phi^{-2g-\alpha} \ln \Phi > 0$. This implies $\hat{a}(1) > \hat{a}(0)$ and thus $a = [1 - \hat{a}(1)]/[1 - \hat{a}(0)] < 1$ as well as $A(1/\alpha) = \hat{a}(0)/\hat{a}(1) < 1$, and it establishes $\hat{\omega}_{ed}(1/\alpha) < 1$. Beyond that, we can also compute $\lim_{\tau \to \infty} \hat{\omega}_{ed}(\tau) = 0$. We next look at the derivative of $\omega_{ed}$, which, according to Eq. (A.1), is given by

$$\hat{\omega}_{ed}'(\tau) = \frac{A'(\tau)}{\alpha \tau - (\alpha \tau)^{1-g} \bigg[ 1 - \frac{g+1}{2g+1}(1 - \Phi^{-2g-1}) \bigg]},$$  \hspace{1cm} (A.2)

with

$$\kappa(\tau) \equiv \frac{g(\alpha \tau)^{-g}}{2} \left[ \frac{1}{\tau} + \Phi^{-2g} \right] - \left[ \alpha \tau + (g - 1)(\alpha \tau)^{1-g} \left( \frac{g}{2g+1} + \frac{g+1}{2g+1}\Phi^{-2g-1} \right) \right] A(\tau).$$  \hspace{1cm} (A.3)

For $A(\tau) \geq 1$, we have $\kappa(\tau) \geq 0$ and $A'(\tau) > 0$ to hold for some $\tau$, because $A(1/\alpha) < 0$ has been shown above. Since this is in contradiction to the finding $\kappa(\tau) \geq 0$, it follows that $A(\tau) < 1$ and thus $\omega_{ed} < 1$ must hold for all $\alpha \tau > 1$. This completes the first part of the proof.

Let us now consider the properties of $\omega_{ea}$. From Eqs. (12) and (17), we have $\omega_{ea} = \hat{\omega}_{ea}(\tau) \equiv a \alpha B(\tau)$, with $a$ given above and

$$B(\tau) \equiv \frac{1 - (\alpha \tau)^{-g} \bigg[ 1 - \frac{g}{2g+1}(1 - \Phi^{-2g}) \bigg]}{(\alpha \tau) - (\alpha \tau)^{1-g} \bigg[ 1 - \frac{g+1}{2g+1}(1 - \Phi^{-2g-1}) \bigg]}.$$  \hspace{1cm} (A.4)

We can compute of $\lim_{\tau \to \infty} \hat{\omega}_{ea}(\tau) = 0$, whereas $\hat{\omega}_{ea}(1/\alpha) > 0$, and $\hat{\omega}_{ea}(1/\alpha) < 1$ is equivalent to $\Phi^{-2g} \mu(\Phi) > 0$, and $\mu(\Phi) > 0$, with

$$\mu(\Phi) \equiv \frac{-2g}{2g+1} + \Phi^{-1} - \frac{1}{2g+1} \Phi^{-2g-1},$$  \hspace{1cm} (A.5)

$\mu(1) = 0$, $\mu'(\Phi) < 0$, and $\lim_{\Phi \to \infty} \mu(\Phi) = -2g/(2g+1) < 0$. This establishes $\mu(\Phi) < 0$ and thus
\( \hat{\omega}(1/\alpha) < 1 \) for all \( \Phi > 1 \). Furthermore, differentiating \( \omega_{ea} \) gives

\[
\hat{\omega}'_{ea}(\tau) = \frac{a\nu(\tau)/\tau}{\alpha\tau - (\alpha\tau)^{1-g} \left[ 1 - \frac{g}{2g+1}(1 - \Phi^{-2g-1}) \right]},
\]

(A.6)

with

\[
\nu(\tau) = \frac{g(\alpha\tau)^{-g}}{2} \left( 1 + \Phi^{-2g} \right) - \left[ \alpha\tau + (g-1)(\alpha\tau)^{1-g} \left( \frac{g+1}{2g+1} + \frac{g}{2g+1}\Phi^{-2g-1} \right) \right] B(\tau),
\]

(A.7)

Following the derivation steps from above, we can compute

\[
\hat{\omega}''_{ea}(\tau)\big|_{\omega_{ea}(\tau)=0} = -\frac{a}{\tau^2} \frac{(g+1)\alpha\tau + (g-1)(\alpha\tau)^{1-g} \left[ 1 - \frac{g}{2g+1}(1 - \Phi^{-2g-1}) \right]}{\alpha\tau - (\alpha\tau)^{1-g} \left[ 1 - \frac{g}{2g+1}(1 - \Phi^{-2g-1}) \right]} < 0,
\]

(A.8)

and hence, we can safely assume that if \( \omega_{ea} \) has an extremum in \( \tau \), it must be a maximum. We can note that \( \nu(1/\alpha) >, =, < 0 \) is equivalent to \( \hat{\nu}(\Phi) \equiv -2 + 2\Phi^{-2g} + \Phi^{-2g-1} - \Phi^{-4g-1} >, =, < 0 \), \( \hat{\nu}(1) = 0 \), \( \lim_{\Phi \to \infty} \hat{\nu}(\Phi) = -2 < 0 \). Differentiation of \( \hat{\nu}(\Phi) \) gives \( \hat{\nu}'(\Phi) = \Phi^{-2g-2}\hat{\nu}_0(\Phi) \), with \( \hat{\nu}_0(\Phi) \equiv -4g\Phi - (2g + 1) + (4g + 1)\Phi^{-2g} \), \( \hat{\nu}_0(1) = -2g \), \( \lim_{\Phi \to \infty} \hat{\nu}(\Phi) = -\infty \), and \( \hat{\nu}_0'(\Phi) < 0 \). This establishes \( \hat{\nu}_0(\Phi) < 0 \), \( \hat{\nu}'(\Phi) < 0 \), \( \hat{\nu}(\Phi) < 0 \), and thus \( \nu(1/\alpha) < 0 \) for \( \Phi > 1 \). Accordingly, we have \( \hat{\omega}'_{ea}(1/\alpha) < 0 \) and can therefore safely conclude that \( \omega_{ea} \) has no extremum and is monotonically decreasing in \( \tau \). This completes the proof.

### A.2 Proof of Proposition 2

Let us define

\[
Z(\tau) \equiv 1 - (\alpha\tau)^{-g} \left[ 1 - \frac{g}{2g+1}(1 - \Phi^{-2g-1}) \right],
\]

(A.9)

\[
N(\tau) \equiv 1 - (\alpha\tau)^{-g-1} \left[ 1 - \frac{g+1}{2g+1}(1 - \Phi^{-2g-1}) \right],
\]

(A.10)

such that \( \omega_{ad} = Z(\tau)/[\alpha N(\tau)] \), according to Eq. (18). Then, twice differentiating \( \omega_{ad} \) with respect to \( \tau \) gives

\[
\frac{d^2\omega_{ad}}{d\tau^2} = \frac{Z''(\tau) - N''(\tau) \frac{Z'(\tau)}{N(\tau)}}{\alpha N(\tau)} - \frac{N'(\tau) d\omega_{ad}}{d\tau}.
\]

(A.11)

Accounting for

\[
Z'(\tau) = -\frac{g[Z(\tau) - 1]}{\tau} > 0, \quad N'(\tau) = -\frac{(g+1)[N(\tau) - 1]}{\tau} > 0
\]

(A.12)

and

\[
Z''(\tau) = -\frac{(g - 1)Z'(\tau)}{\tau} < 0, \quad N''(\tau) = -\frac{gN'(\tau)}{\tau} < 0,
\]

(A.13)

it is immediate that \( d\omega_{ad}/d\tau = 0 \) establishes \( d^2\omega_{ad}/d\tau^2 = Z'(\tau)/\tau > 0 \). From this, we can conclude that if \( \omega_{ad} \) has an extremum in \( \tau \), it must be a minimum. Since evaluating \( d\omega_{ad}/d\tau \) at the minimum trade cost level \( \tau = \alpha^{-1} \) gives \( d\omega_{ad}/d\tau = g/(g + 1) > 0 \), it follows that \( d\omega/d\tau > 0 \) must hold for
all possible \( \tau > \alpha^{-1} \). Finally, evaluating Eq. (18) at the two limiting cases \( \tau = 1/\alpha \) and \( \tau \to \infty \) yields \( \omega_{ad} = \alpha^{-1}g/(g+1) \) and \( \omega_{ad} = \alpha^{-1} \), respectively. This completes the proof of Proposition 2.

**A.3 Derivation of Eq. (37) and Eq. (38)**

Let us first consider the derivation of \( \omega_{ad} \) in the model variant with vertical multinational activity. Noting that firms with a foreign amenity draw higher than \( x\tau \) opt for serving domestic consumers through foreign production, we can compute the average wage paid by domestic plants of horizontal multinationals according to

\[
E[w|MNE, d] = \frac{1}{\chi_h} \left\{ \int_{\mathbb{R}^+} \left[ 1 - \left( \frac{x \tau}{\chi} \right)^{-g} \right] w(\chi) \frac{dG(\chi)}{1 - G(\chi)} \right. \\
+ \left. \int_{\mathbb{R}^+} \left[ \left( \frac{x}{\chi} \right)^{-g} - \left( \frac{x \tau}{\chi} \right)^{-g} \right] w(\chi) \frac{dG(\chi)}{1 - G(\chi)} \right\}
\]

\[
= \frac{w(\chi)}{\chi_h} \frac{g}{g+1} \left[ 1 - \tau^{-g} \left( 1 - \frac{g}{2g+1} \left( 1 - \Phi(\tau)^{-2g-1} \right) \right) \right] \\
- \frac{g}{2g+1} \tau^{-g-1} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right], 
\]

where \( \chi_h \) is given by Eq. (36). In a similar vein, we can compute the average wage paid by foreign subsidiaries of horizontal multinationals according to

\[
E[w|MNE, a] = \frac{1}{\chi_h} \left\{ \int_{\mathbb{R}^+} E[w_a|x \leq x_a < x\tau] \frac{dG(\chi)}{1 - G(\chi)} + \int_{\mathbb{R}^+} E[w_a|\chi/x \leq x_a < \chi x\tau] \frac{dG(\chi)}{1 - G(\chi)} \right\}
\]

\[
= \frac{w(\chi)}{\chi_h} \frac{g}{g+1} \left[ 1 - \tau^{-g} \left( 1 - \frac{g}{2g+1} \left( 1 - \Phi(\tau)^{-2g-1} \right) \right) \right] \\
- \frac{g}{2g+1} \tau^{-g-1} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right], 
\]

where

\[
E[w_a|x_a \leq x_a < x\tau] \equiv w_a(\chi) \int_{x_a}^{\tau x} \left( \frac{\chi}{\chi} \right)^{-1} \frac{dG(\chi)}{1 - G(\chi)} = \frac{w_a(\chi)g}{g+1} \left[ \left( \frac{\chi}{\chi} \right)^{-g-1} - \left( \frac{\tau x}{\chi} \right)^{-g-1} \right]
\]

and \( w_a(\chi) = w(\chi) \) have been used. Eq. (37) is then established by \( \omega_{ad} = E[w|MNE, a]/E[w|MNE, d] \).

In a further step, we can compute the average wage paid by a foreign subsidiary of a vertical multinational according to

\[
E[w|MNE, v] = \frac{1}{\chi_v} \int_{\mathbb{R}^+} E[w_a|x_a \geq \tau x] \frac{dG(\chi)}{1 - G(\chi)}
\]

\[
= \frac{w(\chi)}{\chi_v} \frac{g}{g+1} \frac{\tau^{-g-1}}{2g+1} \left[ 1 - \tau^{-2g-1} \Phi(\tau)^{-2g-1} \right], 
\]

where

\[
E[w_a|x_a \geq \tau x] \equiv w_a(\chi) \int_{\tau x}^{\infty} \left( \frac{\chi}{\chi} \right)^{-1} \frac{dG(\chi)}{1 - G(\chi)} = \frac{w_a(\chi)g}{g+1} \left( \frac{\tau x}{\chi} \right)^{-g-1}
\]

and \( w_a(\chi) = w(\chi) \) have been considered. Eq. (38) then follows from \( \omega_{va} = E[w|MNE, v]/E[w|MNE, a] \).
To complete the proof, we show that $\omega_{ad} < 1$ and $\omega_{va} < 1$. For this purpose, we treat $\Phi(\tau)$ parametrically and set $\Phi \equiv \Phi(\bar{\tau})$ to emphasize that derivatives with respect to $\tau$ are partial and computed for a given level of $\Phi$ in the subsequent analysis. Then, we can note that $E[w|MNE,a]$ is equivalent to $\tau^{-g-1}\Phi^{-2g-1}C(\tau) > = < 0$, with

$$C(\tau) = \frac{g + 1}{2g + 1} - \frac{g + 1}{2g + 1} - \frac{g}{2g + 1} \tau - \frac{g}{2g + 1} \tau^{-2g-1}.$$  \hspace{1cm} (A.19)

Accounting for $C(1) = 0$, $\lim_{\tau \to 1} C(\tau) = -\infty$, $C'(\tau) = -g/(2g + 1)\dot{C}(\tau)$, with $\dot{C}(\tau) \equiv (2g + 1)\tau^{-2g-1} + 1 - \tau^{-2g-1} > 0$, it follows that $C(\tau) < 0$ and thus $E[w|MNE,a] < E[w|MNE,d]$ holds for all $\tau > 1$, establishing $\omega_{ad} < 1$. In the limiting case of $\tau \to \infty$, we furthermore have $\lim_{\tau \to \infty} \tau^{-g-1}\Phi^{-2g-1}C(\tau) = 0$. To establish $\omega_{va} < 1$, we can write $\omega_{va} = \nu_0(\tau)\nu_1(\tau)$, with

$$\nu_0(\tau) = \frac{2g}{2g + 1} \left(1 - \frac{1 - \tau^{-2g-1}\Phi^{-2g-1}}{1 - \tau^{-2g}\Phi^{-2g}}\right),$$  \hspace{1cm} (A.20)

$$\nu_1(\tau) = \frac{1 - \frac{\tau^{-g}(1 + \Phi^{-2g})}{\tau}}{\tau - \tau^{-g} \frac{1 - \tau^{-g}(1 + \Phi^{-2g})}{1 - \frac{g}{2g + 1}(1 - \Phi^{-2g-1})} - \frac{g}{2g + 1} \tau^{-g}(1 - \tau^{-2g-1}\Phi^{-2g-1})},$$  \hspace{1cm} (A.21)

according to Eqs. (35), (36), and (38). Then, differentiating $\nu_0(\tau)$ gives

$$\nu_0'(\tau) = \frac{2g}{\tau} \frac{(\tau\Phi)^{-2g-1}}{(1 - (\tau\Phi)^{-2g})^2} \dot{\nu}_0(\tau\Phi), \quad \text{with} \quad \dot{\nu}(\tau\Phi) \equiv 1 - \frac{2g}{2g + 1} \tau\Phi - \frac{1}{2g + 1} (\tau\Phi)^{-2g}$$  \hspace{1cm} (A.22)

Accounting for $\dot{\nu}_0'(\tau\Phi) < 0$, $\dot{\nu}_0(1) = 0$, and $\tau\Phi > 1$, it follows that $\nu_0'(\tau) < 0$. Hence, $\lim_{\tau \to 1/\Phi} = 1$ establishes $\nu_0(\tau) < 1$, because $\tau \geq 1 > 1/\Phi$.

Let us now consider $\nu_1(\tau)$. Evaluating $\nu_1(\tau)$ for the two limiting cases $\tau = 1$ and $\tau \to \infty$ gives

$$\nu_1(1) \frac{2g + 1}{2(g + 1)} \frac{1 - \Phi^{-2g}}{1 - \Phi^{-2g-1}} < 1 \quad \text{and} \quad \lim_{\tau \to \infty} = 0.$$  \hspace{1cm} (A.23)

Differentiating $\nu_1(\tau)$ further establishes that $\nu_1'(\tau) > = < 0$ is equivalent to $g\tau^{-g-1}/2\dot{\nu}_1(\tau) > = < 0$, with

$$\dot{\nu}_1(\tau) \equiv 1 + \Phi^{-2g}(1 - \tau^{-2g}) - g\tau^{-3g-1}\Phi^{-2g} - \left(1 + (g - 1)\tau^{-g} \left[1 - \frac{g}{2g + 1}(1 - \Phi^{-2g-1})\right]\right) \nu_1(\tau) - \frac{g^2}{2g + 1} \tau^{-g-1} \left[1 - (\tau\Phi)^{-2g-1}\right] \dot{\nu}_1(\tau) + g\tau^{-3g-2}\Phi^{-2g-1}.$$  \hspace{1cm} (A.24)

We can note that $\dot{\nu}_1(1) - \frac{g}{2g + 1} \Phi^{-2g} < 1$. Furthermore, under the assumptions that there exists a $\bar{\tau}$ implicitly determined by $\nu_1(\bar{\tau}) = 1$, we can compute

$$\dot{\nu}_1(\bar{\tau}) = -\frac{1}{\bar{\tau}} \left((\tau - 1)g - \left[\tau - \tau^{-1-g} \left(1 - \frac{g}{2g + 1}(1 - \Phi^{-2g-1})\right)\right] - g\tau^{-3g-2}\Phi^{-2g} \left[1 - (\tau\Phi)^{-1}\right]\right) < 0.$$  

However, $\nu_1(1) < 1$ together with $\nu_1(1) < 0$ implies that if there exists a $\tau$-range with $\nu_1(\tau) > 0$ there must be at least one $\bar{\tau} > 1$ such that $\dot{\nu}_1(\bar{\tau}) > 0$ and thus $\nu_1'(\bar{\tau}) > 0$. This is in contradiction to our finding that $\dot{\nu}_1(\bar{\tau})$ holds for all $\bar{\tau} > 1$. This proves that $\nu_1(\tau) < 1$ and together with $\nu_0(\tau) < 1$ it establishes $\omega_{va} < 1$, which completes the proof.
B Empirical appendix

B.1 Further descriptives

In the estimations reported in Section 2, we use further controls not reported in Tables 1 and 2. Tables B.1 and B.2 summarize descriptives of these additional variables. The first set of controls reported in Table B.1 are observed at the parent level. Interestingly, there is almost no difference between multinationals and non-multinationals in parent profitability, which is measured by the log of revenues per employee. However, in line with the descriptives reported in Table 1, we find a sizable difference in the corporate network sizes of multinationals and non-multinationals. The variables parents from industrialized countries and horizontal ownership are defined for multinationals only. In our dataset, the vast majority of parents are countries that are classified as industrialized by United Nations (2014) and about 35 percent of the German plants have a parent from the same industry and are therefore classified as horizontal according to Alfaro and Charlton (2009).

Table B.1: Additional controls

<table>
<thead>
<tr>
<th></th>
<th>Non-multinationals</th>
<th>Multinationals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>sd</td>
</tr>
<tr>
<td>Parent controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent profitability</td>
<td>5.265</td>
<td>1.229</td>
</tr>
<tr>
<td>Network size in 1,000</td>
<td>0.009</td>
<td>0.017</td>
</tr>
<tr>
<td>Parents from ind. countries</td>
<td>0.987</td>
<td>0.115</td>
</tr>
<tr>
<td>Horizontal ownership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workforce occupations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural occupations</td>
<td>0.037</td>
<td>0.154</td>
</tr>
<tr>
<td>Simple manual occupations</td>
<td>0.073</td>
<td>0.185</td>
</tr>
<tr>
<td>Simple service occupations</td>
<td>0.170</td>
<td>0.244</td>
</tr>
<tr>
<td>Simple commercial and admin. occupations</td>
<td>0.095</td>
<td>0.204</td>
</tr>
<tr>
<td>Advanced manual occupations</td>
<td>0.113</td>
<td>0.216</td>
</tr>
<tr>
<td>Advanced service occupations</td>
<td>0.029</td>
<td>0.106</td>
</tr>
<tr>
<td>Advanced commercial and admin. occupations</td>
<td>0.324</td>
<td>0.330</td>
</tr>
<tr>
<td>Technicians</td>
<td>0.041</td>
<td>0.110</td>
</tr>
<tr>
<td>Semiprofessions</td>
<td>0.054</td>
<td>0.177</td>
</tr>
<tr>
<td>Engineers</td>
<td>0.031</td>
<td>0.106</td>
</tr>
<tr>
<td>Professions</td>
<td>0.018</td>
<td>0.075</td>
</tr>
<tr>
<td>Further plant controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outflow from advanced occ.</td>
<td>0.280</td>
<td>1.140</td>
</tr>
<tr>
<td>Outflow from age group 25-55</td>
<td>0.257</td>
<td>0.928</td>
</tr>
<tr>
<td>Inflow to advanced occ.</td>
<td>0.248</td>
<td>0.266</td>
</tr>
<tr>
<td>Share of simple occ.</td>
<td>0.375</td>
<td>0.337</td>
</tr>
</tbody>
</table>

Notes: Data sources are BvD and BHP, 2013. Parent firms maintain at least 25 percent of controlling interest.

The second set of controls in Table B.1 refers to workforce occupations, which are divided into
11 groups following Blossfeld (1987) with the “objective of making these groups as homogeneous as possible in their average general and vocational training requirements as well as in their occupational activities” (p. 98). The workforce composition along the occupational dimension differs considerably between multinational and non-multinational plants.

**Table B.2: Descriptives of occupational affiliation of workforce (in shares)**

<table>
<thead>
<tr>
<th>Nace Rev 2.2</th>
<th>Non-multinationals</th>
<th>Multinationals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>sd</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1-3</td>
<td>0.043</td>
</tr>
<tr>
<td>Mining</td>
<td>5-9</td>
<td>0.006</td>
</tr>
<tr>
<td>Manufacture of food, beverages, and tobacco products</td>
<td>10-12</td>
<td>0.020</td>
</tr>
<tr>
<td>Manufacture of textiles, wearing apparel, leather, and related products</td>
<td>13-15</td>
<td>0.002</td>
</tr>
<tr>
<td>Manufacture of wood and of products of wood and cork</td>
<td>16</td>
<td>0.003</td>
</tr>
<tr>
<td>Manufacture of paper, paper products, and media</td>
<td>17, 18, 58, 59</td>
<td>0.022</td>
</tr>
<tr>
<td>Manufacture of coke and refined petroleum products</td>
<td>19</td>
<td>0.000</td>
</tr>
<tr>
<td>Manufacture of chemicals, chemical products, and pharmaceutical products</td>
<td>20, 21</td>
<td>0.004</td>
</tr>
<tr>
<td>Manufacture of rubber and plastic products</td>
<td>22</td>
<td>0.006</td>
</tr>
<tr>
<td>Manufacture of other non-metallic mineral products</td>
<td>23</td>
<td>0.010</td>
</tr>
<tr>
<td>Manufacture of basic and fabricated metals</td>
<td>24, 25</td>
<td>0.021</td>
</tr>
<tr>
<td>Manufacture of machinery and equipment n.e.c.</td>
<td>28</td>
<td>0.017</td>
</tr>
<tr>
<td>Manufacture of computer, electronic and optical products, and electrical equipment</td>
<td>26, 27</td>
<td>0.014</td>
</tr>
<tr>
<td>Manufacture of motor vehicles, trailers and semi-trailers, and other transport equipment</td>
<td>29, 30</td>
<td>0.003</td>
</tr>
<tr>
<td>Other manufacturing (including furniture)</td>
<td>31, 32</td>
<td>0.007</td>
</tr>
<tr>
<td>Electricity, gas, steam, air conditioning supply, and water collection, treatment and supply</td>
<td>35, 36</td>
<td>0.019</td>
</tr>
<tr>
<td>Construction of buildings, civil engineering, and specialized construction activities</td>
<td>41-43</td>
<td>0.056</td>
</tr>
<tr>
<td>Wholesale and retail trade, repair and installation</td>
<td>33, 45-47, 95</td>
<td>0.254</td>
</tr>
<tr>
<td>Accommodation, food and beverage service activities</td>
<td>55, 56</td>
<td>0.036</td>
</tr>
<tr>
<td>Transport, warehousing, postal and courier services, and travel</td>
<td>49-53, 79</td>
<td>0.062</td>
</tr>
<tr>
<td>Financial services and insurance</td>
<td>64-66</td>
<td>0.018</td>
</tr>
<tr>
<td>Programming, consultancy, information services, research and development, real estates, household services</td>
<td>62, 63, 68, 72, 77, 97</td>
<td>0.117</td>
</tr>
<tr>
<td>Other services (including legal ones)</td>
<td>69-71, 73, 74, 78, 80-82, 96, 98</td>
<td>0.162</td>
</tr>
<tr>
<td>Public services (including sewerage, waste collection, telecommunication, etc.)</td>
<td>37-39, 60, 61, 75, 84, 86-88, 90-94, 99</td>
<td>0.085</td>
</tr>
<tr>
<td>Education</td>
<td>85</td>
<td>0.014</td>
</tr>
</tbody>
</table>

**Notes:** Data sources are BvD and BHP, 2013. Parent firms maintain at least 25 percent of controlling interest.

The third set of controls listed in Table B.1 are defined at the plant level and are used as explanatory variables in Table 4. Outflow of workers is expressed relative to the total number of workers from the same occupation or age group, where advanced occupations refer to the bottom
seven items from the list of workforce occupations. Since the outflow reported in the data refers to workers no longer employed in the current period whereas the reference group are workers currently employed, the share of workers leaving a plant can be larger than one if there was a general downsizing of the respective workforce at the plant. Inflows of workers are defined as new hirings between the previous and the current business year relative to the current workforce from the same occupation group. Simple occupations capture the top four items of the occupation list (and thus include agricultural occupations). We find sizable differences between multinationals and non-multinationals in particular with respect to the outflow variables, and it is notable that the share of workers in simple occupations (requiring less vocational and general training) is higher in multinational than non-multinational plants.

Table B.2 lists 25 broad sector categories, which are constructed using the two-digit NACE Rev 2.2 industry classification system. The table describes in detail how the 88 industry divisions are aggregated to the 25 broad sector categories. Contrasting sector affiliations of multinationals and non-multinationals reveals some notable differences. For instance, multinationals are less prevalent in agriculture, public services, and education, and are more prevalent in manufacturing and services.

B.2 Robustness checks

In this section, we consider robustness checks of our main results. Thereby, Table B.3 repeats the estimation underlying the results in column (5) of Table 3, excluding two parents that are outliers regarding their network sizes – column (1); excluding headquarters from the sample of German subsidiaries – column (2); adding 25 sector dummies for the industry affiliation of the ultimate owner as further controls – column (3); excluding plants that are no classified as subsidiaries of horizontal multinationals – column (4); and using the share of foreign subsidiaries instead of a dummy as an alternative, non binary measure of multinational activity – column (5).

From columns (1) and (2) we see that dropping outliers or plants that are classified as headquarters reduces but does not eliminate the multinational wage premium. This indicates that multinationals operating a larger network pay higher wages and that multinationals pay higher wages in their headquarters than in their local subsidiaries, in line with the knowledge-based rationale for multinational wage premia put forward by Gumpert (2017). In column (3), we see that adding controls for the parent’s industry affiliation also reduces the multinational wage premium. The results in column (4) confirms the finding from Table 3 that horizontal multinationals pay higher wages than other (primarily vertical) multinationals. Finally, using the share of foreign subsidiaries as a control for multinationals, we find again a considerable premium of multinationals. Evaluated at the mean share of foreign subsidiaries (0.605) gives a wage premium of 15.6 percent, which is close to the point estimate for the dummy variable reported in Table 3.

Table B.4 reports robustness checks regarding the role of distance for the size of the multinational wage premium. Thereby, we rely on our preferred specification from column (4) in Table 5 and conduct the same experiments as in Table B.3. From the results reported in columns (1)-(4) we see that changing the sample of plants used for the estimation has a considerable impact on the estimated distance effects. However, by and large the main finding from our analysis of a negative border and a positive distance effect seems to be robust to the changes in the sample of subsidiaries. Finally, evaluated at the mean shares of foreign subsidiaries reported in Table 1.

40
Table B.3: Wages and multinational ownership (robustness)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No large</td>
<td>Subsidiaries</td>
<td>Parent ind. controls</td>
<td>Horizontal multinationals</td>
<td>Non-binary measure</td>
</tr>
<tr>
<td>Multinational parent</td>
<td>0.129**</td>
<td>0.127**</td>
<td>0.148**</td>
<td>0.207**</td>
<td>0.207**</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.021)</td>
<td>(0.030)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>Share foreign subsidiaries</td>
<td>0.207**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.063)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.963**</td>
<td>3.891**</td>
<td>4.025**</td>
<td>4.013**</td>
<td>4.064**</td>
</tr>
<tr>
<td></td>
<td>(0.087)</td>
<td>(0.079)</td>
<td>(0.080)</td>
<td>(0.106)</td>
<td>(0.095)</td>
</tr>
<tr>
<td>Other controls</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Plant and workforce</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network size</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>22,996</td>
<td>20,582</td>
<td>26,690</td>
<td>12,309</td>
<td>26,701</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.584</td>
<td>0.595</td>
<td>0.575</td>
<td>0.498</td>
<td>0.556</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the log of the plant’s gross mean daily wage. Plant and workforce controls are plant size, the shares of full-time, female, non-German, medium skilled, high skilled workers among the plant’s workforce, the share of workers aged 25–34, 35–44, 45–54, above 55 as well as groups of dummies for the share by occupation and one-digit industries. We further add a dummy indicating whether the plant is located in former East Germany and the log of the local labor market density. Parent firms maintain at least 25 percent of controlling interest. Standard errors in parentheses are clustered at the parent country level: ** $p < 0.01$, * $p < 0.05$, and + $p < 0.1$.

the marginal effect of the non-binary multinational variable in column (5) gives a similar distance pattern as the one reported for the dummy variable in Table 5.\textsuperscript{20}

In a final robustness check, we consider alternative thresholds for defining the distance groups. In the first case, we expand the interval for the first and the third distance group and accordingly reduce the distance interval for the second group. The results are reported in columns (1) and (2). The point estimates in the two columns differ, because in the estimation reported in column (2) we additionally account for the controls of Table 4. Contrasting the distance effects with the respective counterparts in Table 5 we see almost no difference, suggesting that our results are not too sensitive to the specific choice of thresholds for grouping the countries in our dataset. Finally, in columns (3) and (4) we distinguish only two distance groups and show that our main results are also robust to such a big change in the way we define these groups.

\textsuperscript{20} Robustness of our results is also warranted when including the additional plant controls from column (7) in Table 4, which, as outlined in the main text, would reduce the sample of establishments considerably.
### Table B.4: Multinational wages and distance (robustness)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No large Subsidiaries only</td>
<td>Parent ind. controls</td>
<td>Horizontal multinationals</td>
<td>Non-binary measure</td>
<td></td>
</tr>
<tr>
<td>Multinational parent</td>
<td>0.121** (0.011)</td>
<td>0.108** (0.013)</td>
<td>0.165** (0.014)</td>
<td>0.246** (0.006)</td>
<td>0.303** (0.029)</td>
</tr>
<tr>
<td>Share foreign subsidiaries (SFS)</td>
<td>-0.004 (0.013)</td>
<td>0.007 (0.014)</td>
<td>-0.047* (0.018)</td>
<td>-0.073† (0.040)</td>
<td>0.083** (0.023)</td>
</tr>
<tr>
<td>Distance 1–2,000 miles</td>
<td>0.073** (0.003)</td>
<td>0.087** (0.003)</td>
<td>0.011† (0.006)</td>
<td>-0.092** (0.012)</td>
<td>0.109** (0.016)</td>
</tr>
<tr>
<td>Distance &gt; 6,000 miles</td>
<td>0.060** (0.015)</td>
<td>0.068** (0.014)</td>
<td>-0.013 (0.022)</td>
<td>-0.050 (0.036)</td>
<td>0.219** (0.062)</td>
</tr>
<tr>
<td>SFS * distance 1–2,000 miles</td>
<td>-0.240** (0.015)</td>
<td></td>
<td></td>
<td></td>
<td>-0.240** (0.034)</td>
</tr>
<tr>
<td>SFS * distance 2,000–6,000 miles</td>
<td>-0.137** (0.006)</td>
<td></td>
<td></td>
<td></td>
<td>-0.137** (0.026)</td>
</tr>
<tr>
<td>SFS * distance &gt; 6,000 miles</td>
<td>-0.307** (0.006)</td>
<td></td>
<td></td>
<td></td>
<td>-0.307** (0.076)</td>
</tr>
<tr>
<td>Constant</td>
<td>3.966** (0.091)</td>
<td>3.891** (0.086)</td>
<td>4.018** (0.081)</td>
<td>3.997** (0.105)</td>
<td>4.040** (0.092)</td>
</tr>
<tr>
<td>Observations</td>
<td>22,996</td>
<td>20,582</td>
<td>26,690</td>
<td>12,309</td>
<td>26,701</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.587</td>
<td>0.598</td>
<td>0.577</td>
<td>0.501</td>
<td>0.565</td>
</tr>
<tr>
<td>Plant and workforce</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Network size</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Notes:** The dependent variable is the log of the plant’s gross mean daily wage. Plant and workforce controls are plant size, the shares of full-time, female, non-German, medium skilled, high skilled workers among the plant’s workforce, the share of workers aged 25–34, 35–44, 45–54, above 55 as well as groups of dummies for the share by occupation and one-digit industries. We further add the log of local labor market density, and a dummy indicating whether the plant is located in former East Germany. Parent firms maintain at least 25 percent of controlling interest. Standard errors in parentheses are clustered at the parent country level: ** $p < 0.01$, * $p < 0.05$, and $p < 0.1$. **
Table B.5: *Multinational wages and alternative distance measures*

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multinational parent</td>
<td>0.166**</td>
<td>0.136**</td>
<td>0.166**</td>
<td>0.136**</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.012)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Distance 1-2,500 miles</td>
<td>-0.037*</td>
<td>-0.043**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.016)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance 2,501-5,500 miles</td>
<td>0.045**</td>
<td>0.018**</td>
<td>(0.004)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Distance &gt; 5,500 miles</td>
<td>0.045*</td>
<td>0.010</td>
<td>(0.018)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Distance 1-3,000 miles</td>
<td></td>
<td>-0.036*</td>
<td>-0.043*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.017)</td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td>Distance &gt;3,000 miles</td>
<td></td>
<td>0.044**</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.007)</td>
<td>(0.009)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>4.060**</td>
<td>4.203**</td>
<td>4.060**</td>
<td>4.204**</td>
</tr>
<tr>
<td></td>
<td>(0.105)</td>
<td>(0.227)</td>
<td>(0.104)</td>
<td>(0.224)</td>
</tr>
</tbody>
</table>

Other controls

- Plant and workforce: Y Y Y Y
- Network size: Y Y Y Y
- Table 4 controls: N Y N Y
- Observations: 26,701 16,402 26,701 16,402
- R-squared: 0.556 0.650 0.556 0.650

*Notes:* The dependent variable is the log of the plant’s gross mean daily wage. Plant and workforce controls are plant size, the shares of full-time, female, non-German, medium skilled, high skilled workers among the plant’s workforce, the share of workers aged 25–34, 35–44, 45–54, above 55 as well as groups of dummies for the share by occupation and one-digit industries. We further add the log of local labor market density, and a dummy indicating whether the plant is located in former East Germany. Table 4 controls are those from column (7). Parent firms maintain at least 25 percent of controlling interest. Standard errors in parentheses are clustered at the parent country level: ** * p < 0.01, * p < 0.05, and + p < 0.1.