Foreign Firms, Domestic Wages*

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Abstract:

Three types of theories have been used to explain the wage premium in foreign firms: the heterogeneous-workers theory, the heterogeneous-learning theory, and the heterogeneous-firms theory. We set up a model that explicitly encompasses two of these, and which can illustrate the third. This unifying framework allows us to rigorously compare the predictions of the different theories and thus provides a workhorse for interpreting new and existing empirical evidence. We illustrate the usefulness of the model on matched employer-employee data and find considerable support for all three theories. In particular, the heterogeneous-workers theory can explain up to 75% of the premium.

Keywords: heterogeneous firms, heterogeneous workers, learning, wage premium

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I. Introduction

A number of papers have documented that foreign and/or multinational firms (MNEs) pay higher wages (see, e.g., Aitken et al., 1996; Lipsey, 2004; Bernard et al., 2009), and, to the best of our knowledge, no study has found the opposite. Several possible explanations for this wage premium can be found in the literature, but the implications of the underlying theories have not been rigorously spelled out and contrasted, and empirical analyses are often not based on hypotheses derived explicitly from these theories. An interesting question is, of course, whether the observed wage differences reflect productivity differences of workers and/or firms. With this in mind, the existing explanations can be grouped into three types, reflecting the different assumptions of the underlying theories.[1]

According to the first type of explanation, the observed premium reflects a pure selection phenomenon. Foreign firms simply employ ex-ante better workers in terms of observable and/or unobservable characteristics. The reason behind this could be a complementarity between technology (or capital) and worker skills (Yeaple, 2005; Ekholm and Midelfart, 2005), between skilled managers and skilled workers (Manasse and Turrini, 2001), or among skilled workers themselves. We refer to this set of explanations as the heterogeneous-workers (HW) theory.

The second type of explanation instead argues that the premium is a pure learning phenomenon. The underlying theory is that workers become more productive in foreign firms through better training (Görg et al., 2007), through more useful experience, or by picking up valuable ideas (Fosfuri et al., 2001; Ethier and Markusen, 1996; Markusen, 2001; Glass and Saggi, 2002). Hence, this group of explanations relies on different learning opportunities in

[1] In a parallel literature on the wage premium in large firms, Troske (1999) lists seven main explanations, which he subsequently tests on US data. As we shall argue below, these explanations are closely related to those of the wage premium in foreign firms.

foreign vs. domestic firms, and we therefore refer to it as the heterogeneous-learning (HL) theory.

The third type of explanation also relies on heterogeneous firms – but not in terms of learning opportunities. Instead, the premium is believed to reflect common characteristics of foreign firms that influence the firm-specific wage setting. It could either be a compensation for different working conditions in foreign firms (Fabbri et al., 2003; Bernard and Sjo□holm, 2003; and Lipsey, 2004) or reflect rent sharing under imperfect labor markets. We refer to this set of explanations as the (static) heterogeneous-firms (HF) theory.

Only the first two theories involve workers who are actually more productive in foreign firms, and only according to the second theory do foreign firms improve the productivity of the domestic workers.[2] The HF theory, on the other hand, implies that rents may be transferred from foreign firms to domestic workers. Hence, from a host-country perspective, knowing the relevance and relative importance of the different theories is important input for policy makers deciding on, e.g., the conditions for foreign direct investments. We shall return to a discussion of this issue later in the paper.

We first set up a relatively simple model that encompasses both the HW and the HL theories. It is the first model to incorporate both theories into a simple and tractable model that allows each of the theories to emerge as special cases. The model shows how both theories can give rise to a wage premium in foreign firms in a competitive labor-market setting. We also explain less rigorously how the model can be extended to nest the HF theory. This is the first contribution of the paper.

The model provides a unifying framework that allows us to spell out and rigorously compare the predictions and implications of the HW, HL and HF theories. This has not been

[2] Foreign firms can, of course, also benefit host economies through other channels. Thus, there is a large literature focusing on firm-to-firm and firm-to-market spillovers; see Lipsey (2004) for a review.

done systematically before. The model thus provides a workhorse for interpreting existing and new empirical evidence in light of the existing theories. This constitutes the second contribution of the paper.

Finally, we illustrate the usefulness of the model by testing the theoretical predictions on a huge matched employer-employee data set from Denmark to see if we can find evidence of and even assess the relative importance of the different theories for wage determination in foreign firms. This is the third contribution of the paper.

To preview our results, we find that the HW theory can explain up to 75% of the observed foreign-firm wage premium within an industry-area group, while the remainder is consistent with the HL and HF theories. To the best of our knowledge, this is the first study to provide such an estimate. We also find considerable evidence of the importance of the HF and HL theories. One finding that supports the HL theory is that wage growth is found to be (considerably) higher in foreign firms – also when controlling for observed and unobserved worker heterogeneity. Another finding supporting the HL theory is that experience from foreign firms is more valuable than experience from domestic firms and, furthermore, that foreign-firm experience acquired in previous employments is (at least) as important as foreign-firm experience acquired in the current employment. Finally, we also find explicit support for the HF theory, as starting wages in foreign firms are found to be higher than in domestic firms even when controlling for observed and unobserved worker heterogeneity.

The rest of the paper is structured as follows: In section II, we review the existing theories more carefully, present our theory model and derive its implications. Section III describes the data, while section IV presents the empirical results. Section V concludes.

II. Theory

In this section, we first review existing theories of the wage premium – and wage setting more generally – in foreign firms. We then set up the basic version of our theory

model and discuss possible extensions. Finally, we outline and compare the empirical implications of the HW, HL, and HF theories.

Existing literature

As mentioned in the introduction, several arguments have been used in the literature to explain the higher wages in foreign firms. Our grouping of these explanations into three general theories about the wage setting in foreign firms is based on the involved assumptions about worker and firm productivity differences.

First, the heterogeneous-workers (HW) theory has been developed carefully in the case of exporting firms by Yeaple (2005), Ekholm and Midelfart (2005) and Manasse and Turrini (2001). In Yeaple (2005) and Ekholm and Midelfart (2005), workers differ exogenously in skills and ex-ante homogeneous firms endogenously choose between a more scale-intensive and a less scale-intensive technology. As skilled workers have a comparative advantage in the scale-intensive technology, the firms that choose this technology will employ more skilled workers, be larger, engage in international trade, and pay higher wages. Manasse and Turrini (2001) develop a model with heterogeneous entrepreneurs, where the most able of these (the "superstars") operate on a larger scale, engage in trade, employ workers of higher skills, and as a consequence pay higher wages on average. In the model below, we allow workers to differ exogenously in skills and firms to choose endogenously between two technologies as in Yeaple (2005) and Ekholm and Midelfart (2005).

Second, the heterogeneous-learning (HL) theory builds on Rosen's (1972) idea of on-the-job learning and has been formalized in set-ups with foreign-owned firms by Ethier and Markusen (1996), Markusen (2001), Fosfuri et al. (2001) and Glass and Saggi (2002). In these papers, learning is exogenous in the sense that it is not an endogenous "training" decision by the firms. Glass and Saggi (2002) thus build an oligopoly model where workers employed by the foreign firm immediately get access to its superior technology. Hence, it

must pay a wage premium to prevent workers from immediately switching to other companies bringing along information about this technology. In Fosfuri et al. (2001), Ethier and Markusen (1996), and Markusen (2001), on the other hand, workers only learn about the superior technology after one period of employment; see also Pakes and Nitzan (1983). Hence, workers are not immediately paid a higher wage in foreign firms, but only over time. In all three papers, productivity transfers may arise when workers employed by foreign firms move to domestic firms. Recently, Go□rg et al. (2007) have used a two-period bargaining framework to argue that if training is more productive and specific in foreign firms, workers in these firms will have a steeper wage profile and therefore acquire a wage premium over time.[3]

Finally, the heterogeneous-firms (HF) theory does not rely on workers in foreign firms to either be or become more productive. Instead, firm characteristics are allowed to affect the firm-specific wage setting. Hence, the premium could be a compensation for higher labor demand volatility in foreign firms (Fabbri et al., 2003), a higher closure rate of foreign firms (Bernard and Sjo□holm, 2003), or due to preferences by workers for domestic firms (Lipsey, 2004). These explanations are all consistent with competitive labor markets. Alternatively, allowing for imperfect labor markets, the wage premium may reflect rent sharing between foreign firms and their workers through bargaining or efficiency wages (Budd et al., 2005). If supervision is more expensive in foreign firms due to cultural differences or size, these firms could rely more extensively on efficiency wages to avoid shirking or to induce optimal effort. Alternatively, upward-sloping labor supply curves for the individual firm (monopsony) could result in larger firms (including foreign firms) paying higher wages. Hence, both in the rent-

[3] Elements of both the heterogeneous-workers theory and the heterogeneous-firms theory are found in the paper of Markusen and Trofimenko (2009). In this paper, ex-ante identical firms can choose to employ foreign experts and ex-ante identical workers learn from these experts.

sharing and in the compensating-differential cases, the implication of the HF theory is that wages of similar workers are higher in foreign-owned firms.

In sum, the HW and HL theories rely on ex-ante and ex-post worker productivity differences, respectively, while the HF theory assumes identical workers throughout.

The theories presented above relate closely to those of the older and more extensive literature on firm size and wages. Troske (1999) thus lists and tests seven main explanations for the wage premium in large firms. The first four explanations are all examples of the HW theory relying on different complementarities between skilled workers and characteristics of the large firms; see also Oi (1983), Kremer (1993), Dunne and Schmitz (1995), and Fox (2009). The last three explanations in Troske (1999) are examples of the HF theory relying on bargaining and efficiency wages; see also Brown and Medoff (2003). While Troske (1999) does not explicitly consider the HL theory, it is mentioned in the handbook chapter by Oi and Idson (1999) on the same issue.

As we shall see, our model also predicts a close relationship between size and ownership. Hence, a distinct contribution of this paper is to highlight the close connection between the two strands of literature, although separate effects of ownership can also be expected.

The basic model

This paper is the first to incorporate the HW and HL theories into one simple and tractable model. Hence, we allow for both ex-ante heterogeneous workers and firms. We allow workers to differ exogenously in skills and firms to choose endogenously between two technologies as in Yeaple (2005). This is cast in a set-up with on-the-job learning possibilities as in Markusen (2001) and with potentially heterogeneous firms engaging in monopolistic competition as in Melitz (2003), where firms now differ with respect to learning opportunities.

The model has a quasi-dynamic OLG structure where workers live for two periods, but firms are long-lived. There are no saving/investment decisions and demand is stationary. Hence, it is sufficient to analyze a single period. The model is of a partial-equilibrium nature. In particular, consumption expenditure is fixed, and there is an unlimited supply of workers available at a given wage.

Domestic consumers have Dixit-Stiglitz preferences over an endogenous number, *K*, of differentiated goods and spend an exogenous amount of income, *I*, on these goods. Each period's demand does not depend on prices in the other period. Hence, demand for any good, *i*, is given by:

$$X_i = p_i^{-\sigma}[\sum_{k=1}^{K} p_k^{1-\sigma}]^{-1} I \quad (1)$$

where σ denotes the elasticity of substitution between varieties. Domestic (D) and Foreign (F) firms each produce one variety, and hence *K* is determined by the number of firms serving the domestic market in equilibrium.

Following Yeaple (2005), we assume that there are two types of technologies available to domestic and foreign firms: An Advanced technology (A), which is skill-intensive and offers opportunities for learning, and a Basic technology (B), with firms using these technologies referred to as type-A and type-B firms, respectively. There is free entry of domestic and foreign firms into both types of technologies, but the use of a technology is associated with fixed costs per period, which are higher for foreign firms, reflecting the higher costs of entry into the domestic market for foreign firms as in Helpman et al. (2004).

Specifically, we assume that the fixed costs for the type-B technology are the same for all potential domestic firms, FC_d^b, and lower than the fixed costs for all potential foreign firms, $FC_d^b < FC_f^b$. As a consequence, no foreign firms using the type-B technology will enter in equilibrium. In line with Melitz (2003) and Helpman et al. (2004), we assume that there is a distribution of fixed costs across potential firms for their use of the type-A technology with

foreign firms facing proportionately higher costs. To capture this in a tractable way, we assume that if n_d^a domestic and n_f^a foreign type-A firms enter in equilibrium, the fixed costs of the marginal (highest cost) firms are given by $n_d^a FC_d^a$ for domestic firms and by $n_f^a FC_f^a$ for foreign firms, where $FC_d^a < FC_f^a$. An added benefit of this formulation is that it allows for an alternative interpretation in which firms are ex-ante homogeneous (as in Yeaple, 2005) and the fixed costs of using the type-A technology are therefore identical for all potential domestic (or foreign) firms, but are increasing in the total number of firms choosing the technology, e.g., due to shortages of skilled workers in the labor market.[4] Under the former interpretation, all type-A firms except the marginal ones will earn rents in equilibrium, while in the latter case, all type-A firms are pushed down to zero profits. While labor is the only variable input for firms, we assume that fixed costs are "purchased" and not part of a firm's labor demand.

All workers within a firm produce the same variety of output, but workers may differ in productivity. There are two types of workers ex-ante: Skilled (S) and High-skilled (H), each having a two-period career. The productivity of a worker depends on her ex-ante type, the technology of the firm, and – in period 2 – her experience from period 1. In the basic version of the model, we assume that workers do not switch firm type after period 1, but that skills can be perfectly transferred within firm types.

If an S-worker joins a type-B firm, she does not improve her productivity over time, and we normalize it to one in both periods: $rs_1^b = rs_2^b = rs^b = 1$, where rs_1^b denotes the productivity of an S-worker in a type-B firm in period 1, etc. If she instead joins a type-A firm, she has at least as high a productivity in her first period as those who join type-B firms, and learning may result in an even higher productivity in the second period of her career:

[4] In this case, it may be more reasonable to assume that fixed costs of all type-A firms (domestic or foreign) are identical and given by $\left(n_f^a + n_d^a\right)FC^a$, in which case only the total number of type-A firms in equilibrium can be determined, while their distribution on foreign and domestic firms is indeterminate.

$1 \leq rs_1^a \leq rs_2^a$. H-workers have the same productivity as S-workers in type-B firms, $rh_1^b = rh_2^b = 1$, but have an absolute advantage when working with the type-A technology: $rs_1^a \leq rh_1^a$ and $rs_2^a \leq rh_2^a$. This is similar to Yeaple (2005). While there is a limited supply of H-workers, which for simplicity we assume is not sufficient to meet the demand from type-A firms, there is a sufficient supply of potential S-workers available at a fixed wage (= 1) to meet the demand from all firms. These assumptions imply that all H-workers are always employed by type-A firms and that the wage for S-workers in type-B firms is one in both periods: $ws_1^b = ws_2^b = ws^b = 1$.

Under the so-called "large-group" assumption, individual firms are assumed to be too small to influence the price-index term in the square brackets in (1). Hence, output prices are determined as a constant mark-up on the marginal costs. As output is produced by five "different" types of labor, there are five first-order conditions for output in our model: Four for a type-A firm (output produced by S- and H-workers in each period of their two-period career), and one for a type-B firm (output produced by S-workers). To allow for corner solutions, we adopt a complementarity representation of our model in which all equations are written as weak inequalities each with an associated non-negative complementary variable:

$$p^a(1-1/\sigma)rs_1^a \leq ws_1^a \qquad XS_1^a \tag{2}$$

$$p^a(1-1/\sigma)rs_2^a \leq ws_2^a \qquad XS_2^a \tag{3}$$

$$p^a(1-1/\sigma)rh_1^a \leq wh_1^a \qquad XH_1^a \tag{4}$$

$$p^a(1-1/\sigma)rh_2^a \leq wh_2^a \qquad XH_2^a \tag{5}$$

$$p^b(1-1/\sigma)rs^b \leq ws^b = 1 \qquad X^b \tag{6}$$

p^a and p^b are the prices of the representative good produced by a type-A and a type-B firm, respectively. ws_1^a is the wage of an S-worker in a type-A firm in the first period of her career, and XS_1^a is the output produced by S-workers in a representative type-A firm, etc. Hence, equation (2) says that in equilibrium, the marginal revenue product of a young S-worker in a

type-A firm should be less than or equal to her wage. If it is strictly less, the complementary variable, XS_1^a, must be zero, i.e., no young S-workers are employed by type-A firms in equilibrium. Similar interpretations apply to the other four equations.

Total production by a representative type-A firm is then given by: $X^a = XS_1^a + XS_2^a + XH_1^a + XH_2^a$. Note that domestic and foreign type-A firms will have the same amount of output, as they face the same demand and marginal costs. There will just be fewer foreign type-A firms in equilibrium due to their higher fixed costs. The free-entry conditions for domestic and foreign type-A firms and domestic type-B firms are then given by:

$$(p^a/\sigma)X^a \leq n_d^a FC_d^a \qquad n_d^a \qquad (7)$$

$$(p^a/\sigma)X^a \leq n_f^a FC_f^a \qquad n_f^a \qquad (8)$$

$$(p^b/\sigma)X^b \leq FC^b \qquad n^b \qquad (9)$$

Equation (7) says that revenue less variable costs (the left-hand side) for domestic type-A firms should be less than or equal to the fixed costs of the marginal domestic type-A firm (the right-hand side). If strictly less, it is because no domestic type-A firms enter in equilibrium. Similarly for equations (8) and (9).

Because of symmetry within firm types, there are just two equations for goods-market clearing, where the complementary variables are the prices:

$$X^a \geq (p^a)^{-\sigma}\left[\left(n_d^a + n_f^a\right)(p^a)^{1-\sigma} + n^b(p^b)^{1-\sigma}\right]^{-1} I \qquad p^a \qquad (10)$$

$$X^b \geq (p^b)^{-\sigma}\left[\left(n_d^a + n_f^a\right)(p^a)^{1-\sigma} + n^b(p^b)^{1-\sigma}\right]^{-1} I \qquad p^b \qquad (11)$$

where the right-hand sides in (10) and (11) are the demands for a representative good at the prices p^a and p^b, respectively.

Finally, there are four conditions, (12)-(15), for labor-market clearing. First, there is an exogenous supply, *SH*, of H-workers of each vintage, which must equal the demand for H-workers by type-A firms (with wages being the complementary variables). This results in the first two conditions:

$$SH \geq \left(n_d^a + n_f^a\right) XH_1^a / rh_1^a \qquad wh_1^a \tag{12}$$

$$SH \geq \left(n_d^a + n_f^a\right) XH_2^a / rh_2^a \qquad wh_2^a \tag{13}$$

In equation (12), the left-hand side is the exogenous supply of young H-workers which must equal the demand for young H-workers by domestic and foreign firms (the right-hand side). The latter is determined by the number of type-A firms, $n_d^a + n_f^a$, times the employment of young H-workers in a representative firm, which is given by their output divided by their productivity, XH_1^a / rh_1^a.

Second, S-workers can join both types of firms initially. In equilibrium, workers must be indifferent between joining type-A and type-B firms. Hence, the net present value of earnings over two periods from joining a type-A firm should equal the two-period return from joining a type-B firm:

$$ws_1^a + \delta ws_2^a \geq 1 + \delta \qquad ws_1^a \tag{14}$$

where δ is the discount rate.

Finally, the number of inexperienced S-workers in type-A firms should equal the number of experienced S-workers employed in the second period. This is essentially a "steady-state" condition, where the second-period wage is the complementary variable:

$$\left(n_d^a + n_f^a\right) XS_1^a / rs_1^a \geq \left(n_d^a + n_f^a\right) XS_2^a / rs_2^a \qquad ws_2^a \tag{15}$$

Model solution

Our model given by (2)-(15) thus constitutes fourteen non-linear inequalities in fourteen non-negative variables. In the case where we have an interior solution for all variables (all equations hold with equality), it is straightforward to solve analytically for the equilibrium prices and wages. From (6), our choice of $rs^b = ws^b = 1$ gives us:

$$p^b = \sigma/(\sigma - 1) \tag{16}$$

and from (9), the equilibrium output of a representative type-B firm is then:

$$X^b = (\sigma - 1) FC^b \tag{17}$$

Wages for S-workers in type-A firms can then be found from (2), (3), and (14). From (2) and (3), we get:

$$\frac{ws_1^a}{ws_2^a} = \frac{rs_1^a}{rs_2^a}, \tag{18}$$

and using these in (14) gives us:

$$ws_1^a = \frac{(1+\delta)rs_1^a}{(rs_1^a+\delta rs_2^a)} = \beta rs_1^a \leq 1, \quad ws_2^a = \frac{(1+\delta)rs_2^a}{(rs_1^a+\delta rs_2^a)} = \beta rs_2^a \geq 1 \tag{19}$$

where: $\beta = (1+\delta)/(rs_1^a + \delta rs_2^a) \leq 1$ and $rs_2^a \geq 1/\beta \geq rs_1^a \geq 1$. Given that we know ws_1^a from (19), we can solve for p^a from (2):

$$p^a = \frac{\sigma}{\sigma-1} \cdot \frac{(1+\delta)}{(rs_1^a+\delta rs_2^a)} = \frac{\sigma}{\sigma-1}\beta \leq p^b \tag{20}$$

Finally, we can use (4) and (5) along with (20) to solve for the wages of H-workers:

$$wh_1^a = \beta rh_1^a \geq ws_1^a, \quad wh_2^a = \beta rh_2^a \geq ws_2^a \tag{21}$$

Furthermore, equilibrium output of a type-A firm as well as the equilibrium number of domestic and foreign type-A firms and domestic type-B firms can then be found from (7)-(11) using the expressions for p^a, p^b and X^a derived above.[5] In equilibrium, the profits of all type-B firms as well as the marginal type-A firms are pushed down to zero, while the average type-A firm earns a positive profit.[6] In the equilibrium of the basic model, the average foreign firm is different from the average domestic firm because all foreign firms are type-A firms, while domestic firms are a mix of type-A and type-B firms.

The pure HW case arises when $rh_2^a = rh_1^a > rs_2^a = rs_1^a \geq rs^b = 1$. In this case, there is no learning, but S- and H-workers differ in their initial productivity when working with the type-A technology. It follows from (19) that $ws_1^a = ws_2^a = ws^b = 1$, and from (21) that $wh_1^a = wh_2^a > 1$. Hence, S-workers are paid the same wage in both periods in both types of

[5] A complete solution of the model as well as numerical examples are available from the authors upon request.

[6] Under the alternative interpretation that all firms have identical fixed costs of using the type-A technology, the equilibrium profits of all type-A firms are pushed down to zero.

firms, while H-workers receive a higher (but still constant) wage in type-A firms only, which results in higher average wages in foreign firms than in domestic firms.

The pure HL case arises when $rh_2^a = rs_2^a > rh_1^a = rs_1^a \geq rs^b = 1$ or when $rs_2^a > rs_1^a \geq rs^b = 1$ and the supply of H-workers is zero. In this case, all workers are identical ex-ante, and they all learn when employed by a type-A firm. It follows from (19) and (21) that $ws_1^a = wh_1^a < 1$ and $ws_2^a = wh_2^a > 1$. Workers joining type-A firms receive higher second-period wages, but then have to accept a lower wage in the first period. However, due to discounting, the average wage in a type-A firm still exceeds the wage in a type-B firm, $\frac{ws_1^a + ws_2^a}{2} > 1$. Hence, the HL theory predicts both a wage premium and higher wage growth in foreign firms.

A mix between the two cases is possible when $rs_2^a > rs_1^a \geq rs^b = 1$, $rh_2^a \geq rs_2^a$, and $rh_1^a > rs_1^a$. S-workers (and possibly also H-workers) learn when employed by type-A firms, but S-workers remain less productive than H-workers when working with the type-A technology. In this case, S-workers employed by type-A firms earn less in period 1 and more in period 2 than S-workers employed by type-B firms, while H-workers – who are only employed in type-A firms – might earn more in both periods.

Except in the pure HW case with $rs_1^a = rs_2^a = 1$, type-B firms charge a higher price and are smaller in terms of output, although not necessarily in terms of employees, as the average employee in a type-B firm is less productive than the average employee in a type-A firm. This highlights the potentially close connection between the wage premium in foreign firms and the wage premium in large firms. We return to this issue below.

Extensions

In this section, we will discuss a couple of extensions of the basic set-up. To save space, we do not formally present the extended versions but focus on the intuition.

First, the model can be extended to nest the HF theory. The case where the wage premium represents a compensating differential could be thought of as a situation in which $rh_2^a = rh_1^a = rs_2^a = rs_1^a = rs^b$, i.e., where all workers are equally productive in both types of firms, but where the employment in a type-A firm is associated with a disutility for the worker. In a competitive labor market, the wage premium in type-A firms would then reflect exactly this disutility. This would also reduce the profit earned by, and hence the entry of, type-A firms, cf. (7)-(8).

The rent-sharing case, on the other hand, departs from the maintained assumption of a competitive labor market in our basic model. Still, the situation could be thought of as one in which there are no differences between workers, $rh_2^a = rh_1^a = rs_2^a = rs_1^a \geq rs^b$, but where workers are (randomly) assigned to type-A and type-B firms. If workers for some reason (efficiency wages or bargaining) get a share of the firm's profit, those assigned to type-A firms would earn a rent relative to other workers.

Second, an implication of the basic model in the case of learning is that workers joining a type-A firm would have to take a wage cut in the first period compared to workers joining a type-B firm. In the presence of minimum wages such a wage cut may not be feasible, forcing type-A firms to pay their workers higher wages in the first period. This is related to the assumption in Fosfuri et al. (2001) where firms are required to pay at least the subsistence wage in the first period. The second-period wage would be unaffected, as skills are perfectly transferable within firm types. As a consequence, the average wage in type-A firms would go up and workers joining type-A firms would now earn a rent relative to workers joining type-B firms.[7] Profits of type-A firms would again be reduced, causing less entry.

[7] Alternatively, a progressive income tax would work somewhat like a minimum wage by making experienced H-workers more expensive for the firms. We have worked out this extension formally, but have not included it due to space limitations.

Third, in the basic model, we only allowed for switching within firm types after period 1. We have also analyzed a more complicated version of the model in which workers may switch firm types after the first period. Allowing for switching in the pure HW case is straightforward, as the wages of S-workers are independent of the firm type, while H-workers will never switch. In the pure HL case, all workers are ex-ante identical, but face a steeper wage profile in type-A firms. A worker in a type-A firm might thus want to switch after period 1 if she can get the same (or a higher) wage in a type-B firm. This may happen even if she carries only a part of the acquired productivity to a type-B firm. The reason is that type-B firms are smaller and thus have a higher price, $p^b > p^a$, and a higher marginal revenue product for a given productivity level. More formally, let rs^{ab} denote the productivity of a worker switching from a type-A to a type-B firm after one period. This worker will be indifferent to switching if:

$$p^a(1-1/\sigma)rs_2^a = p^b(1-1/\sigma)rs^{ab} \tag{22}$$

where the left-hand side is the second-period wage if she stays, whereas the right-hand side is the wage after switching. It follows that the productivity of a switching worker should be at least:

$$rs^{ab} = \frac{p^a}{p^b}rs_2^a = \frac{(1+\delta)rs_2^a}{(rs_1^a+\delta rs_2^a)} \quad \Rightarrow \quad rs_2^a > rs^{ab} > rs_1^a \geq 1, \tag{23}$$

to make switching worthwhile. On the other hand, in the two-period formulation, a worker from a type-B firm would not switch after one period to a type-A firm when there is no learning in type-B firms. The reason is that the switching worker would have to take a wage cut to compete with new inexperienced workers in the type-A firm. However, in a multi-period version of our HL model, switching from type-B to type-A firms would be perfectly possible.

In the HF case with compensating differentials, switching could easily be accommodated, as workers are indifferent between working in type-A and type-B firms. If the

underlying reason is rent-sharing, switching from type-A to type-B firms will not happen voluntarily, while switching in the other direction will be very attractive. Hence, in this case, switching would occur only if there was some exogenous separations and reassignments between periods.[8]

Fourth, foreign and domestic type-A firms act similarly, and hence, conditional on type/technology, the model predicts no effects per se of foreign ownership. This seems quite reasonable, as it is hard to imagine that foreign firms are inherently different from a similar selection of domestic firms (which are likely to be the domestic MNEs). However, in a few situations, we could imagine that foreign ownership has an independent effect on wages. Thus, according to some HF explanations, domestic and foreign type-A firms could have different degrees of rent-sharing (due to different levels of bargaining power) or pay different compensating differentials (due to preferences by workers for domestic firms).

Finally, the basic model revealed a close relationship between size and firm type – drawing a link to the firm size-wage literature. Actually, in the basic model, size (as measured by output) becomes a perfect predictor for firm type, but other things affecting size (such as product-specific fixed costs) were left out of the model. Hence, in a more realistic set-up, we cannot expect the one-to-one correspondence between size and firm type to survive.

Summary of theoretical predictions

Table 1 summarizes the predictions of the HW, HL, and HF theories, which have been explained above. The prediction of a "raw" (unconditional) premium is common to all three theories (Hypothesis 1). Note, however, that a "true" wage premium in foreign firms in the form of rents to the workers employed can only arise under imperfect labor markets, i.e., under the HF theory with rent-sharing or under the extended HL theory with minimum wages.

[8] Exogenous dissolution of matches between workers and firms and imperfect re-matching (due to search costs) could, of course, also create additional (involuntary) switching between firm types in the HW and HL cases.

According to the HW theory, the wage premium reflects differences in ex-ante skills, while the basic HL theory says that it reflects differences in ex-post skills.

The remaining predictions (Hypotheses 2-7) differ across the three theories and hence, in principle, allow us to discriminate empirically between them. In the remainder of this paper, we investigate the hypotheses from Table 1 on a huge matched employer-employee data set from Denmark to see if we can find evidence of the relative importance of the different theories.

Table 1: Theoretical predictions

	HW	**HL**	**HF**
Hypothesis 1: Wage premium (= higher average wage) in foreign firms	Yes	Yes	Yes
Hypothesis 2: Wage premium in foreign firms conditional on ex-ante worker skills	No	Yes	Yes
Hypothesis 3: Wage growth higher in foreign firms – also conditional on ex-ante worker skills	No	Yes	No
Hypothesis 4: Past experience from foreign firms raises current wages – also conditional on ex-ante worker skills	No	Yes	No
Hypothesis 5: Starting wages are different in foreign firms	Yes, higher	Maybe	Yes, higher
Hypothesis 6: Starting wages are different in foreign firms conditional on ex-ante worker skills	No	Yes, lower	Yes, higher
Hypothesis 7: Effects disappear (are reduced) when conditioning on firm type (or other firm characteristics correlated with type)	Yes	Yes	Maybe

III. Data

The data come from the Integrated Data Base of Labor Market Research (IDA), which contains register based annual data since 1980 on all individuals with Danish residence. IDA provides detailed information on individual background variables such as education and family characteristics as well as labor market performance, including occupations and income.

All workers are linked to establishments that from 1995 and onwards can be linked to firm-level information, which, e.g., allows us to identify all employees in foreign-owned

firms in Denmark. Information about foreign ownership is currently available only for the years 2002-2007.[9] As a consequence, in the regressions we rely on a panel for the years 2002-2007, while we use the historical information to construct, e.g., measures of total labor market experience of an individual.

Note that information about occupation in a given year is based on the individual's occupation in the last week of November. Hence, we cannot observe worker flows within a given year. In the regressions to follow, we restrict our attention to workers aged 20-65 years in the non-primary private sector, who entered the labor market in 1981 or later.

Table 2 presents the number of firms as well as the total employment of foreign-owned and domestically owned firms in Denmark in the years 2002 and 2007. While the total stock of firms averaged approximately 275,000 in 2002 and 305,000 in 2007, only slightly more than 1% of these were foreign-owned. However, as also shown in the table, the foreign firms were considerably larger on average, which implies that they accounted for 13-16% of total employment. This relationship between size and ownership is fully consistent with the model of the previous section.

[insert Table 2 around here]

In Table 3, we provide a first check on the relationship between ownership, wage levels, and wage growth. The table contains the average wages and average wage growth rates for employees in foreign-owned and domestically owned firms, respectively. The income measure used is an hourly (nominal) wage reported by Statistics Denmark. As predicted by all three versions of our model, the average wages reveal a significant wage gap between domestically owned and foreign-owned firms (more than 15% in 2002 and 13% in 2007).

[9] A firm is classified as foreign-owned if foreigners ultimately own more than 50% of the firm. Danish-owned MNEs cannot be identified in the data and are hence included among the domestic firms.

Consistent with the HL theory, the table also shows that average wage growth has been higher in foreign firms by 0.5 percentage points.

[insert Table 3 around here]

The data also reveal that a considerable amount of individuals flow between foreign- and domestically owned firms each year. Around 15-20% of those employed in a foreign-owned firm in a given year move to another firm the following year. Approximately half of these end up in a domestically owned firm.

Table 4 contains summary statistics (and definitions) of the main variables used in the regressions in the following section. In addition to the variables listed, we use dummy variables for industries, areas (Copenhagen, urban, and rural), years, and – in some of the regressions – different size-classes of firms.

[insert Table 4 around here]

IV. Empirical Results

In this section, we investigate more formally the hypotheses from Table 1. First, we test the existence of a wage premium in foreign firms, how much of it that can be explained by ex-ante worker characteristics, and whether it is reduced by conditioning on other observable firm characteristics. This relates to Hypotheses 1, 2, and 7. Second, we look for more specific evidence of the HL and HF theories by testing whether wage growth is higher in foreign firms (Hypothesis 3), whether past experience matters (Hypothesis 4), and whether starting wages are different in foreign firms (Hypotheses 5 and 6).

All three theories predict an unconditional wage premium in foreign firms compared to domestic firms. A simple way of testing this is by regressing (the log of) individual wages on a dummy for foreign ownership of the firm. This is done in the first column of Table 5. We find that the unconditional premium is 8.4%. Hence, Hypothesis 1 is strongly supported.

[insert Table 5 around here]

Note that all regressions include time, area, and industry dummies. Hence, we are ex-ante eliminating the part of the wage premium that can be ascribed to a different industry pattern and location of the foreign-owned firms. In other words, the premium identified in column 1 is a within industry-area premium. For comparison, a recent paper by Balsvik (2011) focusing on the Norwegian manufacturing sector finds a wage premium of 5.7% in foreign firms compared to domestic non-multinational firms when controlling for industry but not area. Heyman et al. (2007) find a wage premium of 4.3% in foreign-owned firms in Sweden when controlling for industry, while Martins (2004) finds a premium of close to 30% in Portugal when controlling neither for industry nor for area. The unconditional wage premium in Table 3, where we did not control for industry and area, was 15.1% in 2002 and 13.2% in 2007.

According to the HW version of our theory model, the higher average wage in foreign firms can be fully explained by ex-ante differences in worker skills. Hence, the wage premium should disappear once we control for these. One way to do this is by including a range of observable worker characteristics intended to capture ex-ante skills in the regression. This is done in column 2 where we control for gender, education, age (second-order polynomial), experience (fourth-order polynomial[10]), and tenure (second-order polynomial). As predicted by the HW theory, the premium drops, but only by 1.3 percentage points to 7.1%.[11]

In column 3, we also control for (the log of) establishment size. As predicted by hypothesis 7, this further reduces (but does not eliminate) the premium. The foreign-firm

[10] The fourth-order polynomial for experience is chosen to avoid the symmetry properties imposed by a quadratic specification. In this way, it can better capture the strength of the wage growth in the first years of the workers' careers. We thank one of the referees for pointing this out.

[11] The estimated effects of age, experience, and tenure are generally as expected. Wages increase with age and experience, especially early in the career, while tenure is found to have a more limited but also declining effect.

wage premium is still estimated at 5.7% and highly significant. Note that for comparison the gender wage gap is estimated to be around 20%, and that an establishment with 100 employees is found to pay wages that are approximately 4.8% higher than in an establishment with 10 employees.[12]

Controlling for observable worker characteristics may not completely eliminate differences in ex-ante worker skills, as some of these skills may be unobservable. Adding worker fixed effects (FE) as in columns 4-6 removes the effects of all time-invariant observable and unobservable worker characteristics. This reduces the raw premium to 2.5% (column 4). Further adding the observable time-variant individual characteristics (age, experience, and tenure) reduces the foreign-firm wage premium to 2.3% (column 5).

Considering how the wage premium changes as we control for time-variant and time-invariant worker characteristics gives us an estimate of the relative importance of the HW theory in explaining the observed wage premium. Specifically, comparing the wage premium in column 1 with that in column 5 provides an estimate of the upper bound for the importance of the HW theory in explaining the premium. It follows that the HW theory can explain up to 75% of the observed wage premium in foreign vs. domestic firms. The estimate is an upper bound, as some of the decrease in the estimated coefficient between columns 1 and 5 could reflect firm differences picked up by worker fixed effects if individuals do not move (too much) between firms. In any case, it still leaves a significant share (at least 25%) of the premium to be explained by the HL and HF theories. Again, controlling for establishment size (column 6) reduces the estimated premium to 1.9% consistent with Hypothesis 7.

While a number of other studies find that the foreign wage premium is reduced when controlling for observable worker characteristics (see, e.g., Aitken et al., 1996, Doms and

[12] The estimated establishment-size wage premium can be calculated as $(size_1/size_2)^{0.0205} - 1$ where 0.0205 is the estimated elasticity from column 3.

Jensen, 1998, Lipsey and Sjöholm, 2004, and Feliciano and Lipsey, 2006), we are not aware of any other study that analyses how much of the premium can actually be explained by the HW theory, i.e., by observable as well as unobservable worker characteristics. Recent studies by Balsvik (2011) and Martins and Esteves (2008), Heyman et al. (2007), and Andrews et al. (2009) include both worker and firm fixed effects in their regressions, but they do not attempt to assess how much of the premium can be explained by differences in ex-ante worker skills. Our approach is more in line with that of Schank et al. (2007) who use German linked employer-employee data to analyze how much the wage premium in exporting firms is reduced when controlling for observable and unobservable characteristics of the workers.[13]

The remaining wage premium in column 5 is an estimate of the importance of the HL and HF theories in generating a wage premium, but as we shall argue this may not fully reflect the economic importance of these theories for the wage determination more generally in foreign firms. Thus, with worker fixed effects included, identification of the coefficient of the foreign dummy in column 5 comes from (a) worker mobility (workers switching between firms of different status); and (b) change of firm status (through foreign take-overs or domestic buy-backs).

With respect to (a), according to our theory model, worker mobility will only identify a positive wage premium if switching between domestic type-B and foreign type-A firms is observed, while switches between domestic and foreign type-A firms will not be associated with a wage change and hence will serve to drag the estimate towards zero. In the HF case with rent-sharing, switches between firm types require some exogenous (and involuntary) reassignment of workers to firms. In the HL case, voluntary switching from a domestic type-B to a foreign type-A firm is possible and should eventually result in a higher wage (although

[13] In the labor-market literature, the importance of worker heterogeneity for the large-firm premium has been analyzed by, e.g., Abowd et al. (1999).

the higher average wage may not have time to manifest itself in a short panel), while the effect of switching from a foreign type-A to a domestic type-B firm should not be negative if switching is voluntary, as workers only switch if they maintain their wage level. In sum, even if the HL and HF theories are correct, the wage premium identified from worker mobility between foreign and domestic firms is watered down by switches within type-A firms and by switches from type-A to type-B firms in the HL case.[14]

With respect to (b), our theory model does not explicitly allow for any changes of ownership. However, two real-life situations can be imagined and could possibly be incorporated into our model. First, a change of firm status could represent a real change of firm type (from a type-B to a type-A firm or the other way around) if the new owners acquire the assets but use their own technology, organization, etc. In this case, we would expect an effect on wages according to all three theories. Second, the change of firm status could merely reflect a simple change of ownership with no consequences for the firm type. In this case, we would expect to find no effect on wages. If the second type of ownership change is common in the data, this will again drag the estimated premium towards zero.

To eliminate the latter effect, the foreign-firm dummy can be constructed such that it takes the value one for all observations in a given job spell if the firm is foreign-owned in at least one of the years within the spell. In this way, we eliminate any time-series variation in the foreign dummy within job spells, and its coefficient is thus identified exclusively from

[14] Furthermore, even under the pure HW version of the model, we may find an effect of switching on individual wages if H-workers (involuntarily) switch from type-A to type-B firms, as type-B firms are not able to fully exploit the skills of the worker. However, according to our model, observing such a switch requires some sort of market disequilibrium, as other type-A firms should be interested in hiring the worker. Alternatively, introducing a match-specific component of worker productivity could result in an effect of (involuntary) switching in the HW case.

individuals switching firms.[15] This definition of the foreign-firm dummy can also be seen as an attempt to let it capture the underlying firm type rather than the nationality of ownership. Using this approach (columns 7 and 8 in Table 5), we find that the unconditional premium of 8.2% (column 7) is only reduced to 3.7% (column 8) when we control for observable and unobservable worker characteristics.[16] Hence, as expected, a large premium remains to be explained by the HL and HF theories.

In sum, we find significant evidence of a wage premium in foreign firms consistent with Hypothesis 1, which is common to all three theories. Furthermore, up to 75% of the unconditional wage premium can be explained by ex-ante worker characteristics pointing to an important role for the HW theory.[17] However, as a significant part of the premium remains, this points to an important role of the HF and/or HL theories as well. We also argued that the estimated wage premium may not fully reflect the relevance of these theories. Hence, in the remainder of this section we will look for more specific evidence of these.

[15] As pointed out by one referee, using this approach may both remove and magnify measurement error if (some) firms erroneously change status from one year to another.

[16] We also tried to let the foreign dummy take the value one only if the firm was foreign-owned in all years in a job spell. In this case, the unconditional premium is reduced from 8.3% to 3.6% by the inclusion of observable and unobservable worker characteristics. Alternatively, one could exclude from the sample all job-spells where the foreign dummy is not stable. However, this would induce serious sample-selection issues.

[17] We also ran regressions separately for men and women. For men, the unconditional premium is reduced from 10.1% to 2.5% when we include observable and unobservable worker characteristics. For women, the corresponding numbers are 5.8% and 1.7%, respectively. We did not include firm fixed effects in any of the regressions. With firm fixed effects, identification comes exclusively from change of firm status from foreign to domestic or the other way around, and this does not help us to distinguish between the three explanations of the wage premium.

To test Hypothesis 3, Table 6 regresses annual wage growth within a job spell (i.e., it is required that the worker is in the same establishment in two subsequent years) on the same set of explanatory variables as used in Table 5.

[insert Table 6 around here]

Column 1 regresses annual wage growth on our foreign-firm dummy as well as on the set of industry, area, and time dummies used in Table 5. The estimated coefficient is significant and predicts a wage-growth rate which is 0.21 percentage points higher in foreign firms. With an annual wage growth rate of, say, 2% this amounts to 10% higher wage growth in foreign firms. Controlling for observable worker characteristics (column 2) actually increases the estimated coefficient slightly, and it remains significant. Furthermore, as predicted by Hypothesis 7, controlling for establishment size (column 3) reduces the estimated effect.

It could be argued that the estimated effect is due to an omitted variable bias, as foreign firms select workers that have more potential for wage growth. Our model in section II, did not allow for such differences between individuals, but one could think of this as an extended version of Yeaple's heterogeneous-worker model, and a similar feature was actually present in Rosen's (1972) original model. However, wage growth should still be higher in foreign firms when controlling for worker unobservables if the HL theory is correct (Hypothesis 3). One way to check this is by including individual fixed effects in the regressions. This is done in columns 4-6. This reduces the estimated coefficient slightly, and it becomes insignificant when individual controls are added (column 5). Including establishment size (column 6) further reduces the size (and significance) of the estimate. Instead, establishment size becomes significant, which is consistent with hypothesis 7, as size may be a better proxy for the underlying firm type. This can be further investigated by using the alternative definition of the foreign-firm dummy from above where it takes the value one if the firm is foreign-owned

for at least one year of a job spell. This increases the level and significance of the estimated coefficient considerably (column 7), which is consistent with this alternative definition of the foreign dummy better capturing the underlying firm type.[18, 19]

While a number of studies have previously dealt with the relationship between ownership (or size) and wage *levels*, only a few have considered the effects on wage *growth*. In a somewhat different context, Møen (2005) finds higher wage growth in R&D intensive firms. In a cross-sectional setting, Pearce (1990) has also previously found higher wage growth in large firms, whereas Barron et al. (1987) found a negative relationship between size and wage growth. In more recent studies, Görg et al. (2007) find evidence that wage growth is higher in foreign firms in Ghana, but only for workers receiving on-the-job training, while Martins (2011) finds higher wage growth for workers who move from domestic to foreign firms compared to those who stay.

To test the importance of past experience, Table 7 extends the regressions from Table 5 with information about past experience from foreign firms. Column 1 more or less reproduces column 3 of Table 5, but includes nine size dummies as controls (constructed from the observed deciles in the distribution of establishment size) instead of the log of establishment size. This is a more flexible specification of the wage-size relationship, but the coefficient of

[18] If we instead let the foreign dummy take the value one only if the firm is foreign owned during all years of a job spell, results become very similar to the main specification in Table 6. We also tried to run regressions separately for men and women, but did not find any noteworthy differences between the genders, although results for men in general tend to be more significant.

[19] Note that the estimated coefficient of the log of establishment size increases significantly (by more than 50%) when adding individual fixed effects. This is somewhat surprising and seems to go against Rosen's (1972) original idea that workers with high learning capacity will self-select into jobs where the potential for learning is high. However, it could reflect that large establishments employ more blue-collar workers or less-skilled workers with less potential for wage growth and that this is not fully captured by the observable characteristics in the OLS regressions.

the foreign dummy is almost unaffected by this. Hence, while the inclusion of controls for establishment size reduces the foreign-firm wage premium (cf. Table 5) as predicted by all three theories (Hypothesis 7), it cannot eliminate the premium.

[insert Table 7 around here]

Column 2 includes a variable measuring the total accumulated experience from foreign firms called "Foreign-Firm Experience", which is the number of years employed in a foreign firm over the entire career of the worker. Note, however, that our information only goes back to 2002. Hence, the experience measure from foreign firms is a truncated measure. The coefficient of this variable will capture the additional effect of experience since 2002 from (current as well as previous) employments in foreign firms. Furthermore, to distinguish between effects from current and previous employments in foreign firms, we also include the cross-product between "Foreign" and "Tenure". The coefficient of this latter variable will indicate whether foreign-firm experience obtained in the current employment relationship has a different effect than foreign-firm experience obtained in previous employments.

It turns out that experience in general pays off: initially around 5% per year, but dropping to less than 1% after 10 years.[20] These estimates are similar to those from Table 5. More interestingly, "Foreign-Firm Experience" adds another 0.9% indicating that experience from foreign firms is indeed more valuable than experience from domestic establishments. Furthermore, as the coefficients of "Foreign * Tenure" and "Foreign * Tenure^2" are slightly negative and insignificant, foreign-firm experience acquired in previous employments is (at

[20] Average experience in the data set is close to 15 years, cf. Table 4.

least) as important as foreign-firm experience acquired in the current employment. This is strongly supportive of the idea of learning and transferable skills as stated in Hypothesis 4.[21]

As the measure of total foreign-firm experience is truncated in 2002, we also construct a measure of total large-establishment experience as an alternative proxy for experience from type-A firms. This measure is constructed as the total accumulated experience since 1981 from establishments with a size exceeding the median size (= 50 employees) for workers in the data set. In column 3, we include this variable together with interaction terms between a "Large" establishment dummy (constructed in a similar way) and "Tenure" and "Experience", respectively.

As can be seen from column 3, this only marginally affects the coefficient estimates from column 2. On top of that, we find that total experience from large establishments also influences wages positively. Again, it is the total experience that matters. There is no extra positive effect if the experience is from the current employment. Actually, the coefficient of "Large * Tenure" is slightly negative.

Together, these results are supportive of the HL theory. However, we could get positive coefficient estimates to "Foreign-Firm Experience" even in the absence of learning if total experience from foreign (or large) firms is correlated with ex-ante worker quality. To eliminate this possibility, we can control for worker fixed effects. This is done in columns 4-6 of Table 7. As can be seen, this does not significantly alter the conclusions. The coefficient estimates to "Foreign-Firm Experience" actually increase somewhat (although the second-order terms also become more negative) and significant, whereas the effect of large-establishment experience decreases, but remains significantly positive. Hence, the effects of

[21] Note also that general experience does not seem to be valued more in foreign firms, as the coefficients of "Foreign * Experience" and "Foreign * Experience^2" jointly result in a tiny negative effect, which seems to be counteracted by a higher coefficient of the foreign dummy in column 2.

previously acquired skills at foreign or large establishments do not seem to be due to ex-ante "better" workers having more experience from foreign and large establishments.[22]

Note, however, that with worker fixed effects, the coefficients of the foreign-firm experience variables are identified from within changes, i.e., from workers switching or from change of ownership. The latter can again be eliminated by using the alternative definition of the foreign dummy, where it takes the value one if the firm is foreign-owned for at least one year of a job spell. This increases the size and significance of the coefficient of "Foreign-Firm experience" both in OLS and FE (columns 7 and 8).[23]

Existing studies by Görg and Strobl (2005) and Balsvik (2011) also find evidence that previous experience from multinationals pays off in subsequent employment. Compared to these studies, we explicitly test for the importance of the amount of previous experience, and we control for ex-ante unobserved skills using fixed effects. One problem is that with worker fixed effects and the alternative definition of the "Foreign" dummy, the identification of the coefficient of "Foreign-Firm Experience" exclusively stems from worker switching. This introduces a selection issue given the relatively short nature of the panel. Hence, the estimates of the coefficients should be interpreted with some caution.

Another hypothesis specific to the HL theory is that starting wages should be lower in foreign firms – at least when conditioning on ex-ante worker skills (Hypothesis 6). This can be tested indirectly by looking at the estimated coefficient of the foreign dummy in columns 2 and 3 of Table 7. When interactions between the foreign dummy and both experience and tenure are included, this coefficient should reflect the effect of foreign ownership on the

[22] We also ran the regressions separately for men and women. The coefficient to "Foreign-Firm Experience" was only significantly positive for females in OLS, while the FE estimates were significantly positive for both sexes. The coefficients to "Large-Establishment Experience" were significantly positive for both sexes in OLS and FE.

[23] Very similar results are obtained if we instead let the foreign dummy take the value one only if the firm is foreign-owned during all years of a job spell.

initial wage. As the coefficient is positive, it does not support the HL theory. Instead, a positive effect is consistent with both the HF and the HW theories (cf. Hypothesis 5). However, according to the HW theory, the positive effect should disappear once we control for ex-ante worker skills as in columns 5 and 6 (cf. Hypothesis 6). In this case, the coefficient is identified from comparing (starting wages of) different job spells by the same worker (controlling for the amount of total experience). But although the estimated coefficient drops, the fact that it is still positive lends strong support to the HF theory.

In sum, the evidence in relation to Hypotheses 4, 5, and 6 provides considerable support for the HL theory, as wage growth is higher in foreign firms and as skills acquired in these firms are transferable to subsequent employments. Furthermore, the fact that starting wages remain higher in foreign firms even after controlling for worker fixed effects lends support to the HF theory.

V. Conclusion

Three general theories of the different wage-setting practices in foreign-owned firms can be identified from the existing literature: A heterogeneous-workers (HW) theory, a heterogeneous-learning (HL) theory, and a heterogeneous-firms (HF) theory. In this paper, we have set up a model that explicitly encompasses the first two of these and which can also be used to analyze the implications of the third. This unifying framework allowed us to derive and compare the predictions of all three theories – highlighting important similarities as well as differences.

Testing the implications on Danish matched employer-employee data revealed significant support for all three theories. The HW theory, which says that foreign firms simply employ ex-ante better workers, was thus capable of explaining up to 75% of the observed wage premium, while the evidence of higher wage growth in foreign firms and the importance of past foreign-firm and large-firm experience supports the HL theory. Finally, the higher

starting wages in foreign firms (even when controlling for worker fixed effects) bear evidence of the HF theory.

All three theories – and the empirical evidence – suggest a productivity advantage of foreign firms. But the host-country implications differ between the theories. Both in the HW and the HL cases foreign firms may help to realize the production potential of domestic workers if domestic type-A firms are in limited supply. In the HF case, on the other hand, benefits for domestic workers arise if foreign firms share some of their rents with them.

The HL theory probably offers the most interesting perspectives for the host countries. Throughout the paper, we have referred to the improvement in productivity as "learning", but as mentioned in the introduction, this also covers explicit training, learning-by-doing, or the discovery of technology, "tricks", or "recipes" that can be used in competing firms. Our theory model provides a theoretical foundation for the existence of such productivity transfers. In our model, however, these were fully internalized by the agents, and as such did not provide any extra gains for the host country. But positive externalities in the form of spillovers to domestic forms through worker mobility can, of course, be conceived. Imperfect labor markets, in the form of, e.g., non-competitive wage setting, may prevent both domestic workers and subsequent domestic employers from paying for the full value of the workers' experience. Balsvik (2011) thus finds that the productivity effects in the domestic firms seem to exceed the higher wages paid to workers with experience from multinationals. In that case, encouraging more foreign direct investment may have large potential benefits for the host country.

Before jumping to policy conclusions, three things should be emphasized. First, we have not investigated the existence of externalities empirically in this paper. Second, we have focused only on the benefits that arise directly through domestic workers. As argued by, e.g., Lipsey (2004), other types of benefits and spillover channels have been suggested in the

literature, including firm-to-market and firm-to-firm spillovers. Third, a thorough analysis of the host-country benefits requires a general-equilibrium set-up. Thus, according to all three theories, foreign firms also reduce the profits of domestic firms and affect consumers through prices and product varieties. Further research is required to guide policy in this area.

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Table 2: Firm Types and Employment

	Absolute numbers			
	2002		2007	
	Domestic	Foreign	Domestic	Foreign
Firm Size (# employees)	# Firms			
0-49	268,398	2,301	297,996	2,672
50-499	2,705	665	3,449	792
500+	176	71	305	105
Total	271,279	3,037	301,750	3,569
	Employment			
0-49	593,837	26,335	700,958	29,353
50-499	309,586	102,668	396,681	119,686
500+	289,633	100,245	898,795	140,621
Total	1,193,056	229,248	1,996,434	289,660

Note: The table includes firms in the private sector and workers in full-time equivalents. The division of firms into size classes is based on the average number of employees over the year.

Table 3: Firm Types, Average Wages and Wage Growth

	Average wages		Average annual wage growth
	2002	2007	2002-7
Domestic	193.03	222.58	3.5%
Foreign	222.26	252.07	4.0%

Note: The table includes full-time workers in the non-primary private sector, aged 20-65 years. Average wages are hourly wages in DKK. Average annual wage growth is based on workers that stay in the same job in two consecutive years.

Table 4: Summary Statistics

	Mean	St.dev
Foreign	0.209	0.406
Age	36.088	8.395
Experience[a]	14.828	7.970
Tenure[a]	5.918	5.024
Male	0.644	0.479
Years of education[a]	12.453	2.446
Establishment size[a]	267.284	586.113
Number of observations	3,163,381	

Note: The sample is based on all workers in the non-primary private sector, aged 20-65 years, who entered the labor market in 1981 or later. Observations are at the worker-year level, and observations with missing values for some of the variables above or with a low quality of the hourly-wage variable according to Statistics Denmark have been excluded. Summary statistics have been computed as simple averages across all observations.

[a] *Experience* is a continuous measure (in years of full-time work) of actual labor market experience based on the number of days in employment over the worker's career. *Tenure* is the number of years employed at the current establishment. *Years of education* is years of completed education. *Establishment size* is the number of employees in the last week of November at the establishment where the worker is employed.

Table 5: The Wage Premium in Foreign Firms

	Dependent variable: log(hourly wage)							
	(1) OLS	(2) OLS	(3) OLS	(4) Indv. FE	(5) Indv. FE	(6) Indv. FE	(7) OLS	(8) Indv. FE
Foreign	0.08414	0.07145	0.05744	0.02490	0.02267	0.01943	0.08178	0.03729
	(0.00897)**	(0.00667)**	(0.0065)**	(0.0018)**	(0.00156)**	(0.00149)**	(0.00908)**	(0.00162)**
Log(establishment size)			0.02048			0.01355		
			(0.00155)**			(0.0006)**		
Age		0.03805	0.03722					
		(0.00134)**	(0.00131)**					
Age^2		-0.00046	-0.00045		-0.00078	-0.00077		-0.00078
		(0.00001)**	(0.00001)**		(0.00002)**	(0.00002)**		(0.00002)**
Experience		0.06560	0.06622		0.08987	0.08956		0.08981
		(0.00177)**	(0.00173)**		(0.00219)**	(0.00217)**		(0.00218)**
$Experience^2$		-0.00445	-0.00446		-0.00739	-0.00739		-0.00738
		(0.00017)**	(0.00017)**		(0.00018)**	(0.00018)**		(0.00018)**
$Experience^3$		0.00013	0.00013		0.00024	0.00024		0.00024
		(0.00001)**	(0.000006)**		(0.000007)**	(0.000007)**		(0.000007)**
$Experience^4$		-0.000001	-0.000001		-0.000003	-0.000003		-0.000003
		(0.0000001)**	(0.0000001)**		(0.0000001)**	(0.0000001)**		(0.0000001)**
Tenure		0.00801	0.00698		0.00681	0.00631		0.00687
		(0.0007)**	(0.00068)**		(0.00032)**	(0.00031)**		(0.00031)**
$Tenure^2$		-0.00032	-0.00029		-0.00026	-0.00025		-0.00026
		(0.00002)**	(0.00002)**		(0.00002)**	(0.00001)**		(0.00001)**
Male		0.1992	0.2011					
		(0.00388)**	(0.00386)**					
Years of education		0.05138	0.04994					
		(0.00067)**	(0.00063)**					
Worker fixed effects				Yes	Yes	Yes		Yes
Area dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869
Number of individuals				877,898	877,898	877,898		877,898
R-squared	0.16	0.40	0.41	0.27	0.32	0.32	0.16	0.32

Note: Estimations are based on a panel from 2002-2007 of workers in the private non-primary sector of age 20-65 years, who entered the labor market in 1981 or later. See Table 4 and main text for variable definitions. In columns 7 and 8, *Foreign* is defined such that it takes the value one for all observations in a given job spell if the firm is foreign owned in at least one of the years within the spell. Note that the coefficient to *Age* cannot be identified in the fixed-effects regressions as they also include time dummies. The reported R-squared statistics for the fixed-effects regressions are computed after the removal of the fixed effects. Robust standard errors in parentheses are clustered at the firm level. * = significant at 5% level, **= significant at 1% level.

Table 6: Wage Growth in Foreign Firms

	Dependent variable: dlog(hourly wage)						
	(1) OLS	(2) OLS	(3) OLS	(4) Indv. FE	(5) Indv. FE	(6) Indv. FE	(7) Indv. FE
Foreign	0.00213	0.00277	0.00213	0.00256	0.00173	0.00143	0.00435
	(0.00077)**	(0.00069)**	(0.00074)**	(0.00103)*	(0.00107)	(0.00108)	(0.00097)**
Log(establishment size)			0.00094			0.00164	0.00154
			(0.00021)**			(0.00035)**	(0.00035)**
Age		-0.00671	-0.00676				
		(0.00021)**	(0.00021)**				
Age^2		0.00006	0.00007		0.00007	0.00007	0.00007
		(0.000002)**	(0.000002)**		(0.000006)**	(0.000006)**	(0.000006)**
Experience		-0.00429	-0.00425		0.01107	0.01104	0.01102
		(0.00043)**	(0.00043)**		(0.00125)**	(0.00125)**	(0.00125)**
$Experience^2$		0.00021	0.00021		-0.00027	-0.00027	-0.00027
		(0.00004)**	(0.00004)**		(0.00007)**	(0.00007)**	(0.00007)**
$Experience^3$		-0.000002	-0.000002		0.000015	0.000015	0.000015
		(0.000001)	(0.000001)		(0.000003)**	(0.000003)**	(0.000003)**
$Experience^4$		-0.00000003	-0.00000003		-0.00000021	-0.00000021	-0.00000021
		(0.00000001)*	(0.00000001)*		(0.00000003)**	(0.00000003)**	(0.00000003)**
Tenure		0.00168	0.00163		0.00531	0.00526	0.00527
		(0.00012)**	(0.00013)**		(0.00022)**	(0.00023)**	(0.00023)**
$Tenure^2$		-0.00008	-0.00008		-0.00023	-0.00023	-0.00023
		(0.00001)**	(0.00001)**		(0.00001)**	(0.00001)**	(0.00001)**
Male		0.00187	0.00196				
		(0.00036)**	(0.00035)**				
Years of education		0.00101	0.00094				
		(0.00007)**	(0.00007)**				
Worker fixed effects				Yes	Yes	Yes	Yes
Area dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,704,381	2,704,381	2,704,381	2,704,381	2,704,381	2,704,381	2,704,381
Number of individuals				795,020	795,020	795,020	795,020
R-squared	0.02	0.03	0.03	0.02	0.02	0.02	0.02

Note: Estimations are based on a panel from 2002-2007 of workers in the private non-primary sector of age 20-65 years, who entered the labor market in 1981 or later. See Table 4 and main text for variable definitions. In columns 7, *Foreign* is defined such that it takes the value one for all observations in a given job spell if the firm is foreign owned in at least one of the years within the spell. Note that the coefficient to *Age* cannot be identified in the fixed-effects regressions as they also include time dummies. The reported R-squared statistics for the fixed-effects regressions are computed after the removal of the fixed effects. Robust standard errors in parentheses are clustered at the firm level. * = significant at 5% level, **= significant at 1% level.

Table 7: Past Experience from Foreign Firms

	Dependent variable: log(hourly wage)							
	(1) OLS	(2) OLS	(3) OLS	(4) Indv. FE	(5) Indv. FE	(6) Indv. FE	(7) OLS	(8) Indv. FE
Foreign	0.05767	0.07909	0.06818	0.01934	0.04834	0.04542	0.07100	0.05365
	(0.00647)**	(0.01098)**	(0.01126)**	(0.00147)**	(0.00558)**	(0.00565)**	(0.01128)**	(0.00702)**
Age	0.03747	0.03729	0.03568				0.03560	
	(0.00131)**	(0.00131)**	(0.00128)**				(0.00129)**	
Age^2	-0.00045	-0.00044	-0.00043	-0.00077	-0.00077	-0.00077	-0.00043	-0.00077
	(0.00001)**	(0.00001)**	(0.00001)**	(0.00002)**	(0.00002)**	(0.00002)**	(0.00001)**	(0.00002)**
Experience	0.06620	0.06171	0.06213	0.08953	0.08699	0.08740	0.06124	0.08599
	(0.00173)**	(0.00177)**	(0.00172)**	(0.00218)**	(0.00217)**	(0.00212)**	(0.0018)**	(0.00211)**
$Experience^2$	-0.00447	-0.00410	-0.00415	-0.00739	-0.00710	-0.00709	-0.00407	-0.00695
	(0.00017)**	(0.00016)**	(0.00016)**	(0.00018)**	(0.00018)**	(0.00018)**	(0.00017)**	(0.00018)**
$Experience^3$	0.00013	0.00012	0.00012	0.00024	0.00023	0.00023	0.00012	0.00022
	(0.00001)**	(0.00001)**	(0.00001)**	(0.00001)**	(0.00001)**	(0.00001)**	(0.00001)**	(0.00001)**
$Experience^4$	-0.000001	-0.000001	-0.000001	-0.000003	-0.000003	-0.000003	-0.000001	-0.000002
	(0.0000001)**	(0.0000001)**	(0.0000001)**	(0.0000001)**	(0.0000001)**	(0.0000001)**	(0.0000001)**	(0.0000001)**
Tenure	0.00701	0.00583	0.00548	0.00635	0.00645	0.00683	0.00533	0.00590
	(0.00068)**	(0.00065)**	(0.00053)**	(0.00031)**	(0.00036)**	(0.0003)**	(0.0005)**	(0.00031)**
$Tenure^2$	-0.00029	-0.00023	-0.00024	-0.00025	-0.00025	-0.00027	-0.00023	-0.00023
	(0.00002)**	(0.00002)**	(0.00002)**	(0.00001)**	(0.00002)**	(0.00001)**	(0.00002)**	(0.00002)**
Male	0.20105	0.20095	0.20096				0.20122	
	(0.00388)**	(0.00387)**	(0.00388)**				(0.00389)**	
Years of education	0.05007	0.04989	0.04957				0.04956	
	(0.00064)**	(0.00063)**	(0.00063)**				(0.00064)**	
Foreign-Firm Experience		0.00868	0.00712		0.02271	0.02241	0.00984	0.03475
		(0.00349)*	(0.00352)*		(0.00151)**	(0.00151)**	(0.00331)**	(0.00169)**
Foreign-Firm $Experience^2$		0.00047	0.00056		-0.00286	-0.00282	0.00041	-0.00414
		(0.00034)	(0.00034)		(0.0002)**	(0.0002)**	(0.00035)	(0.00021)**
Foreign * Tenure		-0.00111	-0.00055		-0.00294	-0.00267	-0.00279	-0.00116
		(0.00186)	(0.00188)		(0.0006)**	(0.00062)**	(0.00179)	(0.00071)
Foreign * $Tenure^2$		-0.00005	-0.00007		0.00013	0.00011	0.00001	0.00008
		(0.00007)	(0.00007)		(0.00003)**	(0.00003)**	(0.00007)	(0.00003)**
Foreign * Experience		-0.00207	-0.00113		-0.00209	-0.00184	-0.00111	-0.00264
		(0.00118)	(0.00123)		(0.00059)**	(0.00059)**	(0.00121)	(0.00078)**
Foreign * $Experience^2$		0.00009	0.00007		0.00005	0.00005	0.00006	0.00008
		(0.00003)**	(0.00003)*		(0.00001)**	(0.00001)**	(0.00003)	(0.00002)**
Large-Establ. Experience			0.00467			0.00107	0.00463	0.00101
			(0.00053)**			(0.00021)**	(0.00052)**	(0.00021)**
Large-Establ. $Experience^2$			-0.00011			-0.00004	-0.00011	-0.00004
			(0.00002)**			(0.00001)**	(0.00002)**	(0.00001)**
Large * Tenure			-0.00183			-0.00105	-0.00172	-0.00118
			(0.00065)**			(0.0003)**	(0.00063)**	(0.00031)**
Large * $Tenure^2$			0.00008			0.00005	0.00008	0.00006
			(0.00002)**			(0.00001)**	(0.00002)**	(0.00001)**
Large * Experience			-0.00248			-0.00117	-0.00252	-0.00111
			(0.00046)**			(0.00019)**	(0.00046)**	(0.00019)**
Large * $Experience^2$			0.00003			0.00001	0.00003	0.00001
			(0.00001)**			(0.000002)**	(0.000006)**	(0.000002)**
Worker fixed effects				Yes	Yes	Yes		Yes
Establishment size dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869	3,162,869
Number of individuals				877,898	877,898	877,898		877,898
R-squared	0.41	0.41	0.41	0.32	0.32	0.32	0.41	0.32

Note: Estimations are based on a panel from 2002-2007 of workers in the private non-primary sector of age 20-65 years, who entered the labor market in 1981 or later. See Table 4 and main text for variable definitions. In columns 7 and 8, *Foreign* is defined such that it takes the value one for all observations in a given job spell if the firm is foreign owned in at least one of the years within the spell. Note that the coefficient to *Age* cannot be identified in the fixed-effects regressions as they also include time dummies. The reported R-squared statistics for the fixed-effects regressions are computed after the removal of the fixed effects. Robust standard errors in parentheses are clustered at the firm level. * = significant at 5% level, **= significant at 1% level.