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Malchow-Møller, Nikolaj; Markusen, James R.; Schjerning, Bertel

CAM

Centre for Applied Microeconometrics

Department of Economics
University of Copenhagen

http://www.econ.ku.dk/CAM/

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Nikolaj Malchow-Møller, James R. Markusen
and Bertel Schjerning

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Nikolaj Malchow-Møller
Centre for Economic and Business Research (CEBR) and
University of Southern Denmark

James R. Markusen
University of Colorado, Boulder,
University College Dublin and
Centre for Economic and Business Research (CEBR)

Bertel Schjerning
University of Copenhagen and
Center for Applied Microeconometrics (CAM)

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Abstract

Many papers have documented a wage premium in foreign-owned and large firms. However, there is very little formal theory in the literature and empirical analyses are typically not based on hypotheses which are rigorously derived from theory. This paper contributes to the theory-empirics gap by developing a model that allows for two "pure" explanations for the wage premium. The first is a heterogenous-*worker* explanation along the lines of Yeaple (2005), where firms that select more scale-intensive technologies select ex-ante more productive workers. In this case, the wage premium is a pure *selection* phenomenon. The second explanation builds on the heterogeneous-*firm* model of Melitz (2003) combined with on-the-job learning as in Markusen (2001). Productivity differences between firms are internalized by ex-ante homogeneous workers, so the wage premium is a pure *learning* phenomenon due to ex-post higher productivity in foreign firms. Our model yields a number of precise empirical hypotheses. When these predictions are tested on Danish matched employer-employee data, we find that both explanations play a role in explaining the observed wage premium. Specifically, the foreign- and large-firm premiums explained by selection are in the neighborhood of 30-65% of the total premium, with the remainder consistent with learning. There is also considerable support for a number of other predictions specific to the worker-learning explanation.

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1. Introduction

A number of papers have documented that foreign (and large) firms pay higher wages and, to the best of our knowledge, no study has found the opposite. However, there is relatively little formal theory in the literature and empirical analyses are typically not based on hypotheses which are rigorously derived from theory.

This paper contributes to the theory-empirics gap by developing a model that allows for two "pure" explanations of the wage premium: a heterogenous-*worker* explanation along the lines of Yeaple (2005), where the wage premium is a pure *selection* phenomenon, and a heterogenous-firm / worker-learning explanation, where the wage premium is a pure *learning* phenomenon.[1] Our model allows for each explanation to emerge as a special case as well as for a combination of the two. A number of empirical hypotheses are derived directly from this theory model; some which are shared by the two explanations and some which are not. These are subsequently tested on Danish matched employer-employee data in order to assess the relative importance of the two explanations.

The heterogeneous-worker explanation has previously been developed carefully in Yeaple (2005) in a setting where workers differ exogenously in skills and where ex-ante homogenous 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. In an earlier paper, Ekholm and Midelfart (2005) build a model with similar characteristics where firms can choose between a "modern" and a "traditional" technology, where the former is more scale-intensive. In equilibrium, firms choosing this technology therefore operate on a larger scale and pay higher wages. Finally, 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

[1] Other theoretical explanations of the foreign wage premium offered in the literature include higher labor demand volatility in foreign plants (Fabri et al., 2003); compensation for a higher closure rate in foreign firms (Bernard and Sjöholm, 2003) or compensation due to preferences by workers for domestic firms (Lipsey, 2004). We should also note that we are not dealing with the question of how liberalization leading to inward foreign investment affects the wages of *all* workers (see, e.g., Markusen and Venables, 2000).

trade, employ workers of higher skills and as a consequence pay higher wages on average.

Our heterogeneous-firm / worker-learning explanation builds on Melitz's (2003) idea that firms differ exogenously in productivity (or costs); with only the most productive firms finding it optimal to engage in export activities. In the present paper, this set-up is extended to differences in on-the-job learning possibilities, which are proportional to a firm's productivity, and which are internalized by ex-ante homogeneous workers. On-the-job learning was introduced in Rosen (1972) in a model of optimal occupational choices over an individual's lifetime. It has later been formalized in set-ups with foreign-owned firms and multinational enterprises (MNEs) by Ethier and Markusen (1996), Markusen (2001), Fosfuri et al. (2001) and Glass and Saggi (2002). In these papers and in the current one, learning is exogenous in the sense that it is not a "training" investment 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 following one period of employment. Hence, workers are not immediately paid a higher wage in MNEs, but only over time. In all three papers, as well as in our model, productivity transfers may arise when workers employed by MNEs move to domestic firms. Recently, Görg et al (2007) have used a two-period bargaining framework to show 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.

The present paper is the first to incorporate both explanations into a simple and tractable model which also allows each of the explanations to emerge as a special case. 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, e.g., Markusen (2001), but with potentially heterogeneous firms as in Melitz (2003), where firms now differ with respect to learning possibilities. The model has a quasi OLG structure where workers live for two periods, but

firms are long lived.[2]

In the empirical part of the paper, we investigate a number of specific hypotheses that come out of this model. First, we test the existence of a wage premium in foreign (and large) firms (as predicted by both explanations), and how much of it that can be explained by differences in observed and unobserved worker characteristics, i.e. worker heterogeneity. Second, we test three more specific predictions of the worker-learning explanation: (i) that learning and therefore wage growth is higher in foreign/large firms; (ii) that starting wages are lower in these firms; and (iii) that subsequent earnings increase with experience from foreign-owned and large firms.

To preview our results, we find support for both theories: The shares of the foreign-firm and large-firm premiums explained by worker heterogeneity are in the neighborhood of 30-65% of the total premiums, with the remainder consistent with learning. Furthermore, there is considerable support for the predictions specific to the worker-learning explanation.

The foreign-firm wage premium has already been analysed extensively in the existing empirical literature; see Lipsey (2004) for a review. Using plant- or firm-level data, a number of studies have also tried to determine how much of the overall "wage-gap" between foreign-owned and domestically-owned firms that can be explained by a higher average quality of the workers in the foreign-owned firms.[3] The general conclusion is that while part of the difference can be attributed to a higher average quality of workers, a considerable part can only be explained by foreign owned firms having different firm characteristics than the average domestically-owned firm; see Lipsey (2004).

While most of the empirical literature can only control for observable differences in average worker characteristics across plants (and often has limited information on this), a few recent studies by Martins (2004), Heyman et al. (2007), and Balsvik (2007) use matched employer-employee data. This

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[2] Elements of both the heterogeneous-worker explanation and the heterogeneous-firm explanation are found in the theoretical and empirical 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.

[3] Studies include (but are by no means confined to): Aitken et al. (1996), Doms and Jensen (1998), Lipsey and Sjöholm (2004), and Feliciano and Lipsey (2006).

allows them to control for more detailed individual differences among the employees. All three studies, however, find that a significant wage premium remains in MNEs also after controlling for observable worker characteristics. This indicates that the heterogeneous-worker model may explain part – but not all – of the wage premium of foreign firms.[4]

Recent studies by Andrews et al. (2007) and Martins (2008) also control for unobserved worker differences using fixed effects, although in slightly different contexts. Andrews et al. (2007) thus search for any evidence of take-over effects, whereas Martins (2008) analyzes movers between domestic and foreign firms and find evidence of what he terms a "wage policy effect" as workers increase their wage upon moving to a foreign firm.

As opposed to these studies, we provide an upper-bound estimate on the importance of the heterogeneous-worker model. Thus, we control for observable as well as unobservable worker characteristics (fixed effects) to examine how much of the wage premium that can be explained by ex-ante worker differences. Furthermore, we distinguish explicitly between the importance of firm and worker controls in the analysis of the wage premium. For example, a prediction that comes out of our theory is that the foreign wage gap should disappear when controlling appropriately for firm size.

Turning to the more specific hypotheses related to the worker-learning explanation, the existing evidence is much more limited. To our knowledge, Görg *et al.* (2007) is the only paper to explicitly analyze whether part of the wage gap could be explained by higher learning in foreign firms. Using data from Ghana, they find evidence that wage growth is higher in foreign firms, and only so for workers receiving on the job training. In his analysis of movers, Martins (2008) also estimates wage growth equations and finds evidence of higher wage growth for workers that move from domestic to foreign firms compared to those who stay.

Our paper is thus the first to formally test whether higher learning in foreign firms may

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[4] The literature referenced above also finds that controlling for differences in plant characteristics, especially the establishment size, further reduces and sometimes even eliminates the wage premium; see Lipsey (2004). Finally, there is also a large literature examining the effects of foreign acquisitions on the wages of the employees; see Girma and Görg (2007), Almeida (2007) and Huttunen (2007).

explain part of the wage premium in developed countries – relying on a much more extensive data set than Görg et al. (2007). As opposed to previous studies, we also control for unobserved worker differences (fixed effects) in analyzing this, and we test whether the effect disappears when controlling for firm size as predicted by our worker-learning explanation. We also test whether the higher wage growth is compensated for by lower starting wages.

Finally, the hypothesis that experience from foreign-owned firms also add to subsequent wages (in a new job) has recently been considered by Görg and Strobl (2005), Martins (2005), Balsvik (2007) and Pesola (2007). They all find evidence that previous experience from multinationals pays off in subsequent employment. Compared to these studies, we explicitly test the importance of the *amount of* previous experience from large (foreign) firms. For this purpose, we apply a very long panel that allows us to appropriately capture such effects. Only Pesola (2007) has previously considered the importance of the time spent in foreign firms (what we think of as the learning period) for subsequent wages.

The rest of the paper is structured as follows: In Section 2, we present the theory model and derive the empirical hypotheses. Section 3 describes the data, while Section 4 tests the hypotheses. Section 5 concludes. An appendix with details of the theory model and specifications of the variables used in the empirical analysis is attached at the end.

2. A model of entry, productivity, and industry structure

The model will draw on the contributions of Melitz's (2003) model of industry structure with heterogeneous firms and Yeaple's (2005) model of heterogeneous workers and ex-ante identical firms. These are combined with a learn-on-the-job model of Ethier and Markusen (1996) and Markusen (2001) in which workers are ex-ante identical. Very significant simplifications of all three approaches are made in order to provide a tractable model that combines the key ingredients of each.

(1) There are two types of technologies available to domestic (D) and foreign (F) firms: advanced (A) and basic (B), with firms using these technologies referred to as type-A and type-B firms, respectively. Firms produce differentiated goods that are symmetric substitutes, denoted X.

(2) There is free entry of domestic and foreign firms into both types of technologies, but foreign firms must pay a higher fixed cost to enter the domestic market (reminiscent of Helpman, Melitz and Yeaple, 2004). In both countries, an unlimited potential number of firms can access the B technology, and so foreign type-B firms will be excluded from the market due to their higher fixed costs. More on type-A firm entry below.

(3) The model is quasi-dynamic. Firms are long lived, but fixed costs are per period, and demand is stationary. There are no investment or borrowing decisions or any other intertemporal features. Thus, we can analyze a single period in this "stationary" environment.

(4) The model also has a quasi-overlapping-generations feature, with two sets of workers (S- and H-workers). Each worker has a two-period career. S-workers begin their careers as identical low-skilled workers. Those workers who join type-B firms do not improve their productivity over time while those who join type-A firms have at least as high productivity in their first period (as those who join type-B firms) and learning results in higher productivity in the second period of their career. Skills are not firm-specific, so experienced workers are priced in a competitive market, and their wage path is such that young workers are indifferent between joining type-A and type-B firms. These ex-ante identical workers are all referred to as S-workers, even though those that join type-B firms do not increase their productivity over their career.

(5) A second set of workers, denoted H (high skilled) are more productive in both periods of

their two-period career, and they may or may not improve their productivity between periods. Specifically, H-workers have an absolute advantage working with the type-A technology relative to the S-workers, but are not more productive than S-workers with the type-B technology. We assume that they are in limited fixed supply, so that all H-workers are employed with the type-A firms (*i.e.*, when all the scarce H-workers are hired, the type-A firms still wish to hire additional S-workers).

(6) In the simplified version of the model presented here, workers do not transit between firm types between periods: S- or H-workers cannot transfer enough of their productivity advantage to type-B firms for this to be worthwhile and experience in type-B firms does not make these workers more productive in type-A firms than new entrant workers.[5]

(7) Finally, the model is largely partial equilibrium. Expenditure on X-goods is fixed. Furthermore, there is an unlimited supply of new S-workers available at a fixed wage, and a given worker disappears after two periods. Both the endogenous numbers of domestic type-A and type-B firms and the endogenous number of foreign type-A firms hire experienced and inexperienced workers in a competitive market. The steady-state or stationarity assumption is that the number of S-workers with experience from type-A firms available is equal to the number of inexperienced S-workers hired by type-A firms.

Our notation is as follows:

rs_i^a labor productivity (in physical units of X output) of S-workers in type-A firms, where i = 1 is an inexperienced worker and i = 2 is an experienced worker. Workers in type-B firms do not learn and their productivity in both periods is normalized to $rs_i^b = 1$.

ws_i^a wage of an inexperienced S-worker (i = 1) and an experienced S-worker (i = 2) in a type-A firm. These workers have an outside-option wage of one, so in type-B firms these workers earn $ws_1^b = ws_2^b = 1$.

rh_i^a, wh_i^a similarly defined productivity and wages for H-workers in type-A firms.

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[5] We have worked out more complicated versions of our model. We are thus confident that the assumptions such as (a) a fixed number of H-workers, and (b) no transiting workers, do not affect the qualitative results. Switching firm type is important theoretically and empirically and below we comment on an extension that includes workers switching firm types.

n_d^a, n_d^b, n_f^a number of domestic type-A and type-B firms and foreign type-A firms, respectively. These are *variables* determined by free entry. No foreign type-B firms enter.

p^a, p^b prices of a representative differentiated good produced by a type-A and a type-B firm, respectively.

XS_1^a, XS_2^a outputs of a type-A firm produced by inexperienced and experienced S-workers, respectively.

XH_1^a, XH_2^a outputs of a type-A firm produced by inexperienced and experienced H-workers, respectively.

X^b output of a type-B firm produced by inexperienced or experienced workers.

δ the discount factor, $0 < \delta = 1/(1+r) < 1$, where r is some rate of interest/discount.

Consumers have Dixit-Stiglitz preferences over an endogenous number, k, of differentiated goods, and spend a fixed amount of income, I, on X-sector goods. σ denotes the elasticity of substitution between varieties. Each period's demands do not depend on prices in the other period. Demand for any good i is given by:

$$X_i = p_i^{-\sigma}\left[\sum_k p_k^{1-\sigma}\right]^{-1} I \qquad (1)$$

Under the so-called "large-group" assumption, individual firms are assumed to be too small to influence the price index term in square brackets, and hence each firm's perceived elasticity of demand is just σ and the optimal markup is $1/\sigma$.

The equilibrium output of each type-A (high-productivity) firm, whether foreign or domestic, is determined by marginal revenue product less-than-or-equal to the wage. All workers within a firm produce the same variety of output, but workers differ in productivity. There are five first-order conditions for outputs in our model: four for a type-A firm (S- and H-workers in each period of their two-period career), and one for workers (inexperienced or experienced) in type-B firms. 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. The pricing inequalities for output are:

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

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

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

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

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

We assume that fixed costs for type-A and type-B domestic firms are "purchased" and not part of the firms' value added, employment, and wages. This greatly simplifies notation without affecting the results in any quantitative way. These fixed costs are denoted FC^b for domestic type-B firms.

Analogous to Melitz (2003) and Helpman, Melitz and Yeaple (2004), we assume that there is a distribution of fixed costs across potential firms for their use of the type-A technology. Firms are ordered in terms of proportionately increasing fixed costs, with foreign firms facing higher costs for the same number of entrants. If n_d^a domestic and n_f^a foreign type-A firms enter, the fixed cost 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 with $FC_f^a > FC_d^a$. An equilibrium with free entry then identifies a zero-profit "cutoff" firm as well as the number of domestic and foreign firms that enter.

Given (2)-(6), we have the well-known results that zero profits can simply be expressed as markup revenues equal fixed costs. Let $X^a = XS_1^a + XS_2^a + XH_1^a + XH_2^a$ denote the total output of a type-A firm (domestic and foreign type-A firms that enter have the same output since they have the same demand and marginal cost; there will just be fewer foreign firms). The three free-entry conditions are thus:

$$(p^a/\sigma)X^a \le n_d^a FC_d^a \qquad n_d^a \tag{7}$$

$$(p^a/\sigma)X^a \le n_f^a FC_f^a \qquad n_f^a \tag{8}$$

$$(p^b/\sigma)X^b \le FC^b \qquad n^b \tag{9}$$

Finally, we have six supply-demand equations to determine six prices: four wages rates and two representative X-prices (on goods from type-A and type-B firms, respectively). First, one equation, with ws_1^a as the complementary variable, is an arbitrage condition that the 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:

$$ws_1^a + \delta ws_2^a \ge 1 + \delta \qquad ws_1^a \tag{10}$$

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

$$(n_d^a + n_f^a)XS_1^a/rs_1^a \ge (n_d^a + n_f^a)XS_2^a/rs_2^a \qquad ws_2^a \tag{11}$$

Third, let *SH* be the exogenous supply (number) of H-workers of each vintage, inexperienced (first period) and experienced (second period). Supply equal to demand for these workers has the wages as the complementary variables:

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

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

Finally, there are supply-demand equations for X-output with complementary variables being the X-prices. Because of symmetry within firm types, we can reduce (1) to two representative supply-demand equations; one for each firm type:

$$X^a \ge (p^a)^{-\sigma}\left[(n_d^a + n_f^a)(p^a)^{1-\sigma} + n^b(p^b)^{1-\sigma}\right]^{-1} I \qquad p^a \tag{14}$$

$$X^b \ge (p^b)^{-\sigma}\left[(n_d^a + n_f^a)(p^a)^{1-\sigma} + n^b(p^b)^{1-\sigma}\right]^{-1} I \qquad p^b \tag{15}$$

Our model given by (2)-(15) thus constitutes fourteen non-linear inequalities in fourteen non-negative variables. We solve this model analytically in Appendix A to this paper. It follows that type-B firms are smaller in terms of output (and typically also in terms of employment). Type-B firms therefore charge a higher price, $p^b > p^a$, in equilibrium. Furthermore, due to learning, S-workers joining type-A firms receive higher second-period wages, but then have to accept a lower wage in the first period.

Before we go into more detail with the implications of the model, we shall briefly consider a a more complicated version in which workers may switch firm types after the first period. We do not present the complete longer version here. Instead, we concentrate on the intuition: In the two-period formulation, a worker from a type-B firm would never switch after one period to a type-A firm if there was no learning at all in a type-B firm, because the switching worker would have to take a wage cut, competing with new inexperienced workers in the type-A firm. But if the experience in a type-B firm is of some value in a type-A firm, a worker from a type-B firm could switch to a type-A firm and still earn a wage of one if that worker's productivity in a type-A firm is somewhere between rs^b and rs_2^a, i.e. there is some learning in a type-B firm but it is only useful if the worker switches. Specifically, recall that prices and therefore marginal revenue products are different in type-A and type-B firms ($p^b > p^a$), reflecting differences in firm size. Let rs^{ba} denote the productivity of a worker switching from a type-B to a type-A firm after one period. A worker in a type-B firm is then indifferent to switching when:

$$p^a(1 - 1/\sigma)rs^{ba} = p^b(1 - 1/\sigma)rs^b = 1 \quad \Rightarrow \quad rs^{ba} = p^b/p^a \tag{16}$$

Our analytical appendix solves for this price ratio, which then implies that the indifference productivity is given as:

$$rs^{ba} = \frac{(rs_1^a + \delta rs_2^a)}{(1 + \delta)} \qquad \text{and thus} \qquad rs_2^a > rs^{ba} > rs_1^a \geq 1 \tag{17}$$

Thus, when switching from type-B to type-A firms is observed, the empirical implication is that

among workers employed in type-A firms, those with a longer tenure in the firm (or more total experience from type-A firms) should earn more than those with a short tenure.

Now, consider workers switching from type-A to type-B firms. A worker in a type-A firm might want to switch even if he or she carries only a part of the higher type-A firm 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. Let rs^{ab} denote the productivity of a worker switching from a type-A to a type-B firm after one period. A worker from a type-A firm is then indifferent to switching after one period if:

$$p^a(1 - 1/\sigma)rs_2^a = p^b(1 - 1/\sigma)rs^{ab} = ws_2^a \quad => \quad rs^{ab} = (p^a/p^b)rs_2^a \tag{18}$$

Derivations in the appendix shows that this indifference condition reduces to:

$$rs^{ab} = \frac{(1 + \delta)rs_2^a}{(rs_1^a + \delta rs_2^a)} \qquad \text{and thus} \qquad rs_2^a > rs^{ab} > rs_1^a \geq 1 \tag{19}$$

Thus, if workers are observed to switch from type-A to type-B firms, the empirical observation is that, among experienced type-B firm workers, those with more prior experience from type-A firms should earn more.

In the remainder of this section, we will report and briefly discuss qualitative results from the model (numerical simulations are available from the authors). Table 2.1 summarizes a number of theoretical predictions from three different "versions" of the model: Version 1 (V1) is the pure case of learning with no worker heterogeneity (no H-workers or H-workers identical to S-workers); Version 2 (V2) is a combined case of learning with a "large" number of H-workers; and Version 3 (V3) is the pure case of worker heterogeneity with no learning. The predictions in Table 2.1 are phrased as seven hypotheses where V1 predicts a "yes" for all seven. The hypotheses are tested empirically in the following sections. Below, we shall first briefly go through the predictions of each of the three versions of the model with respect to the seven hypotheses:

V1: learning, no worker heterogeneity: $rh_2^a = rs_2^a > rh_1^a = rs_1^a \geq rs^b = 1$

Hypothesis 1: The average wage level is higher in foreign/large firms. Although the present value of life-time earnings is the same for all workers under pure learning, average wages will be higher in type-A firms due to a steeper wage profile in these firms combined with discounting. This follows formally from (A3) in the appendix. Furthermore, type-A firms are larger than type-B firms and all foreign firms are of type A.

Hypothesis 2: Average wages in foreign firms are not higher when controlling for firm size. This follows almost trivially from the first hypothesis since foreign firms are all of type A, but not all type-A firms are foreign.

Hypothesis 3: Wages are higher in foreign/large firms even after controlling for time-invariant observed and unobserved worker characteristics. This follows from Hypothesis 1 and the fact that under V1, all workers are ex-ante identical.

Hypothesis 4: Wage growth is higher in foreign/large firms. This follows from the steeper wage profile in type-A firms under learning. It also implies that wages are lower for inexperienced workers in foreign/large firms. This latter is Hypothesis 7. Both hypotheses follow more formally from (A3) in the appendix.

Hypothesis 5: The foreign-firm effect on wage growth disappears when controlling for firm size. Again, this follows from the fact that foreign firms are all of type A, while not all type-A firms are foreign.

Hypothesis 6: Past experience from foreign/large firms raises current wages. This is true both when workers stay in the same firm type, as shown in (A3) of the appendix, and in the switching extension discussed above, where it follows formally from (18) and (19).

V2: learning and H-workers: $rs_2^a > rs_1^a \geq rs^b = 1, \quad rh_2^a \geq rs_2^a, \quad rh_1^a > rs_1^a$

The theory model in the case of V2 generates the same predictions as V1 for six of the seven

hypotheses. The hypothesis that does not follow is number 7: It need no longer be the case that wages for inexperienced workers are lower in foreign/large firms. While an S-worker will earn a lower starting wage in a type-A firm than in a type-B firm, the presence of H-workers in type-A firms will raise the average observed starting wage in the type-A firms. The wage for inexperienced H-workers is given in (A5) of the appendix. If there are "enough" H-workers and their productivity exceed that of S-workers by a sufficient amount, then the average starting wage in a type-A firm can exceed the wage in type-B firms.

V3: no learning, worker heterogeneity: $rh_2^a = rh_1^a > rs_2^a = rs_1^a \geq rs^b = 1$

While the simple Hypothesis 1 is supported in all three versions of the model (and confirmed in many earlier empirical papers), there now emerge some important differences compared to V1. In the pure heterogenous-worker model, V3, wages should not be higher in type-A firms once worker observables and unobservables have been controlled for (Hypothesis 3); the difference between type-A and type-B wages is totally due to selection and ex-ante worker differences. Nor should wage growth be higher in type-A firms (Hypothesis 4) as shown in (A3) and (A4) in the appendix. Hence, Hypothesis 5 does not apply under V3. Similarly, past experience from foreign/large firms should not be important for wages (Hypothesis 6). And finally, starting wages will not be lower in type-A firms (Hypothesis 7) as there is no learning in version 3 of the model. This follows formally from (A3) and (A5) in the appendix.

3. Data

In this and the following section, we test the empirical hypotheses in Table 2.1 using matched employer-employee data from Denmark. The data come from the Integrated Data Base of Labor Market Research (IDA) compiled by Statistics Denmark, combined with firm level information about foreign ownership, size, turnover, and exports. IDA contains register based annual data since 1980 on

all individuals with Danish residence. It provides detailed information on individual background variables such as education and family characteristics as well as detailed records of individual labor market performance, including occupations and income.[6]

All workers are linked to establishments which in turn (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 2000-2002.[7] As a consequence, in the regressions including foreign ownership, we have to rely on a panel for the years 2000 to 2002 (we shall refer to this as our "short" panel), while for the regressions without foreign ownership, we can extend the panel to the period 1981-2003 (our "long" panel) but then have to rely on establishment-level information.

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 attention to workers aged 20-65 years in the manufacturing and service sectors and (in the long panel) who entered the labor market in 1981 or later.

Table 3.1 presents the number of firms as well as the total employment of foreign-owned and domestically-owned firms in Denmark in the years 2000-2002 divided into different size classes. While the total stock of firms averaged approximately 245,000, only slightly more than 1% of these were foreign owned in the years 2000-2002. However, as also shown in the Table, the foreign firms were considerably larger on average, which implies that they accounted for 12-15% of total employment.[8] This relationship between size and ownership is fully consistent with both the heterogenous-worker version and the worker-learning version of our theory model, cf., e.g., Hypothesis 2.

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[6] For more information on the IDA data; see Abowd and Kramarz (1999).

[7] A firm is classified as foreign owned by Statistics Denmark if foreigners ultimately own more than 50% of the firm, and the foreign direct investment amounts to more than DKK 10 million.

[8] The employment figures in Table 3.1 are based on firm-level information about full-time employees. Note that part of the difference between foreign- and domestically-owned firms may be due to the fact that some of the smaller foreign-owned firms are not classified as foreign-owned in the data, as it requires FDI of a certain amount (see footnote above).

In Table 3.2, we provide a first check on the relationship between firm type, wage levels, and wage growth (Hypotheses 1 and 4 in Table 2.1). The Table contains the average wages and average wage growth rates for employees in foreign-owned and domestically-owned firms, respectively, as well as in different size classes. The income measure used is an hourly (nominal) wage reported by Statistics Denmark. As predicted by both versions of our model (Hypothesis 1), the average wages reveal a significant wage gap between domestically- and foreign-owned firms (more than 16% in each of the three years) as well as between small and large firms (10-12% in each year).

Consistent with the worker-learning model, the Table also shows that average wage growth is higher in larger firms (Hypothesis 4). As an example, the difference in wage growth rates between small (<50 employees) and large (>500 employees) firms was 1.0 percentage points in 2001-2, which corresponds to 36% higher annual wage growth in large firms. The difference between foreign-owned firms and domestically-owned firms is, however, much smaller.

Note that the Danish labor market is characterized by a high degree of flexibility as firing costs are extremely low. In that vein, Denmark compares better to US and UK labor markets than to the labor markets of other Continental European countries. At the same time, the Danish welfare state takes care of the unemployed through for example particularly high compensation rates which is why the Danish model is often termed "Flexicurity".

The data also reveal that a considerable amount of individuals flow between foreign- and domestically-owned firms, and between small and large firms, each year. Around 20% of those employed in a foreign-owned firm in a given year move to another firm the following year. Out of these, around two thirds end up in a domestically-owned firm. Of those employed in large (>500 employees) firms, a similar share move to another firm, and here around 1/3 end up in a small firm the following year. This extensive amount of mobility is extremely useful for our subsequent analysis of the foreign- and large-firm wage premiums, as it allows us to identify the premiums from individual workers moving between firms thereby controlling for unobserved (time-invariant) individual differences.

4. Empirical Results

In this section, we test the empirical hypotheses from Table 2.1. First, we test the existence of a wage premium in foreign/large firms, and how much of it that can be explained by differences in observed and unobserved worker characteristics. This relates to Hypotheses 1, 2 and 3 in Table 2.1. Second, we look for more specific evidence of the worker-learning theory by testing whether: (i) wage growth is higher in foreign/large firms (Hypotheses 4 and 5); (ii) subsequent earnings increase with experience from large and foreign-owned firms (Hypothesis 6); and (iii) initial wages are lower in foreign/large firms (Hypothesis 7).

Tables 4.1 and 4.2 present estimates of the wage premium using our short and long panel, respectively. In the short panel, we use a 50% sample drawn at the worker level, while in the long panel, we use a 10% sample also drawn at the worker level. Note that as our measure of firm (or establishment) size, we use the number of employees at the beginning of an individual job-spell. Hence, if worker *i* is observed in the same firm in two (or more) consecutive years, we use the size of the firm in the first year as the measure of firm size for both (all) years.[9] By, alternatively, using current firm size, we may find an effect of firm size simply because growing firms have rising wages and shrinking firms have declining wages. As both versions of our theory are silent on this issue, we wish to eliminate this effect on the estimated wage premium. In other words, we are interested in the wage premium across firms. Thus, the estimated wage premiums in Tables 4.1 and 4.2 are identified from workers switching jobs (and in the OLS regressions also from variation across workers employed in different firms). In this respect, the large observed mobility of workers between firms is extremely useful.

Similarly, the foreign dummy is set to equal one for all observations within a given job-spell if the firm was foreign owned in at least one of the years in the spell. This is done to eliminate effects from firms changing status during a job spell, whether this is due to measurement error or a take-over. Again, as neither of the theories that we compare in this paper has anything to say about the effects of

[9] Alternatively, we could have used the average firm (or plant) size for the years in which the firm is present in the data. It turns out that this yields very similar results.

changes in ownership status, we choose to focus on the cross-sectional variation in the premium.[10]

All regressions include time dummies, three regional dummies and 16 industry dummies. Hence, we are ex-ante eliminating that part of the wage premium which can be ascribed to a different industry or regional pattern of the foreign-owned firms. The appendix contains more details on the variables used in the regressions.

The first two columns in Table 4.1 present OLS estimates of the "raw" wage premiums in foreign and large firms respectively, using the short panel. Both the heterogenous-worker version and the worker-learning version of our theory model predict a wage premium in foreign and/or large firms (Hypothesis 1). We find that foreign-owned firms pay approximately 9% higher wages and that a firm with 100 employees pays wages that are approximately 3.4% higher than in a firm with 10 employees.[11] In sum, Hypothesis 1 is confirmed.

Controlling for both size and ownership as in column 3, we see that both premiums drop somewhat. This is consistent with foreign ownership and firm size both being proxies for the same thing (the type-A firms). However, we do not find that the foreign premium disappears completely as predicted by Hypothesis 2, which is also shared by both theoretical explanations.

Hypothesis 3 differs between the two pure versions of the theory. According to the heterogeneous-worker model, the premiums are entirely due to a different composition of ex-ante heterogenous workers in foreign/large firms than in domestic/small firms. Hence the premium should disappear when controls for worker observables and unobservables are added, whereas the worker-learning theory predicts that a premium should remain.

Now, controlling for observable worker characteristics as in column 4 of Table 4.1 reduces the estimated coefficients on foreign ownership and firm size to 0.069 and 0.009, respectively. Adding individual fixed effects as in columns 5-8 controls for all time-invariant (observed as well as

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[10] Furthermore, measurement errors in the sense that a firm erroneously changes status from one year to the next would tend to bias the estimated foreign wage premium towards zero.

[11] The estimated wage difference can be computed as $(size_1/size_2)^{0.014}$ - 1 where 0.014 is the estimated elasticity from Table 4.1.

unobserved) worker characteristics. Consistent with the worker-learning model, the premiums remain positive albeit lower than in the case without worker fixed effects. Hence, the evidence in relation to Hypothesis 3 is supportive of both theoretical explanations.

Considering how the premium changes as we control for time-invariant worker characteristics should actually give us an estimate of the relative importance of the heterogenous-worker theory in explaining the wage premium. Specifically, comparing the wage premiums in columns 1 and 2 with those in columns 5 and 6 of Table 4.1 gives an estimate of the upper bound for the importance of the heterogenous-worker model in explaining the observed wage premiums. We see that the heterogenous-worker model can explain up to 30% (= (0.014-0.010)/0.014) of the size premium and up to 2/3 (= (0.091-0.034)/0.091) of the wage premium for foreign vs domestic firms. This conclusion is not altered with the inclusion of the time-variant experience measures in column 8.

In Table 4.2, we reach the same conclusions using our long panel. Controlling for time-invariant observed and unobserved worker characteristics can explain approximately 20% (= (0.022-0.018)/0.022) of the establishment size premium. Together, this leaves a significant share to be explained by the worker-learning model (or competing theories).[12]

While a number of other studies (see Section 2) find that the foreign wage premium is reduced when controlling for observable worker characteristics, we are not aware of any other study that analyses how much of the premium that can actually be explained by observable as well as unobservable worker characteristics.[13]

In sum, we find significant evidence of a premium in foreign/large firms consistent with Hypothesis 1 which is common to both theories, although the foreign premium does not vanish when controlling for firm size as predicted by Hypothesis 2. Furthermore, as the premiums are reduced but

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[12] As a further check, we tried to compute the correlation between the estimated individual fixed effects and the firm size and foreign ownership variables and found only very small positive correlation coefficients (in the order of 0.05 - 0.1), providing only weak signs of a sorting of initially better workers into larger/foreign firms.

[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).

not eliminated by controlling for observable and unobservable time-invariant worker characteristics, this is supportive of both theories (Hypothesis 3).

The last four hypotheses discriminate more directly between the empirical implications of the two underlying theories. Hypothesis 4 states that according to the worker-learning model wage growth should be higher in foreign/large firms, while this is not an implication of the heterogenous-worker model. Furthermore, Hypothesis 5 says that the effect of foreign ownership on wage growth should disappear once we control firm size, as size is a better proxy for the unobserved firm type. These hypotheses are investigated in Tables 4.3 and 4.4 which regress annual wage growth within a job-spell (i.e. it is required that the worker is in the same job in two subsequent years) on the same set of explanatory variables as used in Tables 4.1 and 4.2.

For the short panel in Table 4.3, we observe higher wage growth in both foreign and large firms (columns 1 and 2). Furthermore, there does not seems to be higher wage growth in foreign firms once we control for size (columns 3 and 4). These results are thus fully consistent with Hypotheses 4 and 5 for the worker-learning model. The estimated coefficient to firm size in column 3 implies that, *e.g.*, a doubling of firm size should be associated with an increase in the wage growth rate of 0.12 percentage points. With an annual (real) wage growth rate of 2%, this would amount to more than 5% higher wage growth. The long panel (Table 4.4) confirms the higher wage growth in large establishments (columns 1 and 2).

One could argue that the estimated effects in Tables 4.3 and 4.4 may be due to foreign/large firms selecting workers that have more potential for wage growth. One could think of this as an extended version of Yeaple's heterogenous-worker model. According to Hypothesis 4, however, wage growth should still be higher in foreign/large firms when controlling for worker unobservables if the worker-learning story is correct. One way to check this is to include individual fixed effects in the regressions. While this can only be done in the long panel,[14] the results (columns 3 and 4 of Table 4.4)

[14] In the short panel, we only have three years of data. Hence, we can only compute wage growth for at most one job-spell for each worker.do not observe wage changes from different employments for the same individual, as the computation of wage changes requires two consecutive years with the same employer. As a consequence, the foreign/large premiums cannot be identified in

strongly suggest that the wage-growth premium does not reflect large (or foreign) firms selecting "high-growth workers". The estimated coefficient thus increases significantly (by more than 50%) when adding individual fixed effects. Hence, the evidence in relation to Hypotheses 4 and 5 clearly supports the worker-learning model.

While a number of studies have previously dealt with the relationship between ownership or size and wage *levels*, much fewer studies 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.

Hypothesis 6 also differs between the two pure versions of the theory. It states that past experience from foreign/large firms (or establishments) influences current wages positively according to the worker-learning model (V1). Workers with previous experience from large/foreign firms should earn more than workers with experience only from small/domestic firms.

To test this hypothesis, Table 4.5 contains estimates of an extended version of the model in Table 4.2. While columns 1-2 and 4-5 are similar to those in Table 4.2, columns 3 and 6 now also include a measure of total "Experience from large establishments"; i.e. years employed at a large establishment over the entire career. The coefficient to this variable will capture the additional effect of experience (from current as well as previous employments) when experience is from a large establishment. Furthermore, to distinguish between effects from current and previous employments, the columns also include "Large x Tenure", which captures tenure (*i.e.*, the total number of years with the current employer) given that the current establishment is large. A positive coefficient to this latter variable will indicate that large-establishment experience obtained in the current employment relationship has a more positive effect than large-establishment experience obtained in previous employments.

It turns out that while "Experience" in general pays off (around 3% per year), "Experience

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regressions including individual fixed effects.

from large establishments" adds another 1.5% indicating that experience from large establishments is indeed more valuable than experience from small establishments. Furthermore, as the coefficient to "Large x Tenure" is slightly negative, large-establishment experience acquired in previous employments is (at least) as important as large-establishment experience acquired in the current employment. This is strongly supportive of the idea of learning and transferable skills as stated in Hypothesis 6.[15]

Furthermore, these effects are preserved with the inclusion of worker fixed effects (Table 4.5, column 6), and also with the inclusion of establishment fixed effects (results not shown but available from authors upon request). Hence, the effects of previously acquired skills at large establishments are not due to ex-ante "better" workers having more experience from large establishments, and they do not disappear when controlling for current establishment characteristics. Related to this, Martins (2005), Balsvik (2007) and Pesola (2007) also find evidence that previous experience from multinationals pays off in subsequent employment.

Finally, hypothesis 7 states that according to the worker-learning model, wages for inexperienced workers should be lower in foreign/large firms. This can be tested indirectly by looking at the estimated coefficient to the (log of the) establishment size variable in column 3 of Table 4.5. With the various measures for experience and tenure included, this coefficient should reflect the effect of establishment size on the initial wage. As the coefficient is positive, it does not support the pure worker-learning model (V1). The positive coefficient in the OLS regression in column 3 is, however, consistent with the heterogeneous-worker story (V3) and the "mixed" version (V2).

In column 6, we include worker fixed effects. In this case, the coefficient on plant size is identified from comparing (starting wages of) different job spells by the same worker (controlling for the amount of total experience). The fact that it is still positive is, however, not consistent with either of the two pure theories.

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[15] Note also that general experience is not valued more in large firms as the coefficient to "Large x Experience" is zero (slightly negative in column 6, in fact). This is also fully consistent with the worker-learning theory.

In sum, the evidence in relation to Hypotheses 4, 5 and 6 provides considerable support for the worker-learning model as wage growth is higher in foreign/large firms and as skills acquired in these firms are transferable to subsequent employments. The evidence relating to Hypothesis 7 (without worker fixed effects), on the other hand, is only partly supportive of the heterogeneous worker or mixed model, and not the worker-learning model.

6. Summary and Conclusions

The paper is motivated by the interests by both researchers and policy makers in possible beneficial effects of foreign companies on local companies and workers.

Theoretically, we contrast two theories: One that assumes ex-ante worker heterogeneity (the heterogenous-worker model) and one that assumes ex-ante firm heterogeneity (the worker-learning model). Our theoretical model embeds both of these in a relatively simple framework, and we show how both can give rise to a wage premium. The heterogenous-worker model yields a wage premium as more able workers sort into scale intensive firms which are also the international and larger firms. In the worker-learning model, ex-ante identical workers learn more in high-productivity firms which are also larger in equilibrium. Assuming a competitive labor market, we show that a wage premium may then arise due to discounting.

Our basic worker-learning model does not involve “spillovers” as the learning effects become fully internalized by the agents. However, the model is consistent with higher wages for workers with previous experience from foreign firms (which may look like spillovers through worker mobility) and with higher wages in sectors with a larger share of foreign firms. Thus, we provide an explanation for these empirical observations which does not rely on the presence of externalities.

We have particularly well-suited data for analyzing the relative empirical importance of the two theories. First, by having matched employer-employee data, we can control for observable as well as unobservable differences in worker characteristics. Second, by having a long panel, we can analyze the importance of learning both in current and subsequent employment.

We find that while the heterogenous-worker model may explain between 20% and 30% of the

observed wage premium in large firms and about 66% in foreign firms, there is also considerable evidence of the worker-learning model. Worker learning is supported by the findings that wage growth is higher in large firms - also when controlling for unobservable worker characteristics - and that experience from these firms matters positively for wages in subsequent employment. Controlling for firm size reduces the foreign-firm premium by about 15-20% for wage levels and eliminates it for wage growth; results which are consistent, though not completely, with our model, which predicts both should be fully eliminated when controlling for firm size.

Appendix A: Analytical solution

This appendix gives the analytical solution to the model in the case where there is an interior solution in which type-A firms use both types of labor (the number of H-workers is sufficiently small) and both domestic type-A and type-B firms enter.

From (6), our choice of $rs^b = ws^b = 1$ gives us p^b, and then (9) gives us X^b:

$$p^b = \frac{\sigma}{\sigma - 1}, \qquad X^b = (\sigma - 1)FC^b \tag{A1}$$

Wages for S-workers in type-A firms can be solved for from (2), (3), and (10). From (2) and (3), we get:

$$\frac{ws_1^a}{ws_2^a} = \frac{rs_1^a}{rs_2^a} \tag{A2}$$

Using these in (10) gives:

$$ws_1^a = \frac{(1+\delta)rs_1^a}{(rs_1^a + \delta rs_2^a)} = \beta rs_1^a < 1, \qquad ws_2^a = \frac{(1+\delta)rs_2^a}{(rs_1^a + \delta rs_2^a)} = \beta rs_2^a > 1 \tag{A3}$$

where $\beta \equiv \frac{(1+\delta)}{(rs_1^a + \delta rs_2^a)} < 1$ and $rs_2^a > 1/\beta > rs_1^a \geq 1$.

Given that we know ws_1^a from (A3), we can solve for the price of an A-good from (2):

$$p^a = \frac{\sigma}{\sigma - 1}\frac{1+\delta}{(rs_1^a + \delta rs_2^a)} = \frac{\sigma}{\sigma - 1}\beta < p^b \tag{A4}$$

Now we can use (4) and (5) along with (A4) to solve for the high-skilled wages:

$$wh_1^a = \beta rh_1^a > ws_1^a, \qquad wh_2^a = \beta rh_2^a > ws_2^a \tag{A5}$$

Now, divide (14) by (15), and using (A1) and (A4) for the prices, we have:

$$\frac{X^a}{X^b} = \left[\frac{p^b}{p^a}\right]^\sigma = (1/\beta)^\sigma \tag{A6}$$

where $X^a > X^b$, and from (A1):

$$X^a = (\sigma - 1)FC^b(1/\beta)^\sigma \text{ [16]} \tag{A7}$$

Now that we have the price of an A-good from (A4) and the quantity from (A7), we can solve for the number of domestic and foreign type-A firms from (7) and (8):

$$n_d^a = \frac{FC^b}{FC_d^a}(1/\beta)^{\sigma-1}, \qquad n_d^a = \frac{FC^b}{FC_f^a}(1/\beta)^{\sigma-1} \tag{A8}$$

This in turn means that the equilibrium "cutoff" fixed cost for domestic and foreign type-A firms is given in (7) and (8) by:

$$n_d^a FC_d^a = n_f^a FC_f^a = FC^b(1/\beta)^{\sigma-1} > FC^b \tag{A9}$$

Because demand is symmetric and marginal costs are equal for domestic and foreign type-A firms, the cutoff fixed cost is the same, but fewer foreign firms can enter.

Finally, we can check that the type-A firms are not only larger in output relative to B firms, but also in employment. The number of workers in a type-A firm will be between two extremes: one in which there are only S-workers (SH = 0) and one in which the supply of H-workers is large enough to just squeeze out all S-workers (so (A7) remains valid). In each of these cases, we know that the number of workers from each vintage is the same, so that the number of workers in a representative firm is just the total output in (A7) divided by the average productivity of a worker. Let us express this relative to the number of workers in a type-B firm which is just equal to a type-B firm's output in (A1). So for a type-A firm using only S-workers, the number of workers relative to a type-B firm is given by:

$$\frac{X^a/X^b}{(rs_1^a + rs_2^a)/2} = \frac{2}{(rs_1^a + rs_2^a)}\left[\frac{(rs_1^a + \delta rs_2^a)}{1 + \delta}\right]^\sigma \tag{A10}$$

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[16] XS_1^a, XS_2^a, XH_1^a and XH_2^a can be solved from (11)-(13) and (A7).

whereas for a type-A firm using only H-workers, the number of workers relative to a type-B firm is given by:

$$\frac{X^a/X^b}{(rh_1^a + rh_2^a)/2} = \frac{2}{(rh_1^a + rh_2^a)}\left[\frac{(rs_1^a + \delta rs_2^a)}{1 + \delta}\right]^{\sigma} \qquad \text{(A11)}$$

As a check, note that if there is no productivity advantage of S- or H-workers, $rs_i^a = rh_i^a = 1$, then (A10) and (A11) reduce to one as they should.

(A10) and (A11) are messy due to the presence of δ combined with higher second-period productivity. Recall that the expression in brackets must be greater than one and σ >1. *Sufficient* conditions for (A10) to be greater than one (type-A firms have higher employment) are that *either* there is no learning *or* there is no discounting. If δ and σ are small (δ close to zero and σ close to one) and second-period productivity is much higher, then (A10) could be less than one. In addition, (A11) could be less than one if H-workers are much more productive. But even then, employment will be closer to (A10) than (A11) if the number of H-workers is small.

As an example to put this in perspective, with a productivity growth of 33 percent between periods, 33 percent higher productivity for an H-worker in each period relative to an S-worker, an elasticity of σ = 3, and a 50 percent discount factor, a type-A firm will still have twice as many workers even if the work force contains only H-workers.[17]

A final variable in the model, though not of much interest, is the number of domestic type-B firms. This can be solved for from (14) or (15) since everything else in those equations is now known. Note from (A8) that the number of domestic type-A firms does not depend on the number of foreign type-A firms, nor do the prices and X quantity variables in (14) and (15). Taken together, these results imply that the entry of additional foreign firms "crowds out" domestic type-B firms, not type-A firms.

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[17] Specifically, $rs_1^a = 1.5$, $rs_2^a = 2.0$, $rh_1^a = 2.0$, $rh_2^a = 2.667$, $\sigma = 3$, $\delta = 0.5$ implies that employment of a type-A firm is 1.984 times that of a type-B firm if all workers are H-workers, and 2.645 times that of a type-B firm if all workers are S-workers.

With enough foreign firms, domestic type-B firms would disappear entirely, and the average domestic and average foreign firm would be identical.

Appendix B: Definitions of variables used in regressions

Variables available in both panels	
Variable	*Definition*
Hourly wage (continuous variable)	Wages divided by number of hours worked. The number of hours is imputed from mandatory pension payments, which are determined by the number of hours in employment per week. These variable is computed by Statistics Denmark.
Experience (continuous variable).	This variable is a continuous measure of actual labor market experience based on the number of days in employment over the worker's career. Experience is measured in number of years of full time work.
Years of education (count variable)	Scheduled number of years of completed education. Examples: High-school = 12 years; Master degree = 18 years.
Industry (dummy variables)	A full set of industry dummies for 17 industries of the manufacturing and service sectors.
Variables only available in the short panel	
Variable	*Definition*
Foreign (dummy variable).	Takes the value one for workers employed in firms where foreigners ultimately own more than 50% of the firm, and FDI amounts to more than DKK 10 million. Zero otherwise.
Firm size (count variable).	The average number of full-time employees (within a year) in the firm where the individual is employed. The firm is defined as the legal entity which employs the worker.
Variables only available in the long panel	
Variable	*Definition*
Establishment size (dummy variable).	The number of employees in the last week of November at the establishment where the individual is employed. An establishment is defined by its address.
Tenure (count variable)	The number of years employed at the current establishment. Tenure is reset to zero when the individual changes establishment.
Large (dummy variable)	Takes the value one for workers employed at establishments with more than 50 employees. Zero otherwise. The dummy variable *Large* is then interacted with *Experience* and *Tenure*.
Experience from large establishments (count variable)	Total number of years of employment at establishments with more than 50 employees, measured from the beginning of the individual's career to the current date.

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Table 2.1: Theoretical predictions, empirical results

N.B. all results are the same for large firm and foreign firms, so they are not broken out separately.

Simulation model version:

V1:	pure learning model:	no H workers, learning
V2:	mixed model:	"large" number of H workers, learning
V3:	pure selection model:	H workers present, no learning

E: empirical results

	V1	V2	V3	E
Hypothesis 1:				
Average wage level higher in large/foreign firms	Yes	Yes	Yes	
Empirics: Column 1 of Tables 4.1 and 4.2				Yes
Hypothesis 2:				
Foreign firm effect on average wage level disappears when controlling for firm size	Yes	Yes	Yes	
Empirics: Column 2 versus 3 in Table 4.1				No[18]
Hypothesis 3:				
Wages higher in foreign/large firms after controlling for time-invariant worker observables/unobservables	Yes	Yes	No	
Empirics: Tables 4.1 and 4.2				Yes
Hypothesis 4:				
Wage growth higher in foreign/large firms also after controlling for worker characteristics	Yes	Yes	No	
Empirics: Tables 4.3 and 4.4				Yes
Hypothesis 5:				
Foreign firm effect on wage growth disappears when controlling for firm size	Yes	Yes	NA[19]	
Empirics: Column 2 versus 3 in Table 4.3				Yes
Hypothesis 6:[20]				
Past experience from foreign/large firms important for current wages, also when controlling for worker characteristics	Yes	Yes	No	
Empirics: Columns 3 and 6 in Table 4.5				Yes
Hypothesis 7:				
Wage for inexperienced workers lower in foreign/large firms	Yes	No	No	
Empirics: Implicit in Tables 4.2 and 4.5 (see text)				No

[18] Foreign firm effect falls by 15-20% when controlling for firm size, but remains significant.

[19] NA: not applicable; no foreign-firm effect predicted with or without firm-size control.

[20] Due to space limitations, we do not formally model workers switching firm type in our theory section, but hypothesis 6 is supported by the theory.

Table 3.1: Firm Types and Employment

	Absolute numbers					
	2000		2001		2002	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Firm Size (# employees)			Firms			
0-49	241,946	1,966	240,393	2,037	237,605	2,119
50-499	2,632	573	2,631	579	2,586	564
500+	195	58	194	52	186	55
Total	244,773	2,597	243,218	2,668	240,377	2,738
			Employment			
0-49	551,159	23,245	543,985	23,738	537,882	24,250
50-499	302,658	84,765	304,132	88,435	299,516	86,621
500+	322,316	74,561	321,540	75,598	298,222	84,360
Total	1,176,133	182,571	1,169,657	187,771	1,135,620	195,231

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

Table 3.2: Firm Types, Average Wages and Wage Growth

	Average wages			Wage growth	
	2000	2001	2002	2000-1	2001-2
Domestic	174.89	183.02	186.93	5.0%	3.2%
Foreign	203.77	212.33	218.32	5.0%	3.3%
Small (0-49)	167.68	175.62	178.75	4.8%	2.7%
Medium (50-499)	186.13	194.70	199.68	5.0%	3.5%
Large (500+)	185.41	193.98	199.93	5.2%	3.7%

Note: The table includes all full-time workers in the private sector, aged 20-65 years. The division of firms into size classes is based on the average number of employees over the year. Average wages are hourly wages in DKK.

Table 4.1: Firm Type and Wage Levels (short panel)

	Dependent variable: log(hourly wage)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	Indv. FE	Indv. FE	Indv. FE	Indv. FE
Log(firm size)	0.014		0.012	0.009	0.010		0.010	0.009
	(0.00014)**		(0.00015)**	(0.00013)**	(0.00019)**		(0.0002)**	(0.00019)**
Foreign		0.091	0.077	0.069		0.034	0.027	0.027
		(0.00083)**	(0.00084)**	(0.00072)**		(0.00102)**	(0.00104)**	(0.00103)**
Age				0.039				
				(0.00027)**				
Age^2				-0.0005				
				(0.000003)**				
Experience				0.016				0.053
				(0.00015)**				(0.00124)**
$Experience^2$				-0.0002				-0.0010
				(0.000004)**				(0.000008)**
Years of education				0.050				
				(0.00013)**				
Female				-0.191				
				(0.00055)**				
Observations	1,546,933	1,555,378	1,546,932	1,526,776	1,546,933	1,555,378	1,546,932	1,546,932
Number of individuals					632,460	634,662	632,460	632,460
R-squared	0.13	0.13	0.14	0.37	0.09	0.09	0.09	0.11

Note: The table is based on a panel from 2000-2002. The panel includes a 50% sample of all workers in the manufacturing and service industries drawn randomly at the worker level. All workers are aged 20-65. Foreign=1 for workers employed in firms where foreigners ultimately own more than 50% of the firm, and FDI amounts to more than DKK 10 million – in at least one year during a job spell. Firm size refers to the number of full-time employees in the first year of a job spell. Time-, regional- and industry- effects are included in all regressions. The reported R-squared for the fixed effects regressions are based on the demeaned regression (i.e. after removing the fixed effects). Standard errors are in parentheses (robust for OLS results). * significant at 5%; ** significant at 1%.

Table 4.2: Establishment Size and Wage Levels (long panel)

	Dependent variable: log(hourly wage)			
	(1)	(2)	(3)	(4)
	OLS	OLS	Indv. FE	Indv. FE
Log(establishment size)	0.022	0.018	0.018	0.016
	(0.00035)**	(0.00031)**	(0.00041)**	(0.0004)**
Age		0.062		0.125
		(0.00053)**		(0.00075)**
Age^2		-0.001		-0.001
		(0.000007)**		(0.000008)**
Experience		0.033		0.027
		(0.00032)**		(0.00048)**
$Experience^2$		-0.001		-0.001
		(0.000012)**		(0.000015)**
Tenure		0.018		0.007
		(0.00047)**		(0.00049)**
$Tenure^2$		-0.001		-0.001
		(0.000034)**		(0.000037)**
Years of education		0.041		
		(0.00024)**		
Female		-0.157		
		(0.00101)**		
Observations	706,713	706,713	706,713	706,713
Number of individuals			116,741	116,741
R-squared	0.25	0.42	0.38	0.41

Note: The table is based on a panel from 1981-2003. The panel includes a 10% sample of all workers in the manufacturing and service industries drawn randomly at the worker level. All workers are aged 20-65 and entered the Danish labor market in 1981 or later. Establishment size refers to the number of full-time employees at the establishment in the first year of a job spell. Time-, regional- and industry- effects are included in all regressions. The reported R-squared for the fixed effects regressions are based on the demeaned regression (i.e. after removing the fixed effects). Standard errors are in parentheses (robust for OLS results). * significant at 5%; ** significant at 1%.

Table 4.3: Firm Type and Wage Growth (short panel)

	Dependent variable: dlog(hourly wages)			
	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	OLS
Log(firm size)	0.16		0.17	0.17
	(0.009)**		(0.009)**	(0.009)**
Foreign		0.12	-0.06	-0.08
		(0.048)*	(0.049)	(0.049)
Age				-0.64
				(0.021)**
Age^2				0.006
				(0.0002)**
Experience				-0.09
				(0.012)**
$Experience^2$				0.002
				(0.0003)**
Years of education				0.08
				(0.009)**
Female				0.34
				(0.038)**
Observations	753,648	756,036	753,647	745,174
R-squared	0.01	0.01	0.01	0.02

Note: All coefficients are multiplied by 100. The table is based on a panel from 2000-2002. The panel includes a 50% sample of all workers in the manufacturing and service industries drawn randomly at the worker level. All workers are aged 20-65 and worked in the same establishment the year before. Foreign=1 for workers employed in firms where foreigners ultimately own more than 50% of the firm, and FDI amounts to more than DKK 10 million – in at least one year during a job spell. Firm size refers to the number of full-time employees in the first year of a job spell. Time-, regional- and industry-effects are included in all regressions. Standard errors are in parentheses (robust for OLS results). * significant at 5%; ** significant at 1%.

Table 4.4: Establishment Size and Wage Growth (long panel)

	Dependent variable: dlog(hourly wages)			
	(1) OLS	(2) OLS	(3) Indv. FE	(4) Indv. FE
Log(establishment size)	0.24 (0.026)**	0.20 (0.026)**	0.34 (0.051)**	0.35 (0.051)**
Age		-1.29 (0.042)**		-1.75 (0.082)**
Age^2		0.01 (0.0006)**		0.02 (0.0008)**
Experience		0.37 (0.029)**		0.08 (0.056)**
$Experience^2$		-0.0124 (0.0009)**		0.0001 (0.0014)
Tenure		0.47 (0.039)**		0.46 (0.053)**
$Tenure^2$		-0.032 (0.0023)**		-0.029 (0.0035)
Years of education		0.38 (0.019)**		
Female		-0.40 (0.084)**		
Observations	397,686	397,686	397,686	397,686
Number of individuals			83,041	83,041
R-squared	0.01	0.02	0.02	0.02

Note: All coefficients are multiplied by 100. The table is based on a panel from 1981-2003. The panel includes a 10% sample of all workers in the manufacturing and service industries drawn randomly at the worker level. All workers are aged 20-65, entered the Danish labor market in 1981 or later and worked in the same establishment the year before. Establishment size refers to the number of full-time employees at the establishment in the first year of a job spell. Time-, regional- and industry- effects are included in all regressions. The reported R-squared for the fixed effects regressions are based on the demeaned regression (i.e. after removing the fixed effects). Standard errors are in parentheses (robust for OLS results). * significant at 5%; ** significant at 1%.

Table 4.5: Previous Establishment Size and Wage Levels (long panel)

	Dependent variable: log(hourly wage)					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	Indv. FE	Indv. FE	Indv. FE
Log(establishment size)	0.022	0.018	0.017	0.018	0.016	0.019
	(0.00035)**	(0.00031)**	(0.00045)**	(0.00041)**	(0.0004)**	(0.00053)**
Age		0.062	0.059		0.125	0.121
		(0.00053)**	(0.00054)**		(0.00075)**	(0.00077)**
Age^2		-0.001	-0.001		-0.001	-0.001
		(0.00001)**	(0.00001)**		(0.00001)**	(0.00001)**
Experience		0.033	0.031		0.027	0.027
		(0.00032)**	(0.00041)**		(0.00048)**	(0.00054)**
Experience^2		-0.001	-0.001		-0.001	-0.001
		(0.00001)**	(0.00002)**		(0.00001)**	(0.00002)**
Tenure		0.018	0.017		0.007	0.005
		(0.00047)**	(0.00069)**		(0.00049)**	(0.00068)**
Tenure^2		-0.0011	-0.0009		-0.0008	-0.0004
		(0.00003)**	(0.00005)**		(0.00004)**	(0.00005)**
Female		-0.157	-0.158			
		(0.00101)**	(0.00101)**			
Years of education		0.041	0.040			
		(0.00024)**	(0.00024)**			
Experience from large establishments			0.015			0.016
			(0.00053)**			(0.0007)**
(Experience from large estab.)^2			-0.0005			-0.0009
			(0.00004)**			(0.00004)**
Large x Tenure			-0.005			-0.002
			(0.001)**			(0.00102)**
Large x Tenure^2			-0.0002			-0.0002
			(0.00007)**			(0.00008)**
Large x Experience			-0.003			-0.004
			(0.00045)**			(0.00048)**
Large x Experience^2			0.00002			0.00013
			(0.00002)			(0.00002)**
Observations	706,713	706,713	706,713	706,713	706,713	706,713
Number of individuals				116,741	116,741	116,741
R-squared	0.25	0.42	0.42	0.38	0.41	0.41

Note: The table is based on a panel from 1981-2003. The panel includes a 50% sample of all workers in the manufacturing and service industries drawn randomly at the worker level. All workers are aged 20-65 and entered the Danish labor market in 1981 or later. Establishment size refers to the number of full-time employees at the establishment in the first year of a job spell. Large =1 for workers employed in firms where Establishment size > 50 in the first year of the job spell. Time-, regional- and industry- effects are included in all regressions. The reported R-squared for the fixed effects regressions are based on the demeaned regression (i.e. after removing the fixed effects). Standard errors are in parentheses (robust for OLS results). * significant at 5%; ** significant at 1%.