Foreign Firms, Domestic Wages

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Abstract

Foreign-owned firms are often hypothesized to generate productivity "spillovers" to the host country, but both theoretical micro-foundations and empirical evidence for this are limited. We develop a heterogeneous-firm model in which ex-ante identical workers learn from their employers in proportion to the firm's productivity, and foreign-owned firms have, on average, higher productivity in equilibrium due to entry costs: low-productivity foreign firms cannot enter. Foreign firms have higher wage growth and, with some exceptions, pay higher average wages, but not when compared to similarly large domestic firms. In the second part of the paper, we provide empirical estimates of the characteristics of the learning processes as well as the degree of transferability of the foreign technology to subsequent wage and self-employment using Danish data. The effects of experience in foreign-owned firms is clearly beneficial on wage levels, wage growth, and subsequent wage and self-employment earnings. These effect are, however, significantly reduced and but generally not eliminated when controlling for firm size, results which are largely consistent with our model.

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1. Introduction

The last decades have witnessed a significant increase in the amount of foreign direct investment (FDI) and the activities of multinational enterprises (MNEs). This has led to considerable academic and political interest in the role of FDI an MNEs for both source and host countries. One aspect of this concerns the potential for FDI and MNEs as important channels for productivity transfers to host countries. MNEs are hypothesized to possess superior knowledge, better production technology or management techniques compared to the average domestic firm.

However, the microeconomic foundations of these ideas are weak, and empirical analysis is limited and indirect. In this paper, the productivity advantages of foreign firms are assumed to affect domestic workers directly. We assume that firms have different productivity levels, and that workers learn more (increase their productivity more) when they are employed by higher productivity firms. Similarly, they earn more in self-employment if they had previously worked for a high-productivity firm.

Our model builds on Melitz's (2003) model of industry structure with heterogeneous firms, and blends this with the learning-on-the-job models of Ethier and Markusen (1996), Markusen (2001), Fosfuri et. al. (2001), and Glass and Saggi (2002). Small numbers of domestic and foreign firms get high productivity "draws" and a potentially unlimited number of other domestic and foreign firms get low productivity draws. Foreign firms of both types face higher fixed costs of entry. All high-productivity firms can enter, but only low-productivity domestic firms can enter: they enter until profits are zero, which excludes the foreign low-productivity firms due to the latter's higher fixed costs.

The consequence of this is that foreign firms *on average* are larger and have higher productivity than domestic firms on average. But it also provides the hypothesis that,

corrected for firm size, foreign firms are not more productive than domestic firms.

Our model does not rely on externalities or on foreign firms identifying and hiring better workers. All workers are ex ante identical and earn the same present value of income over a two-period working lifetime. Skills learned in the first period when employed by a high-productivity firm are transferable to other high-productivity firms and, to a less degree, to low-productivity firms. There is thus no ex post hold-up problem as in Antrás (2003): workers in the second period of their career are paid their full productivity, but first period workers joining high-productivity firms receive a discounted wage reflecting their later higher earnings in wage work or self-employment.

The model allows us to solve for outputs, wage levels and wage growth in high and low-productivity firms, and in domestic and foreign firms. In the base case, workers joining high-productivity firms receive a higher average wage and wage growth over their careers, but a lower initial wage. But the foreign-firm effect disappears when correcting for firm size.

Then we conduct some experiments. Increasing the productivity of a worker who transits from a high to a low productivity firm or increasing the probability of getting a favorable draw on suitability for self-employment *lowers* the average wage premium for workers in high-productivity firms and that premium can go *negative*. Thus the model does not trivially produce a result that workers in high-productivity or foreign firms earn more.

Imposing a minimum wage which prevents high-productivity firms from capturing rents on inexperienced workers or imposing a progressive income tax *raises* the average earnings of workers in high-productivity (larger) and foreign firms relative to those for low-productivity (smaller) and domestic firms.

The empirical section of the paper matches data on individual Danish workers with firm-level information about size, foreign ownership, and industry. Results are as follows.

(1) There is a significant wage premium for working in a foreign firm. This is significantly reduced, but not eliminated, by controlling for firm size. It is further reduced by controlling for other observable worker characteristics, while the coefficient on firm size is not.

(2) Wage growth within job spells is significantly higher in larger firms. Wage growth within job spells is not greater in foreign firms when controlling for firm size.

(3) Current wages are higher for workers previously employed in larger or foreign firms. The value of previous experience in foreign firms is significantly reduced, but not eliminated, by controlling for firm size.

(4) Earnings of newly self-employed are significantly higher if the previous employer was foreign or large. The effect of foreign-firm experience is significantly reduced, but not eliminated, by controlling for firm size.

In summary, many of the hypotheses advanced by the simple model are verified in the estimations. One difference is that empirically, wage *levels* and self-employment earnings in foreign firms are still greater than in domestic firms when controlling for firm size, though the difference is greatly reduced from estimates that do not control for firm size. Consistent with the simple model, however, wage *growth* in foreign firms is not greater when controlling for firm size. We comment on this residual positive effect of foreign firms in the concluding section.

2. Some Relevant Literature

Empirically, it is a well-established fact that foreign-owned firms (or multinational enterprises (MNEs) more generally) pay higher wages on average than domestically-owned firms. Existing studies can be grouped under two headings: (i) studies based on firm-level

data, as in, e.g., Feliciano and Lipsey (1999) and Aitken et al. (1996); and (ii) studies based on matched employer-employee data, as in Martins (2004) and Heyman et al. (2004). The advantage of using matched employer-employee data is that it can be explicitly analyzed whether part of the wage differential can be attributed to individual differences among the employees.

While a number of studies have shown that part of the overall "wage-gap" between foreign-owned and domestically-owned firms can be attributed to a higher average quality of workers in foreign-owned firms, a considerable part can only be explained by different firm characteristics than the average domestically-owned firm. Hence, the existing evidence points to a productivity advantage in foreign-owned firms which is somehow transformed into higher wages of the employees; see Lipsey (2002) for a recent review.

A number of studies have also analyzed how these productivity and wage advantages have influenced the productivity and/or wages of other firms, se, e.g., Haddad and Harrison (1993), Haskel et al. (2002), Almeida (2003), and Javorcik (2004). While we consider the productivity transfers that occur from foreign-owned firms to domestic firms via worker mobility and entrepreneurship, the empirical literature has to a large extent concentrated on wage and productivity transfers and spillovers *between* firms; see Lipsey (2002) for a review. While a positive effect has been found in the case of firm-to-market spillovers (higher average wages), the evidence is more mixed when it comes to firm-to-firm spillovers. However, studies of productivity spillovers between plants within industries have generally found positive effects of foreign-owned companies, see Lipsey (2002).

Only few empirical studies have analyzed productivity transfers via worker mobility, see Martins (2005) and Görg and Strobel (2005), and only the latter, using data from Ghana, considers transfers via worker mobility to self-employment.

Similarly, very few studies have tried to provide a theoretical foundation for such productivity transfers. Glass and Saggi (2002) thus build a model where workers employed by MNEs immediately get access to their superior technology. Hence, MNEs must pay a wage premium to prevent workers from moving 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 get access to the superior technology following a period of training by the MNE. Hence, workers are not immediately paid a higher wage in MNEs. In both types of models, however, productivity transfers arise when workers employed (and trained) by MNEs move to domestic firms. Markusen and Trofimenko (2005) provides a more explicit model of skill transfer from foreign experts to domestic workers. Specifically, they assume that working with foreign experts is an alternative to studying as a means of obtaining skills.

As a final point, we should mention Yeaple (2005) who provides an alternative to the Meltiz framework that we borrow here. Yeaple assumes that firms are ex ante identical while workers are not (both opposite to the present paper) and that there are alternative technologies to choose from. In general equilibrium, some firms choose technologies that make then larger and they pay higher wages because they hire more skilled workers. These larger firms are also the exporters (easy generalize to establishing subsidiaries). It strikes us that this alternative approach generates at least some predictions close to ours, and clearly deserves empirical investigation.

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

A principal objective of this theory section is to develop a plausible model that, at least in some circumstances, generates (1) higher average earnings in larger and/or foreign-

owned firms, (2) a steeper earnings profile for the average worker in larger or foreign-owned firms, and (c) newly self-employed workers earn more, on average, if they previously worked in a larger and/or foreign-owned firm. But we want to generate these results while assuming that (a) all workers are ex ante identical (foreign firms are not merely selecting the best workers) and (b) foreign firms are not arbitrarily more productive than domestic firms. The model will draw heavily on the contribution of Melitz's (2003) model of industry structure with heterogeneous firms with monopolistic competition. This is combined with a learn-on-the-job model of Markusen (2001).

We are attempting to keep the model relatively simple, and so will make a number of restrictive assumptions.

(1) There are two types of domestic and foreign firms: high productivity (HP) firms and moderate productivity (MP) firms that produce differentiated goods, denoted X. Foreign firms face an added fixed cost of entering a foreign market with a subsidiary.[1]

(2) An unlimited number of domestic and foreign firms take productivity draws. A small number in each country draw high productivity, the rest all draw moderate productivity. Note that this avoids a more ad hoc assumption that foreign firms are inherently better.

(3) The number of high productivity firms is sufficiently small and/or the domestic market is sufficiently large, such that all high productivity foreign and domestic firms can enter the domestic market.

(4) The "residual" demand is then satisfied by a limited number of moderate-productivity domestic firms entering up to the point where a zero-profit condition holds for

[1]We originally called the MP firms LP for low productivity. But a lower-case L is confused with the number 1 in the notation, so we switched. The MP terminology is consistent with the Lake Woebegone principle that "all children are above average".

moderate-productivity domestic firms. Foreign moderate-productivity firms cannot enter in competition with the domestic moderate-productivity firms: the former face the fixed cost.

(7) 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 decision or any other intertemporal features except that MP firms decide whether or not to enter in a given period. Thus we can analyse a single period in this "steady-state" environment.

(8) The model also has a quasi-overlapping-generations feature. Each worker has a two-period career, and they begin their careers as identical inexperienced workers. Workers who join MP firms do not improve their productivity over time while workers who join HP firms have both higher productivity in their first period and learning results in an even 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 new workers are indifferent between joining MP and HP firms.

(9) We allow workers to transit from a HP to an MP firm (the opposite transition possibility did not seem to add anything interesting so we dropped it). They have a lower productivity than if they stay in the HP firm but a higher productivity than new workers or workers with one period in an MP firm (who do not learn).

(10) In the second period of their careers, workers take a draw which determines whether they will be good or bad as self-employed entrepreneurs in period 2. Among workers who get favorable draws, those who worked in HP firms will have a higher productivity than those who worked in MP firms.

(11) Finally, the model is largely partial equilibrium. There is an unlimited supply of new workers available at a fixed wage, and a given worker disappears after two periods. Expenditure on X goods is fixed, and those who go to self-employment disappear off to

another industry. Both the exogenous number of HP and the endogenous number of MP firms hire experienced and inexperienced workers in a competitive market. The steady-state or stationarity assumption is that the number of experienced workers available is equal to the number of inexperienced workers hired by HP firms.

Our notation is as follows.

r_i^h - labor productivity (in physical units of X output) in HP firms, where i = 1 is an inexperienced worker and i = 2 is an experienced worker. Workers in MP firms do not learn and their productivity in both periods is normalized to $r_i^m = 1$.

r_t^m A worker with one-period of experience in an HP firm can transit to an MP firm, with r_t^m denoting that worker's productivity. We assume that $1 < r_t^m < r_2^h$. In other words, a worker transiting from an HP firm to an LP firm carries only part of the HP firm's productivity advantage with him/her. This will be a variable and discussed more below.

w_i^h - wage of an inexperienced worker (i = 1) and an experienced worker (i = 2) in an HP firm. If there are transiting workers, they are indifferent in equilibrium to transiting and so a worker employed by an HP firm in period 1 earns w_2^h in period 2 regardless of whether the worker is in an HP firm or transits to an MP firm.

n_d^h, n_f^h - number of HP firms of domestic (d) and foreign (f) origin respectively. These are *constants* (all existing HP firms can enter).

n^m - number of MP firms, determined by free entry. This is a *variable.*

p^h - price of a representative differentiated good produced by an HP firm.

p^m - price of a representative good produced by an MP firm.

X_1^h, X_2^h Outputs of an HP firm produced by inexperienced and experienced workers.

X^m, X_t^m Outputs of an MP firm produced by (first or second period) inexperienced workers and produced by transit workers from HP firms respectively.

α - the share of workers who, at the beginning of period 2 of their career, learn that they have a higher productivity as self-employed

ν - multiplier on the wage of an experienced worker that gives self-employment earings in period 2 for workers who get a favourable draw on self-employment productivity (e.g., self-employment earnings are $w_2^h * \nu$ for a worker from a H firm).

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 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 good i (k) 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 high-productivity firm, whether foreign or domestic, is determined by marginal revenue product equal the wage. Outputs by experienced and inexperienced workers are identical (homogeneous), but these worker types differ by productivity. There are two first-order conditions for output from inexperienced workers (X_1^h) and for output from experienced workers (X_2^h). 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 from inexperienced and experienced workers followed by associated complementary variables are given by

$$p^h\ (1 - 1/\sigma) r_1^h \ \le\ w_1^h \qquad X_1^h \tag{2}$$

$$p^h\ (1 - 1/\sigma) r_2^h \ \le\ w_2^h \qquad X_2^h \tag{3}$$

MP firms can hire inexperienced workers, including those who have already been employed by a MP firm for one period (no productivity increase) and transit workers from HP firms. The latter must be paid the wage w_2^h.[2] Similar to equations (2) and (3), the two pricing equations and complementary quantity variables are

$$p^m\ (1 - 1/\sigma) \ \le\ 1 \qquad X^m \tag{4}$$

$$p^m\ (1 - 1/\sigma) r_t^m \ \le\ w_2^h \qquad X_t^m \tag{5}$$

Assume that the fixed costs for MP firms require F^m number of inexperienced workers at wage = 1 or F^m/r_t^m number of transit workers at wage w_2^h. When there are transit workers in equilibrium, (4) and (5) imply that $w_2^h/r_t^m = 1$ and so fixed costs for MP firms are always given by F^m regardless of whether or not there are transit workers, and the firm is indifferent between the two types. Given this indifference, we assume that different worker types are used in proportion to their overall contributions to the output of the firm.

Fixed costs for domestic and foreign HP firms require F_d^h/r_1^h and F_f^h/r_1^h units of inexperienced workers respectively at a wage of w_1^h, or F_d^h/r_2^h and F_f^h/r_2^h units of

[2]The reason that MP firms may employ transit workers at wage w_2^h even though they have lower productivity than when continuing to work in HP firms is that the latter are larger and hence have lower equilibrium prices $(p^h < p^m)$.

experienced workers at a wage of w_2^h. By virtue of (2) and (3), the firm is indifference between using inexperienced and experienced workers and, given this indifference, we assume that the two types are used in proportion to their overall contributions to output of the firm. $F_f^h > F_d^h$ and we rather arbitrarily assume that $F_d^h/r_1^h = F^m$.

Turning now to wages of HP workers, the wage of second period experienced workers will be determined by a supply = demand relationship. Stationarity requires that the number of workers used in HP firms in the first period of their careers, minus losses to self-employment, equal the demand for experienced (second period) HP workers by HP firms and by MP firms hiring transit workers. To incorporate our assumptions about fixed costs, let

$$s_t^m = X_t^m/(X_t^m + X^m) \tag{6}$$

be the proportion of transit workers in the total employment of MP firms. Let

$$s_1^h = X_1^h/(X_1^h + X_2^h) \qquad s_2^h = X_2^h/(X_1^h + X_2^h) \tag{7}$$

be the share of experienced and inexperienced workers in HP firms. The stationarity relationship determines w_2^h.

$$w_2^h \tag{8}$$
$$(1-\alpha)[n_d^h(s_1^h F_d^h/r_1^h + X_1^h/r_1^h) + n_f^h(s_1^h F_f^h/r_1^h + X_1^h/r_1^h)] \geq$$
$$n_d^h(s_2^h F_d^h/r_2^h + X_2^h/r_2^h) + n_f^h(s_2^h F_f^h/r_2^h + X_2^h/r_2^h) + n^m(s_t^m F^m/r_t^m + X_t^m/r_t^m)$$

where the left-hand side is the use of inexperienced workers by HP firms minus losses to self-employment and hence "supply" of second-period experienced workers. The right-hand side is demand for second-period experienced workers by HP and MP firms.

Working backwards, the first-period wage for workers hired by HP firms will be given by a condition that the entering worker is indifferent over his or her two-period career

to being hired by a HP firm or a MP firm. Note that if $w_2^h > 1$, this in turn implies that the first-period HP workers will accept a wage $w_1^h < 1 = w^m$. The indifference condition takes into account the expected value of a good self-employment draw (probability α).

$$w_1^h \geq 1 - \delta(1-\alpha)(w_2^h - 1) - \delta\alpha(w_2^h v - v) \qquad w_1^h \tag{9}$$

As noted earlier, we assume free entry and exit of MP firms gives us a zero-profit condition, where the complementary variable is the number of firms active in equilibrium.

$$p^m X^m + p^m X_t^m \leq F^m + X^m + w_2^h X_t^m / r_t^m = F^m + X^m + X_t^m \qquad n^m \tag{10}$$

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

$$X_1^h + X_2^h = (p^h)^{-\sigma}\left[(n_d^h + n_f^h)(p^h)^{1-\sigma} + n^m(p^m)^{1-\sigma}\right]^{-1} I \qquad p^h \tag{11}$$

$$X^m + X_t^m = (p^m)^{-\sigma}\left[(n_d^h + n_f^h)(p^h)^{1-\sigma} + n^m(p^m)^{1-\sigma}\right]^{-1} I \qquad p^m \tag{12}$$

Finally, consider the productivity of a transit worker r_t^m. If this is fixed, the model has a bang-bang property with respect to the productivity of transiting workers (at some critical value all experienced workers go to MP firms and HP firms employ only inexperienced workers). In order to smooth this, we assume that r_t^m is a decreasing function of the share of transit workers in the workforce of MP firms. The idea is the first HP worker hired has a big effect on productivity, but subsequent workers are less able to exploit their skills in low-tech production. Our final equation thus gives the productivity of a transit

worker as

$$r_t^m = \gamma + \rho(1 - s_t^m) \qquad (\gamma + \rho) > 1 \qquad r_t^m \tag{13}$$

γ is then the minimum productivity of a transit worker, taken on if all workers in MP firms are transit workers (this never happens in our simulations). $(\gamma + \rho)$ is the maximum productivity, attained for the first transit worker employed, assumed strictly greater than one as noted earlier, the latter being the productivity of an inexperienced worker.

Our model given by (2)-(13) thus constitutes thirteen non-linear inequalities (there are two equations in (7)) in thirteen non-negative variables. We solve this model analytically in the appendix to the paper. But in what follows from this point, we will just report some simulation results using the non-linear complementarity solver in GAMS, working directly with (2) - (13).

Before looking at some numerical outcomes, let us quickly summarize some general results. We do not think that these depend on the specific parameter values chosen (except of course they do depend on the inequality assumptions among parameters), but we can have no general proof in this regard. Most of these are shown analytically in the appendix.

(1) HP firms are bigger than MP firms in equilibrium both in terms of physical output and in value terms; the value difference is smaller, since the HP firm's higher output commands a lower price in equilibrium. Productivity differences are amplified in output and value difference, so a 75% productivity advantage generates about 350% more output and about 175% more value (revenue) depending on other parameters.

(2) HP firms pay a lower wage in the first period and a higher wage in the second period relative to MP firms. Obviously, the wage profile over time is steeper in a HP firm than in a MP firm. Higher wages paid to experienced workers in HP firms are not due to

selection, but to higher learning within the HP firm.

(3) In our base cases, HP firms pay a higher average wage to its work force than MP firms, due to discounting. (In our numerical solutions, we use a high discount rate motivated by the view that one-period of the worker's career may be at least ten years.) However, this is not a general result, and it can be reversed by high equilibrium transit rates and high self-employment opportunities. These alter the composition of experienced and inexperienced workers in HP firms and so alter the average wage.

(4) Foreign firms will be observed to pay a higher average wage than domestic firms. However, this is due to the composition of the two groups, with domestic firms' wages being an average of those in low and high-productivity firms.

(5) Combining this with finding (1), it follows that, corrected for firm size, foreign firms do not pay experienced workers more than (large) domestic firms. Similarly, the higher wage to experienced workers in large firms is not due to selection, but to the fact that firm size is just a reflection of productivity.

(6) It follows directly from the assumption that self-employment earnings are greater for a worker previously employed by an HP firms than by an MP firm that self-employed workers with a background in larger or (uncorrected for size) foreign firms earn more.

We now turn to some simulations, first presenting a "base" case, in which there is no self-employment and no transiting workers. Key parameter values are as follows:

Self-employment probability:	$\alpha = 0.0$
Discount factor:	$\delta = 0.5$
Elasticity of substitution among varieties:	$\sigma = 3.0$
Income level (picked to given $n^m = 50$):	$I = 116.6667$
Fixed costs	$F^m = F_d^h = 0.5 \qquad F_h^f = 0.6$
Exogenous number of HP firms:	$n_d^h = n_f^h = 5.0$
Productivity multiplier in self-employment	$v = 1.2$
Normalized wages in MP firms:	$w_1^m = w_2^m = 1$

Productivities: $r_1^h = 1.5$ $r_2^h = 2.0$

$r_1^m = 1.0$ $r_2^m = 1.0$

$\gamma = 0.94$ $\rho = 0.25$;[3]

Tables 3.1-3.4 present results. The first column is identical in all simulations, and this is our benchmark solution. HP firms have a higher average wage and higher wage growth (calibrated to zero growth for MP firms). The higher average wage is due entirely to discounting in this case. The output of an HP firm is 4.63 times the output of an MP firm. Income was picked so that the benchmark number of MP firms is 50.

Table 3.1 presents simulations that gradually increase γ with the initial (endogenous value) of r_t^m given by 1.19 from (12) (ρ is set at 0.25 in equation (12)). Raising γ makes it more attractive for MP firms to hire workers who have spent one period in HP firms. Fixed values of MP wages, income and so forth give the model a critical value of $r_t^m = 1.2$ at which workers start to "defect" to MP firms. They would all jump at a higher value, and hence our formulation in (12) above "smooths" this. As indicated in the top two lines of Table 3.1, increases in γ are just offset by a falling share of continuing MP workers (rising share of transiting workers) and so r_t^m stays constant at 1.2 until all experienced HP workers are hired away (we don't run the values out that far in the table, but it can happen).

Table 3.1 shows that the increased productivity of transit workers does not affect wages in HP firms or wage growth of a given worker. However, it does affect the *average wage* paid by HP firms, because there are a lower and lower proportion of experienced workers in these firms. The bottom row of the Table indicates the share of first-period HP

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[3] $r_t^m = 1.19 = 0.94 + 0.25$ is then the initial calibrated value of the transit productivity.

workers who transit to MP firms. At some point, the average wage paid by foreign firms falls *below* the wage (=1) paid by domestic firms. HP firms become "nurseries" where inexperienced workers learn skills that they take to MP firms. These results emphasize that the model by no means trivially produces an outcome in which average wages are higher in HP or foreign firms versus domestic firms, but wage growth and wages corrected for experience continue to be higher in HP firms (and hence the average foreign firm).

Table 3.2 conducts an experiment in which the probability of a favorable draw on self-employment, α, is increased, starting at the benchmark value of 0. While this is the same for both workers who chose HP and MP firms in the first period of their careers, the HP workers get a bigger absolute bonus (bonus is a proportion of what would have been their second-period wage). In equilibrium, this forces down the wages in HP firms proportionately in both periods of a worker's career: higher expected self-employment earnings reduce the wages needed to make workers indifferent to joining HP firms. While wage growth of HP workers is unaffected, the average wage in HP firms decreases and can fall below that in MP firms, and this is also true in this case corrected for experience as just noted. Similar comments then apply to foreign versus domestic firms.

Because of this fall in HP firm wages, MP firms can hire away workers. For the parameters we use, this begins to happen at $\alpha = 0.06$ in Table 3.2.[4] Employment in HP firm shifts toward inexperienced workers, but total output per firm rises due to the lower wages.

Table 3.3 considers a minimum wage. We begin the simulations with this unconstrained and then equal to the free-market wage of 0.90 for HP workers in their first period, so these two are of course the same solution. Then we gradually raise the minimum

[4]In order to get this to happen, we had to use a very large value of $v = 6$; so those that do get a favorable draw are very well off indeed.

until it hits w = 1 in the right-hand column, the wage of inexperienced workers available to the industry. In addition to having the obvious effect of raising the wages of inexperienced workers in HP firms, it cuts output by HP firms (price rises), and so has the equilibrium effect of raising the wages of experienced workers in HP firms as well. Wage growth is in fact unaffected, but the average wage paid in HP firms is considerably higher in the right-hand column of Table 3.3. HP workers collect pure rents. There is no transit of workers to MP firms, which cannot afford these pricey experienced workers. Thus minimum wages is a reason to expect to observe both higher wages and higher wage growth in high productivity firms. The HP firms remain large, but less so.

Table 3.4 imposes a progressive income tax. We keep this very simple by assuming that the tax rate on wages less than or equal to one is zero, and that there is a constant tax rate t on wages in excess of one (the so-called “flat tax”). Table 3. 4 shows that this acts somewhat like the minimum wage, but by making experienced rather than inexperienced labor more expensive for HP firms. The resulting fall in demand pushes up (before tax) wages for both experienced and inexperienced workers, although the growth rate remains the same. The average wage in HP firms is significantly higher than in MP firms and hence similarly much higher in foreign than in domestic firms.

However, care must be taken in the presence of income or payroll taxes. Results depend very much on which wage is reported in the data: the producer (before tax) cost or the household (take-home) wage. If the producer cost, then the income tax increases the average wage paid in HP firms relative to MP firms as we have just indicated. If it is the consumer (take home) wage that is measured, the difference in the average wage between HP and MP firms is smaller. The growth in take-home wage is reduced by the tax. The growth rate in the take-home wage is reported in the fourth row of Table 3.4, and so we see that the profile

of the take-home wage is flatter (higher initial wage, lower take-home wage) than in the base case.

We suspect that data is generally reporting producer cost of labor, or gross wage before tax, and hence here we have another reason why the average wage and wage growth is higher in HP firms and hence higher in foreign than in domestic firms.

4. Data

We use data from the Integrated Data Base (IDA) for Labor Market Research compiled by Statistics Denmark combined with firm level information about foreign ownership, size and industry. 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 a detailed record of previous labor market performance, including occupations and income.

All workers are linked to workplaces (plants) which in turn can be linked to firm level information about turnover, exports, size and ownership, which, in principle, allows us to identify all employees in foreign-owned firms in Denmark. Information about foreign ownership is only available since 2000.[5] As a consequence, we use a panel for the years 2000 to 2002 (the last year currently available), but include information about labour market performance of the individuals prior to 2000. Note that information about occupation in a given year is based on the individual's occupation in the last week of November. We cannot observe worker flows within a given year.

Since we cannot directly observe whether firms are HP or MP firms, we rely on measures of firm size and foreign ownership. According to our theory, larger firms and

[5] A firm is defined as foreign owned if foreigners ultimately own more than 50% of the firm. and the foreign direct investment amounts to more than DKK 10 million.

foreign-owned firms should exhibit both higher wage growth and pay higher wages on average. Furthermore, new self-employed with a background in large and/or foreign-owned firms should also be more productive and therefore earn more.

Table 4.1 presents the number of firms as well as the total employment of foreign (F) and domestic (D) firms in Denmark in the years 2000-2002 divided into size classes. The division into size classes is based on the number of full-time employees over the year, as reported in the firm level statistics.

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.[6] However, as also shown in the Table, the foreign firms are considerably larger on average, which implies that they account for 12-15% of total employment.[7] What we cannot see from the Table is that the share of foreign-owned firms is somewhat larger in manufacturing than in services, although the employment shares of foreign-owned firms in manufacturing and services are almost the same. This reflects the presence of some large foreign-owned firms in the service sector.

Table 4.2 describes the worker flows from domestic and foreign firms, respectively. Specifically, the first part of the table shows the occupations in 2001 and 2002 of those employed in a foreign-owned firm in 2000 and 2001, respectively.[8] We can see that approximately 2/3 can be found in the same foreign-owned firm the following year, while an additional share (11% in 2000 and 4% in 2001) stay in the same firm, but experience a change in ownership from foreign to domestic. While 11-12% move to a domestic firm, we observe that approximately 0.6% move to self-employment. Turning, to the workers in

[6] Firms in the public sector as well as firms with unknown industry classification have been dropped from Table 4.1. Also small firms.

[7] The employment figures in Table 4.1 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.

[8] Note that Table 4.2 includes only workers between 20 and 65 years. Furthermore, workers in the public sector have not been excluded.

domestic firms in the second part of the Table, we observe, among other things, that the share of workers moving to self-employment is slightly higher in this case.

Table 4.3 contains a similar description of worker flows between large (500+) firms and smaller (<500) firms. Note, among other things, that the share moving to self-employment is twice as high for small firms as for large firms. Furthermore, it looks as if workers moving from large (small) firms tend to move to other large (small) firms.

In Table 4.4, we provide average hourly (nominal) wages for employees in foreign-owned and domestically-owned firms, respectively and in the different size classes. The income measure used is an hourly wage computed by Statistics Denmark. The average wages reveal a significant wage gap between domestically- and foreign-owned firms - more than 20% in each of the three years - and between small and large firms. This comparison, however, does not control for any background characteristics of the individuals, such as education, age and experience.

The Table also contains estimates of (nominal) wage growth for employees in the different types of firms. While the difference in wage growth between small (<50) and large (500+) firms was around 1 percentage point, corresponding to 25%-50% higher wage growth in large firms in the two years, the difference between foreign-owned firms and domestically-owned firms is much smaller (5-10%). What we cannot see from the Table is that while large domestically-owned firms exhibit high wage growth, it is especially the medium-sized firms among the foreign-owned firms that follow this pattern, while the large foreign-owned firms actually have had much less wage growth on average.

Finally, in Table 4.5 the average gross income of newly self-employed is presented, where we have distinguished between those who were employed in a foreign-owned and a domestically-owned firm the year before; as well as between the sizes of these firms. We can see that the average income of those with a background in a foreign-owned firm is between

20% and 30% higher than for those with a career from a domestically owned firm, while the income of those with a background in a large firm is around 20% higher than the income of those from a small firm.

Taken together, these statistics point to both higher wages and wage growth in larger and foreign-owned firms as well as a subsequent better performance in self-employment. However, the evidence for higher wage growth in foreign-owned firms is limited. Table 4.6 presents summary statistics of the variables to be used in the analyses.

5. Empirical Results

The empirical analyses in this section aims at identifying (or at least throw some light on) the importance of learning in small vs. large firms and foreign vs. domestic firms as well as the transferability of these skills. The analyses proceed in four steps. In Section 4.1, we analyze the effects of firm size and foreign ownership on the wage level in order to identify whether larger firms and foreign-owned firms pay higher wages. This is a basic implication of our theoretical model – at least in the presence of minimum wages. It is also the focus of most of the existing empirical literature in this area. A more specific prediction of our theoretical model is that learning and therefore wage growth should be higher in these firms. We turn to this in Section 4.2. In Section 4.3, we consider wage levels once more, but this time, we try to determine whether previous experience from foreign-owned or large firms matter for the wage level. That is, we try to uncover the degree of transferability of the skills/technology acquired in previous employments. Finally, in Section 4.4, we consider the effects of previous experience from large and foreign-owned firms for earnings among the newly self-employed. That is, we analyze whether the acquired skills can also be transferred to subsequent self-employment.

5.1 Wage Levels

First, we estimate simple income regressions for all wage employed in 2000-2, where we include a dummy for employment in a foreign-owned firm as well as the log of firm size. That is, we estimate:

$$\ln y_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 \ln(\mathit{firmsize}_{it}) + \beta_3 x_{it} + \varepsilon_{it} \quad (13)$$

where y_{it} is income (hourly wage) of individual *i* in period *t*, F_{it} is a dummy that takes the value 1 if individual *i* is employed in a foreign-owned firm in period *t*, $\mathit{firmsize}_{it}$ is the size (number of full-time employees) of the firm in which individual *i* is employed at time *t*, and x_{it} is a vector of individual characteristics (possibly time variant), including age, experience, gender, region of residence, industry and time dummies. ε_{it} is a random error.

OLS and fixed effects (FE) estimates of (13) are shown in Table 5.1 for various specifications of the right hand side. Regressions are restricted to individuals aged 25-60.

In the OLS regressions (columns 1-5), the effects of firm size and foreign ownership are both highly significant. Note, however, that the effect of foreign ownership decreases when controlling for firm size in column 2. In general, the effect of foreign ownership is found to be in the order of 8-9% depending on the control variables included, whereas the parameter to ln(firmsize) varies between 0.012 and 0.014. This implies that an increase in firm size of 100% is associated with a wage increase of around 1%. Thus, apparently foreign ownership seems to be most important for the wage level.

The result that foreign-owned firms pay significantly higher wages is consistent with a number of existing studies (Aitken et al., 1996; Feliciano and Lipsey, 1999; and Griffith and Simpson, 2003). See Martins (2004) and Lipsey (2002) for recent surveys.

The above findings could be partly due to unobserved (individual specific) ability differences. That is, if more “able” individuals tend to become employed in larger or foreign-

owned firms, then we may find a positive effect of employment in these firms on wages which is entirely due to such unobserved ability differences.[9]

One way out of this is to exploit the longitudinal dimension of the data and estimate (13) using fixed effects (FE) techniques based on a panel covering the years 2000-2002.[10] Allowing for individual fixed effects, eliminates the inconsistency caused by unobserved ability differences. On the other hand, it implies that identification of the parameters in (13) comes solely from time-series variation within individuals, *i.e.* from individuals changing jobs or from individuals who experience changes in ownership status or size, while much of the relevant variation according to our theoretical model is likely to be of a cross-sectional nature, *i.e.* between individuals employed in different firms.

FE estimates are contained in the second part of Table 5.1. Note how the wage premium on employment in a foreign-owned firm drops to around 1.4%, while the effect of firm size is much less affected. Thus, the wage benefit of being in a foreign versus domestic firm of equal size is now equivalent to being in a domestic firm that is approximately 2-3 times the size of an alternative domestic firm.

The few existing studies based on matched employer-employee data, as in the current study, also find that the overall "wage-gap" between foreign-owned and domestically-owned firms is reduced significantly when controlling for firm and worker characteristics, see Heyman et al. (2004) and Martins (2005). In fact, Martins (2004) concludes that the wage

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[9]Technically, we get a correlation between the error term, ε_{it}, on the one hand, and the foreign ownership dummy and the firm size variables on the other hand. To illustrate this, the error term can be split up into a time-invariant individual component, c_i, which may be correlated with firm size and foreign ownership, and a residual term, u_{it}, which is uncorrelated with all the right hand side variables: $\varepsilon_{it} = c_i + u_{it}$. If c_i is correlated with firm size and/or foreign ownership, then OLS estimates become inconsistent.

[10] Another possibility would be to find suitable instruments for firm size and foreign ownership. We experimented by using the local density of foreign-owned firms as an instrument for the foreign ownership dummy, but found that while the effects of foreign ownership on wages increased substantially compared to the OLS estimates, this was most likely due to a "weak instrument" problem. As a consequence, we have chosen not to report these results.

premium found in the OLS regressions disappears when difference-in-difference and propensity score matching techniques are applied.

However, it should be stressed that when using fixed effects techniques in a short panel as above, or difference-in-difference estimators for that matter, the estimated coefficient to, *e.g.*, foreign ownership reflects the immediate effect of a take-over on wages and/or the immediate effect on an individual's wage from changing job. That is, it captures only the short-run effect of foreign ownership. Furthermore, if firms changing ownership status or individuals changing jobs are not representative, it may introduce another endogeneity problem into the estimations.

In sum, both foreign ownership and firm size seem to matter for wages, although the effect of foreign ownership is significantly reduced when including individual fixed effects. However, while FE estimations may provide a solution to the problem of unobserved ability differences, they neglect potentially important cross-sectional variation, which means that the estimates are identified exclusively from individuals changing jobs and/or from firms changing status/size. As this may induce another endogeneity problem into the estimations, we are careful not to blindly prefer the FE estimates over the OLS estimates. The truth is likely to be somewhere in between. Furthermore, none of the estimates in this section are very informative about the wage profiles in large vs. small firms and foreign firms vs. domestic firms. We turn to this in the next subsection.

5.2 Wage Growth

In this section, we consider the importance of foreign ownership and firm size for wage growth within job spells. This is a more direct test of the implications of our theoretical model, which implies that there is more learning and hence higher wage growth in HP firms. Specifically, we estimate the following equation:

$$\Delta \ln y_{it} = \gamma_0 + \gamma_1 F_{it} + \gamma_2 \ln(\mathit{firmsize}_{it}) + \gamma_3 x_{it} + v_{it} \qquad (14)$$

where the left hand side is the change in log wages, *i.e.* wage growth, given that the individual stays in the same job. If employees in larger (and foreign-owned) firms experience higher wage growth, we should expect a positive value of γ_1 (and γ_2).[11] Table 5.2 presents OLS estimates of this equation for various specifications of the right hand side.

We observe that the coefficient to the log of firm size is significantly positive in all regressions, implying that, *e.g.*, a doubling of firm size should be associated with approximately 0.2 percentage points higher wage growth. With an annual wage growth of 2%, this corresponds to 10% higher wage growth. Foreign ownership, on the other hand, appears in itself to have a negative effect on wage growth, although the effect is much less significant. Note, however, that without firm size included, the coefficient to foreign ownership becomes significantly positive, although small (results not shown in the Table).

As we consider wage growth in this regression, unobserved individual heterogeneity which affects the wage level (as in (13)) is unlikely to bias the results. If, however, individuals have different potentials for learning or different personal costs of learning, it might be the case that workers with higher learning potential will self-select into jobs with greater learning opportunities (Rosen, 1986), *i.e.* the larger firms. If that is the case, the effects of firm size on wage growth may be overestimated. Note also that identification of of γ_1 (or γ_2) in an FE estimation of (4.2) would rest exclusively on individuals experiencing a change in ownership (or size) of their current firm. For this reason, we choose not to pursue that approach here.

5.3 Transferability in Wage Employment

[11]This approach is similar in spirit to Moen (2005) who compares wage growth in R&D intensive and R&D non-intensive firms.

To get an idea about the transferability of the skills acquired in an HP firm, we extend the estimations from Section 5.1 by including measures of previous experience from large and/or foreign-owned firms, i.e. measures of previous employment spells in such firms.

One problem is that with the current panel at hand, we need to construct these measures from the observations for 2000-2. That is, we can only construct a measure of, e.g., previous foreign-firm experience for individuals who have changed jobs within the period 2000-2, because only in that case do we observe the identity (size and ownership) of the firm at which the worker was previously employed. For these workers, we can retrospectively observe the number of years at which the worker was at this workplace, and if the firm was foreign owned in the last year, we use this measure as our measure of previous foreign-firm experience. For individuals who do not change jobs between 2000 and 2002, the measure of previous foreign-firm experience will inevitably be zero. In that sense, the measure becomes a measure of recent foreign-firm experience. To be consistent, the measure of previous large-firm experience is constructed in the same way. Specifically, we estimate the following equation:

$$\ln y_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 \ln(\mathit{firmsize}_{it}) + \beta_3 x_{it} + \beta_4 \mathit{previous}_{it} + \varepsilon_{it} \qquad (15)$$

where $\mathit{previous}_{it}$ is oor measure of previous experience from large and foreign-owned firms. If learning is more important in foreign and larger firms and the skills are transferable to subsequent employment relations, we should expect a positive coefficient to $\mathit{previous}_{it}$ when controlling for the general amount of experience.

Since the effect of previous experience cannot be appropriately identified in an FE regression, only OLS estimates of this equation are contained in Table 5.3. The first column in Table 5.3 extends column 4 from Table 5.1 by adding tenure and tenure squared to the regressors as well as these interacted with the dummy for foreign ownership and a dummy for the firm having more than 50 employees. While tenure in itself has a positive effect on the

wage level (although diminishing), there is an additional positive effect of tenure in a large firm. This corroborates the finding from Table 5.2 that wage growth is higher in larger firms.

The second and third columns of Table 5.3 add the constructed measures of previous experience from foreign-owned and large firms, respectively, and in the final column both measures are included. We observe that while both types of previous experience add to the current wage - which indicates transferability of the skills acquired - especially the effect of foreign-firm experience is significantly reduced when controlling for large-firm experience; as we would expect from our theory model. In the final column, each extra year of experience from a foreign-owned or large firm is associated with approximately a 1% higher current wage - although the effect is declining due to the quadratic term. Thus, after 5 years, the effect is down to 0.5% of an extra year of previous experience from a large or foreign-owned firm.

Related to this, Martins (2006) also finds some evidence of higher wages for workers moving from foreign to domestic firms compared to their colleagues in the domestic firms.

5.4 Transferability to Self-Employment

We now turn to an analysis of the newly self-employed. Table 5.4 contains income regressions for all new self-employed in 2001-2 where we include measures of previous experience from foreign-owned and large firms. I.e. we estimate:

$$\ln y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 previous_{it} + \varepsilon_{it} \qquad (16)$$

Note that the income measure used in these regressions is gross annual income, as an hourly wage is not constructed for the self-employed. Furthermore, since the effects of previous employments cannot be appropriately identified in a fixed effects regression - unless we have individuals switching back and forth between self-employment and wage-employment parameters are estimated by OLS.

In the first column, we just include a dummy for employment in a foreign-owned company in the previous year, while we also add the size of the firm in column 2. We observe that previous employment in a foreign-owned firm increases income as self-employed by 13.5%; an effect which is reduced to 7.3% when also controlling for the size of the firm.[12] An increase in the size of the firm, on the other hand, from, *e.g.*, 10 to 100 employees raises income as self-employed by approximately 5%.

In columns 3-5, we add the amount of experience from foreign-owned and large firms - where the measures of past experience are constructed as in Section 5.3. In the case of foreign-owned firms this moves the effect away from the simple dummy variable to the experience variable, indicating that not just experience from a foreign-owned firm, but also the amount of this experience matters for self-employment income. Apparently, a similar thing does not hold for the experience from large firms

Taken together, this section has provided evidence of higher wages in foreign-owned and larger firms, even in fixed effects estimations. More importantly, the evidence also points to higher wage growth in larger firms. Furthermore, acquired skills in both foreign-owned and large firms can - at least to some extent - be transferred to both subsequent wage work and self-employment.

[12] Note that the smaller t-values in the estimations in Table 5.4 reflect the much smaller sample sizes when considering exclusively the new self-employed.

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. We focus on workers, and on the direct effects of working for a high-productivity firm on the individual's productivity in subsequent wage work or self-employment. Using a much-simplified version of Meltiz's heterogeneous firms model, our theory model predicts that foreign firms pay higher average wages, their workers have higher average wage growth, and they earn more in subsequent self-employment for workers who switch.

However, this is due to foreign firms having a higher average productivity, in turn due to the inability of low-productivity foreign firms to enter due to fixed entry costs. High productivity firms are larger, and hence our model also predicts that foreign firms are not more productive than larger domestic firms. In other words, most of the favorable effects of foreign firms disappear when correcting for firm size.

Several experiments with the model indicate that the average wage premium in foreign firms is reduced as either (1) the productivity in MP firms of workers who switch to MP firms from HP firms is increased or (2) the absolute expected value of self-employment earnings when switching from an HP firm grows relative to switching to self-employment from an MP firm. This fall in the average wage premium is due to a decrease in the share of HP firm workers who are experienced and also in (2) by a willingness to work for less in the first period in a HP firm due to the higher expected payoff in self-employment. In these cases, the HP firms are partly performing the function of "nurseries", training inexperienced workers who work on the cheap and then leave for MP firms or self-employment.

On the other hand, the theory model also concludes that the wage premium is increased by either (1) a minimum wage which prevents HP firms from paying a low initial wage and/or (2) a progressive income tax that hits the second-period earnings of workers in

HP firms (or transiting to MP firms). Both of these factors seem empirically relevant, and should lead to the observation of a higher wage premium simultaneously with higher wage growth in HP firms.

Our empirical analysis takes the theory to an analysis of matched data between individual Danish workers and firms. We find that working for a foreign owned firm significantly (1) increases the worker's wage, (2) increases the worker's wage growth, (3) increases the earning of newly self-employed. (4) previous experience in foreign-owned firms also increases a worker's current wage, consistent with our theoretical assumption that at least part of a worker's learning in HP firms can be carried to other firms.

We also find that effects (1), (3), and (4) are significantly reduced, but not eliminated, by controlling for firm size. Effect (2) disappears completely when controlling for firm size and indeed the coefficient on foreign ownership becomes negative (and still significant). Thus the empirical results are certainly close to our theoretical predictions although, again, the foreign ownership effect does not disappear in three of the four results.

There are several plausible reasons for the residual foreign-ownership effect after controlling for firm size and observable worker characteristics. One is simply that the top end of the productivity distribution of foreign firms is higher than that for domestic firms and so the average entering foreign firm has a higher average productivity than the higher-productivity domestic firms. This is pretty ad hoc and again, within the heterogenous-firms approach, those higher productivity foreign firms would then have higher outputs, so the effect on wages should disappear controlling for size. Of course, the effect of size may be non-linear, offering a second explanation for the residual foreign-ownership effect, and we are considering that.

Second, and perhaps related, is that foreign firms are somehow able to pick the best workers and the characteristics in question are unobservable. This obviously calls for fixed

effects at the worker level, but the short nature of our panel creates difficulties. All we are able to identify with our fixed-effects regressions is essentially the initial wage premium from switching to a foreign firm. We estimate this to be positive, but quite small . But this is perfectly consistent with the theory model, which predicts a low or negative initial wage premium in equilibrium which balances higher earnings later on. Thus the question of whether or not the foreign firms have a better ability to select must await further research.[13]

[13]As noted in our literature review, the alternative approach of Yeaple,(2005) with ex ante identical firms and heterogeneous workers deserves a careful and thorough examination in the empirical context.

Appendix: analytical solutions

This appendix gives analytical solutions to the model.

Wages for workers in HP firms can be solved for from (2), (3), and (9).

$$\frac{w_1^h}{w_2^h} = \frac{r_1^h}{r_2^h} \quad \text{from (2) and (3), so using these in (9) gives} \tag{A1}$$

$$w_1^h = \frac{(1+\beta)}{(1+\beta(r_2^h/r_1^h))} < 1 \qquad w_2^h = \frac{(1+\beta)}{(r_1^h/r_2^h+\beta)} > 1 \tag{A2}$$

where $\beta = \delta(1-\alpha+\alpha v)$. $\beta = \delta$ in the base case with no self-employment probability.

The price of a representative good from an MP firm is solved for from (4).

$$p^m = \frac{\sigma}{\sigma-1} \tag{A3}$$

The price of a representative good from an HP firm is solved for from (3) given that we know w_1^h from (A2).

$$p^h = \frac{\sigma}{\sigma-1}\frac{1+\beta}{(r_1^h+\beta r_2^h)} < p^m \tag{A4}$$

The output of a representative good from an MP firm is solved for from (10) given that we know the output price from (A3).

$$X^m + X_t^m = (\sigma-1)F^m \tag{A5}$$

The total output of a representative good from an HP firm is solved for from the consumer's marginal rate of substitution condition.

$$\frac{X_1^h + X_2^h}{X^m + X_t^m} = \left[\frac{p^h}{p^m}\right]^{-\sigma} \tag{A6}$$

Given that we know $X^m + X_t^m$, p^h, p^m, we then have

$$X_1^h + X_2^h = \left[\frac{r_1^h + \beta r_2^h}{1+\beta}\right]^{\sigma}(\sigma-1)F^m > X^m + X_t^m \tag{A7}$$

We then have one remaining variable, n^m and parameter *I*. The expenditure-income equation is

$$p^m n^m (X^m + X_t^m) + p^h (n_d^h + n_f^h)(X_1^h + X_2^h) = I \tag{A8}$$

All of the endogenous variables except n^m are now known and so this gives one remaining equation in one unknown. In our base case numerical solution, we chose an initial value of $n^m = 50$ and so this then calibrates, given our choice that $n_d^h + n_f^h = 10$ and the endogenous values of prices already solved for, to a value of *I* = 116.6667. This is given by the equation

(A9)

$$I = n^m \frac{\sigma}{\sigma - 1}(\sigma - 1)F^m + (n_d^h + n_f^h)\frac{\sigma}{\sigma - 1}\frac{1 + \beta}{(r_1^h + \beta r_2^h)}\left[\frac{r_1^h + \beta r_2^h}{1 + \beta}\right]^{\sigma}(\sigma - 1)F^m$$

$$I = n^m \sigma F^m + (n_d^h + n_f^h)\sigma\left[\frac{r_1^h + \beta r_2^h}{1 + \beta}\right]^{\sigma - 1} F^m \tag{A10}$$

The calibrated value of *I* is then held constant in subsequent analysis, and (A10) is inverted to give the equilibrium value of n^m.

We have been able to solve for all of these values independently of knowing the self-employment probability or whether or not there are any transit workers in equilibrium. But to get average wages within the firm, we have to push the analysis further and must solve for the shares in (6) and (7). This requires us to make use of (8). From (13),

$$s_t^m = 1 - (r_t^m - \gamma)/\rho \qquad \text{where} \qquad r_t^m = w_2^h = \frac{(1 + \beta)}{(r_1^h / r_2^h + \beta)} \tag{A11}$$

where $s^t \geq 0$ by virtual of the non-negativity constraint on X_t^m .

Briefly, we have the share of transit workers in MP firms along with the equilibrium output per firm in (A5)

$$s_t^m = \frac{X_t^m}{X_t^m + X^m} = 1 - \frac{(1+\beta)}{(r_1^h/r_2^h + \beta)}\frac{1}{\rho} + \frac{\gamma}{\rho} \qquad X^m + X_t^m = (\sigma - 1)F^m \tag{A12}$$

These two equations can be solved to get X_t^m .

$$X_t^m = \left[\rho + \gamma - \frac{1+\beta}{r_1^h/r_2^h + \beta}\right]\frac{(\sigma-1)}{\rho}F^m \tag{A13}$$

With respect to the experiments conducted in the paper, note that the share or transiting workers (or alternatively we report the share of first-period HP workers who transit) is increasing in γ, which is the experiment in Table 3.1. Also, β is increasing α, and ν, the probability of a successful self-employment draw and the self-employment premium respectively. The share of transiting workers is increasing in β and therefore in α and ν. The former is the experiment in Table 3.2, so both analytical findings are confirmed in the simulations.

Consider values of γ, the productivity of the first transit worker, such that there is transit in equilibrium. The minimum value such that below this value there is no transit, is given by setting (A13) equal to zero.

$$\gamma_{\min} = \frac{1+\beta}{r_1^h/r_2^h + \beta} - \rho \tag{A14}$$

The maximum value such that above this value all workers transit from HP firms is given by setting the number of first-period workers who do not go into self-employment $(1-\alpha)X_1^h/r_1^h$ equal to the number of transit workers X_t^m/r_t^m, and then setting X_1^h equal to (A7). This gives

$$(1-\alpha)\left[\frac{r_1^h + \beta r_2^h}{1+\beta}\right]^{\sigma}(\sigma - 1)F^m/r_1^h = \left[\rho + \gamma - \frac{1+\beta}{r_1^h/r_2^h + \beta}\right]\frac{(\sigma-1)}{\rho}F^m/r_t^m$$

which solves to

$$\gamma_{max} = \gamma_{min} + \frac{\rho(1-\alpha)}{r_1^h}\left[\frac{r_1^h + \beta r_2^h}{1+\beta}\right]^{\sigma}\frac{1+\beta}{r_1^h/r_2^h + \beta} \qquad \text{(A15)}$$

(A13), (A14), and the number of MP firms (A10) are inserted into equation (8). The only remaining variables in (8) are then X_1^h and X_2^h . (8) can be reduced to

$$(1-\alpha)X_1^h/r_1^h - X_2^h/r_2^h = T/R \qquad \text{(A16)}$$

$$R = n_d^h(F_d^h/Q^h + 1) + n_f^h(F_f^h/Q^h + 1) \qquad Q^h = X_1^h + X_2^h$$

$$T = n^m(s_t^m F^m/r_t^m + X_t^m/r_t^m)$$

Equation (A16) combined with Q^h from (A7) allows us to solve for two equations in two unknowns.

$$X_1^h = \frac{Q^h/r_2^h + T/R}{(1-\alpha)/r_1^h + 1/r_2^h} \qquad X_2^h = \frac{(1-\alpha)Q^h/r_1^h - T/R}{(1-\alpha)/r_1^h + 1/r_2^h} \qquad X_1^h + X_2^h = Q^h \qquad \text{(A17)}$$

The numbers of inexperienced and experienced workers are then found by dividing the first two equations by r_1^h and r_2^h respectively.

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Table 3.1: increase in parameter γ (determining r^m_t), producitivty of HP firm transiting to MP firms.

γ	0.940	0.950	0.960	0.970	0.980	0.990
r^m_t	1.190	1.200	1.200	1.200	1.200	1.200
WH1	0.900	0.900	0.900	0.900	0.900	0.900
WH2	1.200	1.200	1.200	1.200	1.200	1.200
average wage growth in a HP firm	0.333	0.333	0.333	0.333	0.333	0.333
average wage domestic firm	1.009	1.009	1.012	1.016	1.019	1.023
average wage foreign firm	1.050	1.050	1.038	1.026	1.015	1.004
total output of a MP firm	1.000	1.000	1.000	1.000	1.000	1.000
total outpout of a HP firm	4.630	4.630	4.630	4.630	4.630	4.630
share of first period HP workers who transit to MP firms			0.119	0.226	0.323	0.410

Table 3.2: increase in the probability of a favorable self-employment draw, a

α	0.000	0.020	0.040	0.060	0.080	0.100
WH1	0.900	0.894	0.889	0.884	0.879	0.875
WH2	1.200	1.192	1.185	1.179	1.172	1.167
average wage growth in a HP firm	0.333	0.333	0.333	0.333	0.333	0.333
average wage domestic firm	1.009	1.007	1.006	1.005	1.006	1.006
average wage foreign firm	1.050	1.042	1.034	1.025	1.011	0.998
total output of a MP firm	1.000	1.000	1.000	1.000	1.000	1.000
total outpout of a HP firm	4.630	4.720	4.805	4.887	4.964	5.038
share of first period HP workers who transit to MP firms				0.017	0.089	0.151

Table 3.3: increase in the minimum wage, which impacts only on wh1

w^h_1	0.9	0.92	0.94	0.96	0.98	1
WH1	0.900	0.920	0.940	0.960	0.980	1.000
WH2	1.200	1.227	1.253	1.280	1.307	1.333
average wage growth in a HP firm	0.333	0.333	0.333	0.333	0.333	0.333
take home wage growth in a HP firr	0.333	0.333	0.333	0.333	0.333	0.333
average wage domestic firm	1.010	1.014	1.018	1.020	1.023	1.025
average wage foreign firm	1.050	1.073	1.097	1.120	1.143	1.167
total output of a MP firm	1.000	1.000	1.000	1.000	1.000	1.000
total outpout of a HP firm	4.630	4.334	4.063	3.815	3.586	3.375
share of first period HP workers who transit to MP firms						

Table 3.4: progressive income tax (tax on earnings above w = 1)

tax rate	0	0.04	0.08	0.12	0.16	0.20
WH1	0.900	0.914	0.927	0.940	0.953	0.964
WH2	1.200	1.219	1.237	1.254	1.270	1.286
average wage growth in a HP firm	0.333	0.333	0.333	0.333	0.333	0.333
take home wage growth in a HP firr	0.333	0.282	0.235	0.190	0.149	0.111
average wage domestic firm	1.010	1.013	1.016	1.018	1.019	1.021
average wage foreign firm	1.050	1.066	1.082	1.097	1.111	1.125
total output of a MP firm	1.000	1.000	1.000	1.000	1.000	1.000
total outpout of a HP firm	4.630	4.419	4.230	4.060	3.905	3.764

Table 4.1: Firms and Employment

	Absolute numbers					
	2000		2001		2002	
Firm Size	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
(# 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: Employment refers to full-time employees.

Table 4.2: Worker Flows, by Ownership of the Firm

Workers employed in foreign-owned firms

Status the following year	2000		2001	
Same firm, foreign owned	99,437	65.6%	111,501	69.8%
Same firm, domestically owned	16,763	11.1%	6,453	4.0%
New firm, foreign owned	9,905	6.5%	12,511	7.8%
New firm, domestically owned	17,466	11.5%	19,664	12.3%
Self-employment	900	0.6%	883	0.6%
Unemployment/non-employment	7,019	4.6%	8,793	5.5%
Total	151,490	100.0%	159,805	100.0%

Workers employed in domestically-owned firms

Status the following year				
Same firm, domestically owned	1,270,418	73.8%	1,295,233	74.6%
Same firm, foreign owned	21,124	1.2%	15,804	0.9%
New firm, domestically owned	282,979	16.4%	265,977	15.3%
New firm, foreign owned	40,922	2.4%	39,621	2.3%
Self-employment	14,067	0.8%	14,991	0.9%
Unemployment/non-employment	92,165	5.4%	104,912	6.0%
Total	1,721,675	100.0%	1,736,538	100.0%

Note: Large firms are fims with more than 500 employees.

Table 4.3: Worker Flows, by Firm Size

Workers employed in large firms

Status the following year	2000		2001	
Same firm, large	721,911	70.9%	733,039	73.8%
Same firm, small	42,525	4.2%	14,818	1.5%
New firm, large	140,380	13.8%	129,061	13.0%
New firm, small	56,840	5.6%	52,578	5.3%
Self-employment	4,675	0.5%	4,908	0.5%
Unemployment/non-employment	51,837	5.1%	58,304	5.9%
Total	1,018,168	100.0%	992,708	100.0%

Workers employed in small firms

Status the following year				
Same firm, small	716,798	73.0%	742,365	72.1%
Same firm, large	12,032	1.2%	19,944	1.9%
New firm, small	132,365	13.5%	132,061	12.8%
New firm, large	50,966	5.2%	53,700	5.2%
Self-employment	11,361	1.2%	12,157	1.2%
Unemployment/non-employment	58,800	6.0%	69,772	6.8%
Total	982,322	100.0%	1,029,999	100.0%

Note: Large firms are fims with more than 500 employees.

Table 4.4: Average Wages and Wage Growth for Employees

	Average wages			Wage growth	
	2000	2001	2002	2000-1	2001-2
Domestic	181.1	188.7	192.0	4.5%	2.8%
Foreign	208.3	216.5	222.3	4.8%	3.1%
Small (0-49)	176.2	183.6	186.1	4.2%	2.2%
Medium (50-499)	190.4	198.7	203.1	4.7%	3.1%
Large (500+)	190.7	199.0	204.2	5.0%	3.5%

Note: Average wages are hourly wages in DKK.

Table 4.5: Average Income, New Self-Employed

	Average wages	
	2001	2002
Domestic	264,292	274,735
Foreign	342,318	331,848
Small (0-49)	255,529	280,049
Medium (50-499)	305,774	383,044
Large (500+)	303,027	340,548

Note: Average gross income in DKK.

Table 4.6: Summary Statistics

	2002	
	Mean	Standard deviation
Foreign owned	0.14	0.35
# employees	1,647.6	4,329
Age	40.0	11.1
Experience	17.1	10.1
Tenure	5.8	5.9
Female	0.3	0.5
Years of educ.	12.0	2.4
Manufacturing	0.31	0.46
Services	0.55	0.50
Copenhagen	0.34	0.47
Rural	0.32	0.47
City	0.34	0.47

Table 5.1: OLS and Fixed Effects Estimates for Wage Employed

	Dependent variable: log(hourly wages)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	OLS	OLS	FE	FE	FE	FE	FE
foreign	**0.134**	**0.110**	**0.090**	**0.095**	**0.081**	**0.020**	**0.013**	**0.014**	**0.015**	**0.014**
	(216.47)**	(173.95)**	(174.40)**	(185.41)**	(160.06)**	(36.53)**	(24.32)**	(25.85)**	(26.81)**	(26.65)**
ln(firmsize)		**0.019**	**0.014**	**0.013**	**0.012**		**0.012**	**0.011**	**0.011**	**0.011**
		(234.76)**	(195.11)**	(167.22)**	(155.67)**		(101.14)**	(95.86)**	(90.00)**	(89.84)**
age			0.045	0.043	0.042					
			(248.50)**	(234.98)**	(232.47)**					
age^2 x 10e-3			-0.520	-0.492	-0.484					
			(239.79)**	(227.45)**	(225.53)**					
X, experience			0.013	0.014	0.015			0.054	0.054	0.054
			(120.68)**	(132.74)**	(147.08)**			(66.35)**	(66.35)**	(66.28)**
X^2 x 10e-3			-0.150	-0.184	-0.219			-1.074	-1.073	-1.072
			(58.19)**	(71.58)**	(85.83)**			(199.51)**	(199.27)**	(199.12)**
years of educ.			0.058	0.053	0.051					
			(716.20)**	(629.81)**	(604.90)**					
female			-0.185	-0.197	-0.199					
			(513.68)**	(530.80)**	(544.91)**					
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry dummies				yes	yes				yes	yes
Regional dummies					yes					yes
Observations	3,584,810	3,537,563	3,491,421	3,491,421	3,491,421	3,584,810	3,537,563	3,537,563	3,537,563	3,537,563
Number of individu						1,449,607	1,443,101	1,443,101	1,443,101	1,443,101
R-squared	0.02	0.03	0.32	0.34	0.35	0.09	0.09	0.11	0.11	0.11

NOTES: Robust t statistics in parentheses. * significant at 5%; ** significant at 1%.

Table 5.2: Wage growth within job-spells

	Dependent variable: dlog(hourly wages)				
	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	OLS
foreign	**0.07**	**-0.18**	**-0.18**	**-0.15**	**-0.17**
	(2.05)*	(5.44)**	(5.35)**	(4.41)**	(4.81)**
ln(firmsize)		**0.21**	**0.24**	**0.25**	**0.25**
		(42.10)**	(49.60)**	(47.20)**	(46.68)**
age			**-0.77**	**-0.77**	**-0.77**
			(54.06)**	(53.89)**	(53.92)**
age^2 x 10e-3			**7.26**	**7.26**	**7.26**
			(44.94)**	(44.84)**	(44.86)**
experience			**-0.10**	**-0.10**	**-0.10**
			(13.04)**	(12.67)**	(12.32)**
exper.^{2} x 10e-3			**2.40**	**2.26**	**2.20**
			(13.51)**	(12.70)**	(12.33)**
years of educ.			**0.11**	**0.08**	**0.07**
			(20.16)**	(13.76)**	(12.96)**
female			**0.43**	**0.39**	**0.39**
			(17.13)**	(15.08)**	(15.02)**
Time dummies	yes	yes	yes	yes	yes
Industry dummies				yes	yes
Regional dummies					yes
Observations	1,728,268	1,704,367	1,684,944	1,684,944	1684944
R-squared			0.02	0.02	0.02

NOTES: All coefficients are multiplied by 100. Robust t statistics in parentheses.
* significant at 5%; ** significant at 1%.

Table 5.3: OLS and Fixed Effects Estimates for Wage employed

	Dependent variable: log(hourly wages)			
	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	OLS
foreign	**0.089**	**0.069**	**0.075**	**0.071**
	(87.33)**	(51.51)**	(56.99)**	(52.75)**
ln(firmsize)	**0.010**	**0.010**	**0.010**	**0.010**
	(102.99)**	(81.95)**	(75.81)**	(76.55)**
female	-0.200	-0.202	-0.202	-0.202
	(546.20)**	(439.11)**	(439.27)**	(439.26)**
Years of educ.	0.051	0.051	0.051	0.051
	(604.32)**	(465.95)**	(465.64)**	(465.64)**
age	0.042	0.037	0.037	0.037
	(233.49)**	(153.68)**	(154.03)**	(153.95)**
age^2 x 10e-3	-0.487	-0.427	-0.427	-0.427
	(227.04)**	(151.63)**	(151.94)**	(151.86)**
experience	0.014	0.011	0.011	0.011
	(133.10)**	(77.55)**	(75.27)**	(75.25)**
$exper.^2$ x 10e-3	-0.198	-0.134	-0.129	-0.129
	(76.79)**	(40.09)**	(38.40)**	(38.38)**
tenure	0.004	0.001	0.003	0.003
	(26.78)**	(7.75)**	(14.51)**	(14.47)**
$tenure^2$ x 10e-3	-0.096	-0.004	-0.051	-0.051
	(13.28)**	-0.500	(5.84)**	(5.81)**
foreign x tenure	-0.002	0.001	0.000	0.000
	(7.72)**	(2.20)*	-0.970	-1.330
foreign x $tenure^2$ x 10e-3	0.065	-0.055	-0.011	-0.043
	(4.56)**	(3.18)**	-0.620	(2.52)*
large x tenure	0.004	0.004	0.005	0.005
	(28.80)**	(23.03)**	(25.59)**	(25.16)**
large x $tenure^2$ x 10e-3	-0.221	-0.195	-0.212	-0.209
	(27.19)**	(20.17)**	(21.84)**	(21.55)**
Ten. in prev. Empl, F-firm		0.016		0.010
		(25.08)**		(14.37)**
(Ten. in prev. Empl, F-firm)^2 x 10e-3		-0.785		-0.488
		(17.54)**		(10.18)**
Ten. in prev. Empl, Large			0.011	0.009
			(37.07)**	(29.35)**
(Ten. in prev. Empl, Large)^2 x 10e-3			-0.517	-0.431
			(27.40)**	(21.44)**
Time dummies	Included	Included	Included	Included
Industry dummies	Included	Included	Included	Included
Regional dummies	Included	Included	Included	Included
Observations	3,491,695	2,091,542	2,091,542	2,091,542
R-squared	0.35	0.33	0.33	0.33

NOTES: Robust t statistics in parentheses. * significant at 5%; ** significant at 1%

Table 5.4: Earnings of new self-employed

	Dependent variable: log(gross annual earnings)				
	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	OLS
foreign$_{t-1}$	**0.135**	**0.073**	**-0.044**	**0.067**	**-0.031**
	(6.11)**	(3.11)**	(1.070)	(2.85)**	(0.720)
ln(firmsize$_{t-1}$)		**0.022**	**0.022**	**0.016**	**0.018**
		(7.44)**	(7.44)**	(4.16)**	(4.51)**
age	0.003	0.008	0.008	0.008	0.008
	(0.620)	(1.480)	(1.480)	(1.450)	(1.450)
age^2 x 10e-3	0.011	-0.04	-0.04	-0.038	-0.039
	(0.170)	(0.600)	(0.600)	(0.570)	(0.580)
experience	0.047	0.046	0.046	0.046	0.046
	(14.90)**	(13.98)**	(13.84)**	(13.85)**	(13.79)**
exper.^{2} x 10e-3	-0.999	-0.985	-0.982	-0.992	-0.99
	(11.09)**	(10.52)**	(10.49)**	(10.51)**	(10.49)**
years of schooling	0.047	0.046	0.046	0.046	0.046
	(15.41)**	(14.39)**	(14.37)**	(14.38)**	(14.36)**
female	-0.272	-0.267	-0.268	-0.268	-0.268
	(15.39)**	(14.35)**	(14.38)**	(14.37)**	(14.39)**
Prev. exper in F-firm			0.047		0.043
			(3.05)**		(2.59)**
(Prev. exper in F-firm)^2 x 10e-3			-1.899		-1.91
			(2.15)*		(2.04)*
Prev. exper in large firm				0.012	0.006
				(1.790)	(0.880)
(Prev. exper in large firm)^2 x 10e-3				-0.247	0.001
				(0.670)	
Time dummies	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes
Regional dummies	yes	yes	yes	yes	yes
Observations	23,125	20,183	20,183	20,183	20,183
R-squared	0.08	0.09	0.09	0.09	0.09

NOTES:Robust t statistics in parentheses. * significant at 5%; ** significant at 1%