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July 27, 2005

Abstract

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JEL classification: F2, J3

Key-Words: FDI, foreign takeover, cross-border M&A, wage regression, employee-employer matched data; propensity score matching; FDI technology spillover;

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1) Introduction

Both the major growth of foreign direct investment (FDI) in the last decade and some spectacular development success stories such as Ireland have drawn attention to the impact of FDI on the local economy. According to Barba-Navaretti and Venables (2004), host countries can benefit from FDI via several channels: competition effects, the impact on national factor demand, and technology spillover effects. This study restricts its view on the last channel.

The empirical research in this channel is not straight forward, because technology spillover effects are not directly observable. We employ an approach, where we use a theoretical model to derive observable conditions and test them. Then, we conclude by theoretical induction on the significance of spillover effects and whether they benefit the host country.

There is a sub-branch of the empirical and theoretical FDI literature that can be interpreted as such an approach. Aitken et al. (1996) showed for Venezuela and Mexico that multinational enterprises (MNEs) have higher average wage cost than comparable indigenous firms.[2] Fosfuri et al. (2001) and Glass and Saggi (2002)[3] derive from theoretical models the conclusion that MNEs pay higher wages, because they want to prevent leakage of superior technology to local competitors through worker turnover. The wage premium then indicates the economic value of the host country benefit from potential technology spillover effects.

We depart from the theoretical models of Fosfuri et al. (2001) and Glass and Saggi (2002) by assuming that learning from MNEs takes time. When incorporating this assumption, we find that MNEs are able to internalize the learning effect by paying higher wages than indigenous

[2] These results have been extended to the US by Doms and Jensen (1998) and Feliciano and Lipsey (1999) and replicated on a number of other countries such as Canada by Globerman, Ries, and Vertinsky (1994), the UK by Dickerson et al. (1997), Conyon et al. (2002), Girma et al. (2001), Indonesia by Lipsey and Sjöholm (2001, 2003), five African countries by Te Velde and Morrisey (2001), Ghana by Görg et al. (2002), and for Hungary by Kertesi and Köllő (1999, 2001) to mention a few.
[3] A similar model set-up has been used earlier in Markusen (2001) to discuss intellectual property right protection in developing countries.

firms after learning and lower wages before. Hence, the expected life-time income of host-country workers remains unaffected by foreign takeovers. A host-country benefit can still arise from a technology spillover effect additional to learning such that an MNE-trained worker contributes more to local firms' productivity than to MNEs'. Then, MNEs will specialize in training workers, discount wages by the value of their human capital production, and workers will move to indigenous firms after training. Since there is a productivity gain to indigenous firms that does not accrue to MNEs, indigenous firms are able to hire the MNE-trained worker at wages below marginal productivity. Hence, the host countries' welfare gain from technology spillovers consists of an increase of indigenous firms' profits.

We use a large employee-employer matched dataset of a representative sample of workers in Hungarian manufacturing firms with more than 20 employees over the period from 1992 until 2001 and test three conditions on the change in the wage-, the productivity-, and the worker-turnover-rates during the course of foreign takeovers. We find that wages of high-skilled workers fall directly after a foreign takeover and rise again in the following years. Matching and control function techniques control for takeover-selection bias on observables and unobservables. Moreover, productivity grows gradually after a takeover suggesting a slow learning process. Finally, worker turnover falls after takeover. All three observations square only with the regime in our theoretical model, when the host country does not benefit from technology spillover effects, but reject Fosfuri et al. (2001) and Glass and Saggi (2002).

Hungary can be considered a particularly interesting country to investigate the research question of spillover effects through MNEs for three reasons: 1) Hungary was largely cut-off from Western technology during the cold-war period and suddenly exposed to this technology after the fall of the iron curtain. Hence, there is a large and suddenly arising potential for technology spillovers. Still, the overall education level of the workforce is very high such that there is a fertile ground for technology adoption. 2) The labor market of Hungary is quite liberal and factor prices flexible. 3) Hungary is open to FDI such that technology transfer could occur on large scale.

Our results on the wage profile are in contrast to several other unpublished studies on employee-employer matched data. Heyman et al. (2004) and Martins (2003) find no difference in wage setting of MNEs and indigenous firms from Sweden and Portugal, respectively. Görg et al. (2002) finds a positive wage premium for workers who are trained by MNEs in Ghana but there is only an insignificant fall in the wage premium directly after a worker joins an MNE.[4] Kertesi and Köllő (2001), while sharing the same database with this study, do not deal with foreign takeovers.

The rest of the paper is organized as follows: section 2 develops a theoretical model; section 3 describes the data and the macroeconomic environment of Hungary; section 4 contains the empirical results and section 5 concludes.

2) An FDI Technology Spillover and Learning Model

In this section, we develop a theoretical model that serves the purpose of deriving observable conditions to test indirectly for unobservable spillover and learning effects.

2.1) Model Set-up

There are two time periods t=1,2. We consider an economy with 2 sectors i=1,2 in addition to a "rest of the economy". Goods are homogeneous within each sector. There is one production factor labor with differences in efficiency across workers. There is also one MNE (M) with particularly efficient technology (e.g. patent holder), fixed cost and constant marginal cost. The MNE exists only in sector 1. In all sectors operates a competitive fringe of symmetric

[4] Görg et al. (2002) provides a theoretical model of rent sharing that also explains wage premia.

potential indigenous firms. There is free firm entry and exit at any time of all competitive fringe firms which have ex ante identical CRS technology across all sectors. Also workers are identical within each firm. In this setting, limit pricing will occur (Murphy et al., 1989).

Workers are initially identical and allocate to the MNE and active indigenous firms. Henceforth, we call MNE-trained workers those with MNE experience in period 1. There are three alternative moves τ of MNE-trained workers: (a) $\tau = N_1$: MNE-trained workers move to an indigenous firm in sector 1; (b) $\tau = M$: no worker turnover; (c) $\tau = N_2$: MNE-trained workers move to indigenous firms in sector 2. We refer for simplicity to τ also as a regime.

Firms maximize their profits $\pi^F(t,\tau)$:

$$\pi^F(t,\tau) = x^F(t,\tau) \cdot \left[P_i(t,\tau) - A^F(t,\tau)^{-1} \cdot w^F(t,\tau)\right] \tag{1}$$

with i=1,2 denoting the sector index, t the time index, $F \in \{M, N_1, N_2\}$ the firm index, $x^F(t,\tau)$ the firm-specific demand in units, $P_i(t,\tau)$ the price in sector i at time t in regime τ, and $w^F(t,\tau)$ the corresponding wage. For example, $w^F(2,F)$ is the wage rate of firm type F, when the MNE-trained worker is hired in period 2 by this firm.

Total factor productivity (TFP) $A^F(t,\tau)$ consists of two components:

$$A^F(t,\tau) = \widetilde{A}^F(t,\tau) \cdot \widetilde{A}_F^W(t,\tau); \qquad \tau \in \{M, N_1, N_2\}; \quad t = 1,2; \tag{2}$$

There is an F-firm specific asset $\widetilde{A}^F(t,\tau)$ at time t in regime τ. We assume that workers cannot contract their marginal productivity based on any firm-specific knowledge assets that provide an above-common-practice productivity. When leaving the firm, workers cannot transfer this firm-specific component of productivity. There is also a worker-specific efficiency component $\widetilde{A}_F^W(t,\tau)$ in regime τ at time t of a worker initially allocating to firm F. This productivity component is fully contractable by workers. The multiplication of the two productivity components in equation (2) implies that high-quality workers are relatively more productive in high-tech than in low-tech firms.

We conclude the discussion of technology by giving the initial conditions on the two productivity components in each regime, firm type, and worker type:

$$\tilde{A}^{N_i}(1,\tau)=\underline{A} \tag{3}$$

$$\tilde{A}^{M}(t,\tau)=\overline{A} \tag{4}$$

$$\tilde{A}^{W}_{\tau}(1,\tau)=\underline{A} \tag{5}$$

$$\tilde{A}^{W}_{M}(2,N_i)=\underline{A} \tag{6}$$

$$\tilde{A}^{N_i}(2,N_j)=\underline{A} \tag{7}$$

for all $\tau \in \{M, N_1, N_2\}$; $t = 1,2$; $i, j = 1,2$; $i \neq j$ and with $0 < \underline{A} < \overline{A}$. There is a common-practice technology level $\underline{A}$ that applies both to the productivity component of workers and local firms initially and remains in place, whenever workers are not exposed to MNEs, and local firms are not hiring workers that have MNE experience. Instead, the MNE firm-component of productivity $\overline{A}$ is above the common-practice level.

Next, we introduce **learning** from MNEs into the model:

$$\tilde{A}^{W}_{\tau}(2,\tau)=\underline{A}\cdot L \tag{8}$$

for all $\tau \in \{M, N_1, N_2\}$. Condition (8) describes a productivity gain of workers through learning from MNEs over time. It corresponds to the dynamic FDI learning model by Findlay (1978). Importantly, learning occurs only one period after having joined the MNE.

In contrast, we consider also a **technological knowledge spillover** effect:

$$\tilde{A}^{N_i}(2,N_i)=\underline{A}\cdot S_i \tag{9}$$

for i=1,2. Condition (9) describes technological knowledge spillovers from MNE-trained workers to domestic firms. Learning results in an equal productivity gain of employing MNE-trained workers in both MNEs and indigenous firms. Knowledge spillovers, instead, imply differential productivity gains from hiring MNE-trained workers that accrue only to indigenous firms, but not to the MNE. Knowledge spillovers, instead, imply that MNE-trained workers contribute more to indigenous firm than to MNE productivity.

Assumption 1: Lack of absorptive capacity of workers.

$$1 < L < \overline{A} / \underline{A} \tag{10}$$

Assumption 1 ensures that the superior technology of the MNE is not entirely transferred to its workers.

Assumption 2: Technological proximity condition.

$$1 \leq S_2 \leq S_1 < L \text{ for i=1,2.} \tag{11}$$

The knowledge spillover from an MNE can occur both to domestic firms within the same sector or even in some other sector. However, knowledge spillovers across sectors may become weaker. A value of 1 implies the absence of any knowledge spillover that shall be discussed, as well. The strict inequality implies a lack of willingness of indigenous firms to adopt to new technology, because its workers have already been learning L by assumption but the firm asset may still remain below that productivity level, for example, because the management blocks innovation to secure its power within the organization.

Assumption 3: No-leapfrogging condition.

$$1 < L \cdot S_1 < \overline{A} / \underline{A} \tag{12}$$

This condition ensures that even an indigenous firm equipped with former MNE workers does not have a technology superior to the MNE when operating with untrained workers.

Finally, we turn to the numeraire sector "rest of the economy". There is a CRS technology with total factor productivity $\underline{A}^2$, perfect competition, and MNEs are absent. There is inter-sectoral labor mobility. Hence, equation (1) implies together with the zero profit condition due to free entry and exit that the wage for workers with productivity $\underline{A}^2$ is $\underline{A}^2$.

Bertrand competition on goods market i=1,2 yields limit pricing, i.e. the firm with the larger profits will compete the other firm type out of the market:

$$Min\{\pi^M(t,\tau);\pi^{N_1}(t,\tau)\}<0\leq Max\{\pi^M(t,\tau);\pi^{N_1}(t,\tau)\} \tag{13}$$

for t=1,2 and $\tau\in\{M,N_1,N_2\}$ at strictly positive output. Since only one firm is active in each sector, output of the active firm equals goods market demand which is assumed to be a function of prices $x_i(P_i)$ in sector i with $x_i'(P_i)<0$. Since there exist many firms that can obtain workers with productivity $\underline{A}^2$ at wage $\underline{A}^2$, and free entry and exit ensure that profits are competed away, there is an upper limit price in the product market of sector 1 such that

$$P_i(t,\tau)\leq 1 \text{ for i=1,2; t=1,2 and } \tau\in\{M,N_1,N_2\}. \tag{14}$$

Since a MNE-trained worker can always work in the position of an untrained one in an indigenous firm at wage $\underline{A}^2$, there is a lower bound on the wage of trained workers:

$$w^\tau(2,\tau)\geq \underline{A}^2 \text{ for } \tau\in\{M,N_1,N_2\}. \tag{15}$$

Free labor mobility across sectors[5] implies also that untrained workers must be indifferent in period 1 of whether to start working in an MNE with the option to get trained and possibly

[5] Görg et al. (2002) developes a rent-sharing model that explains wage premia of workers in foreign-owned firms, when workers learn slowly over time. By assumption, the return to human capital accumulation is larger in foreign firms. To the extent that workers are able to share in the surplus of the higher return to human capital through bargaining, wages in foreign-owned firms rise above the ones in indigenous firms. Görg et al. (2002) deviate in two crucial assumptions from the present model: there is no worker mobility across sectors and there is a lock-in effect in the sense that workers cannot be instantaneously replaced by untrained ones. Such a model is very suitable to describe conclave economies, where MNEs form a modern sector on their own, while the

switch in the second period to an indigenous firm or whether to remain over both periods in an indigenous firm earning the wage $\underline{A}^2$ (Lazear-condition):[6, 7]

$$w^M(1,\tau)+R\cdot w^\tau(2,\tau)=w^{N_i}(1,M)+R\cdot w^{N_i}(2,M)=(1+R)\cdot\underline{A}^2 \qquad (16)$$

for $\tau\in\{M,N_1,N_2\}$ and i=1,2. R denotes the discount factor and we assume in this section a perfect capital market without borrowing constraints. Condition (16) implies immediately that workers cannot benefit from the presence of MNEs in terms of their life-time income. There is one restriction on free labor mobility: trained workers can leave the MNE only at an additional marginal cost χ, $\chi\to 0^+$, which is proportional to output of the firm. This cost will be born in equilibrium by the indigenous firm that hires the MNE-trained worker.[8]

2.2) Subgame Perfect Equilibrium

The above model constitutes a game, where the players are the three firm types M, N_1, N_2, and the MNE-trained workers. Their actions are the setting of wages and prices and the labor allocation decision, respectively. Firms set wages before deciding upon their product prices. Wage offers are made simultaneously and workers have complete information on all offers.

A subgame perfect equilibrium of the game (1)-(16) is defined as a vector of wages, labor allocation in period 2, and product prices over both periods such that neither period 2 profits nor the asset price of any firm can increase by deviating, and no MNE-trained worker can improve wage income in period 2.[9]

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traditional sector of indigenous firms is technologicaly so remote that workers cannot be substituted across sectors. Görg et al. (2002) apply their model consequently to data of Ghana.

[6] Otherwise, either all workers would supply their work to the MNE or exclusively to indigenous firms. Both cannot constitute an equilibrium with MNEs active.

[7] Condition (6) was first used in Lazear (1979) to show that efficiency wage problems can be solved with a steep wage schedule over lifetime, whenever there exists a mandatory retirement age.

[8] The nature of the cost is not important for the model results in this paper. It is only important that some cost exists - even if negligibly small – to ensure uniqueness of equilibria. Letting this cost be marginal intends to make these cost relevant for individual decisions, but not for the overall welfare evaluation of a country, as moving cost should not have a significant negative impact on GDP.

[9] Note that only MNE-trained workers act strategically, while inexperienced workers have no strategic choices.

As usual, the model is solved by backward induction. For solving the Nash equilibrium in period 2, it is useful to define the maximum offer $\hat{w}^{\tau}(2,\tau)$ that a firm type τ is willing to make to obtain the MNE-trained worker in period 2:

$$\hat{w}^{\tau}(2,\tau) \equiv \underset{w^{\tau}(2,\tau)}{\arg\inf}\left\{\pi^{\tau}(2,\tau)\middle|\pi^{\tau}(2,\tau) = \sup_{l\in\{M,N_1,N_2\}}\left\{\pi^{\tau}(2,l)\right\}\right\}. \tag{7}$$

The trained worker will end up in the firm T that is willing to make the highest offer:

$$T = \underset{\tau\in\{M,N_1,N_2\}}{\arg\sup}\left\{\hat{w}^{\tau}(2,\tau)\right\}, \tag{8}$$

Conveniently, (18) is sufficient to constitute a Nash equilibrium of the end game. Analogue to the theory on second-price sealed-bid auctions, the trained MNE worker will, however, only be paid marginally more than the second highest bid.

The intuition is straight forward: when firm N_1 wants to hire the MNE-trained worker, it needs to outcompete the MNE first according to (13). This requires to set the goods price so low that the MNE would make losses when hiring an untrained worker at period 2, i.e.

$$p_1(2,N_1) = \left(\underline{A}/\overline{A}\right) - \varepsilon, \tag{19}$$

where $\varepsilon, \varepsilon \to 0^+$ is a value that is marginally positive. However, then the maximum bid that firm N_1 is able to make without making losses itself is:

$$\hat{w}^{N_1}(2,N_1) = \left[\left(\underline{A}/\overline{A}\right) - \varepsilon - \chi\right]\cdot\left(\underline{A}^2 \cdot L \cdot S_1\right) < \underline{A}^2. \tag{20}$$

Because of the inequality in (20) which contradicts (15), the firm N_1 will never be able to hire MNE-trained workers. Instead, the highest bid of the MNE is:

$$\hat{w}^{M}(2,M) = \underline{A}^2 \cdot L > \underline{A}^2 \tag{21}$$

The MNE is willing to pay for the learning gain L in productivity, when the worker is trained. The MNE does not compensate the entire marginal productivity of the worker, because hiring an unskilled worker will become more profitable in this case. Still, the highest bid stems from firm N_2, whenever there exists some positive technology spillover externality (S_2>1):

$$\hat{w}^{N_2}(2, N_2) = \underline{A}^2 \cdot L \cdot S_2 \cdot (1-\chi). \tag{22}$$

The reason is an advantage in form of the technology spillover term S_2 that firm N_2 has over the MNE, if an MNE-trained worker is hired. Unless there is no technology spillover for N_2 firms from hiring MNE-trained workers, the N_2 firm will outbid the MNE and pay marginally more than what the MNE would have been prepared to pay: $\underline{A}^2 \cdot L + \varepsilon$. If, instead, there is no technology spillover effect (S_2=1), then the MNE wins the bidding competition, because it does not bear moving costs χ, and offers marginally more than the second-highest bid of firm N_2: $\underline{A}^2 \cdot L \cdot (1-\chi)$. In both cases, the wage of the MNE-trained worker is about $\underline{A}^2 \cdot L$. Note that this wage rate is above the one otherwise found in the economy for the same position.

From the Lazear condition (16) follows that the wage that the MNE pays to its workers in the first period must be below the one that prevails otherwise in the economy for the same position. The Lazear condition is graphically displayed in Figure 1.

Insert Figure 1 about here

The Figure 1 depicts wages in periods t=1 and t=2, when enjoying training at an MNE or without. No matter whether the worker remains in the MNE or not, there will be a higher salary of this worker after training. However, the MNE is able to fully internalize the learning effect by discounting period 1 wages of its workers by the expected learning gain. If there is no spillover externality (S_2=1), then the MNE-trained workers remain in the MNE and this gives rise to a U-shape wage profile. MNEs pay less to new workers and more to MNE-trained ones than indigenous firms for comparable occupations to prevent trained workers from being hired away and draining knowledge to competitors. If there is a technology spillover externality (S_2>1), instead, then the MNE wage cost are below average, because the period 1 wage discount prevails but the MNE pays market rates to its newly hired workers in period 2, while there is huge worker turnover of MNE-trained workers to indigenous firms that operate in another market. We summarize the above findings in proposition 1.

Proposition 1: (i) There exists a unique subgame perfect equilibrium T, $T \in \{M, N_1, N_2\}$, to the game (1)-(16) such that there will be worker turnover from the MNE to firm N_2 if there are technology spillover externalities from the MNE-trained worker to firm N_2 beyond pure learning; there will not be any worker turnover otherwise. Formally:

$$T = \begin{cases} N_2 & if\ S_2 > 1 \\ M & if\ S_2 = 1 \end{cases} \tag{23}$$

(ii) The MNE offers a wage for a workplace in period 1 below the one of indigenous firms if there exists a technology spillover from MNE-trained workers to firm N_2 (S_2>1). Otherwise, MNE wages will be below this benchmark in period 1 and above in period 2.

(iii) There exists a direct net benefit through the MNE to the host country if and only if there exists a technology spillover from MNE-trained workers to firm N_2 (S_2>1). There is no net benefit to the host country from learning alone.

Proof: Available on request. **q.e.d.**

A comment is due on the welfare effects of potential takeovers. The presence of multinational firms causes productivity of domestic workers to rise. This is not sufficient, however, for constituting a net benefit to the host country, because MNEs are able to internalize the learning effect and the discounted life-time income of workers is not affected by foreign takeovers. It is the circumstance that an MNE-trained worker contributes more to domestic firms' than to MNEs' productivity which is exploited to create a net benefit to the host country. By the well-known second-price sealed-bid auction argument, the MNE-trained worker is not able to internalize the incremental benefit that she brings to a domestic firm relative to the MNE. But then the MNE has no possibility to cash in this spillover externality.

Next we discuss assumption perturbations and their impact on the model results. Contrary to Markusen (2001), Fosfuri et al. (2001), and Glass and Saggi (2002), there is no export option to the MNE. In our context, the MNE will never choose to export at the price of additional transport cost to prevent knowledge spillovers, because the MNE is able to fully internalize the learning externality. Hence, the model results are not affected by including an exporting option. However, other assumption perturbations change the equilibrium in some respects.

A) Additional Sectors

Suppose there exists many sectors such as sector 2. We denote the additional sectors i=3,..,n and assume that (7) and (9) hold for sectors i=3,..,n, as well. Moreover, we assume without loss of generality that $S_i \geq S_{i+1} \geq 1$ for all i. Since, equation (22) still holds analogously:

$$\hat{w}^{N_i}(2, N_i) = \underline{A}^2 \cdot L \cdot S_i \cdot (1 - \chi), \tag{24}$$

The bidding competition for the MNE-trained worker is still won by firm N_2. But the second highest bid stems from firm N_3. Hence, the wage rate of the MNE-trained worker is:

$$w^{N_2}(2, N_2) = \underline{A}^2 \cdot L \cdot S_3 \cdot (1 - \chi) + \varepsilon . \tag{25}$$

The fact that the MNE training is not uniquely useful for just one indigenous firm but for many allows the worker to internalize the technology spillover via the bidding competition. However, this allows in turn the MNE to internalize even (part of) the technology spillover effect by decreasing wages in the first period even further and the net benefit to the host country decreases. In fact, the profit of the firm N_2 in period 2 is found to be:

$$\pi^{N_2}(2, N_2) = x(1) \cdot \left[1 - S_2^{-1} \cdot S_3\right], \tag{26}$$

which is positive if and only if $S_2 \neq S_3$. Hence, there will only be a net benefit of a foreign takeover to the host country if the expected technology spillover effect is very specific to only one indigenous firm which is not directly competing with the MNE. However, then the scope of this effect is likely to be small.

B) Imperfect Capital Market

Crucial for the strong result is the Lazear condition (16) which rests mainly on the hardly questionable assumption that learning takes time. However, the condition may break down if the assumption of a perfect capital market (free lending and borrowing) does not hold. To make a strong contrast, we assume complete lack of access of workers to the capital market.

We discuss first the case, when workers are homogeneous in the time preference rate λ. Then, condition (16) will be replaced by:

$$U\left(w^{M}(1,\tau)\right)+\lambda\cdot U\left(w^{\tau}(2,\tau)\right)=U\left(w^{N_i}(1,M)\right)+\lambda\cdot U\left(w^{N_i}(2,M)\right)=(1+\lambda)\cdot U\left(\underline{A}^{2}\right) \qquad (27)$$

for $\tau\in\{M,N_1,N_2\}$ and i=1,2, where U(.), U'(.)>0, U''(.)<0, is the period utility function of a representative worker. Note that the end game will not change under condition (27) and thus the wage of MNE trained workers, when staying with the MNE, will be larger in period 2 than prevails in the rest of the economy for a well-defined occupation (i.e. $w^{M}(2,M)>\underline{A}^{2}$). Hence, by the monotony of the utility function, it is still true that

$$w^{M}(2,M)>w^{M}(1,M). \qquad (28)$$

Workers still do not experience a welfare gain from foreign takeovers, because condition (27) requires the welfare of workers to be balanced, when either working for an MNE or not. The host country benefits only from foreign takeovers, if a technology spillover effect cannot be internalized by workers and some indigenous firm can increase its profits.

Next, we drop the assumption of a homogeneous time preference rate. Let there be m workers in the economy with time preference rates $\lambda_1>\lambda_2>...>\lambda_m$. Moreover, labor supply is exogenous and normalized to 1 and to make the case interesting $x(1)\cdot\underline{A}^{-2}>1$, i.e. the MNE will have to hire more than one worker. Integer problems will be evaded by assuming that a worker can partially supply her work to an indigenous firm and partially to an MNE.

Additionally, we assume that the MNE cannot observe the time preference rate of its workers. Now, equation (16) is replaced by (29):

$$U\left(w^{M}(1,\tau)\right)+\bar{\lambda}\cdot U\left(w^{\tau}(2,\tau)\right)=U\left(w^{N_i}(1,M)\right)+\bar{\lambda}\cdot U\left(w^{N_i}(2,M)\right)=\left(1+\bar{\lambda}\right)\cdot U\left(\underline{A}^{2}\right), \tag{29}$$

where $\bar{\lambda}$ is defined as the worker with smallest time preference still required to work for the MNE (formally: $\bar{\lambda}=\max\left\{\lambda_i \middle| i\leq\left(x(1)\cdot\underline{A}^{-2}\right)\right\}$). The MNE will offer a wage schedule over time that corresponds to (29). By self-selection, only workers i with time preference $\lambda_i\geq\bar{\lambda}$ will join the MNE. Hence, some workers will actually benefit from joining the MNE, because $U\left(w^{M}(1,\tau)\right)+\lambda_i\cdot U\left(w^{\tau}(2,\tau)\right)>\left(1+\bar{\lambda}\right)\cdot U\left(\underline{A}^{2}\right)$ if $\lambda_i>\bar{\lambda}$. This is indeed another source of a net benefit to the host country. Such a gain rests on the MNE being an imperfect substitute to a functioning capital market. Since only the most patient workers would self-select to work for the MNE, the implied interest rate $\bar{\lambda}$ would likely be below the market interest rate R if a perfect capital market existed. Hence, the MNE is able to charge lower wages in period 1 compared to the case of the otherwise identical model with a perfect capital market.

Yet another qualification has to be made: if worker utility $U\left(\underline{A}^{2}\right)$ is at the subsistence level or if there is a conclave economy with a highly developed foreign-owned sector, an underdeveloped informal sector, and no labor mobility in between, then our model does not apply. This may be the case for developing countries. Then, the learning and rent-sharing model of Görg et al. (2002) may be more appropriate.

C) More Time Periods

There is an artefact in the previous model that results from the assumption that the game ends after period 2. An untrained worker employed by the MNE in period 2 does not enjoy any learning benefits in the future. Hence, the MNE cannot discount the wage in period 2. To avoid this artefact, we assume that firms exist forever, but workers only for 2 periods. The time index t denotes now the two life periods young and old of a worker of a generation. The full game is an infinite repetition of these two life periods. Then, MNEs will always hire the young generation, because only young workers benefit from learning in the next period.

Under these assumptions the game solution changes only in one respect: the MNE can hire in regime $\tau=N_i$, i=1,2, an untrained young worker at the wage $w^M(1,N_i)$ in t=2, which will be below the rate $\underline{A}^2$ that prevails elsewhere in the market for untrained workers. Intuitively, this will lower the maximum offer that the MNE is willing to pay for the trained worker during period 2, because the outside option has become cheaper. In fact, we find that

$$\hat{w}^M(2,M)=\underline{A}^2\cdot\frac{1+R}{L^{-1}+R}<\underline{A}^2\cdot L. \tag{30}$$

Still, this is larger than what firm N_1 would be willing to offer which is below $\underline{A}^2$. The equilibrium of this modified game will then be:

$$T=\begin{cases}N_2 & if\ L\cdot S_2\cdot(1-\chi)\geq\dfrac{1+R}{L^{-1}+R}\\ M & else\end{cases} \tag{31}$$

The term on the right hand side of the inequality in (31) is smaller than L, and MNE-trained workers will normally move to firm N_2, even when the technology spillover effect is absent (S_2=1). Interestingly, the local firm that hires MNE-trained workers increases its productivity, but there is still no welfare gain to the host country without technology spillover externality and U-shaped wage profile. The empirical FDI literature investigates such productivity increases, e.g. Aitken and Harrison (1999). In the light of our model, this is not sufficient to conclude on FDI technology spillover effects and host country welfare gains.

D) Cournot Competition

The results so far are obtained from a model that assumes Bertrand competition. Next, we show that our results are also obtained from a simple Cournot oligopoly model. To keep the analysis short, we assume that there is an MNE affiliate M, one indigenous firm N in the same sector and in addition the "rest of the economy". Moreover, we assume a linear goods market demand function: $p=a-b(x^M+x^N)$ with parameters a, b such that $a > 2 - \underline{A}/\overline{A}$ and $b>0$.[10] Otherwise, the assumptions of the benchmark model are sustained.

It is straightforward to find the maximum offer that an MNE affiliate is willing to make for MNE-trained workers in period 2:[11]

$$\hat{w}^M = \frac{1+2\left(\underline{A}/\overline{A}\right)}{S_1^{-1}+2\left(\underline{A}/\overline{A}\right)} \cdot \underline{A}^2 \cdot L. \tag{32}$$

The maximum wage offer will be $\underline{A}^2 L$, if there are no FDI technology spillover externalities ($S_1=1$) and else larger. Likewise, the maximum offer of the indigenous firm is found to be

$$\hat{w}^N = \frac{2+\left(\underline{A}/\overline{A}\right)}{2S_1^{-1}+\left(\underline{A}/\overline{A}\right)} \cdot \underline{A}^2 \cdot L. \tag{33}$$

It is easily seen from (32) and (33) that the bidding competition for MNE-trained workers is won by the indigenous firms if and only if technology spillover externalities exist ($S_1>1$). Otherwise, the MNE offers the same wage as the indigenous firm but MNE-trained workers can avoid the marginal moving costs χ and stay with the MNE. Formally, result (23) applies also in the case of Cournot competition.

This result is in contrast to Glass and Saggi (2002), although both models are Cournot duopolies. Notably, the deviating assumption of our model – learning takes time – changes not only the first stage of the game but also the last one (period 2). If learning occurs instantaneously, instead, then the MNE looses its outside option to hire an untrained worker, because every employee is immediately trained by assumption. This change of the game is sufficient to exclude the outcome that the indigenous firm wins the bidding competition even

[10] The restriction on a is a sufficient condition to ensure that no natural monopoly emerges. This condition is also necessary if $S_1=L=1$.

without technology spillover externalities in the case of a large technology gap. The Lazear condition (16) and the fact that the wage in period 2 is at least $\underline{A}^2 L > \underline{A}^2$ ensures that the U-shaped wage pattern continues to hold.

Turning to the welfare effects, there arises a slight modification compared to the previous models. With Cournot competition, price effects arise from technology spillover effects that affect the consumer surplus. The product price in period 2 is found to be in equilibrium:

$$p = \frac{1}{3}\left[a + \left(\underline{A}/\overline{A}\right) + \frac{1+2\left(\underline{A}/\overline{A}\right)}{1+2S_1\left(\underline{A}/\overline{A}\right)} \right]. \tag{34}$$

Since the learning effect L does not appear in (34), the host country does not have an increase of its consumer rent from learning alone. A contrasting result emerges, however, from FDI technology spillovers ($S_1>1$). The larger the technology spillover externality S_1, the more decreases the product price and the larger is the gain of the host country in consumer rent. Indigenous firm profits are also independent from learning effects L:

$$\pi^N = \frac{1}{9b}\left[a + \left(\underline{A}/\overline{A}\right) - 2 \cdot \frac{1+2\left(\underline{A}/\overline{A}\right)}{1+2\left(\underline{A}/\overline{A}\right)S_1} \right]^2 \tag{35}$$

However, they rise with the extent of technology spillover externalities ($S_1>1$).

Summing up, in a simple model of Cournot competition our results are mostly qualitatively sustained. The only major deviation to the previous analysis stems from an additional channel besides indigenous-firm profits through which the host country can benefit from technology spillover externalities: product prices will fall and consumer surplus increase.[12]

2.3) Hypotheses

[11] Calculations are available from the authors upon request.
[12] This fall in product prices due to technology spillover externalities is additional to the effect that new MNEs increase product market competition and drive down profit mark-ups.

Before turning to the empirical analysis, we formulate the testing hypotheses that have emerged from the theoretical model. Since we cannot follow workers in our data when changing firms, we re-interpret the incidence of worker turnover as firm takeover. Whenever a firm is taken over by foreign investors, all its workforce has changed status from working in a firm with domestic owners to one with foreign owners. With this qualification the model can be applied to our data. We formulate as H_0 the hypothesis that there are no significant direct benefits from technology spillover externalities to Hungary. The first H_A (H_{A1}) will be that the regime of the model applies where such net benefits arise. The second H_A (H_{A2}) will be that the model of Fosfuri et al. (2001) applies.

In particular, the H_0 describes an immediate drop of wages relative to the counterfactual of no takeover and a recovery in subsequent years. Moreover, worker turnover drops after takeover and productivity is rising slowly in the years after takeover. Instead, the H_{A1} suggests a permanent drop of wages after foreign takeover below the counterfactual, a rise in worker turnover, and a rise in firm productivity. Finally, the H_{A2} requires that a positive wage premium arises immediately after takeover, productivity jumps up, and worker turnover falls. Hence, the three observations on wages, productivity, and worker turnover are sufficient to discriminate unambiguously among the three hypotheses. Next, we turn to the empirical analysis to test these three hypotheses.

3) Data

3.1) Macroeconomic Background

Hungary opened up to foreign investors earlier than most other Central and Eastern European Countries (CEEC) both by large-scale privatization and by introducing a liberal regime for greenfield investment. The FDI/GDP ratio reached over 40 % in 2001, which is close to the

50% of Ireland and well above the EU average (UNCTAD, 2001). In the same year, 27% of the workforce in the business sector is employed in MNEs. An important factor behind the growth of inward-FDI is a generous investment incentive scheme including, among others, tax breaks, free trade zones for individual firms, grants, and loan guarantees[13].

In the year 1995, a stabilization program was implemented. There was a significant rise in the tariffs for imports, a crawling-peg devaluation of the national currency, and the privatization of the state-property in telecommunication-, electrical-, banking- and insurance industries, among others. GDP growth was accelerating after the reform program from 1997 onwards. Hence, we will have to control for time breaks by appropriate tests and time-fixed effects. Importantly, the typical post-transition slump of the economy is outside our data period and does not interfere with our analysis.

The Hungarian collective bargaining system is mainly firm based.[14] About 10% of the workforce is organized in trade unions industry-wide and about 30% on firm level (Héthy, 2002, p. 11, and Neumann, 2000, p.52). Hence, there are no significant institutions that prevent wages below a nation-wide average. This is in contrast to the studies of Martins (2003) and Heyman et al. (2004) on Portugal and Sweden, respectively, where wages are much more inflexible.

3.2) Data Description

Our analysis is based on the Hungarian „Structure of Earnings Survey" (SES). The SES data have been collected by the Hungarian Employment Office. The SES is a cross-section random sample of employees that contains detailed information about monthly gross earnings which

[13] Interestingly, foreign-owned firms' share in pre-tax profits (around 65 %) is at least five times as high as their share in corporate profit taxes (around 12 %), indicating generous tax breaks for foreign investors (OECD, 2002, p. 111 ff).

includes monthly gross basic wage including ordinary allowances (overtime or nightshift allowances) and 1/12 part of the unordinary premium received in the last year. The data collection occurred in May of every third year in 1986, 1989 and 1992, and from 1992 on every year. Since Hungary was not a market economy in earlier sample years, we consider only data from 1992 until the most recent year 2001.

A random sample is drawn from all employees in firms with a minimum threshold number of 20 employees. We restrict ourselves also to employees in the manufacturing sector as in Aitken et al. (1996).

Unfortunately, we are unable to follow an individual across years. However, we are able to follow firms across years. Hence, we pool all annual cross section employee data which are connected across years by their firm identifier. This distinguishes our data from Kertesi and Köllő (2001) which studies wages and foreign-owned firms in independent annual cross-section datasets. If no worker is drawn randomly in a year from a firm, then it disappears from our sample in this year. However, thanks to the large size of the SES samples (6-7% of total employment among the covered firm-size) there is a high probability that at least one employee of a firm reappears in subsequent years. Indeed, the average number of observations per firm is 5.6 out of a maximum of 10. Summing up, our employee data are representative for Hungarian manufacturing employees in firms with more than 20 employees, but small firms may be under-sampled, as they form shorter panels, because the probability is larger that none of its workers is drawn into the sample for some years.

Using the firm identifier[15], balance sheet and profit and loss account data are merged into the employee dataset.[16] In particular, we have information on the called-up share of capital and

[14] However, all workers are covered with a statutory minimum wage which is bargained yearly on a tripartit forum of employees, employers, and state. This minimum wage is mostly below market rates.

the equity share of different types of owners (foreign, domestic private or state ownership[17]). We define a firm to be foreign owned if the share of foreign owners in the called-up share of capital exceeds 50%. Three types of foreign-owned firms appear in our dataset. First, a firm appears in our sample with less than 50% foreign equity participation and turns in a latter year into a firm with more than 50% foreign equity participation. We call these firms foreign takeovers of domestic firms.[18] Second, a firm appears in the first year of its sample life as a foreign owned one, but its foreign participation rate drops below 50% in a subsequent year. We call these firms domestic takeovers of foreign-owned firms. Third, firms enter the dataset with a participation rate above 50% and stay this way throughout their sample life. Unfortunately, we cannot be sure whether these firms are greenfield investments, although many of them probably are. Particularly, if a firm of the third type is small, it may not have been sampled before, although it existed. But then, this firm may have experienced an ownership change outside the sample and thus may be a foreign takeover. Moreover, we know for some years whether a worker was previously employed in a firm. We find frequently foreign-owned firms that enter our sample but employed already at least one worker in previous years. Hence, there may be additional takeovers among those firms that we observe as foreign-owned throughout their sample life. However, we can be sure about all cases that we identify as foreign takeovers.

A particular problem is multiple ownership change in the case of 63 firms (3856 observations). Quite often this multiple ownership change was erratic due to foreign

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[15] The firm identifier of our dataset is identical with the firm registration code used by the Hungarian Tax and Financial Control Administration and therefore very reliable.
[16] We thank Jozsef Becsei from ECOSTAT in Hungary and his colleagues for their help in collecting the firm data.
[17] Hardly any foreign takeovers of state-owned firms occured in our sample. Privatization of manufacturing occured by and large before our sample period.
[18] Originally, the firm identifier – firm fiscal code – changed if a completely new owner took over a company, but stayed the same if the foreign owner had previously a minority stake. However, Gábor Kőrösi of the Hungarian Academy of Sciences was able to identify fiscal code changes of existing plants and we used this information for identifying takeovers. Unfortunately, in the years 1995, 1996 and 1998 this procedure was not possible.

ownership participation rates close to 50% in general and some years slightly above and others below. Since it is not obvious how to classify these cases, we decided to exclude these observations (about 1% of our sample). Their small number cannot possibly affect our results.

Turning to the control variables, we have gender, experience[19], 4 categories of education levels (primary school-, vocational school-, secondary school participation, and higher education), 3 occupation categories (blue collar, white collar non-managerial, white collar managerial)[20] or a 4-digit occupation code (HSCO-93) with 532 categories[21], average labour productivity (value added per worker) [22], capital intensity[23], the share of white collar workers in total firm employment, operating profits, and a 2-digit NACE industry code. Moreover, we apply in all regressions a firm size category code with the five firm size categories 21-50, 51-300, 301-1000, 1001-3000, and more than 3000 employees per firm[24]. In addition, we have a region code which captures 7 Hungarian NUTS 2 regions which are further divided into countryside, cities, and county capitals. Fortunately the region code is based on plant location rather than firm-headquarter information. Hence, the region code is quite reliable.[25]

We have 346674 full-time employee observations of 7198 different firms in our ten-year panel all together. The number of the sampled firms increases from 2189 to 2925 over the years, the number of employee observations in a year from 30093 to 37473. This reflects both the growth of the Hungarian economy as well as the increasing significance of inward FDI. Table 1 shows the decomposition of firm types within our sample in each year. There are 214 foreign takeovers of domestic firms (6958 employee observations in the year of takeover),

[19] Age minus years spent in school minus common entry age into school (6 years). See Kertesi and Köllő (2001) for the precise definition.
[20] See Kertesi and Köllő (2001) for the precise definitions.
[21] The 4-digit occupation code changed after 1993 and is not compatible with previous years. Whenever applying 4-digit occupation fixed effects regressions, our dataset will be reduced to the years 1994-2001.
[22] The nominal values (in Hungarian Forint) were deflated with the official Consumers Price Index published by the Hungarian Central Statistical Office. Source is Fazekas (2003).
[23] Capital intensity is calculated as book value of fixed assets per employee.
[24] See Oi and Idson (1999) for a review on the evidence that firm size explains wages.

and 125 domestic takeovers of foreign-owned firms (2117 employee observations in the year of ownership change). Foreign takeovers are more or less evenly spread over the sample period and we do not expect any disturbances of our results from particular events or the sample window.

Insert Table 1 about here

4) Results

4.1) Foreign-owned Firms and Wages

We first replicate a standard wage regression for Hungary as in Kertesi and Köllő (2001) which explains monthly gross wages of a worker by her education, experience, occupation, gender, average firm labour productivity, capital intensity, firm size, year-, region- and industry dummies. In addition, the variable of interest is a dummy with value 1 whenever an employee is working for a foreign-owned firm. The result is displayed in Table 2, specification (1).

Insert Table 2 about here

We confirm the result of Kertesi and Kollő (2001) on the same data and even the results of Aitken et al. (1996) on a worker survey rather than firm data; there is a wage premium paid by foreign-owned firms over the one of indigenous firms of 15 % even after controlling for worker and firm characteristics. The coefficients of the control variables are as expected. Gross wages are the higher the better the education, the higher a firms' average labour productivity and its capital intensity. Moreover, there is a typical non-linear relation between

[25] See Fazekas (2000) for a description of this region code and the regional Hungarian inward FDI pattern.

gross wages and job-experience. Male workers earn about 22% more than female workers and white-collar more than blue-collar workers.

In deviation from Kertesi and Köllő (2001), we pool observations on all years together. Hence, we check for a structural break of our results over time. Since there was a break in GDP growth, we present in specification (2) and (3) of Table 2 results on observations until 1998 and after 1998, respectively. While some coefficients of control variables differ across the two sample halves, the coefficient on the foreign-ownership dummy does not. We also estimated the wage premium for each year separately and found a variation between 14% and 16% (not reported in the Tables). Hence, we are confident that pooling all observations across years does not affect the estimates on our variable of interest.

Next, we investigate whether the wage-premium may stem from MNEs having a different employment structure than indigenous firms. For example, MNEs may undertake more specialized production steps due to intra-firm specialization and apply over-proportionately many workers for who learning-by-doing is more important than formal training. Then the wage premium may pick up the effect from MNE specialization in high-skilled, but low-formal-training jobs. When adding fixed effects for 532 occupations, however, the wage premium not only does not disappear, it even remains the same (specification (4) of Table 2).

One of the possible explanations for the wage premium of MNEs is due to some unobservable firm characteristic that is particularly frequent among MNEs. For example, MNEs may frequently produce high-quality goods and pay a premium for a particular care that workers apply at their work. Abowd et al. (1999) found on French firm and worker survey data that gross wages depend both on unobserved worker characteristics and on unobserved firm characteristics. While we cannot implement worker fixed effects without worker-identifier, we introduce in specification (5) of Table 4 firm fixed effects without the foreign-ownership dummy. We observe that firm-fixed effects increase the R^2 from 0.56 to 0.67. Hence, there may exist some firms that follow a high-wage policy and others a low-wage policy.

Finally, we add the foreign-ownership dummy in specification (6) of Table 2 to the specification (5) with firm fixed effects. Now, we need to be careful in the interpretation of this dummy. Since there are firm-fixed effects and ownership is a firm characteristic, the foreign-ownership dummy explains only wage differentials between these domestic and foreign-owned firms that change their ownership status in the sample. Surprisingly, the wage premium drops substantially to a mere 3% while still remaining significant at the 1% level. This result suggests that takeovers behave fundamentally different to foreign-owned firms in general and will thus be the focus of the rest of this study.

4.2) Takeovers and Wages

So far, we found that ownership change between domestic and foreign investors may be correlated with the wage premium, but it is neither possible to follow the time-profile of a takeover firm nor to distinguish the two directions of ownership change. Hence, we consider next the wage premium of foreign takeovers one year before the ownership change, the year of the ownership change, one year thereafter, two years thereafter, and three and more years thereafter. Ownership change is noticed by the change of foreign participation in firm equity from below 50% to above, when comparing one end-year balance sheet to the previous one.[26] Specification (1) of Table 3 includes these takeover dummy variables together with the control variables that were already used in Table 2. However, the control variables are suppressed from now on to ease presentation of the results.

Insert Table 3 about here

[26] We consider only observations with firms that remain at least more than two years after takeover in the sample to alleviate window-end problems. See Heyman et al. (2004) for a similar proceeding.

Foreign-takeover firms have already an 11% wage premium before takeover compared to the average Hungarian manufacturing firm even after controlling for employee-, location-, industry-, and firm characteristics. This indicates the presence of some unobservable characteristics of their labor force that motivates them to pay higher wages. For example, particularly talented workers may be hired by those firms that become later takeover targets. The wage premium may reflect the particular (unobservable) quality of the workforce. A similar result is found by Heyman et al. (2004) for Sweden. We do not further investigate the reason for the wage premium before takeover in this study.

It is stunning that the wage-premium actually drops right after the foreign takeover by about 6%. Only in subsequent years, the wage premium rises slightly above the level before the takeover which explains why there is a small wage premium of foreign-owned firms when controlling for firm-fixed effects in the previous table. Wald-tests confirm the significance of the wage drop directly after takeover and the wage rise, when comparing them three or more years after takeover with one year thereafter. Such a U-shaped wage profile before and after a foreign takeover is in line with the regime of our theoretical model, when the host country does not benefit directly from technology spillover effects (H_0). This result is, however, in strong contrast to the previous literature (H_{A2}) which suggests that foreign-owned firms pay higher wages for comparable jobs and a foreign takeover implies a rise of wages, not a fall.

In the same regression, we control also for domestic takeovers of foreign-owned firms. Foreign-takeover firms pay a wage premium larger than the average domestic takeover of previously foreign-owned firms, and the later a wage premium on the average domestically owned firm in the economy. There is no clear trend in the development of wages of domestic takeovers of foreign-owned firms. Still in the same regression, we include also dummies for those foreign-owned firms that may be greenfield investments or unverifiable foreign takeovers. These firms have clearly the largest wage premium and it is even increasing the longer these firms are in the sample. This suggests that our findings remain restricted to foreign takeovers only, since greenfield investments may be different.

Next, we add firm-fixed effects in specification (4) of Table 3. The U-shape wage-premium time-profile of a takeover firm remains valid. Moreover, the long-run wage premium of acquired firms is substantially larger than their pre-takeover value. In addition, firm-fixed effects increase mildly the R^2 of the regression. A formal F-test confirms the significance of firm fixed effects. Specification (5) uses 532 occupation fixed effects instead of firm fixed effects, and specification (6) is an OLS estimator on the reduced sample size of specification (5) for comparison, because occupation coding is only available from 1994 onwards. The U-shaped wage premium development before and after takeover remains virtually unchanged.

Bertrand et al. (2004) argue in the context of the program evaluation literature that autocorrelation is a serious problem and recommend to apply the autocorrelation and heteroscedasticity consistent covariance matrix of Arellano (1987). Moreover, our variables of interest vary only across firms and this causes the Moulton problem. Again, the problem is resolved by applying this covariance matrix. The results are displayed in Table 4.

Insert Table 4 about here

Unfortunately, the standard errors of the estimated coefficients increase substantially indicating strong correlations of the error term of observations within a firm. As a result, the decrease of wages after takeover is no longer significant in the baseline specification (1). In contrast, the rise of wages over the years after the takeover is still highly significant. The same result is obtained, when adding occupation fixed effects in specification (2). To understand this result better, we distinguish newly hired workers one year after the takeover from those who were employed by the firm already previous to the takeover. We find that the wage of newly hired workers is indeed significantly lower than a comparable wage before takeover. Instead, the wage decrease of workers already appointed at the firm previous to the takeover is marginally insignificant both when controlling for occupation fixed effects (specification 4) and without (specification 3).

The strong wage discount of newly appointed workers right after a foreign takeover may have two explanations. First, there may be a composition change of the workforce in terms of unobservables. For example, if newly appointed workers have unfavorable characteristics unobservable to econometricians but observable to firms (e.g. talent), then wages of new workers appear to be discounted for a given occupation, education and experience level. It remains unclear though why MNEs would hire workers with unfavorable unobservable characteristics. Second, there may be long-lasting wage contracts. After a takeover, wages of previously employed workers cannot all immediately adjust due to fixed contracts, while this constraint does not apply to newly appointed workers. Although the latter explanation is more plausible we are not able to discriminate them. We focus in the following on establishing wage drops of previously employed workers right after a foreign takeover.

Insert Table 5 about here

In Table 5, we split the sample according to occupation and education. The first three specifications divide the sample in blue-collar, white-collar non-managerial, and white-collar managerial workers, respectively. Interestingly, we do not find a change of wages significant at the 5% level during the course of a takeover for blue-collar workers. This is in line with our theoretical model, because we would not expect that technology spillovers are relevant for this occupation group. Instead, we expect that higher positions or better educated staffs are subject to technology spillovers. Indeed, we find both a significant decline of wages after the takeover and a rise again three years or later of white-collar non-managerial workers regardless of being newly appointed or not. A different pattern emerges again for white-collar managerial workers. There is a rise in the wages of newly hired ones after takeover contrary to the other worker types. We suspect that this increase of wages reflects foreign managers who come in as supervisors and are rewarded both for the discomfort of living abroad and the larger wage level that prevails in the home country of the foreign investor. Since there is no coding for nationality of workers, we are unable to exclude those observations from the sample and we have to keep in mind that this will bias results.

The alternative sample split on education yields a very similar picture in specifications (4)-(6). Workers with vocational training or less do not have a significant wage premium change during the course of the takeover. Employees with secondary education are subject to quite a strong and highly significant U-shaped wage premium profile during the course of a takeover, as do university-degree employees despite the problem with foreign managers.[27]

4.3) Controlling for Selection on Observables and Unobservables

In a final step, we want to shed light on (self-) selection of workers. For this purpose, we employ difference-in-difference, matching, and control function techniques.[28] A foreign takeover of an indigenous firm can be considered a treatment. The research question is: what would have happened to wages if the firm had not been taken over?

We apply 3- or 4-stage estimations for repeated cross-section data following Blundell and Costa Dias (2000). In a first stage, we estimate by the nearest-neighbor matching method:

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[27] The group of employees with university degree is quite large compared to the group of white-collar managerial workers. Hence, the bias from foreign managers may be much weaker in regressions on workers with university degree than on white-collar managerial workers.

[28] There exist countless surveys on matching techniques. See, among others, Heckman and Smith (1997), Heckman, Ichimura, and Todd (1997, 1998), Vella and Verbeek (1999), Blundell and Costa Dias (2000), Wooldridge (2002), chapter 18, Heckman and Navarro-Lozano (2004), Imbens (2004), and Blundell et al. (2004) for some overview.

$$\Delta W_{it+1}^{T} \equiv w_{i,t+1}^{nn} - w_{it} \quad for \quad i \in T \ , \tag{36}$$

where w_{it} is the monthly wage rate of worker i in year t, T the set of observations containing workers who are employed in a firm one year before takeover (treatment group), and $w_{i,t+1}^{nn}$ is the wage of a worker in period t+1 of a firm after foreign takeover that corresponds best in observable characteristics to worker i. Nearest neighbors are identified by the score of a regression of wages with the same control variables that were applied in Table 4 on observations of employees in foreign-takeover target firms directly before and after the takeover in year t and t+1. This procedure is repeated for each year-pair in the sample. In a second stage, a variable ΔW_{it}^{C} is calculated analogously using only observations of workers in firms that are never taken over by foreign investors C (control group). These two stages are not reported but available upon request.

Our variable of interest is the average treatment effect on the treated (ATT). It measures the average wage change caused by the foreign takeover and intends to control for workforce selection effects of the takeover firm on average-firm wage cost. Hence, the product of ATT and the number of workers in foreign takeovers yields the change in the Hungarian wage bill caused by foreign M&As. The ATT is formally defined in our context as:

$$ATT = E\left[\Delta W_{it}^{T} - \Delta W_{it}^{NT} \middle| i \in T\right], \tag{37}$$

where ΔW_{it}^{NT} is the wage growth of workers in foreign takeovers under the presumption that the firm would not have been taken over. Since ΔW_{it}^{NT} is not observable, there are several ways to replace it with observable variables. Accordingly varies the third stage of estimation.

If we assume that the foreign-takeover decision is random, we can replace ΔW_{it}^{NT} by ΔW_{it}^{C} (see Wooldridge 2002, chapter 18). Then, ATT can be calculated by running regressions of $\left[\Delta W_{it}^{T}, \Delta W_{it}^{C}\right]'$ on a varying set of control variables X and the dummy variable D which takes value 1 if a worker-observation belongs to a firm one year before takeover of a foreign investor. These regressions mimic the difference-in-difference method in the case of repeated cross-section data. A positive (negative) coefficient on D may be caused by faster (slower) learning of workers in foreign-takeover firms or by a decomposition change within workplaces according to unobservable worker characteristics. Results are biased by possible heterogeneity of the treatment effect and by non-randomness of the foreign-takeover decision. Such estimation underlies specifications (1)-(7) in Table 6.

However, it is likely that foreign investors choose carefully their takeover targets according to their profits, quality of the workforce, technology and other assets, location, and industry, among other factors. Matching techniques are typically used to find a control group of indigenous firms that are not taken over by foreign investors but fit best in observable characteristics to the takeover firms to exclude such a selection bias. In specifications (8)-(14), we employ matching techniques.[29] In particular, an unreported probit estimate of D on a set Z of firm and worker characteristics is undertaken and the propensity score ϕ is calculated. Based on this propensity score, various standard matching methods are applied on $\left[\Delta W_{it}^{T}, \Delta W_{it}^{C}\right]'$. An important assumption of matching techniques is that there is no correlation of the two error terms of the selection equation and the wage regression.

Heckman (1979) suggests a two-stage procedure to control for such a correlation. First, a self-selection correction term λ is calculated from a probit propensity score estimate ϕ of D on Z[30], i.e. $D=1(m(Z)+\nu\geq 0)$ with 1(.) indicator function, m(.) an appropriate functional form, and ν selection equation error term,

[29] We use the STATA program psmatch2 of Leuven and Sianesi (2004). Whenever several nearest neighbours with identical propensity score exist, then the wages are averaged across them.
[30] X may be a subset of Z. For proper identification, Z should contain at least one variable additional to X (exclusion criterium). We use the share of white-collar workers in a firm, and its interaction term with other labor market characteristics in Z to obey the exclusion criterium. The share of white-collar workers is a firm

$$\lambda = D \cdot \frac{\phi}{\Phi} + (1 - D) \cdot \frac{-\phi}{1 - \Phi}, \tag{38}$$

where Φ is the cumulative density function corresponding to ϕ and function arguments are suppressed for convenience. Second, an augmented regression is run as follows:

$$\left[\Delta W_{it}^{T}, \Delta W_{it}^{C}\right]' = Xb + dD + \rho\lambda + \varepsilon, \tag{39}$$

where b, d, and ρ are regression coefficients and ε the usual error term. Moreover, it holds that sign[ρ]=sign[cov(ε,ν)]. A significantly positive ρ implies that the foreign investor targets firms in period t that have a workforce with particularly large unexplained wage growth in period t+1 independent of the takeover event when controlling for observable worker and firm characteristics in t.

Insert Table 6 about here

Without any control variables, the differential wage fall after takeover is 4 % and highly significant, as can be seen from specification (1) of Table 6. The result sustains, when adding more control variables in specification (2), but collapses, when applying heteroscedasticity and autocorrelation consistent standard errors in specification (3). Next, we allow the treatment effect to be heterogeneous across treated individuals by interacting the dummy variable for employees before takeover with individual characteristics such as education, occupation, experience, firm size and gender. Now, the wage drops by 7% and becomes highly significant again. Since heterogeneity seems to matter, we split next the sample according to education level. Employees with vocational training or less have an insignificant wage drop after takeover, while employees with secondary education have a highly significant wage fall of 8%. Employees with university degree have no significant change in the wage premium after takeover. However, the standard error is extremely large indicating that there is

characteristic that may explain the probability of takeover of a firm, but is not needed to explain individual wages, since we control for occupation by an individual characteristic.

heterogeneity of wage setting in this group. This result is consistent with the hypothesis that few foreign managers obtain a wage that is well above the average for such positions. Since they are new in the sample after takeover but still matched to the old managers with the same job characteristics, their wages will show up as a wage increase after takeover that may compensate the wage decrease of domestic employees with university degree. Since we are unable to identify exactly foreign managers in our sample, we will henceforth focus on the education group with secondary education.

Next, we turn to third stage matching techniques that control for observable selection bias by modeling the foreign takeover decision. The selection equation explains the probability of a firm being a takeover target by their share of white-collar workers, their average labour productivity, and their operating profits besides region-, industry- and year dummies. We also include personal characteristics. The propensity score is obtained from conditional logit estimation with occupation fixed effects.[31] A nearest neighbor match based on the propensity score yields an ATT of -6% which is significant at the 5% level according to a bootstrapped bias-corrected percentile distribution with 200 repetitions.[32] The result is robust to reducing the caliper size such that only 89% or 67% of all treated observations have a matching partner. It is also robust to 25-nearest neighbor matching, radius matching, or kernel matching techniques at various bandwidth parameters.

Finally, Heckman estimates imply a wage drop of 19% among workers with secondary education after takeover. At the same time the hazard-rate estimate ρ is positive and highly significant. As argued before, matching techniques do thus not take into consideration that

[31] The pseudo R^2 is 0.2. However, Heckman and Navarro-Lozano (2004) show that this is no guarantee for a correct specification. In fact, bias may even increase if information is added to the selection equation, as long as the minimum relevant information set is not available to the econometrician. Occasionally, covariance imbalancing is tested to ensure that the propensity score is a proper index for neighborhood of all covariates. However, Imbens (2004), section 3.3.2, points out that this is a rule of thumb.

wage growth is above average in takeover-target firms due to some unobservable characteristics. Since this target-firm characteristic cannot be identified against the wage drop caused by the foreign-takeover event, the estimated wage drop assigned to the takeover event picks up partially the contrary effect of the unobservable target-firm characteristic. Hence, matching techniques underestimate the wage drop caused by the foreign-takeover event. One possible explanation could be that foreign-takeover target firms have very innovative workers who constantly improve upon firm efficiency and are consequently rewarded with larger wage growth relative to workers in firms that are not innovative. The unobservable innovation potential may, however, be exactly the reason for the foreign takeover thereby causing a positive correlation of ε and ν, and thus a positive ρ.

4.4) Productivity and Worker Turnover

We turn now to the other two stylized facts of our model. We first compare the development of total factor productivity before and after takeover compared to the benchmark of indigenous firms. For this purpose, we estimate a production function with value added per worker as dependent variable and capital intensity, share of white-collar workers, firm-, region-, year dummies, and the same takeover dummies as in Table 3. Although we estimate a firm regression, we weight each observation by the number of employees per firm in our worker sample to keep the results across datasets comparable. The numbers of observations that are reported in Table 7 are then inflated by the weights.

Insert Table 7 about here

Interestingly, the OLS results in specification (1) of Table 7 show that total factor productivity rises gradually over the years after the takeover. There is no significant fall in productivity

[32] When applying the bootstrap, we ignore the estimation error that may occur from the first two matching stages and the estimation of the propensity score. While it would be principally possible to include these errors, such an

immediately after takeover at the 5% level, even when controlling for firm fixed effects and applying the Arellano (1987) covariance matrix in specification (2). This result is in line with our assumption of gradual learning.

Next, we investigate labor turnover. Since we do not have this information directly, we proceed in two steps. First, we estimate a regression with firm employment as dependent variable and control variables analogue to the production function estimation of specification (1). From specification (3) and (4), we can see that employment of foreign acquisitions rises significantly by about 11% over the years after takeover. In a second step, we employ a variable that indicates whether a worker is new in this firm or has been working for it already in the previous year. This variable is available in our dataset over five years from 1997 until 2001. Specification (5) estimates a Logit-regression to explain the probability of a worker of being new in a firm. As control variables are used those for the wage regressions. The probability that a worker is new in the firm is falling below average over the years after the takeover. This is still true, when applying clustered standard errors in specification (6). If the probability of being a new worker falls while employment rises, then the newly hired workers stick firmly to the acquired firm in the long run and the worker turnover rate must drastically decrease. However, this rejects the regime of our model, where MNEs specialize in training workers and local firms benefit through technology spillover effects from hiring them.

Overall, only H_0 is consistent with all three stylized facts that are investigated in this study and we conclude that our empirical evidence is in line with our theoretical model in the regime, when the host country does not directly benefit from technology spillover effects through foreign acquisitions.

5) Conclusion

enlarged bootstrap is beyond computational feasibility (expected computer running time is several years).

The FDI technology spillover debate is one important approach to produce a piece of evidence for whether and how host countries may benefit from MNEs. We have investigated this issue by setting up a theoretical model which assumes that learning from MNEs takes time. Then, MNEs are able to internalize learning externalities by offering lower wages before and higher wages after learning has taken place. We find such a wage profile for high-skilled workers in foreign-takeover firms in Hungary even when employing techniques that control for takeover selection bias by observables and unobservables. We also find that the productivity of foreign takeovers grows slowly over the years after the takeover, which justifies the assumption that learning takes time. Finally, the worker turnover rate drops after takeover. Because MNE workers are not hired by local firms, there cannot be technology spillover effects. Otherwise, local firms would overbid the MNE on MNE-trained workers. Since, in addition, MNEs are able to internalize learning gains of their workers through the wage-time profile, host countries do not benefit from learning or technology spillovers.

Several caveats remain with respect to our analysis. First, our results apply only to foreign takeovers due to lack of data to identify greenfield investments. Second, we are able to control for takeover decision selection bias on observable and unobservables, but we are unable to control for unobservable time-invariant characteristics of workers in the wage regression.

Our results have several implications for the FDI literature. First, when employing a theoretical model to guide the empirical research, we show that productivity gains of indigenous firms through FDI technology spillovers are not sufficient to conclude on welfare gains of a host country. Instead, host-country benefits may materialize by higher indigenous firm profits or lower product prices after foreign takeover in a sector. Finally, FDI spillover effects may eventually become effective through general equilibrium effects such as increased demand for labor and increase of the wage level of the entire economy which cannot be shown with micro-data, because the cross-country variation is typically missing.

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Tables and Figures

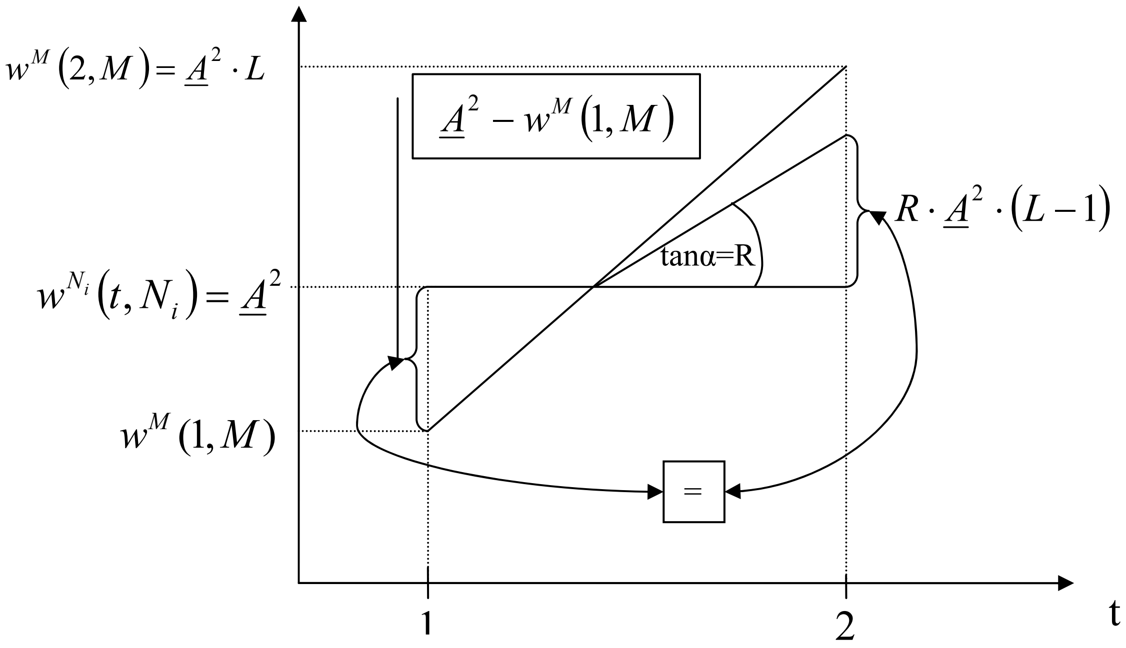

Figure 1: The Lazear-Condition

Table 1: Domestic and foreign-owned firms and number of ownership changes in the sample

Year	# indigenous firms	# foreign-owned firms	# new foreign takeovers of domestic firms	# new domestic takeovers of foreign firms	# new unclassified firms with foreign ownership
1992	1950	239	28	8	205
1993	2110	426	22	3	183
1994	2197	513	31	9	114
1995	1968	583	25	10	121
1996	1821	613	25	21	73
1997	1779	653	18	12	85
1998	1817	681	12	25	81
1999	1885	728	27	17	96
2000	2076	843	26	20	139
2001	2093	832	-	-	100
Total	-	-	214	125	-

Source: SES database and own calculations;

Table 2: Wage regressions with foreign-ownership dummy variable

Dependent Variable: Log Gross Wages	OLS (1)	OLS 1993-1998 (2)	OLS 1999-2001 (3)	Occupation FE† (4)	Firm FE‡ (5)	Firm FE (6)
Foreign Ownership	0.15*** (88.16)	0.15*** (70.56)	0.15*** (47.35)	0.15*** (84.77)	-	0.03*** (10.33)
EDUCATION1	0.15*** (90.00)	0.16*** (79.00)	0.13*** (43.15)	0.10*** (54.49)	0.15*** (97.78)	0.15*** (97.83)
EDUCATION2	0.27*** (135.02)	0.29*** (123.64)	0.21*** (56.69)	0.18*** (73.72)	0.27*** (142.13)	0.27*** (142.19)
EDUCATION3	0.72*** (194.28)	0.74*** (173.52)	0.63*** (88.20)	0.43*** (82.80)	0.71*** (205.78)	0.71*** (205.46)
EXPERIENCE	0.06*** (44.85)	0.05*** (34.56)	0.07*** (29.75)	0.05*** (37.75)	0.05*** (44.69)	0.05*** (44.75)
EXPERIENCE^2	-0.32*** (-28.75)	-0.26*** (-20.00)	-0.42*** (-22.30)	-0.29*** (-25.49)	-0.29*** (-27.46)	-0.29*** (-27.52)
EXPERIENCE^3	0.85*** (23.21)	0.66*** (15.36)	1.17*** (19.37)	0.76*** (20.70)	0.75*** (21.70)	0.75*** (21.75)
EXPERIENCE^4	-0.83*** (-20.48)	-0.63*** (-13.27)	-1.16*** (-17.74)	-0.73*** (-17.99)	-0.73*** (-18.95)	-0.73*** (-18.99)
White Collar Managerial	0.54*** (79.73)	0.45*** (61.47)	0.85*** (53.30)	-	0.55*** (87.43)	0.55*** (87.45)
White Collar Non-Managerial	0.19*** (81.61)	0.15*** (54.21)	0.25*** (64.48)	-	0.19*** (93.56)	0.19*** (93.47)
Male	0.22*** (144.46)	0.22*** (121.19)	0.21*** (78.74)	0.15*** (77.62)	0.22*** (155.44)	0.22*** (155.46)
Log Firm Labor Productivity	0.14*** (126.24)	0.13*** (101.10)	0.16*** (69.72)	0.16*** (119.04)	0.05*** (28.24)	0.05*** (27.82)
Log Capital-Intensity	0.008*** (10.52)	0.004*** (4.04)	0.02*** (12.99)	0.004*** (4.97)	0.004 (0.25)	-0.0008 (-0.50)
F-test	-			121.68*** (0.00)	18.66*** (0.00)	16.66*** (0.00)
R^2	0.56	0.55	0.60	0.64	0.67	0.67
Observations	343 450	235655	107795	275 389	343 450	343 450

Notes: heteroscedasticity-consistent t-values are in parenthesis. *** denotes 99% significance level, ** 95%, * 90%. Additional control variables include firm size categories, year dummies, 2-digit industry dummies and 21 region dummies. † F-Test for significance of joint significance of 538 occupation-group fixed-effects with 538 and 274787 degrees of freedom. Probability of insignificance in parenthesis; ‡ F-Test for significance of firm fixed effects. Probability of insignificance in parenthesis; EXPERIENCE^X means EXPERIENCE to the power of X.

Table 3: Wage regressions with takeovers

Dependent variable: Log Gross Wages	OLS Foreign-Takeover of Domestic Firms	OLS Domestic Takeover of Foreign Firms	OLS Un-classified Foreign Firms[†]	Firm-FE Foreign-Takeover of Domestic Firms	Occupation -FE Foreign-Takeover of Domestic Firms	OLS 1994-2001 Foreign-Takeover of Domestic Firms
	(1)	(2)	(3)	(4)	(5)	(6)
1-Year before Ownership Change (A)	0.11***	0.06***	-	0.13***	0.11**	0.11***
	(19.93)	(7.41)		(19.89)	(17.49)	(15.94)
Year of Ownership Change (B)	0.05***	0.09***	0.16***	0.08***	0.05**	0.05***
	(11.33)	(9.18)	(47.41)	(13.47)	(9.61)	(9.53)
1-Year after Ownership change (C)	0.07***	0.09***	0.12***	0.10***	0.06***	0.06***
	(14.11)	(8.17)	(33.17)	(16.12)	(13.57)	(12.64)
2-Years after Ownership Change (D)	0.13***	0.06***	0.18***	0.15***	0.12***	0.12***
	(22.87)	(5.19)	(39.53)	(20.75)	(22.92)	(22.04)
3- or more Years after ownership change (E)	0.16**	0.04***	0.21***	0.20***	0.14***	0.15***
	(45.09)	(6.09)	(83.62)	(31.59)	(42.96)	(42.22)
F-Test; H_0: (A)=(B)	60.7***	0.81	-	61.5***	60.9***	43.0***
	(0.00)	(0.37)		(0.00)	(0.00)	(0.00)
F-Test; H_0: (B)=(E)	337.2***	3.01*	8.75***	423.1***	287.0***	245.4***
	(0.00)	(0.08)	(0.00)	(0.00)	(0.00)	(0.00)
F-test Fixed Effects	-	-	-	16.53***	-	-
				(0.00)		
R^2		0.57		0.66	0.64	0.59
Observations		343 450		343 450	275 397	275 397

Notes: heteroscedasticity-consistent t-values are in parenthesis. *** denotes 99% significance level, ** 95%, * 90%. [†] X-Years after ownership change has no meaning for unclassified firms (= firms that enter as foreign owned into the sample and stay this way). Instead, X-years of sample entry are counted. FE is a fixed effect estimation with firm-specific fixed effects. RE is a firm-random effect estimator; F-Test for significance of firm fixed effects. Probability of insignificance of fixed effects in parenthesis. Additional control variables include firm size categories, year dummies, 2-digit industry dummies and region dummies, EDUCATION1, EDUCATION2, EDUCATION3, EDUCATION4, EXPERIENCE^1, EXPERIENCE^2, EXPERIENCE^3, EXPERIENCE^4, white collar managerial and non-managerial, male, log average labour productivity of firm, log capital intensity. Dummy variables for unclassified firms and for domestic takeovers of foreign owned firms are always included.

Table 4: Cluster wage regressions

Dependent variable: Gross Wages	Firm-Cluster Regression (1)	Occupation-FE Firm-Cluster Regression (2)	Firm-Cluster Regression (3)	Occupation-FE Firm-Cluster Regression (4)
1-Year before Ownership Change (A)	0.11** (2.29)	0.11* (1.85)	0.18** (2.54)	0.18*** (2.59)
Year of Ownership Change (B)	0.05*** (3.15)	0.05*** (2.83)	-	-
Year of Ownership Change - New Worker (B’)	-	-	-0.09 (-1.21)	-0.04*** (-0.82)
Year of Ownership Change - Old Worker (B’’)	-	-	0.06** (2.07)	0.05* (0.08)
1-Year after Ownership Change (C)	0.07*** (3.95)	0.06*** (3.40)	0.03 (1.02)	0.03 (0.95)
2-Years after Ownership Change (D)	0.13*** (6.64)	0.12*** (6.03)	0.11*** (4.08)	0.10*** (3.75)
3- or more Years after Ownership Change (E)	0.16** (7.02)	0.14*** (6.35)	0.13*** (5.66)	0.12*** (5.47)
F-Test; H_0: (A)=(B)	1.6 (0.21)	1.2 (0.26)	-	-
F-Test; H_0: (B)=(E)	23.5*** (0.00)	17.4*** (0.00)	-	-
F-Test; H_0: (A)=(B’)	-	-	4.48** (0.03)	4.96** (0.03)
F-Test; H_0: (B’)=(E)	-	-	2.15 (0.14)	2.52 (0.11)
F-Test; H_0: (A)=(B’’)	-	-	4.08** (0.04)	4.67** (0.03)
F-Test; H_0: (B’’)=(E)	-	-	9.16*** (0.00)	10.13*** (0.00)
R^2	0.56	0.64	0.61	0.66
Observations	343 450	275 397	173 060	173 060

Notes: heteroscedasticity-consistent t-values are in parenthesis. *** denotes 99% significance level, ** 95%, * 90%. † X-Years after ownership change has no meaning for unclassified firms (= firms that enter as foreign owned firms into the sample and stay this way). Instead, X-years of sample entry are counted. FE is a fixed effect estimation with firm-specific fixed effects. RE is a firm-random effect estimator; OLS Cluster is a GLS estimator that allows for intra-firm autocorrelation and firm-specific heteroscedasticity of general form. F-Test for significance of firm fixed effects. Probability of insignificance of fixed effects in parenthesis. Additional control variables include firm size categories, year dummies, 2-digit industry dummies and region dummies, EDUCATION1, EDUCATION2, EDUCATION3, EDUCATION4, EXPERIENCE^1, EXPERIENCE^2, EXPERIENCE^3, EXPERIENCE^4, white collar managerial and non-managerial, male, log average labour productivity of firm, log capital intensity. With firm specific fixed effects the last two variables are excluded. Dummy variables for unclassified firms and for domestic takeovers of foreign owned firms are always included.

Table 5: Wage regressions with foreign takeovers of domestic firms by occupation and education group

Dependent variable: Gross Wages	Blue collar workers (1)	White-collar non-mana-gerial workers (2)	White-collar mana-gerial workers (3)	voc. training or less (4)	secon-dary edu-cation (5)	Univer-sity degree (6)
1-Year before Owner-ship Change (A)	0.13**	0.28***	0.08	0.11*	0.22***	0.29***
	(2.03)	(4.07)	(0.48)	(1.95)	(3.50)	(4.33)
Year of Ownership Change - New Worker (B')	-0.03	-0.09*	0.54**	0.06***	-0.01	-0.11
	(-0.44)	(-1.66)	(2.37)	(0.91)	(-0.13)	(-1.24)
Year of Ownership Change - Old Worker (B'')	0.06**	0.04	-0.01	0.09**	0.04	0.06*
	(1.98)	(1.16)	(-0.05)	(2.46)	(1.34)	(1.73)
1-Year after Ownership Change (C)	0.03	0.01	0.14	0.09***	0.01	0.01
	(1.18)	(0.34)	(1.27)	(2.81)	(0.49)	(0.39)
2-Years after Ownership Change (D)	0.10***	0.11***	0.20	0.13***	0.08***	0.13***
	(3.71)	(2.79)	(2.33)	(4.13)	(2.75)	(2.71)
3- or more Years after Ownership Change (E)	0.11***	0.16***	0.27	0.09***	0.12***	0.19***
	(4.75)	(4.96)	(1.49)	(3.28)	(4.48)	(5.01)
F-Test; H_0: (A)=(B')	2.96*	13.53***	2.69	0.45	6.89***	9.28***
	(0.09)	(0.00)	(0.10)	(0.50)	(0.01)	(0.00)
F-Test; H_0: (A)=(B'')	0.77	10.79***	0.63	0.08	6.44**	13.86***
	(0.37)	(0.00)	(0.42)	(0.77)	(0.01)	(0.00)
F-Test; H_0: (B'')=(E)	1.60	9.80***	1.94	0.01	5.72**	7.75***
	(0.21)	(0.00)	(0.16)	(0.94)	(0.02)	(0.01)
F-Test; H_0: (B')=(E)	5.13**	19.41***	2.42	0.20	6.41**	10.71***
	(0.02)	(0.00)	(0.12)	(0.66)	(0.01)	(0.00)
R^2	0.55	0.61	0.43	0.52	0.53	0.54
Observations	122 433	47 005	3622	41 794	49 979	18 674

Notes: t-values from Arellano (1987) covariance matrix are in parenthesis. *** denotes 99% significance level, ** 95%, * 90%. F-Test for firm fixed effects. Probability of insignificance of fixed effects in parenthesis. Additional control variables include 532 occupation fixed effects, firm size categories, year dummies, 2-digit industry dummies, region dummies, EDUCATION1, EDUCATION2, EDUCATION3, EDUCATION4, EXPERIENCE1, EXPERIENCE2, EXPERIENCE3, EXPERIENCE4, male, log average labour productivity of firm, log capital intensity. Dummy variables for unclassified firms and for domestic takeovers of foreign owned firms are always included.

Table 6: Two- and three stage matching results full sample – First-stage-NN matching

	Specification Outcome Variable: Annual matched growth rate of wages after foreign takeover relative to control group	ATT	95%-Confidence Interval	# Observations Treated	% Treated with common support	Total # Observations
(1)	3rd stage OLS – no controls	-0.03***	[-0.02;-0.05]	3703	100	161 298
(2)	3rd stage OLS – few controls†	-0.03***	[-0.01;-0.06]	3703	100	109 937
(3)	3rd stage cluster regression – full controls‡	-0.04	[-0.09;0.01]	3703	100	109 937
(4)	3rd stage cluster regression – heterogeneous treatment effect#	-0.07***	[-0.1;-0.04]	3703	100	109 937
(5)	3rd stage cluster regression – vocational training or less	-0.02	[-0.07;0.02]	2003	100	72 255
(6)	3rd stage cluster regression – secondary education	-0.08**	[0.01;0.14]	1398	100	31 775
(7)	3rd stage cluster regression – University degree	0.02	[-0.13;0.09]	302	100	5 907
(8)	Nearest Neighbor Matching – secondary education – caliper 0.0001	-0.06**	[-0.12;-0.02]	1398	89	46 673
(9)	Nearest Neighbor Matching – secondary education – caliper 0.00001	-0.06**	[-0.11;-0.01]	1398	67	46 673
(10)	25-Nearest Neighbor Matching – secondary education – caliper 0.00001	-0.06**	[-0.11;-0.03]	1398	67	46 673
(11)	Radius Matching – secondary education – caliper 0.00001	-0.05**	[-0.08;-0.03]	1398	100	46 673
(12)	Kernel Matching - – secondary education – bandwidth 0.001	-0.05**	[-0.08;-0.03]	1398	100	46 673
(13)	Kernel Matching - – secondary education – bandwidth 0.0001	-0.06**	[-0.10;-0.03]	1398	89	46 673
(14)	Kernel Matching - – secondary education – bandwidth 0.00001	-0.06**	[-0.12;-0.03]	1398	67	46 673
(15)	Heckman Estimate	-0.19***	[-0.11;-0.27]	1398	100	105 487

Notes: First stage matches by the nearest neighbor method a worker in a firm that has just been taken over by foreign investors with workers in firms one year before foreign takeover in the previous year and calculates the log- wage difference; Common support is 62% of all treated observations; The second stage matches workers of indigenous firms (i.e. firms with domestic owners that are never taken over) with observations from the previous year and calculates the log-wage difference; The third stage either regresses the 1st stage matched log-wage difference on the 2nd stage log-wage difference in addition to control variables or uses matching techniques; For matching, a propensity score is estimated based on a conditional fixed effect logit estimator with individual and firm characteristics as regressors and 532 occupation dummies as fixed effects. ATT denotes average treatment effect on the treated; Confidence intervals on ATT are either obtained from estimated covariance matrices of regression analysis or obtained from 200 bootstrap repetitions in the case of matching techniques; Confidence intervals do not take into consideration the estimation error from the first and second stage matching and from the estimation error of the propensity score;

† Few controls contains: year, industry, region, occupation dummies;

‡ Full controls contains additionally: firm size, sex, education dummies, a polynomial of experience, average firm capital intensity and average firm labor productivity;

confidence interval is obtained from 200 bootstrap replications;

Table 7: Productivity and employment with foreign-takeovers

Dependent variable:	OLS Productivity	Cluster-Firm FE Productivity	OLS Employment	Cluster Firm FE Employment	Probability of new worker (Logit)	Probability of new worker (Clustered Logit)
	(1)	(2)	(3)	(4)	(5)	(6)
1-Year before Ownership Change (A)	0.21*** (30.30)	0.07* (0.62)	0.15*** (26.90)	-0.01 (-0.24)	0.87*** (14.07)	0.87*** (3.29)
Year of Ownership Change (B)	0.19*** (25.69)	0.09 (1.29)	0.09*** (19.08)	-0.02 (-0.40)	-0.43*** (-5.16)	-0.43* (-1.68)
1-Year after Ownership change (D)	0.28*** (37.45)	0.16** (2.22)	0.17*** (34.43)	0.01 (0.16)	-0. 48*** (-6.35)	-0. 48*** (-3.16)
2-Years after Ownership Change (E)	0.32*** (41.46)	0.19*** (2.82)	0.27*** (44.19)	0.09 (1.27)	-0.13* (-1.88)	-0.13 (-0.93)
3- or more Years after Ownership Change (F)	0.45*** (85.12)	0.29*** (3.76)	0.26*** (70.42)	0.10 (1.40)	-0.35*** (-9.08)	-0.35** (-2.54)
F-Test; H_0: (A)=(B)	3.55* (0.06)	0.03 (0.86)	73.43*** (0.00)	0.13 (0.71)	206. 91*** (0.00)	-
F-Test; H_0: (B)=(E)	855.2*** (0.00)	9.04*** (0.00)	960.63*** (0.00)	5.78** (0.02)	0.83* (0.36)	-
R^2	0.52	0.86	0.93	0.98	0.05	0.05
Observations	335 971	335 971	335 971	335 971	173 060	173 060

Notes: * 10% significance level; ** 5% significance level; *** 1% significance level; t-values in parenthesis; OLS estimates use heteroscedasticity-consistent standard errors; F-test: Wald test that tests equality of coefficients; Marginal probability of H_0 in parenthesis; All regressions use unreported control variables on firm size categories, year dummies, 2-digit industry dummies, region dummies, log average labor productivity of firm, log capital intensity, share of white-collar workers. Dummy variables for unclassified firms and for domestic takeovers of foreign-owned firms are always included.