International Competition in Hiring Labour and Selling Output: A Theoretical and Experimental Analysis[1]

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Abstract

Two firms, firm A in country $\mathcal{A}$ and firm B in country $\mathcal{B}$, compete in hiring two types of workers. Type 1 workers are less productive when working abroad, whereas type 2 workers are equally productive when working abroad or at home. Employers compete for labour by offering employment contracts for both types of workers in both countries. Hiring determines output and ultimately sales on the homogenous international sales market. We show that the scenario in which firm A(B) hires workers exclusively from country $\mathcal{A}(\mathcal{B})$ creates an equilibrium, i.e. there exists a parameter region with this equilibrium outcome. In our experiment, which utilises a specific parameter constellation, we explore a number of qualitative hypotheses regarding this equilibrium scenario.

1 Introduction

Global competition is an undeniable fact of modern civilisation. Nowadays, it is quite easy to buy from sellers all over the world; information about their supply is easily obtained and worldwide delivery is fairly cheap and reliable. Global competition is not restricted to industrial products, however; it also pertains to labour input. And here it is debatable as to whether globalising the labour market,i.e. shifting workers from one country to another, should be encouraged or prevented. Leaving one's home country may lead to a (better) job but may also result in a sense of cultural loss and incur high emotional costs.

We will not discuss how such negative consequences might be (over)compensated for by economic benefits here. Instead we confine ourselves to mentioning that doing so would require a difficult cost-benefit analysis involving cumbersome measurement problems. In our experimental implementation, we preclude these emotional costs by not employing human participants to play the roles of workers. Rather, we replace workers with rational robots, which should not only encourage equilibrium behaviour on the part of employers but rules out considerations of vertical fairness (i.e. between employers and employees). In this sense our experiment relies on a best-case scenario to observe equilibrium hiring.

Global competition is frequently modelled by means of comparing only two countries. The two countries are assumed to compete not only in selling their products but also in hiring labour. Rather than modelling the countries in the tradition of general equilibrium models, we simply represent them with firm models whose internal strategic conflicts are laid out in principal-agent theory. More specifically, each country has a principal who, in the status quo, employs two types of workers: Type 1 workers have country-specific human capital and would be less productive working abroad. Type 2 workers, however, have capabilities which are not country specific. In our model, product markets are always global, but hiring workers may be done nationally or internationally. Of course, such an analysis can also be interpreted as hiring and sales competition when human capital is partly firm specific.

According to the interpretation of international labour (im)mobility, the principal-agent problem captures the conflicting interests of

- employers who try to reduce labour costs by hiring internationally and

- employees who want their share of their output and to avoid being replaced by foreign workers.

It is interesting that the latter motive applies only to the type 1 workers in both countries, whereas the type 2 workers may stand to gain from international hiring competition.

While our model addresses the typical principal-agent(s) conflict, it avoids the common flaw inherent to traditional principal-agent(s) models that focus solely on intra-firm conflicts without considering that principals compete in hiring agents[1]. If there were no hiring competition, the difference of type 1 and type 2 workers would disappear. It is only in the event of changing employers, i.e. when international labour mobility is possible, that firm specificity of human capital and thereby labour mobility becomes crucial.

Section 2 describes the game model. In addition, we analyse the workers' choices of employers and effort levels. Section 3 goes on to establish an equilibrium scenario in which we rely on different assumptions regarding the effort costs abroad. Section 4 describes the experiment, while Section 5 contains the conclusion.

2 The model

The global sales market is assumed to be homogenous and behave according to a standardised linear demand function

$$p = a - X \ \text{ for } 0 \leq X \leq a \qquad (a > 0),$$

where $p \, (\geq 0)$ denotes the uniform sales price and X total supply, composed of the two individual sales amounts x_a and x_b

$$X = x_a + x_b \ \text{ with } \ x_a, x_b \geq 0 \ \text{ and } \ x_a + x_b \leq a\,.$$

The fact that the sales market is global and homogenous somewhat justifies our decision to neglect any synergy effects that could result from co-employing workers from different countries. Instead, we envisage a situation in which each worker can achieve the same output level but at potentially varying effort costs.

[1]See Berninghaus, González, Güth (2004) for a more detailed discussion of this aspect.

The two principals A and B, owning firm A in country $\mathcal{A}$ and firm B in country $\mathcal{B}$, respectively, initially employ two workers each; firm A engages workers A_1 and A_2 and firm B hires workers B_1 and B_2. Worker i has to expend one unit of effort ($e = 1$) to produce exactly one unit of output while employed by principal j for all $i = A_1,\ A_2, B_1, B_2$ and $j = A, B$.

Type 1 workers (A_1 and B_1) have firm-, i.e. country-specific, skills, meaning that their costs of effort $e(\geq 0)$ are lower in their home country than in the foreign country. Effort costs $C(e)$ for type 1 workers are

$$C(e) = \frac{c}{2} \cdot e^2 \quad \text{with} \quad c > 0 \tag{1}$$

when they remain in their native country. Were they to change country, their effort costs $C(e)$ would increase to

$$C(e) = \frac{d}{2} \cdot e^2 \quad \text{with} \quad d > c. \tag{2}$$

In contrast, effort costs are given by (1) for type 2 workers (A_2 and B_2), regardless of whether they go abroad or not. Table 1 summarises these assumptions:

		type1		type2	
	working in	$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A}$	$\mathcal{B}$
home country	$\mathcal{A}$	c	d	c	c
	$\mathcal{B}$	d	c	c	c

Table 1: Effort costs of type 1 and type 2 workers

The decision sequence of the one-shot-model consists of the stages described below; we assume that all decisions in earlier stages become commonly known.

Contract Offer Stage:
Each principal $j = A, B$ offers a fixed wage[2] $W_j^i \in \mathbb{R}$ and a piece rate $s_j^i \geq 0$

[2] A negative fixed wage rate W_j^i can be easily interpreted as an "entrance fee" a worker has to pay to obtain a particular job.

to every worker i, i.e. there exists a set of linear contracts

$$\left(W_j^i, s_j^i\right)$$

for all possible combinations of workers i and principals j.

Choice of Employer and Choice of Effort Stage:
We simplify our model here by disregarding unemployment; formally, this means that the participation constraint is assumed to be not binding; the labour market is therefore characterised by full employment.

With this simplification, all workers i simultaneously and thus independently choose between working for their domestic principal j (and accept $\left(W_j^i, s_j^i\right)$) or the foreign principal $q \neq j$ (accepting $\left(W_q^i, s_q^i\right)$). This decision depends on the payoffs the contract offers generate for the workers: Worker i will simply choose the employer (either j or q) offering him the higher payoff.

If worker i accepts the contract offer (W_j^i, s_j^i) by firm j, his payoff (depending on his effort) is

$$\omega_i = W_j^i + s_j^i \cdot e_i - C(e_i) \ . \tag{3}$$

The optimal effort is either

- $e_i^* = s_j^i / c$ for a type 1 worker working at home or a type 2 worker or
- $e_i^* = s_j^i / d$ for a type 1 worker working abroad.

Equation (3) leads to

$$\omega_i = W_j^i + \frac{(s_j^i)^2}{2c} \qquad \text{or} \qquad \omega_i = W_j^i + \frac{(s_j^i)^2}{2d} \ . \tag{4}$$

This implies that the condition that a type 1 worker stays in (leaves) his home country working for firm j instead of working for the foreign firm q is

$$W_j^i + \frac{\left(s_j^i\right)^2}{2c} > (<) W_q^i + \frac{\left(s_q^i\right)^2}{2d} \ . \tag{5}$$

Consequently, a type 2 worker stays in (leaves) his home country if

$$W_j^i + \frac{\left(s_j^i\right)^2}{2c} > (<) W_q^i + \frac{\left(s_q^i\right)^2}{2c} \ . \tag{6}$$

These steps lead to the principals' profits: Employer j's profit is:

$$\pi_j = R_j - \sum_i d_j^i \cdot (s_j^i \cdot e_i + W_j^i), \tag{7}$$

where $d_j^i = 1$ if employee i works for principal j and 0 otherwise. The revenue of firm j is defined as

$$R_j = p \cdot \sum_i d_j^i \cdot e_i = [a - \sum_{k=A,B} \sum_i d_k^i \cdot e_i] \cdot \sum_i d_j^i \cdot e_i \ . \tag{8}$$

3 Equilibrium scenario analysis

We are mainly interested in possible effects of international labour (im)mobility, a situation in which global product markets do not necessarily imply the globalisation of labour markets. Rather than exploring the possible multiplicity of equilibria (entailing a study of which conditions are necessary for an equilibrium scenario to exist in which no worker leaves his home country), we confine ourselves to a so-called *equilibrium scenario analysis*. More precisely, we consider particular hiring constellations and then try to find model parameter restrictions guaranteeing that the constellation in question is an equilibrium—all possible unilateral deviations must be unprofitable. If a certain outcome can be justified as a generic equilibrium result, we refer to it as an equilibrium scenario. Characterising all equilibria of this strategic principal-agent and competition problem would be a difficult and tedious task. In contrast, the *immobility hiring constellation* is also attractive from a technical perspective: It is completely *s*ymmetric and thereby facilitates the equilibrium check.

3.1 The basic scenario

We analyse the *immobility scenario* as an equilibrium candidate; we hereafter abbreviate this "old scenario"—every country hires its incumbent workers—as O. An alternative description would be "global competition without international labour mobility".

To analyse all possible deviations from O, we have to take the fifteen alternative hiring constellations into account. In the following, we list these hiring constellations for principals j and q, with $j \neq q$.

- **Scenario N:** In this scenario, one country hires both type 2 workers and the other one engages both type 1 workers. If principal j (q) hires all the type 2 workers and her incumbent type 1 worker, we call this scenario N1 (N2). We specify this scenario as N3 (N4) if the foreign type 1 worker is employed by principal j (q) in addition to the two type 2 workers.
- **Scenario V:** One country hires both type 1 workers in addition to one type 2 worker. Specifications V1 - V4 have similar meanings as above.
- **Scenario E:** In this scenario, each country hires its incumbent type 1 worker and the foreign worker of type 2.
- **Scenario I:** In this scenario, both type 2 workers work for their incumbent principal, while all type 1 workers leave their home countries.
- **Scenario T:** Here all workers leave their respective country.
- **Scenario R:** Both type 1 workers are working in the same country and both type 2 workers in the other one. In R1(R2), both type 2 workers are employed by principal j $(q.)$
- **Scenario J(Q):** In this scenario, principal $j(q)$ hires all four workers.

Our first step is to substitute the fixed wages in the principals' profit equations with the corresponding piece rates assuming equality in conditions (5) and (6). We, thus, define

Substitution principle: *For an equilibrium scenario the following conditions must hold:*

$$W_j^i = W_q^i + \frac{\left(s_q^i\right)^2}{2x} - \frac{\left(s_j^i\right)^2}{2y} \tag{9}$$

for all i, j and q with $j \neq q$. For the cost parameters, $x, y \in \{c, d\}$, depending on the respective worker type.

The *substitution principle* is obviously a set of necessary equilibrium conditions—unilateral deviation would otherwise be profitable.

In the following, we use the notation v (r) for a type 1 (type 2)worker employed by firm j; $\overline{v}$ and $\overline{r}$ denote type 1 and type 2 workers, respectively, employed by principal q. Firm j's scenario O profit function is (eliminating W_j^v and W_j^r by dint of the *substitution principle* (9)):

$$\begin{aligned} \pi_j(s_j^v, s_j^r) &= \left[a - \frac{s_j^v + s_j^r + s_q^{\overline{v}} + s_q^{\overline{r}}}{c}\right] \cdot \frac{s_j^v + s_j^r}{c} - \frac{(s_j^v)^2 + (s_j^r)^2}{c} - \\ & \left[W_q^v + \frac{(s_q^v)^2}{2d} - \frac{(s_j^v)^2}{2c}\right] - \left[W_q^r + \frac{(s_q^r)^2 - (s_j^r)^2}{2c}\right]. \end{aligned} \tag{10}$$

From *symmetry arguments* we obtain q's profit function,

$$\begin{aligned} \pi_q(s_q^{\overline{v}}, s_q^{\overline{r}}) &= \left[a - \frac{s_j^v + s_j^r + s_q^{\overline{v}} + s_q^{\overline{r}}}{c}\right] \cdot \frac{s_q^{\overline{v}} + s_q^{\overline{r}}}{c} - \frac{(s_q^{\overline{v}})^2 + (s_q^{\overline{r}})^2}{c} - \\ & \left[W_j^{\overline{v}} + \frac{(s_j^{\overline{v}})^2}{2d} - \frac{(s_q^{\overline{v}})^2}{2c}\right] - \left[W_j^{\overline{r}} + \frac{(s_j^{\overline{r}})^2 - (s_q^r)^2}{2c}\right]. \end{aligned} \tag{11}$$

Maximising π_j with respect to s_j^v and s_j^r and solving the symmetric programme for q, the analysis of reaction functions (see Appendix A.1 for details) results in the following piece rates in a scenario O equilibrium:[3]

$${}_o s_j^v = {}_o s_j^r = {}_o s_q^{\overline{v}} = {}_o s_q^{\overline{r}} = \frac{ac}{c+6}\,. \tag{12}$$

Due to the symmetry in the firms' technologies and workers' productivities, both firms pay the same piece rates (for both types of workers).

Up to now, we have concentrated on determining the optimal piece rates for scenario O offered to the workers actually working at a firm. According to the model requirements, we need to know which wage rates (fixed wages as well as piece rates) are offered to the remaining workers. Fixed wages will be determined later on. Concerning the piece rates we assume

$${}_o s_j^{\overline{v}} = {}_o s_q^v = r1 \quad \text{and} \quad {}_o s_j^{\overline{r}} = {}_o s_q^r = r2$$

according to *symmetry arguments*. In the following equilibrium analysis of scenario O, ranges for the fixed wage rates (which are dependent on the model parameters) will be determined.

[3]Checking the Hessian of the second order conditions shows that we are really dealing with a maximum here. The same considerations can be made in the remainder. We will not explicitly mention this point again.

The total profits of principals j and q in scenario O can now easily be calculated as

$$\pi_j(o) = \frac{a^2(4+c)}{(6+c)^2} - \frac{r1^2}{2d} - \frac{r2^2}{2c} - W_q^v - W_q^r$$

and

$$\pi_q(o) = \frac{a^2(4+c)}{(6+c)^2} - \frac{r1^2}{2d} - \frac{r2^2}{2c} - W_j^{\overline{v}} - W_j^{\overline{r}} \,.$$

Via the *substitution principle* one can show that firms j's and q's profits can be expressed independently of the parameters $r1$ and $r2$. In fact, after some simple transformations[4], we have

$$\pi_j(o) = \frac{4a^2}{(6+c)^2} - W_j^v - W_j^r$$

and

$$\pi_q(o) = \frac{4a^2}{(6+c)^2} - W_q^{\overline{v}} - W_q^{\overline{r}} \,.$$

In order to establish scenario O as an equilibrium scenario, we have to show that deviations from O are not profitable.

3.2 Analysing deviating hiring constellations

In each hiring constellation differing from O we calculate the optimal piece rates of the deviating firm. Inserting these piece rates into the firm's profit function results in the largest possible deviation profits. The explicit restrictions we require for fixed wages will ensure that deviations from O are not profitable, thus guaranteeing that scenario O is an equilibrium.

Analysing all possible deviations to other scenarios (according to our list in the previous section) is a tedious task whose results are available in Appendix A.2. In this subsection, we demonstrate how we proceed by

[4] For example, in the expression $\pi_j(o)$ we substitute W_q^r by $W_j^r + \frac{(s_j^r)^2}{2c} - \frac{(s_q^r)^2}{2c}$. By inserting the already given values of $s_j^r (= \frac{ac}{c+6})$ and $s_q^r (= r2)$ and proceeding analogously with W_q^v we obtain the desired result.

discussing exemplarily the deviation from scenario O to scenario N2[5]. In this new scenario principal j hires her incumbent type 1 worker only and worker r–ceteris paribus–leaves her employer. Under this condition principal j's profit is given by

$$\pi_j(n2) \quad = \quad \left[a - \frac{s_j^v + s_q^r + s_q^{\overline{v}} + s_q^{\overline{r}}}{c}\right] \cdot \frac{s_j^v}{c} - \frac{(s_j^v)^2}{c} - \left[W_q^v + \frac{(s_q^v)^2}{(2d)} - \frac{(s_j^v)^2}{(2c)}\right] .$$

Analysing the *unilateral* deviation benefit from principal j's point of view, we consider all decisions of principal q as fixed, i.e. ${}_{n2}s_q^{\overline{v}} = \frac{a \cdot c}{c+6}$, ${}_{n2}s_q^{\overline{r}} = \frac{a \cdot c}{c+6}$ and ${}_{n2}s_q^r = r2$.

From the first order condition we obtain the optimal piece rate for firm j's only worker v as

$$s_j^v = \frac{a \cdot c(4+c) - (6+c)r2}{(2+c)(6+c)}$$

which is positive if[6]

$$r2 \leq \frac{a \cdot c(4+c)}{6+c} .$$

Inserting this into principal j's profit function finally yields the (maximum) deviation payoff

$$\pi_j(n2) = \frac{(a \cdot c(4+c) - (6+c)r2)^2}{2c^2(2+c)(6+c)^2} - \frac{r1^2}{2d} - W_q^v .$$

Looking at the same deviation scenario N2 from principal q's point of view, we consider q's profit function.

$$\begin{aligned}\pi_q(n2) \quad = \quad & \left[a - \frac{s_j^v + s_q^r + s_q^{\overline{v}} + s_q^{\overline{r}}}{c}\right] \cdot \frac{s_q^r + s_q^{\overline{v}} + s_q^{\overline{r}}}{c} - \frac{(s_q^r)^2 + (s_q^{\overline{v}})^2 + (s_q^{\overline{r}})^2}{c} \\ & - \left[W_j^r + \frac{(s_j^r)^2}{(2c)} - \frac{(s_q^r)^2}{(2c)}\right] - \left[W_j^{\overline{v}} + \frac{(s_j^{\overline{v}})^2}{(2d)} - \frac{(s_q^{\overline{v}})^2}{(2c)}\right] \\ & - \left[W_j^{\overline{r}} + \frac{(s_j^{\overline{r}})^2}{(2c)} - \frac{(s_q^{\overline{r}})^2}{(2d)}\right]\end{aligned}$$

[5]Note that because of symmetry arguments we need not check situation N1 when situation N2 has been treated. Analogously, this is valid for the deviation scenarios V2, R1 etc.

[6]Similar conditions for the positivity of the piece rates appear for all hiring constellations. We do not mention them explicitly in the following.

Now principal j's decisions are supposed to remain fixed. Optimising q's profit with respect to piece rates $s_q^r, s_q^{\overline{v}}$ and $s_q^{\overline{r}}$ we obtain from the first order conditions the optimal piece rates as

$$s_q^r = s_q^{\overline{r}} = s_q^{\overline{v}} = \frac{c(5a + ac)}{(6+c)^2}.$$

By inserting these values into q's profit function, we obtain q's (maximum) deviation profit

$$\pi_q(n2) = \frac{a^2(75 + 24c + 2c^2)}{2(6+c)^3} - \frac{r1^2}{2d} - \frac{r2^2}{2c} - W_j^r - W_j^{\overline{v}} - W_j^{\overline{r}}.$$

3.3 Equilibrium conditions for scenario O

We have to ensure that any unilateral deviation from hiring configuration O does not pay for any principal. The calculation of the maximum deviation profits induced all results to depend on the fixed wage rates W_j^x, W_q^y (for $x, y = r, v, \overline{r}, \overline{v}$) and the parameters $r1, r2$. In the following, we will fix intervals for the fixed wage rates in order to guarantee that scenario O is an equilibrium. In this subsection, we exemplarily analyse possible upper and lower limits for the fixed wage rate W_j^r. In so doing, we extensively use the *substitution principle* and *symmetry properties* of hiring constellation O.

Determining boundaries for W_j^r :

For O as an equilibrium, it should not pay for principal j to lose her type 2 worker and for principal q to hire an additional type 2 worker (hiring constellation N2). Obviously, we can be sure that this kind of deviation behaviour is not profitable if the following two inequalities are satisfied:

$$\pi_j(o) \geq \pi_j(n2) \qquad (13) \qquad\qquad \pi_q(o) \geq \pi_q(n2) \qquad (14)$$

Combined with our results in Subsection 3.2, we see that inequality (13) is equivalent to

$$W_q^r \leq \frac{a^2(4+c)}{(6+c)^2} - \frac{(ac(4+c) - (6+c)r2)^2}{2c^2(2+c)(6+c)^2} - \frac{r2^2}{2c}.$$

By using the *substitution principle*, inserting the optimal piece rates of situation O into the previous equation and taking the inequality for W_q^r into account, we obtain an upper bound for the fixed wage rate of firm j for type 2 worker r.

$$W_j^r \leq \frac{2a^2c^3 + 2ac(24 + 10c + c^2)r2 - (6 + c)^2 r2^2}{2c^2(2 + c)(6 + c)^2} =: \beta_1.$$

From inequality (14) we directly derive

$$W_j^r \geq \frac{27a^2 + 4a^2c}{2(6 + c)^3} =: \alpha_1.$$

That is, scenario O can be an equilibrium if

$$W_j^r \in [\alpha_1, \beta_1].$$

However, this is not the only restriction for W_j^r. We have to take the further restrictions arising from deviations to hiring constellation N3 into account. In other words, we require the following inequalities to hold:

$$\pi_j(o) \quad \geq \quad \pi_j(n3) \quad (15) \qquad\qquad \pi_q(o) \quad \geq \quad \pi_q(n3) \quad (16)$$

From relation (15) we immediately obtain

$$\begin{aligned} W_q^{\overline{r}} - W_q^v + W_q^{\overline{v}} \quad \geq \quad & [a^2d^2(20c + c^3 - 2c^2(d - 2) + 40d) \\ & -2a(6 + c)^2 d(c + 2d)r1 + (6 + c)^2(c + 2d))r1^2]/ \\ & [2(6 + c)^2 d^2(4d + c(2 + d)) + \frac{r1^2}{(2d)} \end{aligned}$$

By substituting (because of *symmetry considerations*) $W_q^{\overline{r}} + W_q^{\overline{v}}$ by $W_j^r + W_j^v$ and using the *substitution principle*, we finally obtain

$$\begin{aligned} W_j^r \quad \geq \quad & [a^2d^2(c^3 - c^2(d - 6) + 40d + 4c(5 + d)) - 2a(6 + c)^2 d(c + 2d)r1 + \\ & (6 + c)^2(c + 2d)r1^2]/[(2(6 + c)^2 d^2(4d + c(2 + d)))] =: \alpha_2. \end{aligned}$$

With *symmetry considerations*, the *substitution principle*, and relation (16), we furthermore obtain

$$\begin{aligned} W_j^r \quad \leq \quad & [a^2c^2(9 + c^2 - c(d - 8) - 8d)d^2 - 2ac(30 + 11c + c^2)d(cr1 + dr2) + \\ & (6 + c)^2(cr1 + dr2)^2)]/[(2c^2(6 + c)^2 d^2(2 + d))] =: \beta_2. \end{aligned}$$

Therefore, we have the additional restriction

$$W_j^r \in [\alpha_2, \beta_2].$$

<u>Boundaries for the remaining fixed wage rates:</u>

Here, we just list the other restricting intervals.[7,8] For W_j^v we derived

- $W_j^v \in [\gamma_1, \delta_1]$ and $W_j^v \in [\gamma_2, \delta_2]$,

while the restrictions for combinations of W_j^v and W_j^r are

- $W_j^v + W_j^r \in [\epsilon, \zeta]$ and
- $W_j^r - W_j^v \in [\eta, \theta]$.

Because of *symmetry arguments* it suffices to calculate the restrictions on principal j's fixed rates (one would have derived analogous results for fixed wage rates offered by principal q). Furthermore, by virtue of the *substitution principle*, there are always two fixed wages simultaneously determined by the two principals in equilibrium.

One general feature of our model is, that when the cost parameter d approaches c, the interval $[\epsilon, \zeta]$ becomes empty—scenario O cannot be an equilibrium scenario for $d \to c$! This "limit" situation in which all workers are identical (homogenous workers) is not compatible with labour force immobility as an equilibrium. In fact, our experimental results (Subsection 5.2) will empirically support our theoretical findings.

4 A numerical example

Our model is characterised by a set of numerical parameters (a, c, d and $r1$, $r2$) whose values are not subject to prior restrictions.[9] Up to now, we

[7] See Appendix A.2 for the exact terms. There we also discuss some restrictions for the exogenously given parameters a, c and d.

[8] Note that we derived *two* restricting intervals for the fixed wage rates W_j^r and W_j^v. Unfortunately, we were not able to prove generally how these restricting intervals are interrelated.

[9] This is valid except for the non-negativity of the parameter values and of some of the choice variables.

have not shown that there actually exist parameter constellations which make scenario O an equilibrium scenario. We have not shown that the various restrictions we derived so far for equilibrium fixed wage rates can be satisfied simultaneously for a parameter constellation. The one we specify in this section induces generic equilibria. Let us fix the particular parameter values at

$$a = 15, \quad c = 8, \quad d = 60, \quad r1 = 1, \quad r2 = 10.$$

Calculating all explicit restrictions for fixed wage rates results in

$$\alpha_1 = 2.41891,\ \beta_1 = 2.44739; \qquad \gamma_1 = -1.49734,\ \delta_1 = 0.939782;$$

$$\epsilon = 1.74876,\ \zeta = 4.59184; \qquad \eta = 2.35291,\ \theta = 4.90316.$$

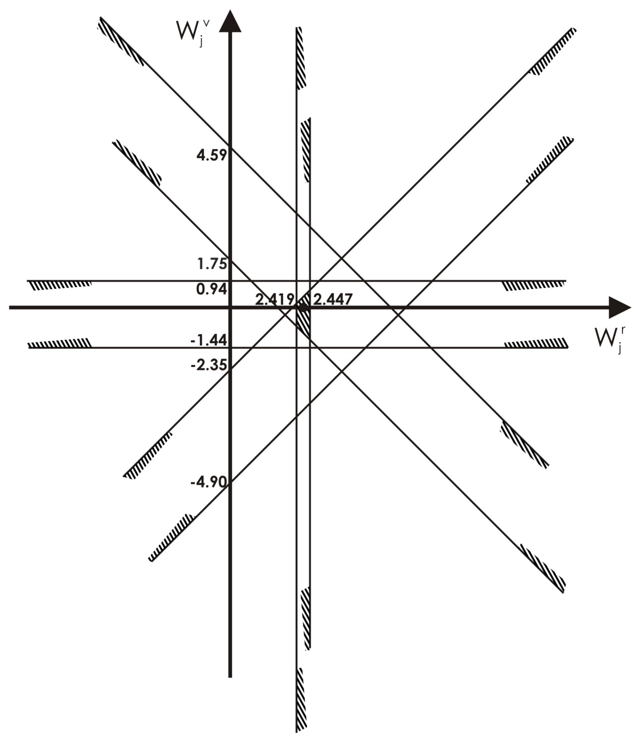

Figure 1: Admissible fixed wage rates

Figure 1 illustrates all relevant restrictions[10]. All points in the dashed area are feasible combinations for fixed wage pairs (W_j^r, W_j^v) and for the sum and difference of fixed wage rates $(W_j^r \pm W_j^v)$ to allow scenario O to be an equilibrium scenario. For example, choosing the combination $W := (W_j^r, W_j^v) = (2.42, 0)$ guarantees that our restrictions are satisfied[11]. With this particular choice of W and the remaining parameters, the following equilibrium values of our model are associated:

$$
\begin{array}{cccc}
W_j^r = 2.42 & W_j^v = 0.00 & W_q^r = 0.761857 & W_q^v = 4.5835 \\
s_j^r = s_j^v = 8.57143, & s_j^{\overline{v}} = 1,\ s_j^{\overline{r}} = 10 & p = 10.7143 & e^v = e^r = 1.07143 \\
\omega_v = 4.54184 & \omega_r = 7.01184 & \pi_j(o) = 2.17184 & \pi_q(o) = 2.17184
\end{array}
$$

5 Experiment

5.1 Experimental design

We decided to run the experiment in a reduced version, i.e. with two employers. They make decisions about their wage offers (fixed wages and piece rates) for 4 potential employees in 30 succesive periods; each period represents our theoretical one-shot-model. The employees' optimal choices (of employer and of effort level) are supplemented by the experimental software. In the instructions, each subject is informed in detail about each principal's possible payoffs depending on the various hiring constellations. The subjects' decisions are quite complex; they have to fix four fixed wage and four piece rate offers (i.e. for all potential employees) in each period.

The experiment was conducted at the experimental laboratory of the Max Planck Institute for Economics (Jena) in September 2006. Subjects were selected from a pool of students from different faculties at the University of Jena. The experiment was organised in two sessions. In each session, the 32 participants were divided into four matching groups consisting of eight subjects each.

[10] Note that the restrictions $[\alpha_2, \beta_2]$ and $[\gamma_2, \delta_2]$ are not binding for our particular parameter values.

[11] It is easy to see that W is in the interior of the set of admissible fixed wage rate configurations, i.e. a continuum of configurations near W will also be candidates for equilibrium configurations.

Treatments differ with respect to the term $d - c$, which measures the difference in productivity between type 1 workers when working abroad or at home. As mentioned before, we know that this productivity difference may be crucial in establishing scenario O as an equilibrium. In treatment I, the workers' productivity is set to $c = 8,\ d = 60$; in treatment II, we assume $c = d = 8$, i.e. workers in this treatment are supposed to be homogenous. The members of each matching group were partitioned into four two-person employer groups (firms A and B) that were rematched every period, giving us four independent observations per treatment.[12] The experimental software was programmed via z-Tree.

Once each player in the group had made a decision, the resulting payoffs were shown on the screen. By clicking the mouse on a button on the computer screen, each player could also obtain information about market prices, hiring constellations, own output levels, rival's profits and own previous wage offers from all previous periods. The payoffs for each subject were accumulated over 30 periods and were paid out in cash after the experiment.[13] The subjects started with an initial financial endowment of 60 ECU. The maximum and minimum payoffs were equal to 25.35 EUR and 0.00 EUR, respectively. The mean payoff was 11.97 EUR, and the experiment lasted about 100 minutes on average.

5.2 Experimental results

In this section, we discuss *two* main aspects of our experimental results.

- Which hiring constellations are visited frequently? Are there any hiring constellations which are not observed at all? Can "typical" features be observed in the firms' wage strategies?
- How do the payoffs of employees and employers evolve during the course of the experiment? Are there observable learning effects from the evolution of payoffs?

[12] Note that subjects were not informed about the size of the matching groups. They were only told that they would not be matched with the same competitor firm from one period to the next.

[13] The conversion rate is 1 EUR per 10 ECU.

5.2.1 Hiring constellations

Figures 2 and 3 show the relative frequency of the different hiring constellations that occur over the course of the experiment for treatments I (Figure 2) and II (Figure 3).[14]

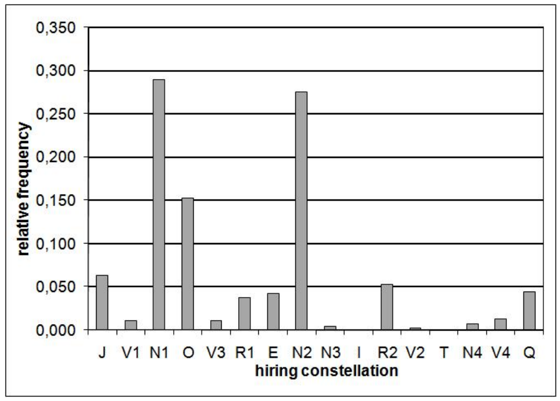

Figure 2: Hiring constellations (treatment I)

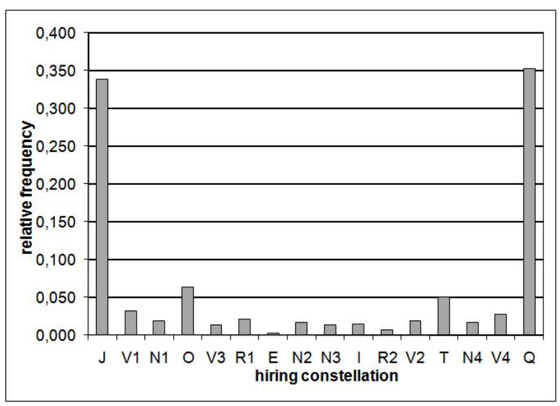

Figure 3: Hiring constellations (treatment II)

We see considerable differences in the hiring constellations between both treatments. In treatment I, which involved heterogenous workers, the im-

[14] Note that *observed* constellations do not necessarily mean that these are the ones that the subjects *intended* to play. Further analyses might shed light on the relation of *intended* and *observed* hiring constellations.

mobility constellation O is reached fairly often (15%), but constellations N1 and N2 are played more frequently. In treatment II, scenario O emerges in only 5% of all cases, whereas both "monopoly scenarios" (in which all workers are employed either at firm A or at firm B) occur in almost all cases with equal probability. A more detailed analysis of per-period hiring data shows that a hiring monopoly of one firm persists for several periods (about four or five periods); ultimately, it breaks down and all workers migrate to the competitor firm.[15] Subjects in the experiment switch from one hiring-monopoly situation to the opposite one. All workers are absorbed by firm j or by firm q. We detect an intense competition between both firms (and therefore countries) for workers.[16]

The results in treatment I, however, are not so clear-cut. Hiring constellation O did not occur often. A more detailed analysis of individual behaviour shows that only a small percentage of players chooses our (theoretical) equilibrium strategy or a strategy close to it. Our search for further "typical" wage strategy constellations to explain the most prominent scenarios in treatment I was not fruitful.

Things look different in treatment II. In this treatment, subjects obviously prefer to play the so-called "indifference strategy", which is characterised by firms offering the same wage rates to all types of workers at home as well as abroad.[17] This strategic behaviour may also explain the striking instability of the monopolistic hiring constellations occurring in this treatment. If both firms were to follow this strategy, just a small increase in all offered wage rates might induce all workers to leave simultaneously one country in order to work in the other.

[15] Note that the parameters in treatment II were chosen such that O would not be an equilibrium situation.

[16] We can interpret–whether we comment on the heterogenous or the homogenous model–the four different workers as representing four classes of workers with partly different effort costs; workers belonging to the same representative worker's class are employed at the same employer. In the homogenous treatment, the four workers have the same effort costs and, thus, the four classes of workers represent only one class of workers. The model might, therefore, have a reduced representation form in which all employees are represented by only one representative worker. But then, employers could not partition the set of four homogenous workers, and our result of labour monopolisation would be the only one possible (and hence trivial).

[17] In up to three quarters of all cases, firms choose this wage strategy, a tendency that even increases in the second half of the experiment.

5.2.2 Evolution of payoffs

To study learning, let us first present the evolution of total period payoffs in Figures 4 and 5 below. Figure 4 shows the temporal evolution of total period payoffs, whereas Figure 5 shows aggregated total payoffs over five periods[18]. The latter diagram smoothes the volatility of the firms' period payoffs shown in Figure 4 so that the tendency of temporal payoff evolution can be seen more clearly.

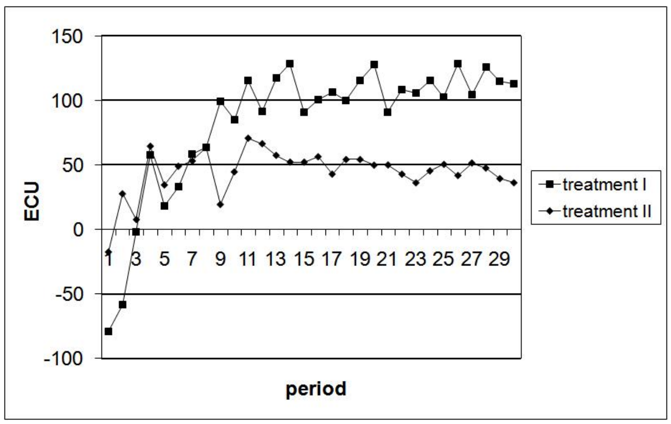

Figure 4: Total period payoffs

Both diagrams are characterised by two remarkable features: a) Firms in both treatments seem to "learn". Starting from rather poor payoff levels, they improve their situation considerably after ten periods. b) Groups in treatment I have a larger payoff than groups in treatment II.

A more detailed analysis of individual data shows that, on average, firms in treatment II offer larger fixed wages and larger piece rates than firms in treatment I. This seems to be motivated by the more intense competition for (the homogenous) workers and may be a first tentative explanation of the firms' payoff differences between the treatments. From similar models in Industrial Organization literature, we know that Bertrand competition in wage rates has negative effects on firms' profits. Moreover, the diagram in Figure 5 shows that firms in treatment II chart a tendency of decreasing payoffs in later periods, again possibly due to increasing competition during

[18]The axis of abscissae is partitioned in "1" to "6", an abbreviation for the first five periods, for the second five periods, and so on.

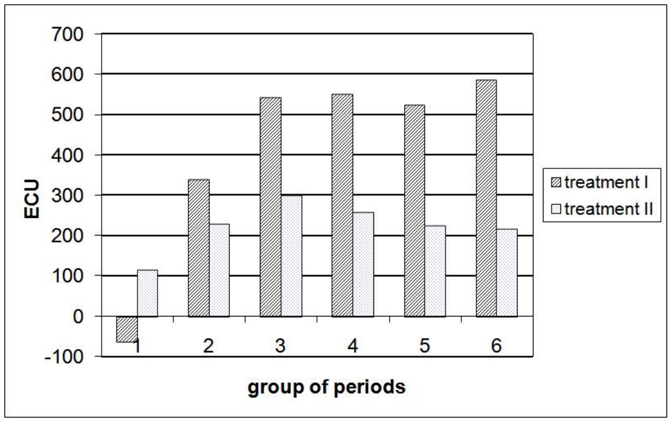

Figure 5: five-period aggregates

the course of the experiment. Conversely, firms in treatment I do not exhibit such a significant change in total payoffs. Their payoffs stabilise after ten periods.

Although workers (A_1 ,A_2, B_1, B_2) do not participate in the actual experiment and are only virtually represented, it is interesting to learn which payoffs rational *employees* would earn if they participated in the actual experiments. Figures 6 and 7 show that the temporal evolution of the employees' payoffs significantly differs between the two treatments: a) In treatment I, type 1 workers in both firms obtain lower wage income than type 2 workers. This is likely to adequately reflect the differences in productivity among type 1 workers when working abroad. However, it is harder to determine why there is a difference in wage income between the type 1 workers in firm A and the type 1 workers in firm B. b) In treatment II, we find a perfect correlation between all workers' total period income which reflects the assumption of homogenous type 1 and type 2 workers. Following a brief learning phase, the workers' payoffs in treatment II show remarkably few fluctuations between periods—evidence of a steady state.

6 Conclusion

The global economy is generally thought to result from decreasing restrictions upon trade. In particular, Internet trading platforms, with their frequent cross-border-transactions are seen to symbolise the prevailing international

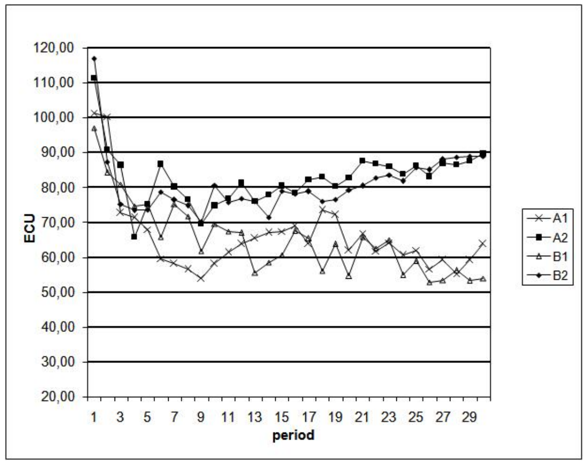

Figure 6: Total workers' payoffs (treatment I)

scope of trade. But does a global economy necessarily mean that employees are being hired internationally? If so, might this development be for better or worse? Working and living abroad can induce feelings of cultural loss and incur high emotional costs, which may threaten one's well-being. This disadvantage of international labour mobility leads us to investigate

- the (im)possibility of the equilibrium scenario O in which each firm keeps its incumbent workers and
- the behavioural appeal of this kind of national hiring when it is (not) an equilibrium scenario by performing a laboratory experiment with two appropriate treatments.

Although we can theoretically establish an equilibrium scenario that does not entail international labour mobility, it does not possess much experimental appeal. Fortunately, it is observable more often in the heterogenous treatment than in the homogenous one that this hiring constellation does not constitute an equilibrium at all. In the latter case, we instead observe monopolistic hiring, i.e. one country (firm) employs all the workers, leaving the other country in a disastrous state. But we do not want to jump to premature conclusions.

In contrast to Berninghaus, González and Güth (2004), ours utilises a much richer labour market consisting of four employees of two types and in which employers compete in an oligopolistic product market as well as

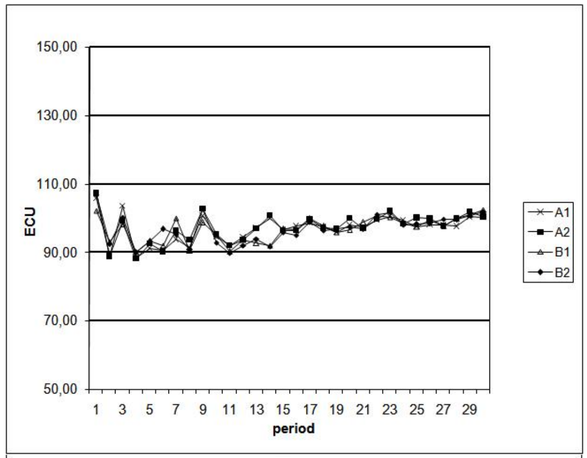

Figure 7: Total workers' payoffs (treatment II)

in the labour market. Since competition in our model involves an eight-dimensional action (generated by a fixed wage and a piece rate to each of the four employees), our theoretical analysis is far from trivial. The multitude of dimensions contributing to an employer's action allows for myriad kinds of unilateral deviation from an equilibrium candidate; the equilibrium analysis thus becomes rather difficult. We therefore limited ourselves to exploring equilibrium scenarios rather than examining the full equilibrium set for each parameter specification.

In economic theory, a high degree of model complexity is usually avoided. Principal-agent theory studies intrafirm-strategic interaction and thus neglects competition among firms altogether.[19] This aspect of theory has misguided our intuition, e.g. by suggesting that managers of poorly performing firms should be paid less. If a firm is performing poorly, it ought to hire the best management, which in all likelihood will not come cheap. Berninghaus, González and Güth (2004) avoid that shortcoming by introducing hiring competition. They conclude from their experimental data that firm loyalty is unimportant. At this juncture we extended the analysis by including sales competition and by distinguishing two types of employees, one with country-specific skills and one without. The discrepancy between the two types can be continuously varied. Actually, this discrepancy is the only

[19]See, for example, Hart and Holmstrom, 1987; Holmstrom and Milgrom, 1994; Laffont and Martimort, 2002, for comprehensive surveys.

treatment aspect varied so far. Many experiments on the principal-agent problem have been conducted thus far[20], but to our knowledge, the particular aspect of hiring competition between principals has not been addressed by the experiments described in theoretical literature up to now.

In future research we plan to

- experimentally explore other parameter constellations with other equilibrium benchmarks and
- enrich the analysis of our theoretical model, e.g. by working out more equilibrium scenarios.

Hopefully, the additional findings will finally allow more definite conclusions about the consequences of global sales and hiring competition. Do this phenomena inspire international labour mobility, and if so, how?

[20]Some experiments were based upon testing fairness and reciprocity in contractual relationships (e.g., Fehr and Schmidt, 2004; Anderhub, Gächter and Königstein, 2002), while other studies emphasised the information aspect of such contractual relations (e.g. Keser and Willinger, 2002).

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A Determining optimal piece rates

A.1 Equilibrium piece rates in scenario O

In order to determine the equilibrium piece rates in scenario O, we identify the first order conditions for an interior optimum of the profit functions (11) with respect to s_j^v and s_j^r.

$$\frac{\partial \pi_j}{\partial s_j^v} = 0 \Rightarrow \qquad s_q^{\overline{v}} + s_q^{\overline{r}} = 10c - 2 \cdot s_j^r - (2+c) \cdot s_j^v$$

and

$$\frac{\partial \pi_j}{\partial s_j^r} = 0 \Rightarrow \qquad s_q^{\overline{v}} + s_q^{\overline{r}} = 10c - 2 \cdot s_j^v - (2+c) \cdot s_j^r,$$

which implies

$$s_j^v = s_j^r := \tilde{s}_j \,.$$

All choice vectors that satisfy these conditions are possible solutions.

The main results for π_q are obviously symmetric to the ones for π_j, such that inserting the results for π_q into these for π_j (and vice versa) leads to four reaction functions:

$$\tilde{s}_j = \frac{10c - 2 \cdot \tilde{s}_q}{4+c}, \qquad \tilde{s}_q = \frac{10c - (4+c) \cdot \tilde{s}_j}{2} \,.$$

and

$$\tilde{s}_j = \frac{10c - (4+c) \cdot \tilde{s}_q}{2}, \qquad \tilde{s}_q = \frac{10c - 2 \cdot \tilde{s}_j}{4+c} \,.$$

Solving this system of equations yields the equilibrium piece rates for principals j and q in scenario O:

$$_O s_j^* = {}_O s_q^* = \frac{ac}{c+6} \,.$$

A.2 Restrictions for fixed wage rates: Further scenarios

Two steps are obligatory to obtain the restrictions for the fixed wages. The first step is to calculate the deviation profits for all scenarios. The second step is to use these deviation profits as well as the *substitution principle* and *symmetry arguments* to derive the restrictions.

Sections 3.2 and 3.3 presented the algorithm of these steps for some hiring constellations exemplarily. We confine ourselves here to listing the final results of this two-step algorithm and to naming the corresponding hiring constellations[21].

A) Restrictions for W_j^v from hiring constellations V1 to V4:

$$W_j^v \geq \frac{9a^2c + 4a^2c^2 + a^2c^3 + 18a^2d - a^2c^2d}{(2(6+c)^2(2c+4d+cd))} := \gamma_1,$$

$$W_j^v \leq \frac{2a^2cd^2 + 2a(24+10c+c^2)dr1 - (6+c)^2r1^2}{(2(2+c)(6+c)^2d^2)} := \delta_1,$$

$$\begin{aligned} W_j^v \quad &\geq \quad [a^2c^2(c^3 - c^2(d-6) + 40d + 4c(5+d)) - 2ac(6+c)^2(c+2d)r2 \\ &\quad +(6+c)^2(c+2d)r2^2]/[(2c^2(6+c)^2(4d+c(2+d)))] := \gamma_2, \end{aligned}$$

and

$$\begin{aligned} W_j^v \quad &\leq \quad -[9a^2c^2d^2 - 2ac(30+11c+c^2)d(cr1+dr2) \\ &\quad +(6+c)^2(cr1+dr2)^2]/[(2c^2(2+c)(6+c)^2d^2)] := \delta_2. \end{aligned}$$

B) Restrictions for the sum $W_j^v + W_j^r$ from hiring constellations J and Q:

$$W_j^r + W_j^v \geq \frac{a^2(c^3 - c^2(d-4) + 60d + 4c(5+d))}{(2(6+c)^2(6d+c(2+d)))} := \epsilon$$

and

$$W_j^v + W_j^r \leq \frac{4a^2}{(6+c)^2} := \zeta.$$

[21] Details provided on request.

C) Restrictions for the difference $W_j^r - W_j^v$ from hiring constellations R1 and R2:

$$W_j^r - W_j^v \geq \frac{a^2(9+2c)d^2 - 2a(30+11c+c^2)dr1 + (6+c)^2 r1^2}{((4+c)(6+c)^2 d^2)} := \eta$$

and

$$\begin{aligned} W_j^r - W_j^v &\leq -[(a^2c^2(c^3 + c(9-2d) - c^2(d-6) + 9d) - \\ &\quad 2ac(30+11c+c^2)(c+d)r2 + (6+c)^2(c+d)r2^2)]/ \\ &\quad [(2c^2(6+c)^2(2d+c(2+d)))] := \theta. \end{aligned}$$

D) Further parameter restrictions for a, c and d from hiring constellations I, T and E:

$$\begin{aligned} \lambda &:= [(a^2d^2(c^3 + c(9-2d) - c^2(d-6) + 9d) - 2a(30+11c+c^2)d \\ &\quad (c+d)r1 + (6+c)^2(c+d)r1^2)]/[(2(6+c)^2d^2(2d+c(2+d)))] \leq 0, \end{aligned}$$

$$\begin{aligned} \kappa &:= \frac{a^2(c-(4+c))}{(6+c)^2} + [(a^2c^2d^2(c^3 - c^2(d-8) \\ &\quad +36d + 4c(9+2d)) - 2ac(6+c)^2d(c+d)(cr1+dr2) + \\ &\quad (6+c)^2(c+d)(cr1+dr2)^2)]/[(2c^2(6+c)^2d^2(2d+c(2+d)))] \leq 0 \end{aligned}$$

and

$$\varrho := \frac{a^2c^2(9+2c) - 2ac(30+11c+c^2)r4 + (6+c)^2 r4^2}{c^2(4+c)(6+c)^2} \leq 0.$$

B Experimental instructions

In this section we present the instructions, exemplarily for treatment I with heterogenous type 1 and type 2 employees. In addition to this main part of the instruction, we provided a detailed table containing the employers' profits for all sixteen hiring constellations.

Anleitung

Sie nehmen mit anderen Teilnehmern an einem Entscheidungsexperiment teil und können abhängig von Ihren Entscheidungen und den Entscheidungen der anderen Teilnehmer bares Geld verdienen, das Ihnen am Ende des Experiments in Euro ausbezahlt wird. Die Recheneinheiten in diesem Experiment sind sogenannte Geldeinheiten GE, wobei 10 GE einem Euro entsprechen. Jeder Teilnehmer trifft seine Entscheidungen isoliert von den anderen an seinem Computerterminal. Kommunikation zwischen den Teilnehmern ist nicht erlaubt. Bitte beachten Sie: Alle von Ihnen getätigten Eingaben werden vertraulich behandelt und anonym ausgewertet.

Das Experiment läuft über 30 Perioden. Sie befinden sich in jeder Periode zusammen mit einem weiteren Teilnehmer in einer Zweiergruppe. Zu Beginn jeder Periode werden alle Zweiergruppen zufällig neu gebildet. Innerhalb einer Periode gibt es keine Interaktion zwischen Ihrer Gruppe und anderen Gruppen. Sie und alle anderen Teilnehmer in jeder Gruppe stehen in jeder Periode der gleichen Entscheidungssituation gegenüber, die im Rest der Anleitung beschrieben wird.

Jeder von Ihnen repräsentiert einen Arbeitgeber. Zu Beginn des Experiments wird Ihnen zufällig die Rolle des Arbeitgebers A oder B zugewiesen, der andere Teilnehmer Ihrer Gruppe ist entsprechend immer Arbeitgeber B oder A und damit Ihr Konkurrent. Arbeitgeber A hat seinen Sitz in Land $\mathcal{A}$, sein Konkurrent, Arbeitgeber B, in Land $\mathcal{B}$. Jeder Arbeitgeber besitzt zu Beginn des Experiments ein Anfangsvermögen von 60 GE. Sie können beide ein homogenes Gut mit Hilfe von bis zu insgesamt vier Arbeitnehmern $A1$, $B1$, $A2$ und $B2$ produzieren. Arbeitnehmer $A1$ und $A2$ kommen aus Land $\mathcal{A}$, $B1$ und $B2$ kommen aus Land $\mathcal{B}$. Jeder Arbeitnehmer wird für genau einen Arbeitgeber arbeiten. Sie und Ihr Konkurrent unterbreiten in jeder Periode den vier Arbeitnehmern simultan Lohnangebote. Die vier Arbeitnehmer sind vom Computersystem simuliert und wählen aus den beiden Lohnangeboten jeweils das für sie individuell beste aus und produzieren dann für ihren Arbeitgeber unter Einsatz von Kosten, die ihnen durch die produktive Tätigkeit entstehen und von den Arbeitnehmern selbst zu bezahlen sind. Der Marktpreis passt sich so an, dass der gesamte produzierte Output auf dem nur von den beiden Arbeitgebern belieferten Markt abgesetzt wird.

Ein Lohnangebot des Arbeitgebers $i \in \{A, B\}$ an Arbeitnehmer $j \in \{$A1, B1, A2, B2$\}$ besteht aus zwei Komponenten (in GE): einem Fixlohn $W_i^j \in [0; 7]$ und einem Stücklohn $s_i^j \in [0; 12]$. Ein angenommenes Lohnangebot generiert dem Arbeitnehmer j einen Fixlohn W_i^j und für jede produzierte Einheit zusätzlich den Stücklohn s_i^j. Somit müssen Sie als Arbeitgeber insgesamt vier Fixlöhne und vier Stücklöhne anbieten, ebenso wie Ihr Konkurrent.

Jeder der vier Arbeitnehmer wählt in jeder Periode genau eines der beiden ihm vorgeschlagenen Lohnangebote aus, produziert also für genau einen Arbeitgeber in der laufenden Periode. Es gibt dabei zwei Typen von Arbeitnehmern:

- **Arbeitnehmertyp 1:** Die Arbeitnehmer $A1$ und $B1$ sind in ihrem Inland produktiver, also bei dem Arbeitgeber, dessen Bezeichnung sie im Namen tragen. Die Kosten für die Erstellung einer Einheit Output sind für Arbeitnehmer $A1$ bei Arbeitgeber A niedriger als bei Arbeitgeber B; umgekehrt ist eine Outputeinheit für Arbeitnehmer $B1$ bei Arbeitgeber B günstiger zu erstellen als bei Arbeitgeber A.

- **Arbeitnehmertyp 2:** Die Arbeitnehmer $A2$ und $B2$ sind in ihrem Inland und ihrem Ausland, also bei jedem Arbeitgeber, gleich produktiv. Die Kosten für die Erstellung einer Einheit Output, sind für sie gleich hoch, unabhängig davon, für welchen Arbeitgeber ein Arbeitnehmer vom Typ 2 arbeitet.

Die Gesamtkosten für x Outputeinheiten, die ein Arbeitnehmer (Spalten) für einen Arbeitgeber (Zeilen) produziert, sind gemäß der folgenden Tabelle gegeben, wobei $d > c > 0$.

Kosten in GE	$A1$	$A2$	$B1$	$B2$
A	$\frac{1}{2}cx^2$	$\frac{1}{2}cx^2$	$\frac{1}{2}dx^2$	$\frac{1}{2}cx^2$
B	$\frac{1}{2}dx^2$	$\frac{1}{2}cx^2$	$\frac{1}{2}cx^2$	$\frac{1}{2}cx^2$

Für jedes der beiden Lohnangebote bestimmen die virtuellen Arbeitnehmer zunächst ihren optimalen Output. Abhängig von den Stückkosten würden, wie man zeigen kann, $\frac{s_i^j}{c}$ bzw. $\frac{s_i^j}{d}$ Einheiten produziert, die zusammen mit dem Fixlohn und nach Abzug der Kosten die Auszahlung $W_i^j + \frac{(s_i^j)^2}{2c}$ GE bzw. $W_i^j + \frac{(s_i^j)^2}{2d}$ GE für den Arbeitnehmer generieren würden. Jeder Arbeitnehmer entscheidet sich für den Arbeitgeber, der für ihn die höhere Auszahlung induziert. Falls zwei Lohnangebote die gleiche Auszahlung generieren, wählt der Arbeitnehmer zufällig mit gleicher Wahrscheinlichkeit einen Arbeitgeber aus.

Die Produktionskosten, hier gleich den Lohnkosten, die aus einem angenommenen Lohnangebot resultieren, liegen für den Arbeitgeber dann bei $W_i^j + \frac{(s_i^j)^2}{c}$ GE bzw. $W_i^j + \frac{(s_i^j)^2}{d}$ GE.[22] Der kumulierte Output eines Arbeitgebers (x_A bzw. x_B) ist die Summe der von seinen angestellten Arbeitnehmern produzierten Einzelmengen. Der Preis (in GE) auf dem Absatzmarkt fällt im Gesamtangebot, $p = 15 - x_A - x_B$.

Im Experiment gelten für die genannten Kosten der Erstellung einer Einheit Output:

$$c = 8 \, ,$$

$$d = 60 \, .$$

Zusammenfassend kann Ihr Periodengewinn (bzw. -verlust) als Arbeitgeber abhängig von der Beschäftigungskonstellation und den Lohnangeboten,

[22]In the additionally provided table of employers' profits the denominators of the piece rate wages were correct for each of the sixteen hiring constellations such that a misprint in the original main part of the instruction—the denominators were $2c$ and $2d$ instead of c and d—was offset. Recent observations from a follow-up experiment proved that the misprint did not bias results.

wie in der Tabelle auf den folgenden Seiten dargestellt, beschrieben werden. Analog ergibt sich der Gewinn des Konkurrenten in Ihrer Gruppe. Ihr Gesamtgewinn am Spielende berechnet sich durch Addieren aller Ihrer Periodengewinne (bzw. -verluste) und Ihres Anfangsvermögens. Falls Ihr Gesamtgewinn am Spielende negativ ist, beträgt Ihre Auszahlung 0 Euro.

Information

Sie können am Ende jeder Periode die in den Vorperioden realisierten Beschäftigungskonstellationen sowie ihren individuellen Output, den Marktpreis und Ihre Lohnangebote an die vier Arbeitnehmer anschauen. Weiterhin sehen Sie Ihre Periodengewinne und die Ihres Konkurrenten.