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Fehr, Ernst; Kirchsteiger, Georg; Gächter, Simon

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Reciprocal Fairness and Noncompensating Wage Differentials

by

ERNST FEHR, SIMON GÄCHTER and GEORG KIRCHSTEIGER *

In this paper we report the results of a series of competitive market experiments in which, according to competitive theory, noncompensating wage differentials should not occur. Contrary to this prediction the evidence shows a stable pattern of noncompensating wage differentials: *The higher the profits of a firm from the employment of a worker, the higher are its wage offers. Moreover, the higher the wage paid, the higher is workers' effort level.* Due to workers' reciprocal behaviour, firms at all profitability levels pay significantly positive job rents. (JEL: J 41, J 64, C 91, C 92)

1. Introduction

During the last decade, many econometric studies have confirmed the existence of inter-industry wage differentials.[1] Even after controlling for a large number of job-related, worker-related and demographic variables, large and statistically significant industry wage differences remain. Moreover, these differences exist for union as well as for non-union workers and seem to be remarkably similar across countries with different labour market institutions (e.g. KRUEGER and SUMMERS [1988], WAGNER [1990], ZWEIMÜLLER and BARTH [1994]), across occupations (e.g. DICKENS and KATZ [1987b]), and across time (e.g. KATZ and SUMMERS [1989]).

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[1] See for example KRUEGER and SUMMERS [1987], [1988], DICKENS and KATZ [1987a], [1987b], MURPHY and TOPEL [1987], [1989], [1990], KATZ and SUMMERS [1989], BLACKBURN and NEUMARK [1992], EDIN and ZETTERBERG [1992], GIBBONS and KATZ [1992], ZWEIMÜLLER and BARTH [1994] for international evidence. Among others, WAGNER [1991] and SCHMIDT [1992] present evidence for Germany, HOFER [1992] and WINTER-EBMER [1994] for Austria, and FERRO-LUZZI [1994] for Switzerland.

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Even though the empirical fact of wage differentials is largely undisputed, the *explanation* of it is not. Basically, there are two rival explanations (see KRUEGER and SUMMERS [1988], MURPHY and TOPEL [1987]). One tries to reconcile the empirical facts with neoclassical labour market theory by claiming that the observed wages compensate for unobserved abilities and/or working conditions. An alternative approach rejects the neoclassical view and invokes an efficiency wage explanation.[2] In particular, wage differentials may be explained by the fair wage-effort approach put forward by AKERLOF and YELLEN [1988], [1990].[3] In this approach workers' effort behaviour induces firms to pay wages according to their profitability.

Both parties in this dispute offer empirical evidence in favour of their point of view. However, all researchers in this field face a severe data problem. Many of the interesting variables cannot be directly measured. This problem plagues those who argue that wages compensate for *un*observed factors, as well as those who argue with, e.g., gift exchange considerations.[4] The incentive to pay fair (efficiency) wages may result from social comparison processes which typically are very hard to measure with field data. These data problems suggest that an experimental approach can shed more light on the validity of competing explanations. In this context the major advantage of an experimental approach stems from the fact that workers' skill levels as well as job and firm characteristics are fully under the control of the experimenter.

In this paper we are mainly interested in the question whether persistent noncompensating wage differentials can occur in competitive markets. In addition, we are interested in the potential determinants of noncompensating differentials. In our view social comparison processes as stipulated in the gift exchange approach are an important potential determinant of noncompensating interindustry wage differentials. Two facts suggest this: First, high profit industries tend to pay high wages. Second, if one occupation in an industry is highly paid, all other occupations in that industry also tend to pay high wages (DICKENS and KATZ [1987a], KATZ and SUMMERS [1989]). Both facts are observed after controlling for observable job and workers' characteristics. They are, therefore, difficult to reconcile with the neoclassical approach unless one invokes *un*observable heterogeneity of workers or jobs as an explanation. Moreover, these facts also speak against the shirking (SHAPIRO and STIGLITZ [1984], FEHR [1986]), the turnover (SCHLICHT [1978], SALOP [1979]), and the adverse selection (WEISS [1980]) version of the efficiency wage hypothesis.

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[2] Logically, if one does not abandon the view that firms maximise profits, firms either compensate their workers for working conditions and/or abilities or they find it in their interest to pay job rents, i.e. efficiency wages.

[3] For a discussion and evaluation of the gift exchange approach see also KUBON-GILKE [1990], SCHLICHT [1990], FEHR, KIRCHSTEIGER and RIEDL [1993], and FEHR, GÄCHTER and KIRCHSTEIGER [1996].

[4] The fair wage-effort approach is sometimes also called "gift exchange approach."

The fair wage-effort model can potentially account for the above facts. The basic hypothesis in this model is that if wages fall short of a fair reference wage, a rise in wages will raise workers' effort. As a consequence, firms have an incentive to pay wages that are close to workers' fair reference wages. Two kinds of social comparison processes[5] may affect the level of the fair reference wage and, hence, the wage-effort relation: (*i*) If workers' perception of what constitutes a fair wage level is positively correlated with firms' profit opportunities, high profit firms are forced to pay a higher wage to elicit a *given* level of effort. Moreover, if higher profit opportunities are associated with a higher marginal product of effort, high profit firms have an incentive to elicit higher effort levels. Both reasons may be responsible for a positive correlation between profits and wages. (*ii*) If workers' perception of what constitutes a fair reference wage is affected by the pay of their colleagues in the same firm (same industry), the existence of one highly paid group in a firm (industry) may induce firms to pay all other categories of workers a wage premium, too.[6] Otherwise, large parts of the workforce would feel underpaid and reduce their effort levels. This mechanism can potentially explain the second of the above facts.

In this paper we do not allow for social comparison processes among workers. We are interested in the extent to which *differences in firms' profit opportunities* give rise to persistent wage differentials. To answer this question we have conducted several competitive market experiments in which firms differed according to their profit opportunities. In the absence of reciprocal effort responses, firms had no reason to pay different wages in these experiments. It turns out, however, that in all periods of the experiments there was a positive relation between firms' profitability and their wage offers. Therefore, our results provide support for the gift exchange explanation of the positive correlation between profits and wages.

The paper is organised as follows: In the next two sections we present an experimental design which allows us to find out whether fair wage-effort considerations are capable of generating noncompensating wage differentials. In section 4 we present the results. Section 5 concludes.

2. The Experimental Design

One of the most impressive pieces of evidence in favour of the perfect competition model comes from the results of competitive market experiments. Although in these markets there is no auctioneer and, hence, out-of-equilibrium trading is possible, they converge rather quickly and under very weak condi-

[5] For an early discussion of the consequences of reference group behaviour and social comparison processes for economic incentives see SCHLICHT [1981 a], [1981 b].

[6] The existence of one highly paid group may be due to the group's superior bargaining power or the scarcity of the group members' skills.

tions to the perfectly competitive outcome (see SMITH [1982], PLOTT [1989], DAVIS and HOLT [1993]). In general, the details of the convergence process differ according to the trading rules and the parameter constellations, but ultimately trade takes place at competitive equilibrium prices.

The impressive power of competitive experimental markets to generate competitive outcomes creates a good test environment for alternative theories. If it can be shown that the predictions of alternative theories hold in competitive experimental markets, one can regard this as a relevant piece of evidence in favour of these alternative theories. For this reason we have designed such a market to which we have added one relevant feature of real world labour markets: Instead of assuming that the labour relation is based on a completely specified and fully enforceable contract our basic assumption is that labour contracts are rather incomplete. This incompleteness concerns, in particular, the specification and the enforcement of effort levels but may also concern the payment of occasional wage bonuses.

Our design consists of four elements: (*i*) a competitive market with an excess supply of workers to create a substantial amount of competitive pressure; (*ii*) firms which differ according to the profitability of an employed worker; (*iii*) incomplete contracts, that is, workers have some discretion in exerting work effort; and (*iv*) a repeated interaction between workers and firms as is common in most real life labour relations.[7]

We have implemented these features as follows: A market session consisted of several trading periods and each period had *three stages*. Parameters were stationary across periods. There were always more workers than firms. In a given period, a firm could – for reasons of simplicity – only employ one worker. The excess supply of workers was common knowledge. It rendered firms rather powerful because it created a lot of competitive pressures among workers. From the very beginning, firms did not have to bother about getting a worker. To render firms even more powerful, they could simultaneously commit themselves[8] – at *stage one* of the market – to a certain wage bid w while workers could accept or reject these bids according to a randomly determined order. If a worker accepted a wage, he incurred fixed costs of working, which we denote by f, whereas firms received q units of experimental money. In the experiments we assigned firms different redemption values q. Obviously, the higher q is, the higher is a firm's profit opportunity. Firms' wage bids had to obey the condition $w \in [f, q]$. Those firms and workers who did not trade in a given period earned nothing during that period.

At the *second stage*, those workers who accepted a wage bid had to choose an effort level. Effort levels were designed as numbers $e \in [e_0, e^0]$, $e_0 < e^0$, and

[7] When we speak of firms and workers, we mean experimental subjects acting in the roles of firms and workers, respectively.

[8] Experiments with posted offer markets (see DAVIS and HOLT [1993, ch. 4]) have shown that the commitment power of sellers works to their advantage. Analogously, we can expect that our posted bid market works to the advantage of the firms.

workers were free to choose any effort level. This reflects the incompleteness of the labour contract. The choice of e was associated with effort costs $c(e)$ which were strictly increasing in e.[9]

It seems obvious that reciprocity and gift exchange are enhanced by trust. Trust, in turn, can more easily emerge within repeated interactions. Since employment relations are usually long-run relations, a two-stage design leaves much less scope for the evolution of reciprocal behaviour than most real world employment relations. On the other hand, however, the theory of repeated games shows that cooperative behaviour may emerge in infinitely repeated games even if all players are purely selfish (see, e.g., FUDENBERG and MASKIN [1986]).[10]

To distinguish between these strategic reasons for purely selfish individuals to cooperate and reciprocity-based cooperation we had to find an experimental design that allows for trust-enhancing repeated interactions without leaving scope for the above mentioned strategic considerations. This was done by introducing a *third stage* into our design in which firms could punish or reward its workers at some cost to themselves.

At the *third stage*, each firm could react to its worker's effort decision by punishing or rewarding their worker at some cost. Again, this was implemented by letting firms choose a number $p \in [p_0, p^0]$, $p_0 < 1 < p^0$, which was then used to multiply its worker's gain $[w - c(e) - f]$ from the first two stages. In case of $p < 1$ the firm's choice represented a penalty while in case of $p > 1$ it was a reward. For $p \leq 1$ the costs which were associated with p, $k(p)$, were strictly decreasing in p whereas for $p > 1$ they were strictly increasing in p. Furthermore, $k(p_0) = k(p^0)$ and in the absence of any penalty or reward, i.e. $p = 1$, $k(p) = 0$.

We want to stress that we do not regard the third stage as a literal copy of some real world feature. Yet, in long-term relations such as the employment relation it is rather likely that opportunities to punish or reward the other side emerge. In our design, if firms are pure money maximisers, that is, if they are not motivated by reciprocity considerations, they will never punish or reward their workers because it is costly. Therefore, in the absence of reciprocity motives the third stage should not matter at all. Put differently: the third stage does not generate a strategic motive for cooperation if subjects are pure money

[9] In our experiments, subjects in the role of workers did not exert some physical effort as is the case in real world labour relations. The disutitity of effort is captured by the monetary costs of choosing non-minimum effort levels. As an experiment is only *isomorphic* to an economic situation outside the laboratory, SMITH [1976], [1982] has shown that if suffices to induce values which capture the basic incentives in a particular economic situation.

[10] Even in finitely repeated games, cooperative behaviour may emerge in the early stages of the game for purely strategic reasons if there is a small probability that the opponent is not purely selfish (KREPS et al. [1982]). Towards the end, however, such strategic cooperation is predicted to break down.

maximisers. Yet, if subjects are motivated by reciprocity the third stage may well enhance cooperation.

Firms' and workers' one-period gains in Austrian Schillings (AS), which we denote by π and u, respectively, were given by

$$\pi = (q - w)\, e + b - k(p) \quad \text{and}$$
$$u = [w - c(e) - f]\, p\,.$$

Several features of these payoff functions are due to our attempt to avoid out-of-pocket losses for experimental subjects. Therefore, we paid firms $b > 0$ in case that they traded. This gave firms who received a very low effort the opportunity to punish their workers without incurring a loss. Also, instead of multiplying only q by e we multiplied $(q - w)$ by e. There are two reasons for this decision. First, we wanted to exclude the possibility that reciprocity phenomena are polluted by loss aversion phenomena.[11] Second, losses cannot be credibly enforced from experimental subjects.[12]

In the experiments b, f, $k(p)$ and $c(e)$ were common knowledge while the choice of e and p was only known by those who were involved in a given trade. Each firm and each worker was informed about all wage offers. The value of q differed across firms and a worker who accepted the wage bid w of a firm was told the value of q after he accepted w but before he had to choose e. This gave workers the opportunity to judge the generosity of the wage bid and, if they considered this as relevant for their effort choice, to act accordingly. Traders did not know with whom they traded nor did any other agent in the market possess information about the identity of traders. The sequence of events in our design is summarised in the following table 1.

3. Parameters and Experimental Procedures

In total we conducted four *computerised* experimental sessions. To allow for learning effects session 1 (S1) lasted 12 periods and the other three sessions (S2, S3, S4) lasted 16 periods. Furthermore, there were two trial periods at the beginning of each session in order to allow subjects to become acquainted with the experiment.

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[11] For the behavioural relevance of loss aversion see THALER [1992, ch. 6], and TVERSKY and KAHNEMAN [1991].

[12] Of course, we could have paid firms at the very beginning a lump sum payment which is higher than all losses that can possibly occur in an experimental session. But this would have exceeded our budget. Forcing a firm that has made an overall loss to leave the experimental session also would have been a bad solution. In that case workers might have chosen high effort levels in order to avoid an increase in the excess supply and not for reciprocal motives. Hence we decided to exclude losses by using the above payoff function for firms.

Table 1

The Sequence of Events

Stage 1	• Firms (which differ in their assigned q-values) simultaneously post binding wage offers $w \in [f, q]$.
	• Workers observe all wages and choose among the available offers in a randomly determined order.
Stage 2	• Workers who accept an offer choose an effort level e and incur costs $c(e)$.
Stage 3	• Firms are informed about the effort choice of their worker and can punish ($p < 1$) or reward ($p > 1$) their worker at some cost $k(p)$.

The number of workers always exceeded the number of firms by 2. In one session we had 5 firms and 7 workers, and in the other sessions there were 6 firms and 8 workers.[13] Subjects were undergraduate students of business administration and, in case of S4, students of psychology from the University of Vienna.

Before the beginning of a session, subjects were randomly allocated to the roles of firms and workers. To avoid a loss of control we framed the whole experiment in as neutral terms as possible. Therefore, we avoided value-loaded labour market terms and instead used goods market terms. Firms were called "buyers" and workers "sellers." For the reading of the instructions, workers and firms were located in different rooms. Communication between subjects was of course strictly forbidden. Subjects had to solve control exercises in order to ensure that they understood the payoff structure. Then all subjects went to the computer lab and each subject took a seat in front of his screen. In the lab there was no possibility for communication between the subjects, neither verbally nor by other means because they could not see each other. Subjects made their decisions in the course of a session by pressing different keys on the keyboard. At the end of a session subjects' per-period gains were added up and paid in cash.

At the first stage of a period, firms had 120 seconds to make their bids. No firm was forced to make a bid. After 120 seconds all participants were informed about all bids. Yet, nobody was informed about the identity of the bidding firms. Afterwards the computer randomly determined the order in which workers were allowed to choose among the available bids. In each period the order of choice was determined by chance. Then workers could choose at most one of the available bids when it was their turn to choose. No worker was forced to accept an offer. The first stage ended after either each bid was accepted or each worker had had the opportunity to accept a bid.

[13] In S1 two subjects did not show up.

In total we implemented six different q-values in each session: 130, 110, 90, 70, 55, 40. In a given period each firm had a different redemption value. The assignment of redemption values to firms alternated between periods. The firm with the highest value in odd-numbered periods was assigned the lowest value in even-numbered periods. The firm with the second highest value in odd-numbered periods was assigned the second lowest value in even-numbered periods, and so forth. This alternation served the purpose of (approximately) equalising expected gains across firms. It was not known to the participants. Participants only knew that different firms had different redemption values within the range of 40 to 130 and that for each firm q changed from period to period.

At the beginning of each period, each firm was informed about its redemption value for the respective period. To allow workers to judge the generosity (i.e. fairness) of a wage offer, a worker – after acceptance of a bid – was informed about the redemption value of "his" firm. Yet, the worker did not know the identity of "his" firm. Likewise, the firm did not know the identity of "its" worker. This *strict anonymity* was maintained during the whole experiment.

The other parameters of the experiment were as follows: $f = 20$, $b = 5$. The $c(e)$-schedule is given by table 2 while the $k(p)$-schedule is given by table 3.

What are the behavioural implications of our design? If firms are rational money maximisers they will always choose $p = 1$ because any other choice is costly for them. Since this will be anticipated by rational money maximising workers, they will choose the lowest possible effort level e_0. This in turn induces firms to choose the lowest possible wage irrespective of their q-value. Even though firms differ in their q-values, from a game-theoretic point of view this does not matter. Hence, if all agents are rational money maximisers we should observe no systematic wage differentials. However, if there is a positive relation between w and e, firms with higher q's have an incentive to pay higher wages.

Table 2

Effort Levels e and Associated Costs $c(e)$.

e	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$c(e)$	0	1	2	3	4	6	8	10	12	15	18

Table 3

Punishment ($p < 1$) and Reward Levels ($p > 1$) and Associated Costs $k(p)$

p	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
$k(p)$	10	9	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10

Moreover, if q affects the wage-effort relation negatively, high profit firms have an additional reason to pay comparatively high wages.[14]

4. Experimental Results

An experimental session lasted approximately 3 hours. During a session subjects earned on average about 242 AS (24 US $) from trading plus a show-up fee of 70 AS.

In the following we organise our empirical results on the basis of several specific hypotheses. In the presentation of our results we proceed "backwards" and start with the behaviour at the third stage. These hypotheses are derived from the notion of reciprocal fairness. Our definition of reciprocal fairness is similar to the one proposed by RABIN [1993] and can be characterised as a propensity to reward (punish) the advantageous (disadvantageous) behaviour of other agents even if rewarding (punishing) is costly. More specifically, if a person, say person A, does another person, say B, a favour, B is more likely to do A a favour, even if this is costly for B. Similarily, if A hurts B the probability that B will hurt A increases, even if this increase is costly for B. According to this definition, reciprocity is a form of *contingent behaviour* even though it is costly and therefore not in a person's immediate material interest. It contains a desire for "equal ex post gains from trade" as a special case.

4.1 Firms' Punishment and Reward Decisions at Stage Three

At the third stage, firms choose the punishment/reward variable p. Since punishing ($p < 1$) or rewarding ($p > 1$) the worker is costly for the firm, pure money maximisers should always choose $p = 1$. On the other hand, if they are motivated by reciprocity considerations we would expect that a particular p-choice depends on the "history" of the particular trade. Specifically, we would expect that, *ceteris paribus*, p should increase with the effort provided by the workers at the second stage. On the other hand, p should, *ceteris paribus*, be decreasing in the wage, since the greater the wage, the greater is the favour already done by the firm to the worker at the first stage. Furthermore, the greater the redemption value q, the lower is the "relative" favour of a certain wage. Hence, p should increase in q. This reasoning leads to our first hypothesis.

[14] Suppose a firm's objective is to maximise π subject to $e = e(w, q)$ with $e_w > 0$, $e_q < 0$, $e_{ww} < 0$ and $e_{wq} \geq 0$. The first order condition for w is given by $(q - w)\, e_w - e(w, q) = 0$. Totally differentiating with respect to q and w yields $sign\,(dw/dq) = sign\,[e_w - e_q + (q - w)\, e_{wq}]$. Thus even purely selfish firms have an incentive to raise wages for higher q's.

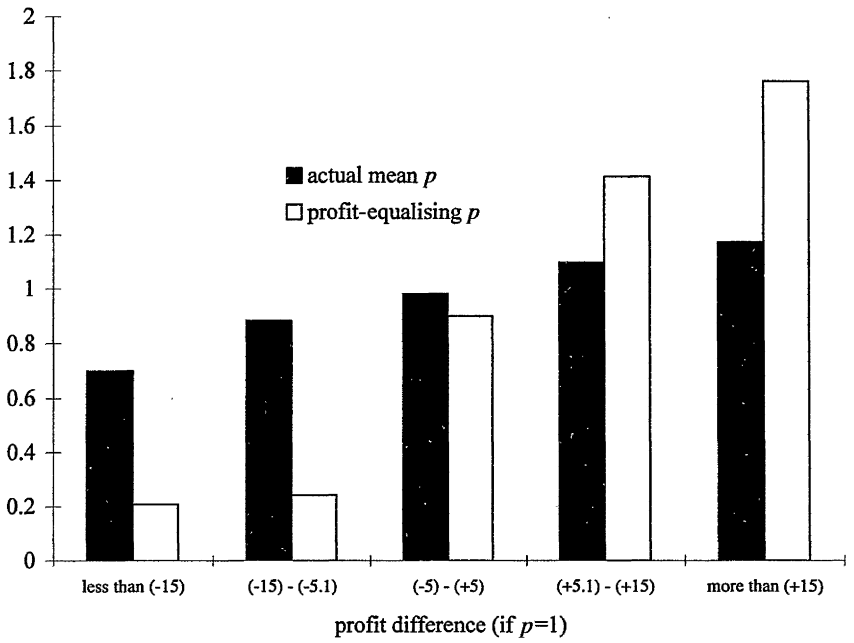

Figure 1

Actual Mean Punishment ($p < 1$) or Reward ($p > 1$)
and Hypothetical Profit-Equalising p

Hypothesis 1: On average, p is increasing in q, decreasing in w, and increasing in e.

It is instructive to first describe the behaviour at the third stage in more detail. In 121 cases, i.e. 36 percent of all cases, a firm did not choose $p = 1$. In 67 cases the firm punished the worker ($p < 1$), in 54 cases a firm rewarded "its" worker ($p > 1$). We observed all possible p-levels except 1.8 and 1.6. The lowest (highest) possible p-level of 0 (2) was observed 18 (1) times. An individual data analysis shows that only three firms always chose $p = 1$. The other 20 firms were – at least sometimes – willing to punish and/or reward their workers.

Figure 1 is a first indication that this deviation from pure money maximising behaviour is not completely random. In figure 1 we computed the difference between a firm's and its worker's profit that would arise if – given the actual wage and the actual effort – the firm neither punishes nor rewards, that is chooses $p = 1$. A negative difference indicates that workers – under the assumption of $p = 1$ at the third stage – earn more than firms.

From figure 1 one immediately sees that the mean actual p increases with this difference. If firm's relative payoff from the first two stages is rather low (profit

differences of less than -15), they are willing to punish "their" workers (in these cases the observed p was 0.69 on average). On the other hand, if the relative result of the first two stages is rather favourable (profit differences of more than $+15$), they are willing to reward "their" workers (in these cases the observed p was 1.2 on average). If both trading partners got roughly the same after the first two stages (profit differences between -5 and $+5$), the average firm decided neither to punish, nor to reward, i.e. to choose $p = 1$ (in these cases the average observed p was 0.99). Thus, figure 1 suggests that reciprocity motives actually affected the p-choice.

There is a clear positive relationship between the profit difference in firms' p-choices. To what extent were subjects motivated by a special case of reciprocity, namely a motive for an equalisation of profits? To find out about the empirical importance of a desire for equal profits, we calculated the *hypothetical* p-values which would have rendered firms' and workers' profit equal at the end of the third stage. In figure 1 we also have depicted these hypothetical profit-equalising p-values. Given that firms' actual p-choice was motivated by a desire for equal payoffs, the hypothetical and the actual p's should not be any different. It is obvious from figure 1 that, to equalise payoffs, subjects would have had to punish and reward much more than they actually did. Thus, on average firms acted reciprocally, but they did not equalise payoffs.

To find out how the observed punishment/reward behaviour is influenced by q, w, and e, we set up the following OLS-regression:

$$p = \alpha_1 + \alpha_2\, q + \alpha_3\, w + \alpha_4\, e + \mu_\alpha\,, \tag{1}$$

where μ_α denotes the normally distributed error term. If α_2 and α_4 are significant positive and α_3 is significantly negative, the data indicate that hypothesis 1 is valid. Table 4 documents our results.

As predicted by hypothesis 1, the e-coefficient α_4 and the q-coefficient α_2 are significantly positive (except α_2 in S4), whereas the w-coefficient α_3 is significantly negative for the observations of all sessions as well as for the observations of each individual session.

In figure 1 and table 4 we have used the data of all periods. Hence, one might argue that they provide a misleading picture of the experimental events because they hide potential temporal effects. This raises the question whether firms' reciprocal behaviour at stage three persists over time or whether it degenerates into purely selfish behaviour towards the end. Such a temporal behavioural pattern may be due to (wrong) beliefs about the possibilities of reputation formation.

As explained in section 3, our experimental design tries to rule out reputation effects by imposing strict anonymity conditions. Therefore, it is impossible to reward or punish the past behaviour of agents. Nonetheless, subjects may believe that reputation effects play a role and this (wrong) belief may cause reciprocal behaviour. If this is the case we should expect that reciprocal be-

Table 4

Results of Regression (1):
$p = \alpha_1 + \alpha_2\, q + \alpha_3\, w + \alpha_4\, e + \mu_\alpha$

	S1–4	S1	S2	S3	S4
N	339	59	94	91	95
α_1	1.05	1.05	1.05	1.22	0.92
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
α_2	0.0027	0.0031	0.0032	0.0047	0.0014
	(0.000)	(0.077)	(0.049)	(0.003)	(0.204)
α_3	−0.012	−0.011	−0.013	−0.022	−0.005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.050)
α_4	0.660	0.490	0.778	0.884	0.49
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.27	0.27	0.32	0.38	0.14
R_t^2	0.27	0.25	0.37	0.36	0.10
pr (ch_1)	0.052	0.78	0.52	0.052	0.35
pr (ch_3)	0.57	0.83	0.52	0.054	0.88
pr (W_t)	0.70	0.64	0.12	0.71	0.79

Remark: prob-values of α_i are in parentheses;
S#: session#;
N: number of observations;
R^2: adjusted coefficient of determination;
R_t^2: adjusted coefficient of determination if the constant is replaced by period dummies;
pr ($ch_{1(3)}$): prob-value of the Chow-test statistic under the hypothesis that there is no structural change before the last (last three) period(s);
pr (W_t): prob-value of the Wald-statistic for the null hypothesis that all estimated period dummy coefficients are equal to α_1.

haviour would vanish in the last periods because reputation is worthless at the end of an experimental session. On the other hand, if such reputation effects are absent, reciprocal behaviour should be observed during the whole experimental session. To detect temporal reputation effects we have to test for the stability of regression (1).

When we apply the usual econometric methods[15] to regression (1), it turns out that there is no evidence in favour of temporary reputation effects. The hypothesis that the data of the last (last three) periods are generated by the same process as all observations cannot be rejected at least at the usual 5 percent-level (see pr(ch_1) and pr(ch_3) in table 4). Furthermore, the inclusion of period dum-

[15] *Chow-tests* are one possibility to test for structural stability. Besides Chow-tests, we have reestimated the regressions with *intercept dummies for each period* instead of the constant. A non-increasing adjusted R^2-value due to the use of time dependent intercepts would indicate that the period does not matter for the decisions. Furthermore, we have computed a *Wald-statistic* for the hypothesis that all estimated period dummy coefficients are equal to the estimated constant of the original regression. In case we cannot reject this null hypothesis, we have no indication that firms' behaviour differs across periods.

mies instead of the constant α_1 does not improve the regression (compare R^2 with R_t^2 in table 4), and the hypothesis that all period dummy coefficients are equal to the estimated constant α_1 of the original regression cannot be rejected even at the 10 percent-level[16] (see $pr(W_t)$ in table 4).

4.2 Workers' Effort Choice at Stage Two

What kind of worker behaviour can we expect at stage two? Under the assumption that firms are pure money maximisers, rational money maximising workers will always choose the minimum level e_0 because they anticipate that firms will always choose $p = 1$. Yet, in the presence of reciprocal fairness workers may have two motives to choose an effort greater than the minimum level. First of all, by choosing a high effort level, workers – irrespective of whether they are pure money maximisers or not – may make an appeal to firms' reciprocity to get a high p from them. Since we do not observe workers' expectations about firms' p-choice, we cannot directly test for this motive. But there may be another reason for choosing $e > e_0$ that we can test for. If workers behave reciprocally, we should expect that they do firms a favour if they have already been treated in a friendly way, i.e. if they have already received a high wage at the first stage. Furthermore, the higher the redemption value q, the easier it is for firms' to pay workers a high wage and, hence, the less generous a given wage offer will appear. This leads to our second hypothesis.

Hypothesis 2: On average, e is increasing in w and decreasing in q.

To test hypothesis 2 we fit the regression:

$$e = \beta_1 + \beta_2 q + \beta_3 w + \mu_\beta . \tag{2}$$

If hypothesis 2 is valid, β_2 should be significantly negative and β_3 should be significantly positive.

The mean effort level was 0.35 and the average effort cost $c(e)$ was 4.4 AS. Since workers earned on average 19.4 AS, this means that they roughly spent 20 percent of their gains in order to do firms a favour. We observed all possible effort levels. The lowest effort level e_0 was observed only in 51 trades, i.e. 15 percent of all cases. The highest e was observed in 10 cases. Individual data show that only one out of 31 workers always chose $e = e_0$.

Figures 2 show how average effort is related to wages.[17] The pattern of these data points is clearly upward sloping. Furthermore, using the results of regres-

[16] Since neither the sign nor the significance of the e-, w- and q-coefficients change when the constant is replaced by the time dummies, we do not report explicitly the coefficients of these regressions.

[17] Due to the discreteness of e, different workers chose the same e at a particular wage several times. As a consequence, many observations are not visible in a two-dimensional figure of effort-wage data points. Such a figure would provide a misleading picture of the evidence. To avoid this problem we plotted the average e.

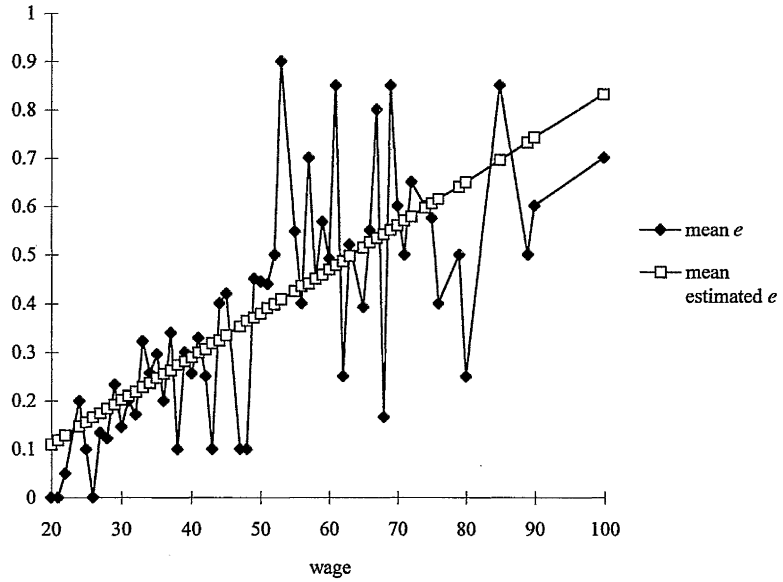

Figure 2a

The Wage–Effort Relation

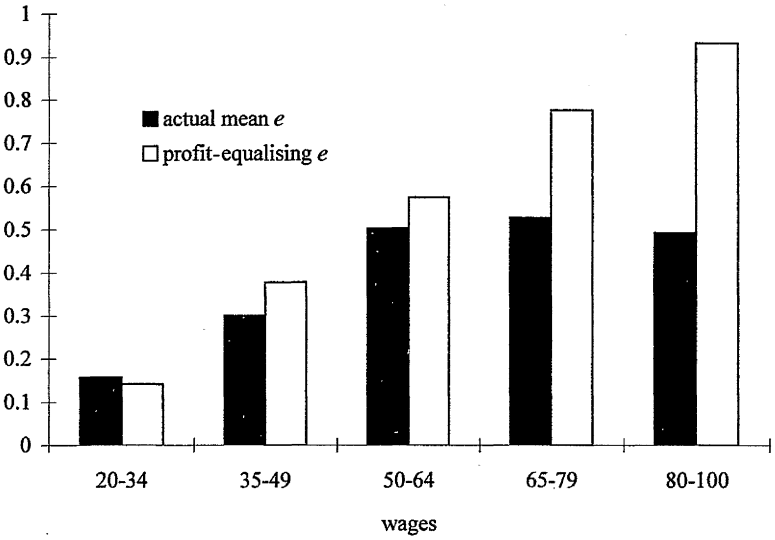

Figure 2b

Actual Mean Effort and Hypothetical Profit-Equalising Effort

Table 5

Results of Regression (2):
$e = \beta_1 + \beta_2 q + \beta_3 w + \mu_\beta$

	S1–4	S1	S2	S3	S4
N	339	56	94	91	95
β_1	−0.067	−0.079	0.054	−0.24	−0.094
	(0.008)	(0.31)	(0.47)	(0.004)	(0.12)
β_2	−0.00008	0.0031	−0.0012	−0.0014	0.00022
	(0.89)	(0.054)	(0.38)	(0.29)	(0.8)
β_3	0.0091	0.0026	0.0086	0.016	0.009
	(0.000)	(0.33)	(0.002)	(0.000)	(0.000)
R^2	0.30	0.30	0.16	0.43	0.34
R_t^2	0.29	0.27	0.08	0.39	0.34
pr (ch_1)	0.28	0.59	0.61	0.91	0.81
pr (ch_3)	0.18	0.76	0.37	0.34	0.15
pr (W_t)	0.66	0.67	0.97	0.87	0.48

Remark: prob-values of β_i are in parentheses;
S#: session #;
N: number of observations;
R^2: adjusted coefficient of determination;
R_t^2: adjusted coefficient of determination if the constant is replaced by period dummies;
pr ($ch_{1(3)}$): prob-value of the Chow-test statistic under the hypothesis that there is no structural change before the last (last three) period(s);
pr (W_t): prob-value of the Wald-statistic for the null hypothesis that all estimated period dummy coefficients are equal to β_1.

sion (2) we depicted the average estimated e (averaged over different q-values). Figure 2a reveals that the average estimated e is positively related to w. This is a first indication that effort is increasing in the wage.

Similarly to firms' hypothetical profit-equalising p-choices, we calculated those hypothetical effort levels which would have rendered firms' and workers' profit equal at the end of the second stage. As figure 2b shows, equality-motivated workers should have chosen higher effort levels than they actually did – especially at high wages.

Table 5 presents the results of regression (2) with the whole data set as well as with the data of each individual session.

As table 5 documents, e is clearly increasing in the wage as predicted by hypothesis 2. On the other hand – and contrary to hypothesis 2 – the redemption value has no significant impact on the effort choice. This indicates that workers behave reciprocally with respect to wages but not with respect to redemption values. This holds for the whole data set as well as for the data of S2, S3, and S4. In S1 the coefficient of w as well as that of q is insignificant. Nonetheless, the average e in this session is 0.3 and the average costs $c(e)$ are 3.7 AS. Hence, workers' behaviour deviates considerably also in this session

from pure money maximisation. But the reason for this deviation is not as clear as in the other sessions.

The estimated relation between effort and wages seems to be stable over time. The hypothesis that the last (last three) period observations follow the same patterns as the other observations cannot be rejected for the whole data set as well as for the data of the individual sessions (see pr (ch_1) and pr (ch_3) in table 5). Furthermore, the replacement of the constant β_1 by period dummies does not lead to an increase of the adjusted R^2 (compare R^2 with R_t^2 in table 5), and the hypothesis that all period dummy coefficients are equal to the estimated constant β_1 of the original regression cannot be rejected in all cases[18] (see pr (W_t) in table 5).

4.3 Firms' Wage Offers at Stage One

So far the results suggest that the second and third stage behaviour is affected by reciprocal fairness. In particular, e is increasing in w. Since a given effort increase generates a larger profit increase the larger the value of q, firms with higher redemption value face a larger incentive to raise w. This leads to

Hypothesis 3: *(a)* w is increasing in q; *(b)* wage differences do not vanish over time.

A first support for hypothesis 3a is figure 3. It shows the average wages paid by firms with different q-values.

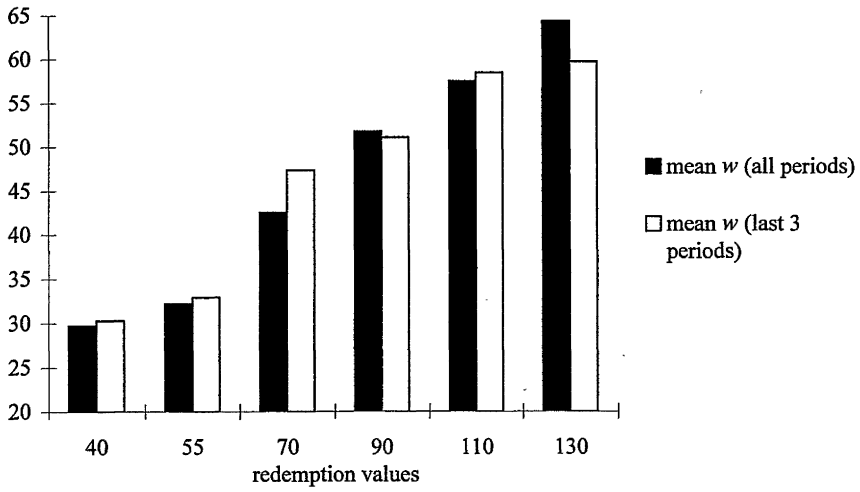

Figure 3

The Redemption Value–Wage Relation

[18] Since neither the sign nor the significance of the w- and q-coefficients change when the constant is replaced by the time dummies, we do not report explicitly the coefficients of these regressions.

Table 6

Results of Regression (3):
$w = \gamma_1 + \gamma_2 q + \mu_\gamma$

	S1–4	S1	S2	S3	S4
N	339	59	94	91	95
γ_1	12.8	4.00	14.3	15.2	14.9
	(0.000)	(0.31)	(0.000)	(0.000)	(0.000)
γ_2	0.41	0.50	0.42	0.39	0.34
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.61	0.69	0.68	0.63	0.51
R_t^2	0.60	0.70	0.67	0.60	0.53
pr (ch_1)	0.63	0.49	0.86	0.97	0.57
pr (ch_3)	0.40	0.10	0.38	0.73	0.90
pr (W_t)	0.89	0.42	0.78	0.94	0.22

Remark: prob-values of γ_i are in parentheses;
S#: session #;
N: number of observations;
R^2: adjusted coefficient of determination;
R_t^2: adjusted coefficient of determination if the constant is replaced by period dummies;
pr ($ch_{1(3)}$): prob-value of the Chow-test statistic under the hypothesis that there is no structural change before the last (last three) period(s);
pr (W_t): prob-value of the Wald-statistic for the null hypothesis that all estimated period dummy coefficients are equal to γ_1.

As it can be seen from figure 3, average wages are increasing in q. This is true for the data of all periods as well as for the last three periods. To get more rigorous evidence on hypothesis 3a we fitted the regression:

$$w = \gamma_1 + \gamma_2 q + \mu_\gamma . \tag{3}$$

If γ_2 is significantly greater than zero, hypothesis 3a is confirmed by the data.

As can be seen from table 6, the q-coefficient γ_2 is significant for the whole data set as well as for each individual session even at the 0.1 percent-level. Moreover, in all regressions the redemption value explains more than 50 percent of the observed wage variance. This relationship also seems to be stable over time: the null hypothesis that the last (last three) period observations are generated by the same process as all other observations cannot be rejected in any session (see pr (ch_1) and pr (ch_3) in table 6). Furthermore, the replacement of the constant γ_1 by period dummies does not lead to a significant increase of the adjusted R^2 (compare R^2 with R_t^2 in table 6). The null hypothesis that all period dummy coefficients are equal to γ_1 also cannot be rejected.[19]

[19] Since neither the sign nor the significance of the q-coefficient changes when the constant is replaced by the time dummies, we do not report explicitly the coefficients of these regressions.

Figure 4a depicts the evolution of average wages for different q-values over time. Remember that according to game-theoretic reasoning, wages should not be distinguishable for different redemption values. Figure 4a clearly shows that wage differentials are quite stable and do not vanish over time. Figure 4b shows

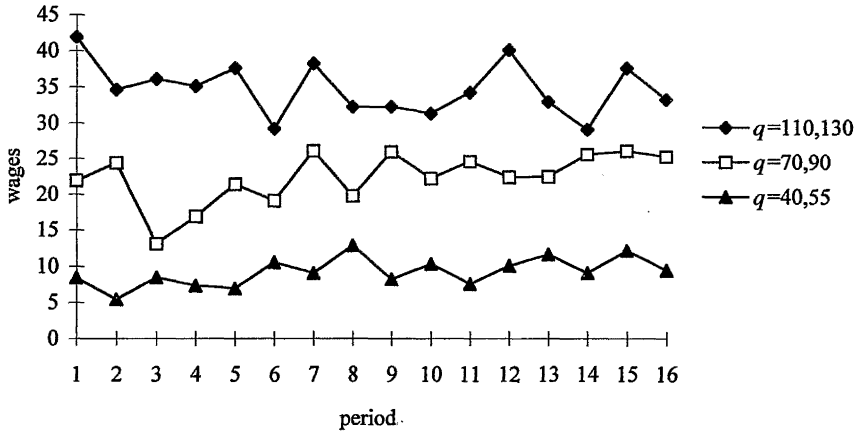

Figure 4a

Wage Differentials Over Time

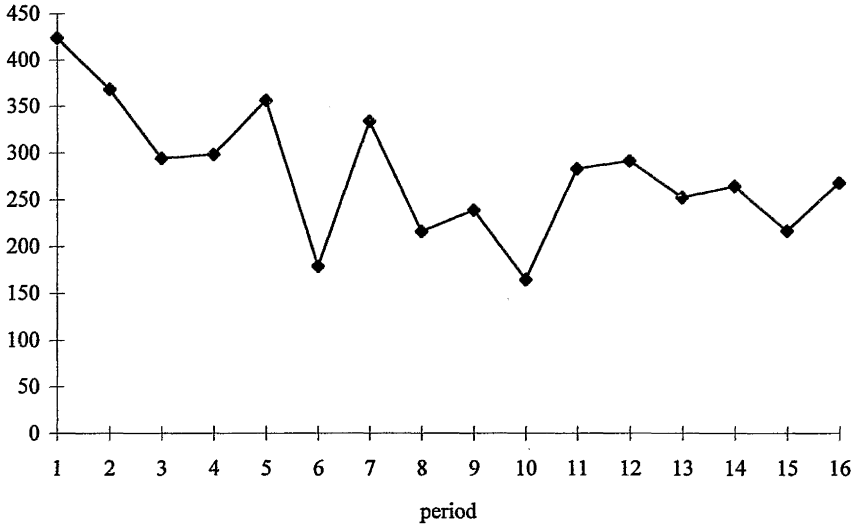

Figure 4b

Variance of Wages Over Time

the variance of wages over all redemption values. Although the variance of wages falls in the first periods, there is no obvious tendency for a decline towards zero and, hence, of vanishing wage differentials. Together with the fact that there are clear wage differentials at different q-values in the last three periods (see figure 3), we regard this as convincing support for hypothesis 3 b. Wage differentials seem to be robust against learning effects. They are not only the temporary result of inexperienced subjects' behaviour. Wage differentials persist until the very end and are, thus, likely to be due to more fundamental forces.

To what extent are wage differentials noncompensating? Note that the validity of hypothesis 3 does not guarantee the existence of noncompensating wage differentials since higher wages may merely reflect the (anticipated) compensation for higher effort levels. However, in the presence of reciprocal fairness we would expect that wage differentials are not simply compensating. This yields

Hypothesis 4: Job rents are increasing in q.

In our experimental design there are two possible definitions of a job rent. On the one hand, the term may be used to denote workers' rents after the second stage, i.e. after their effort choices ($r_2 = w - f - c(e)$). On the other hand, it may denote a worker's rent after the whole trade is conducted, i.e. after the third stage ($r_3 = [w - f - c(e)]\, p$).

Figure 5 shows that – as stipulated by hypothesis 4 – there are considerable job rent differentials, regardless of whether one looks at the two-stage job rent (r_2) or at the three-stage job rent (r_3).

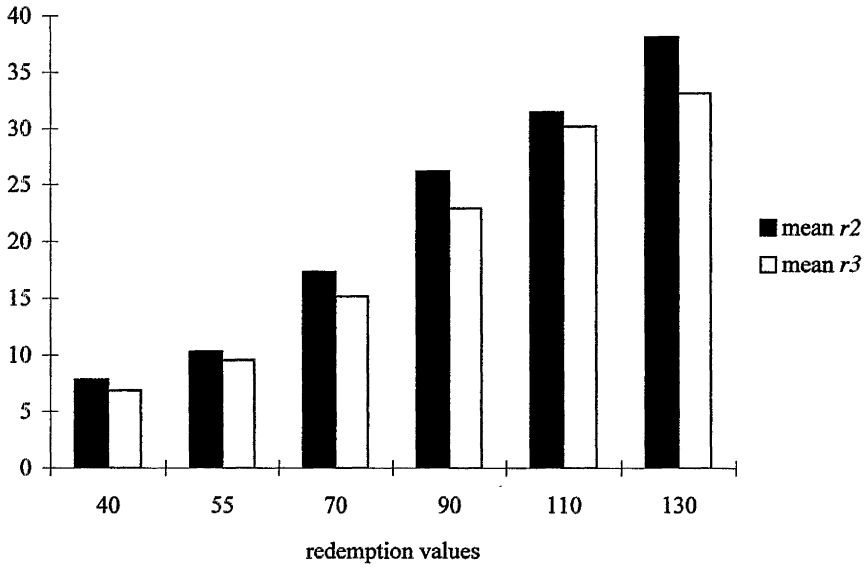

Figure 5

The Redemption Value–Job Rent Relation

Obviously job rents depend positively on redemption values. Although workers are identical, those employed by firms with high redemption values received a much higher rent than those employed by firms with low redemption values.

5. Summary and Interpretation

The existence of large and significant inter-industry wage differences potentially calls into question neoclassical labour market theory. Some writers (e.g. THALER [1992, ch. 4]) have assigned these differentials even the status of an anomaly. However, the difficulties of controlling for all the relevant variables have so far not allowed an unambiguous interpretation of the field evidence. In view of these difficulties an experimental approach, which allows for tighter controls, seems capable of discriminating more sharply between competing hypotheses. With our design we wanted to test the power of reciprocity motives for generating wage differentials in a competitive environment.

Our experiments reveal that (*i*) ex-post rewarding and punishment of workers' effort levels is widespread although it is costly for firms, (*ii*) that workers condition their effort choices on firms' wage offers, and (*iii*) that firms offer noncompensating wage differentials according to the potential revenues they can earn from the employment of a worker. All behavioural regularities prevailed until the very end of the experiments. This questions the view that reputation effects across periods may have been responsible for subjects' behaviour. Moreover, strict anonymity conditions ensured that no firm (worker) could condition his or her actions on the past behaviour of a worker (a firm).

The clear picture of reciprocal interactions suggests that *reciprocal fairness* has driven our results. Reciprocal fairness should be distinguished from *unconditional* fairness, i.e. altruism. If subjects apply reciprocal fairness considerations, they condition their actions either on the expected reciprocation of favours (e.g. when firms offer high wages because they expect workers to respond with high effort levels) or on the past action of an agent (e.g. if workers choose a high effort level in response to a high wage or firms punish low effort). In our design, a desire for payoff equality is simply a special – and particularly strong – case of reciprocity. In contrast, an agent who is unconditionally fair is generous irrespective of the expected or actual behaviour of his trading partner. We cannot completely rule out that unconditional fairness is responsible for the payment of job rents. However, the reciprocal effort behaviour of workers and the reciprocal behaviour of firms at the third stage suggest that firms' wage bids at stage one were *also* driven by the expectation that favours are reciprocated. Moreover, the evidence of several double action experiments (see, e.g., SMITH [1980]) and one-sided oral bid auctions (FEHR, KIRCHSTEIGER and RIEDL [1992], [1993]), in which there was no opportunity for reciprocal effort choices, casts doubt on the unconditional fairness hypothesis. In the Smith as well as in the Fehr et al. experiments, there was a strong tendency for

wages to converge to the market clearing level, that is, no unconditional fairness could be observed.

Finally we want to comment briefly on the significance of our results for the empirical debate about inter-industry wage differentials. Certainly our results do not show that the wage differentials observed in the field are caused by reciprocal fairness considerations. Laboratory experiments can never show that field phenomena are caused by a particular mechanism. They can, however, shed light on the validity of the behavioural hypotheses on which theories are based. For example, the gift exchange explanation of the positive correlation between profits and wages relies on particular assumptions about workers' behaviour. The purpose of our experiments was to check whether these assumptions are valid and whether firms respond in the predicted way to workers' effort choices. Since it turns out that in the presence of incomplete labour contracts reciprocal effort responses are quite common and that better profit opportunities give rise to higher wages, our confidence in the gift exchange approach as a potential explanation of the profit-wage correlation is strengthened.

Appendix: Instructions

Part 1 of this Appendix are the general instructions given to both market sides. Part 2 are the instructions for the sellers and part 3 are the instructions for the buyers. Part 4 is a summary sheet which contains the parameters of the experiment and was given to both market sides. We designed the experiments in goods market terms. Firms were called buyers, the workers were called sellers, the wage was called price etc. These instructions were originally written in German. We have translated them into English as closely as possible.

1. General (for Both Market Sides)

The experiment you will participate in is part of a research project financed by the Austrian Science Foundation. It is used to analyse the decision behaviour in markets. The instructions are simple and if you read them carefully and make appropriate decisions you can earn a considerable amount of money. *At the end of the experiment all the incomes resulting from your decisions will be added up and paid to you in cash.*

The experiment you are participating in consists of three stages.

Some of you will act as sellers and some of you will act as buyers. There are more sellers than buyers and this is known to all participants.

In the *first stage* the buyers may buy a good from the sellers.

In the *second stage* sellers determine the value the good has for the buyers according to certain rules (for a detailed description see below).

In the *third stage* buyers can influence the income of the sellers according to certain rules (for a detailed description see below). After this third stage, a "trading day" is finished and a new trading day starts with stage one. On the whole there will be two trial-trading days and 16 trading days. Each seller and each buyer has a certain seller- or buyer number that is the same during the whole experiment. You will see your number on the top left of your screen.

Communication between the participants is strictly forbidden. In case of communication we would have to terminate the experiment. If you have any questions, ask us.

2. Instructions for Sellers

2.1 The First Stage of a Trading Day

On the market a good is traded and each seller sells the same good. On each trading day, each seller can sell one unit of the good to a buyer. The market is organised as follows:

In order to buy a good, each buyer can make an offer. Such an offer consists of a proposal about the price "*p*." No buyer is forced to make an offer. After each buyer has made an offer or has decided not to make an offer, you as a seller will be informed about all offers. You will see them on the screen within the "price-choice-window" (see figure "price-choice-screen"). The sequence of the offers does not depend on the identity of the buyer who makes the offer. The offers are ordered according to their size.

The order of choice is determined each trading day by chance. It can be seen in the window "sequence" (see figure "price-choice-screen"). The seller whose number is the first in the sequence of seller numbers in the window "sequence" is the first who has the possibility to accept one of the offers. After this seller had made his choice the seller whose number is the second in the window "sequence" has the opportunity to choose one of that offers the first seller has not chosen etc.

When it is your turn you will get in the top middle of the screen the message "please choose a price." If you want to *accept a certain offer* please *mark* this offer with the *cursor* (those offers which have already been chosen by other sellers are written in red and cannot be chosen). Afterwards press the "enter"-key. Now you have the opportunity to change your decision by marking another offer with the cursor. After you have made your final decision you have to press the "F10"-key in order to transmit your decision to the buyer. *By pressing the "F10"-key you have made a final decision.* Then you will get on the top of your screen the message: "please wait."

No seller is forced to accept an offer. Therefore, you may also mark "N.O." (= no offer) with the cursor, press the "enter"-key and transmit your decision to accept no offer to the buyers by pressing the "F10"-key.

You have to make your decision within 20 seconds. How much time you have left for your choice can be seen on the top left of your screen ("time window"

– see figure). If you want to accept an offer please make sure that you transmit your decision to the buyer by pressing the "F10"-key in time.

If you do not accept an offer in a certain trading day – either because you have decided not to accept any offer or because you have not made your decision in time – this trading day is finished for you and you will earn nothing this trading day.

Please notice that you will not know the identity of the buyer whose offer you accept. Similarily the buyers will not be informed about the identity of "their" sellers.

2.2 The Second Stage of a Trading Day

In the first stage of the trading day you may sell one unit of the good on the market. If you have accepted an offer in the first stage, *you can fix the value that the good will have for the buyer* at the second stage by choosing a conversion rate "*UFv*."

Buyers receive a certain amount of experimental money (resale value "*q*") from us (the experimenter) for each unit they have bought. The value of *q* is different for different buyers and it is not the same for a certain buyer in all trading days.

Before you make your decision about *UFv* you will be informed about the resale value of "your" buyer at this trading day. You will see it on the bottom left of your screen (see figure "conversion-rate-screen"). In general the real income of your buyer (in AS) increases with the *UFv* chosen by you. At the same time you have to bear costs "*C(UFv)*" which are increasing with *UFv* (for a detailed explanation of the computation of the incomes see below).

If you have to choose *UFv* you will get the message on the top middle of your screen: "please choose a conversion rate" (see figure "conversion-rate-screen"). At the same time a table with all possible *UFvs*' will be opened automatically on your screen. This table is the same for all sellers in all trading days and it is known to the buyers. You can also see it from the summary sheet. If you want to choose a certain *UFv*, you must mark it with the cursor. On the screen you will also see the formulas which determine your income and that of your buyer. The *UFv* you have marked will be inserted in these formulas. By marking another *UFv* this "new" *UFv*-value will be inserted. Therefore, you have the possibility of seeing the impacts of different *UFvs*' on your income and that of your buyer by marking different *UFvs*'.

In order to close the *UFv*-table you must press the "esc"-key. By doing this you have not made a final decision. By pressing the "F2"-key you have the possibility of opening the table again to mark another *UFv*.

Before you make your final decision about the *UFv*, you will have the opportunity to conduct a simulation about what the buyer may do in the third stage. This will be explained in detail below in the section "*Simulation Possibilities.*"

When you have made your *final decision* about *UFv*, you have to *mark* this *UFv* by the cursor and then you must close the table by pressing the *"esc"-key*. Then you must transmit your decision to the buyer by pressing *the "F10"-key*. Then you will get the message in the top of the screen: "please wait." Until you have not pressed the "F10"-key, you have not made a final decision. *Which UFv you choose will be known by "your" buyer only.*

Take care: You have to make your decision within 80 seconds. How much time is left can be seen on the top right of your screen within the "count-down-window." If you do not choose your *UFv* in time, i.e. if you do not transmit your *UFv* to the buyer by pressing the "F10"-key in time, the most expensive *UFv* will be chosen automatically.

2.3 The Third Stage of a Trading Day

After you have chosen your *UFv* in the second stage and this *UFv* is transmitted to "your" (and only to "your") buyer, the buyers also have to choose a conversion rate, called "*UFk*," in the third stage. The table of possible *UFks'* as well as its associated costs, "*C(UFk)*," is the same for all buyers on all trading days. You can see it on your summary sheet.

In general, your income is increasing with the *UFk* chosen by your buyer. For the buyer *UFk* is associated with costs *C(UFk)*. The more the chosen *UFk* differs (positively or negatively) from unity, the greater is *C(UFk)*.

After "your" buyer has chosen his *UFk*, you (and only you) will learn it.

Then the incomes are computed. The trading day is finished and a new trading day starts with the first stage. In total there will be two trial-trading days and 16 trading days where you can earn money.

2.4 The Computation of Incomes

If a *buyer* makes no offer at a certain trading day, or if his offer is not accepted, he earns nothing that day. If you have accepted an offer of p from a buyer, he gets from us (the experimenter) a certain amount of experimental money, the resale value q. The resale values are between 40 and 130 and they are different for different buyers. Furthermore, each buyer has different resale values on different trading days. The price p is subtracted from q. This net income in experimental money ($q - p$), is converted into "real" money by the conversion rate *UFv* you choose in the second stage. In the third stage, buyer's choice of the conversion rate *UFk* is associated with costs *C(UFk)* that the buyer has to bear. To finance these costs the buyers get from us a certain amount of money, "b," which is the same for all buyers at all trading days and which is known to all buyers and sellers. You can see the value of b from your summary sheet. The real income (in AS) of a buyer, whose offer p is accepted, "whose" seller chooses *UFv* in the second stage and who chooses *UFk* in the third stage, is

computed according to the formula:

$$\text{Income of a buyer in AS} = [q - p] \cdot UFv + b - C(UFk).$$

A *seller* who does not sell on a certain trading day gets nothing this trading day. If you as a seller accept an offer of p, you get p units of experimental money. But you also have to bear production costs "*PK*" which have to be subtracted from p. You can see *PK* from your leaflet. It is the same for all sellers at all trading days and it is known to all sellers and buyers. In the second stage you have to bear costs of $C(UFv)$ units of experimental money that depend of course on your *UFv*-choice. Hence, if you accept an offer of p in the first stage and you choose *UFv* in the second, your income of the first two stages in experimental money is given by $[p - PK - C(UFv)]$. This income is converted into real money (AS) by the conversion rate *UFk* chosen by "your" buyer in the third stage. Therefore, the real income of a seller is computed according to the formula:

$$\text{Income of a seller in AS} = [p - PK - C(UFv)] \cdot UFk.$$

Each seller and each buyer knows the formulas that are used for the computation of their own income and that of their trading partners.

At the end of the whole experiment all the incomes you have made by your decisions will be added up and paid to you in cash.

2.5 Simulation Possibilities

When you choose *UFv* in the second stage, the conversion rate *UFk* which has to be chosen by the buyer in the third stage is of course not yet fixed. But in the second stage you already have the opportunity to make a "what would happen if..."-simulation with respect to the conversion rate *UFk* chosen later by "your" buyer. In order to perform such a simulation you have to press the "F3"-key when the *UFv*-table is closed. Now you can see a table of the *UFks'* the buyer may choose in the third stage. If you want to know what the incomes would be if the buyer chooses a certain *UFk* in the third stage, mark this *UFk* with the cursor. This *UFk*-value and the associated costs *C(UFk)* will be automatically inserted into the income-formulas. Hence, by marking different *UFks'* you can see their impacts on the incomes.

But of course you cannot choose the "real" *UFk*, since it will be chosen by the buyer in the third stage. The possibility of opening the *UFk*-table only gives you the opportunity to simulate the impacts of the decision made by "your" buyer in the third stage. Furthermore, you can only open one table. If you have e.g. opened the *UFk*-table and you want to change your *UFv*, you first have to close the *UFk*-table by pressing the "esc"-key. Only after having closed the *UFk*-table are you able to open the *UFv*-table by pressing the "F2"-key.

Besides, both tables must be closed when you transmit your definite decision about the *UFv* to the buyer by pressing the "F10"-key. Hence, take care that you have closed the tables in time. Do you have any questions?

2.6 Control Questionnaire

We would like to test whether you have understood our instructions. Therefore we ask you to answer the following questions. Please try to answer the questions. You will get no money if an answer is missing. A wrong answer, however, has no consequences for you. All answers will be anonymous.

1) Assume that a buyer with a resale value $q = 80$ offers a price p of 50. You accept this offer. In the second stage you choose $UFv = 0.6$. In the third stage the buyer chooses $UFk = 1.1$. How much money will you earn from this trade, how much will your trading partner earn?
2) Assume that a buyer with a resale value $q = 40$ offers a price p of 30. In the second stage you choose $UFv = 0.1$. In the third stage the buyer chooses $UFk = 0.3$. How much money will you earn from this trade, how much will your trading partner earn?
3) Assume that you will not accept an offer on a certain trading day. What is the income you will make on this trading day?
4) Assume that a buyer does not make an offer on a certain trading day or that his offer is not accepted. What is the income this buyer makes in this trading day?

3. Instructions for Buyers

3.1 The First Stage of a Trading Day

On the market a good is traded and each seller sells the same good. On each trading day, each seller can sell one unit of the good to a buyer. The market is organised as follows:

At the beginning of each trading day, you as a buyer may make an offer. Such an offer consists of a proposal about the price "*p*." On the top middle of your screen you will get the message "please make a price offer – 0.0 means no offer" (see figure "price-offer-screen"). The resale value "*q*" is already given and it is shown on your screen. This resale value is the amount of experimental money you get from us for a unit of the good bought. The conversion of experimental money into real money will be explained in detail below.

In order to offer a certain price, type it on the keyboard and press the "enter"-key. The offer must be an integer, i.e. an offer like 112 is allowed, whereas 112,5 is forbidden. Furthermore, *you are not allowed to make offers which are below 20 or above your resale value.*

You are not obliged to make an offer. In order to make no offer, type "0.0." In this case this trading day would be finished for you and you would earn nothing this day.

By typing the offer and pressing the "enter"-key you have not yet made a definitive decision. *When you have made a definitive decision, you have to press the "F10"-key after having typed the price.* By pressing the "F10"-key you transmit your decision to the sellers. If you make a mistake and type a forbidden price you will get a message on the screen that reminds you of the feasible prices. By pressing any key this message disappears and you can make a new, feasible offer.

If you have made an allowed decision and transmitted it to the sellers by pressing the "F10"-key, you will get on the top middle of the screen the message: "please wait."

You have to make your decision about the price offer within 120 seconds. How much time is left can be seen at the top right of the screen within the "time-window" (see figure "price-offer-screen"). If you do not make an offer and transmit it by pressing the "F10"-key to the sellers in time, it will be regarded as no offer – this trading day is finished for you and you will earn no money this day. Even before having made a definitive decision about your price offer at the first stage you have the possibility to simulate the potential impacts of the decisions made in the second and third stage. This will be explained in detail in the section "*Simulation Possibilities.*"

After each buyer had made an offer or has decided not to make an offer, the sellers see all offered prices on their screens. But the sellers will not know which offer is made by which buyer.

Now the sellers have the possibility of accepting offers. The sequence of accepting the offers is determined by chance. This sequence is determined anew each trading day. The seller who is the first in this sequence can pick and accept one of the offers or decide to reject all offers. If he accepts an offer, the trade is conducted at the proposed price. Now the second seller has the opportunity of choosing one of the remaining, i.e. one of the not yet accepted offers.

Please note that no seller knows the identity of "his" buyer. Similarily, you as a buyer will not be informed about the identity of "your" seller. Furthermore, no seller is forced to accept an offer. If you as a seller make no offer or if your offer is not accepted by a seller on a certain trading day, the respective trading day is finished for you and you will earn nothing this day.

The first stage of the experiment is finished when either all offers are accepted or after all sellers had the opportunity to accept an offer. *Afterwards, "your" seller (and only "your" seller) will be informed about your resale value q.*

3.2 The Second Stage of a Trading Day

After each seller has learned the resale of "his" (and only "his") buyer, he has the possibility of influencing the value of the good for the buyer by choosing a conversion rate "*UFv.*" In general your income as a buyer increases with the *UFv* chosen by "your" seller. The sellers have to bear costs "*C (UFv)*" which are increasing in *UFv*. The table of all possible *UFvs*' and the associated costs

C(UFv) is the same for all sellers on all trading days. You can see this table on your summary sheet. The implications of the resale value *q* and of *UFv* on your earnings will be explained in detail in the section "*The Computation of Incomes.*" You as a buyer need not make any decision at the second stage. After the end of the second stage you will learn whether your offer is accepted and – if so – which *UFv* you have got from "your" seller. You will see this *UFv* in the middle of your screen.

3.3 The Third Stage of a Trading Day

After you have made an offer which was accepted in the first stage and after "your" seller has chosen *UFv* in the second stage, you have the possibility of determining the income of "your" seller in the third stage by choosing the conversion rate "*UFk.*"

When you are asked to choose *UFk*, you get the message on your screen: "please choose the conversion rate" (see figure "conversion-rate-screen"). At the same time a table with all possible *UFks*' is opened automatically. You can see the same table on your summary sheet. The income of "your" seller is increasing with your chosen *UFk*. For you, the choice of *UFk* is associated with costs "*C(UFk).*" The more the chosen *UFk* differs (positively or negatively) from unity, the greater is *C(UFk)*. If you want to choose a certain *UFk* you have to mark it with the cursor. On the screen you will also see the formulas which determine your income and that of your seller. The *UFk* you have marked will be automatically inserted in these formulas. By marking another *UFk* this "new" *UFk*-value will be inserted instead of the former *UFk*-value in these formulas. Therefore, you have the possibility of seeing the impacts of different *UFks'* on your income and that of your seller by marking different *UFks*'.

If you want to choose a certain *UFk*, mark it with the cursor and *press the "esc"-key*. Then the table on your screen will be closed. But by pressing the "esc"-key and closing the table, you have not yet made a final decision. *You may open the table again by pressing the "F3"-key and then you may mark another UFk.*

If you have reached a *definitive decision* about *UFk*, you have to mark this *UFk* in the table, then *close the table by pressing the "esc"-key*, and then you have to transmit your decision to the seller by *pressing the "F10"-key*. You will get the message on the screen: "please wait." As long as you have not pressed the "F10"-key you have not yet made a final decision, and you may mark another *UFk*.

Take care: You have to make your *UFk*-choice within 80 seconds. How much time is left after you have simulated the impacts of different *UFks*' is shown on the top right of your screen. If you do *not* reach a definitive decision *in time*, i.e. if you do not transmit your decision to the seller by pressing the "F10"-key in time, *the UFk-value that is the most costly for you and the most favourable to the seller will be chosen automatically.*

"Your" and only "your" seller will be informed about your *UFk*-choice.

After your *UFk*-choice the incomes are computed, the trading day is finished and a new trading day starts with the first stage. In total there will be two trial-trading days and 16 trading days where you can earn money.

3.4 The Computation of Incomes

A *seller* who does not sell at a certain trading day gets nothing this trading day. A seller who accepts an offer of p gets p units of experimental money. But he also has to bear production costs "*PK*" that have to be substracted from p. You can see *PK* from your summary sheet. It is the same for all sellers at all trading days and it is known to all sellers and buyers. Additionally, a seller has to bear costs of $C(UFv)$ units of experimental money. You can see the $C(UFv)$-schedule on your summary sheet. This schedule is the same for all sellers on all trading days. The income a seller makes in the first two stages is converted into real money (AS) by the conversion rate *UFk* you have chosen in the third stage. Therefore, the real income (in AS) of a seller, who accepts an offer p, who chooses *UFv* in the second stage, and who gets *UFk* from you as a buyer in the third stage, is computed according to the formula:

$$\text{Income of a seller in AS} = [p - PK - C(UFv)] \cdot UFk.$$

If a *buyer* makes no offer on a certain trading day or if his offer is not accepted, he earns nothing this day. If your offer of p is accepted by a seller, you get from us (the experimenter) a certain amount of experimental money, the resale value q. The resale values are between 40 and 130 and they are different for different buyers. Furthermore, each buyer has different resale values at different trading days. Which q you have on a certain trading day is shown on your screen from the very beginning of the first stage. The price p you have spent for buying the good is subtracted from q. This net income in experimental money, $(q - p)$, is converted into "real" money by the conversion rate *UFv* chosen by "your" seller in the second stage. In the third stage, your *UFk*-choice is associated with costs $C(UFk)$ that depend of course on your chosen *UFk*. You can see the cost-schedule on your summary sheet. This cost-schedule is the same for all buyers on all trading days and it is known by all sellers. To finance these costs you get from us a certain amount of money, "*b*," that is the same for all buyers on all trading days and that is known to all buyers and sellers. You can see the value of b from your summary sheet. The real income (in AS) of a buyer, whose offer p is accepted, "whose" seller chooses *UFv* in the second stage and who chooses *UFk* in the third stage, is computed according to the formula:

$$\text{Income of a buyer in AS} = [q - p] \cdot UFv + b - C(UFk).$$

Each seller and each buyer knows the formulas that are used for the computation of their own income and that of their trading partners.

At the end of the whole experiment all the incomes you have made by your decisions will be added up and paid to you in cash.

3.5 Simulation Possibilities

In the second stage, the seller influences the income of "his" buyer by choosing *UFv*. In the third stage the buyers determine the incomes of "their" sellers by choosing the conversion rate *UFk*. Of course, these decisions are made after the first stage. But in the first stage – *before you make your final decision about the price offer*, i.e. before you transmit your offer to the sellers by pressing the "F10"-key – you have the opportunity to *simulate* the consequences of a certain price in combination with a certain *UFv* and with a certain *UFk*. In order to conduct such a simulation, first type the price (but do not transmit it to the sellers by pressing the "F10"-key) and press the "enter"-key. This price will be put into the formulas of your income and that of the seller on the screen automatically. Then press the "F2"-key. A table with all possible *UFvs'* and the associated costs *C(UFv)* will appear on the screen. This table is the same for all sellers on all trading days and you can see it on your summary sheet. If you think that the seller may choose a certain *UFv* in the second stage, mark this *UFv* and press the "esc"-key in order to close the table. Now the marked *UFv* and its costs *C(UFv)* are inserted automatically into the income formulas. You have the same simulation opportunities with respect to your own *UFk*-choice you will possibly make in the third stage. By pressing the "F3"-key the table with all feasible *UFks'* and its costs *C(UFk)* appears on the screen. This table is the same for all buyers on all trading days and known to all sellers. If you think that you may choose a certain *UFk* in the third stage, mark this *UFk* and press the "esc"-key in order to close the table. Now the marked *UFk* and its costs *C(UFk)* are automatically inserted into the income formulas. You may repeat this simulation as many times as you want. By pressing the "F2"-key or the "F3"-key you may open a table again and mark another *UFv* or *UFk* or you may – provided both tables are closed – type another price. *These simulations have no real consequences for you. You are the only one who knows them.* You are not obliged to choose at the third stage any one of the *UFks'* you have simulated with before.

Take care: You can only transmit an offer to the seller by pressing the "F10"-key if both tables are closed (as already mentioned the tables can be closed by pressing the "esc"-key). *Finish your simulation in time in order to have enough time to transmit your offer to the seller.* Do you have any questions?

3.6 Control Questionnaire

We would like to test whether you have understood our instructions. Therefore we ask you to answer the following questions. Please try to answer the questions. You will get no money if an answer is missing. A wrong answer, however, has no consequences for you. All answers will be anonymous.

1) Assume that you as a buyer with a resale value $q = 80$ offer a price p of 50. This offer is accepted by a seller. In the second stage "your" seller chooses $UFv = 0.6$. In the third stage you choose $UFk = 1.1$. How much money will you earn from this trade, how much will your trading partner earn?
2) Assume that you as a buyer with a resale value $q = 40$ offer a price p of 30. This offer is accepted by a seller. In the second stage "your" seller chooses $UFv = 0.1$. In the third stage you choose $UFk = 0.3$. How much money will you earn from this trade, how much will your trading partner earn?
3) Assume that a seller sells nothing on a certain trading day. What is the income the seller will make in this trading day?
4) Assume that you do not make an offer on a certain trading day or that your offer is not accepted. What is the income you will make on this trading day?

4. Summary Sheet (for Both Market Sides)

number of sellers: 8
number of buyers: 6
number of trading days: 16
production costs PK: 20
b: 5
resale values q: between 40 and 130

Sellers' possible conversion rates UFv in the second stage and costs $C(UFv)$:

UFv	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$C(UFv)$	0	1	2	3	4	6	8	10	12	15	18

Buyers' possible conversion rates UFk in the third stage and costs $C(UFk)$:

UFk	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$C(UFk)$	10	9	8	7	6	5	4	3	2	1	0

UFk	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
$C(UFk)$	1	2	3	4	5	6	7	8	9	10

Income of a buyer in AS $= [q - p] \cdot UFv + b - C(UFk)$
Income of a seller in AS $= [p - PK - C(UFv)] \cdot UFk$

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Professor Ernst Fehr
Simon Gächter
Institute for Empirical Economic Research
University of Zürich
Blümlisalpstraße 10
8006 Zürich
Switzerland

Georg Kirchsteiger
Department of Economics
University of Vienna
Hohenstaufengasse 9
1010 Vienna
Austria