Job market signaling and screening: An experimental comparison*

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Abstract

We analyze the Spence education game in experimental markets. We compare a signaling and a screening variant, and we analyze the effect of increasing the number of competing employers from two to three. In all treatments, efficient workers invest more often in education and employers pay higher wages to workers who have invested. However, separation of workers is incomplete and wages do not converge to equilibrium levels. In the signaling treatment, we observe significantly more separating outcomes compared to the screening treatment. Increased competition leads to higher wages in the signaling sessions but not in the screening sessions.

Keywords: job-market signaling; job-market screening; sorting; Bayesian games; experiments.

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1 Introduction

Signaling and screening are two alternative specifications of games with asymmetric information. Spence's (1973, 1974) work on "market signaling" is one of the first treatments of such problems and it has led to a large body of theoretical and empirical literature. In this paper, we use Spence's education game both in its original signaling version as well as in a setup with screening.[1] We analyze experimentally whether such an institutional change causes differences in results, that is, we study how outcomes are affected by the order of moves of the informed and the uninformed party.

Spence studies investments in education which have no productive value and no intrinsic value either in a labor-market context. But by choosing to invest in education, highly productive workers distinguish themselves from less productive workers. Potential employers cannot observe the ability of the workers, but they know that investing in education is cheaper for highly able workers. In this setup, if the (informed) worker moves first, education can serve as a credible signal of unobserved productivity, and it is rewarded by the employer with a higher wage. If the (uninformed) employer moves first, she offers a menu of contracts, each consisting of a wage and an education level, from which the (informed) worker must choose and thereby possibly reveals his type (see e.g. Rasmusen, 1994). Thus, in both the signaling and the screening variant, education is correlated with productivity and can have a sorting effect.[2]

In the signaling treatments of the experiment, we study whether or not signaling occurs and which factors facilitate it. In particular, we look at a situation with one pooling and one separating equilibrium where only the separating equilibrium satisfies Cho and Kreps' (1987) intuitive criterion.[3] The screening game has a unique equilibrium with full separation of types. This screening equilibrium leads to identical wages and investments as in the separating equilibrium of the signaling game. We study whether offered menus of wages correspond to the predictions and

[1] In his paper on "Job market signaling" Spence formulates the problem from the point of view of the employer who forms the expected marginal product for an individual, given the set of signals and unalterable attributes (called "indices") that can be observed. He states that "Potential employees therefore confront an offered wage schedule whose arguments are signals and indices." Although he then analyzes the signaling game, this exposition shows how closely related the signaling and the screening game are.

[2] The Spence game had an enormous influence on game theory itself as it triggered the literature on signaling games and equilibrium refinements. See e.g. Riley (1979), Cho and Kreps (1987), Banks and Sobel (1987), and Mailath *et al.* (1993).

[3] Note that the pooling equilibrium is unique up to beliefs off the equilibrium path.

whether workers self-select by their educational choice.

In the experimental literature, signaling has received considerably more attention than screening. Previous experiments on signaling games suggest that the equilibrium concept has some explanatory power, but that refinements cannot reliably predict which equilibrium players coordinate on.[4] Screening has not yet been studied extensively by experimentalists, so the screening treatments are of some stand-alone interest.[5] Our main focus is on the comparison of signaling and screening in a unified experiment. Signaling and screening may not lead to the same outcome in the lab because the cognitive requirements on players differ in the two games. In the signaling game, workers move first and have to hold second-order beliefs about the education decision, i.e. they have to think about how employers will interpret their education level. In the screening game where employers move first, they have to anticipate each worker type's choice of investment given a certain wage structure. Here, employers have to use backwards induction but second-order beliefs are not needed.

In addition, we use two different competitive environments to study the interaction between separation of types and competition. Either two or three employers bid for the worker in wage competition à la Bertrand. Theoretically, increasing the number of employers from two to three has no impact on the market outcome, but this may not hold empirically. Fouraker and Siegel (1963) and Dufwenberg and Gneezy (2000) show that the Bertrand solution does predict reasonably well with three or four firms but not in the duopoly case. We check whether their result remains valid in situations with asymmetric information.

Our main findings are as follows. In all treatments, efficient workers (*high* ability types) invest more frequently than inefficient workers (*low* ability types). Employers bid higher wages when workers invest than when they do not invest, and *high*-type workers earn higher payoffs than *low*-type workers. These findings are in line with the separating equilibrium. However, the data do not fully conform to the predictions of the separating equilibrium. In particular, not all *high* types invest in education, and wages do not converge to equilibrium levels. We find significantly

[4] Signaling experiments include Miller and Plott (1985), Cadsby, Frank and Maksimovic (1990, 1998), Brandts and Holt (1992, 1993), Cooper, Garvin and Kagel (1997a,b), Potters and van Winden (1996), as well as Cooper and Kagel (2001a,b). Cooper, Garvin and Kagel. (1997b, p. 553) conclude that the "[e]xperiments have raised serious doubts about the validity of equilibrium refinements."

[5] Screening has been studied experimentally in other contexts by Berg, Dickhaut and Senkow (1987) as well as Shapira and Venezia (1999) and Posey and Yavas (2004). While the first two papers find relatively little support for the screening model, the third paper observes strong separation of types.

more separating outcomes with signaling than with screening, even though it is the screening game that has a unique equilibrium which is separating. And finally, increasing the number of employers leads to higher wages in the signaling sessions but not in the screening sessions.

2 Theory

In this section, we present the model underlying the experiments and derive the game-theoretic predictions. We provide the results for the model with one worker and two employers—this is the standard textbook variant of the Spence model. We ran experimental treatments with two and three employers, but it will be obvious that the theoretical results are not affected by adding a third employer. We start with the predictions for the signaling treatments and then add those for the screening variant. All proofs can be found in the working paper version (Kübler et al., 2005) or in any textbook treatment of the Spence model (e.g., Rasmusen, 1994).

The timing of the signaling game is as follows:

1. Nature chooses the worker's ability $a \in \{10, 50\}$ where *low* ($a = 10$) and *high* ($a = 50$) ability are equally likely. Workers know a but employers do not.

2. The worker chooses an education level $s \in \{0, 1\}$ which is observed by the employers.

3. The employers each offer a wage $w(s) \in [0, 60]$.

4. The employer who offered the higher wage hires the worker. If there is a tie, a fair random draw decides which employer hires the worker.

5. Payoffs are as follows:

$$\pi_{\text{worker}} = w - 450s/a \tag{1}$$

where w equals the higher of the two wage offers.

$$\pi_{\text{employer}} = \begin{cases} 25 + a - w, & \text{for the employer who hired the worker} \\ 25, & \text{for the other employer.} \end{cases} \tag{2}$$

The worker's payoff (1) is the wage minus his cost of education, whereas the hiring employer's payoff (2) is a flat payment plus the difference between the worker's ability and the wage. The non-hiring employer receives the flat payment only. (We introduced this fixed positive payment since employers earn zero expected payoffs in both equilibria of the game, see below.) The cost of education is $450/10 = 45$ for the *low* type and $450/50 = 9$ for the *high* type of the worker.

The appropriate solution concept is perfect Bayesian Nash equilibrium, comprising a strategy profile and a system of beliefs. Prior beliefs about the worker's type are common knowledge. Posterior beliefs after the worker has chosen the educational level s are as follows. Let $p = Prob(a = high \mid s = 1)$ denote an employer's belief that the worker has *high* ability after observing that the worker invested in education (and hence $1 - p = Prob(a = low \mid s = 1)$). Likewise, let $q = Prob(a = high \mid s = 0)$ denote an employer's belief that the worker has *high* ability after observing that the worker did not invest in education (and hence $1 - q = Prob(a = low \mid s = 0)$).

The game above has two equilibria—a pooling and a separating equilibrium (there are no other equilibria; see the proof in Kübler et al., 2005). Let us start with the

$$\text{pooling equilibrium:} \quad \begin{cases} s(low) = s(high) = 0 \\ w(0) = w(1) = 30 \\ p = 0.5,\ q = 0.5. \end{cases} \tag{3}$$

In this equilibrium, both types of the worker do not invest in education, and the two employers offer a wage equal to the expected value of the worker's ability ($0.5 \cdot 10 + 0.5 \cdot 50 = 30$). Accordingly, (expected) payoffs are 30 for the workers and 25 for employers (the fixed payment). Note that the employers' information set corresponding to $s = 0$ is on the equilibrium path and q is dictated by Bayes' rule and the worker's strategy. Employers' information set for $s = 1$ is off the equilibrium path and Bayes' rule does not pin down the employer's beliefs. In (3) employers assume that workers choose $s = 1$ have *high* ability with the prior probability 0.5. While the pooling equilibrium (3) is a perfect Bayesian Nash equilibrium, it can be ruled out by applying Cho and Kreps' (1987) "intuitive criterion."

Next consider the

$$\text{separating equilibrium:} \quad \begin{cases} s(low) = 0,\ s(high) = 1 \\ w(0) = 10,\ w(1) = 50 \\ p = 1,\ q = 0. \end{cases} \tag{4}$$

In this equilibrium, the *low*-ability worker does not invest in education whereas the *high*-ability worker does. The employers condition their wage on the signal they receive. They pay a wage which is equal to the *low* type's ability in the case of no education whereas they pay a wage which equals the *high* type's ability after the "education" signal. Since both signals can be observed in equilibrium, Bayes' rule implies $p = 1$ and $q = 0$. In this equilibrium the *low* type earns profit $10 - 0 = 10$, the *high* type earns $50 - 9 = 41$, and employers earn the fixed payment of 25.

Note that the *high* type is better off in the separating equilibrium than in the pooling equilibrium ($41 > 30$) and vice versa for the *low* type ($10 < 30$). The ex-ante expected payoff for the worker is higher in the pooling equilibrium though ($30 > 0.5 \cdot 41 + 0.5 \cdot 10 = 25.5$). This difference in expected wages is equal to the welfare loss of the separating equilibrium as the expected payoff for the employer is the same in both equilibria. Thus, the pooling equilibrium is both ex-ante payoff dominant for the worker and welfare dominant.

Now consider the screening variant. The timing of the screening game is as follows.

1. Nature chooses the worker's ability $a \in \{10, 50\}$. Workers know a but employers do not.

2. The employers each offer two wages, $w(s) \in [0,\ 60]$; $s \in \{0, 1\}$, which are conditional on the education decision. The worker learns the higher wage for the two contingencies. In the case of a tie, a fair random draw decides whose wage is displayed.

3. The worker chooses an education level $s \in \{0, 1\}$.

4. The employer who offered the higher wage for the education level chosen by the worker hires the worker.

5. Payoffs are as above in the signaling variant.

There is no pooling equilibrium in this game. The unique prediction of the screening game is the separating equilibrium with wage and investment levels as described above in (4).

3 Experimental design and procedures

We compare markets where the informed workers move first (signaling markets, henceforth SIG) to markets where the uninformed employers are the first movers (screening markets, labeled SCR). As a second treatment variable, we study the effect of varying the number of employers (two versus three). Thus, we ran four different treatments resulting from a 2×2 design. The SIG2 and SCR2 sessions involved 9 subjects each whereas the SIG3 and SCR3 sessions involved 12 subjects each.

We decided to allow for many repetitions because learning is necessary in such a complex situation, but we randomly rematched subjects in every period in order to create an environment as close as possible to a single-period interaction between subjects. We applied role switching in the experiment, that is, in the course of the experiment participants were both in the role of the worker and in the role of the employer. This was done for two reasons. First, role switching enhances learning. Subjects better understand the decision problem of the other players and therefore the overall game if they play in both roles. Second, role switching emphasizes the one-shot nature of the interaction and therefore strengthens the effects of the random matching scheme. Most signaling experiments employ role switching in order to speed up learning, see Brandts and Holt (1992, 1993), Cooper *et al.* (1997a,b), Potters and van Winden (1996).

All sessions lasted for 48 rounds. In the treatments with two employers, we partitioned the 48 rounds of the experiment into six blocks consisting of eight consecutive rounds each. Within a block of eight rounds, roles did not change. All subjects played the role of the worker for two blocks and the role of the employer for four blocks. In principle, after being a worker for one block, subjects took on the role of employer for two blocks. (For some subjects this pattern was different at the beginning and at the end of the experiment.) In sessions with three employers, we partitioned the 48 rounds of each session into eight blocks of six rounds. Here, subjects played in the role of the worker for two blocks and in the role of the employer for six blocks each. As before, roles did not change within blocks. The usual pattern of role switching was that, after being a worker for one block, subjects were in the employer's role for three blocks. The computer screen indicated the current role of the participant throughout the experiment.

Decision making in each round of the experiment was exactly as described in the theory section. In order to simplify the design, we decided to automatically give the worker the higher wage instead of letting workers reject wage offers. That is, in our signaling experiments, the employer who submitted the highest wage offer automatically hired the worker (possibly after a random computer draw if there was a tie). Similarly, in the screening treatments, the worker was hired by the employer with the highest wage bid given the worker's investment decision. After each round, the computer screen displayed the following feedback information: type and investment decision of the worker, wage offers of both employers (indicating also which employer hired the worker), own profits as well as the profits of the other group members of that round and own accumulated profit.

Experiments were computerized (we used the software tool kit *z-Tree*, developed by Fischbacher, 1999) and were conducted at Royal Holloway, University of London. In total, 126 subjects participated. Instructions are reproduced in Kübler et al. (2005).

We conducted three sessions for each treatment. Sessions lasted about one and a half hours. Earnings were denoted in "points." The exchange rate of £1 for 150 points was commonly known.

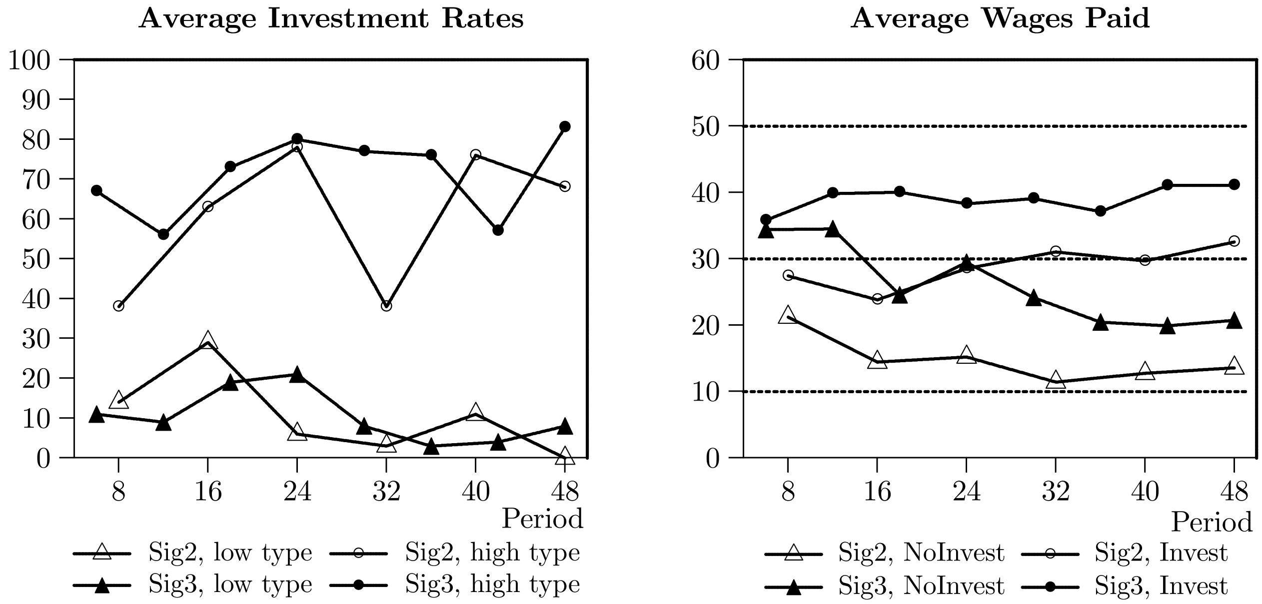

Figure 1: Evolution of investment rates and wages paid in treatments SIG2 and SIG3

Subjects received a one-off endowment of 200 points at the beginning of the experiment in order to cover possible losses in the initial phase of the experiment. Subjects' average earnings were £9.40, including the initial endowment.

4 Results

4.1 Summary and general findings

We summarize the data in Table 1. For workers, Table 1 shows investment rates for each type. For employers, it shows average wages paid (that is, the averages of the winning wage bids).

To test for significance of differences in the data, we run regressions for the investment decisions of workers, the wages paid by employers as well as profits of employers and payoffs of workers. As independent variables we use the worker's type (*high* vs. *low*), the investment decision of workers (*yes* vs. *no*), or *treatment* as a dummy.

We run multi-level random intercept regressions using generalized linear latent and mixed models (gllamm); see Rabe-Hesketh and Skrondal (2005) or http://www.gllamm.org/. They take account of the fact that "level-1" units (subjects) are nested in "level-2" units (sessions) and the

Treatment	Rounds	Investment rate if worker's type is		Employers' wage paid for the case of	
		low	*high*	*no investment*	*investment*
Sig2	All Data	.10	.60	14.85	27.89
		(0.04)	(0.08)	(0.30)	(3.35)
	Last Block	**.00**	**.65**	**13.57**	**29.38**
		(0.00)	(0.19)	(0.26)	(5.52)
Sig3	All Data	.11	.72	26.01	38.97
		(0.03)	(0.07)	(5.17)	(2.00)
	Last Block	**.08**	**.83**	**19.84**	**40.89**
		(0.08)	(0.12)	(5.44)	(0.96)
Scr2	All Data	.14	.68	33.77	43.01
		(0.05)	(0.03)	(2.88)	(1.39)
	Last Block	**.15**	**.92**	**22.27**	**41.3**
		(0.10)	(0.05)	(4.92)	(2.18)
Scr3	All Data	.07	.49	30.02	37.62
		(0.00)	(0.20)	(3.59)	(7.96)
	Last Block	**.00**	**.62**	**27.31**	**43.04**
		(0.00)	(0.26)	(6.24)	(4.08)

Notes: Averages of session averages of investment rates and wages paid. Standard errors of the mean in parentheses. Predictions for the pooling equilibrium: no investment; wage = 30; for the separating equilibrium: only *high* type invests; wage = 10 for *low* type, wage = 50 for *high* type. Last block consists of rounds 41-48 in Sig2 and Scr2 and of rounds 43-48 in Sig3 and Scr3.

Table 1: Average investment rates and average wages paid.

latter are nested in treatments.[6] We run probit regressions for the investment choice and linear regressions for the wages and profits and test whether the coefficient of the dummy is statistically different from zero. We provide details of the regression specifications for each of the results stated in Tables 2 and 6. For the regressions, we used decisions from all rounds.

There are four general results which hold across all treatments. After presenting them below, we will discuss and differentiate these findings in Section 4.2. Finally, we will focus on differences between treatments, reported in sections 4.3 and 4.4.

Result 1 *High types of workers invest significantly more often than low types of workers.*

Investment rates of *high* types are significantly higher in all treatments at the 1% significance level (see Table 2). *Low* types' investment rate is close to zero towards the end of the experiment, as predicted. This demonstrates that different types tend to separate themselves by their investment choice. The result is also apparent in Figures 1 and 2. The left panel in Figure 1 shows the evolution of the average investment rates over time for *high* and *low* types, both for the signaling game with two and three employers. The left panel in Figure 2 contains investment decisions in the two screening treatments. In all treatments, the investment rate of *high* types is always above the investment rate of *low* types. Moreover, this effect becomes more pronounced over time as the difference between the investment rates of *high* and *low* types significantly increases over time (at the 1% level in Sig2, Scr2, and at the 5% level in Sig3, Scr3).[7]

Result 2 *Wages offered and wages paid are significantly higher for workers who invest than for workers who do not invest.*

Table 1 shows that average wages paid are higher for workers who invest in education than for workers who do not invest. This is significant at the 1% level in all four treatments (see Table 2). Test results for wages offered are the same as for wages paid and are therefore not reported.

[6] Regressions that take each subject's data as independent observations and ignore the dependence of observations within a session (using subject clusters) yield nearly identical estimates for results 1-4 and similar estimates for results 5-8.

[7] In the screening sessions, workers know the higher wage offer for each investment decision. Thus, they only have to take the investment decision which maximizes their payoff. The data indicate a high proportion of payoff-maximizing decisions (90% in Scr2 and 91% in Scr3). Moreover, the number of rational decisions is significantly higher in the second half of the experiment. Most irrational decisions (70 out of a total of 81) were taken in situations where a worker should have invested but decided not to do so.

	Estimates for the coefficient β_1. H_0: $\beta_1 = 0$.			
	Result 1[a]	**Result 2**[a]	**Result 3**[a]	**Result 4**[a]
	Workers'	Wages	Workers'	Employers'
Treatment	Investment	Paid	Payoffs	Profits
SIG2	1.822	13.269	6.930	8.398
SIG3	1.950	13.481	6.613	10.462
SCR2	1.800	10.781	9.995	11.465
SCR3	1.669	12.344	6.988	10.973

Notes: [a] Results 1 to 4 are significant at the 1% level for all treatments. We ran the following regressions separately for each treatment. For this purpose, let i, j, and k be indices for measurement occasions, subjects and sessions, respectively. For **Result 1**, we model the binary investment decision, $invest_{ijk}$, of workers by a generalized mixed model with linear predictor $invest_{ijk} = \beta_0 + \beta_1 TYPE + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$ where $TYPE$ is equal to 1 if the worker was of high type and 0 otherwise, $SUBJ_{ijk}$ are dummy variables for subjects, $\eta^{(2)}_{jk}$ is the random intercept for subject j in session k, $\eta^{(3)}_{k}$ is the random intercept for session k, ζ_j is a time-constant error component which varies between subjects and ε_{ij} is a transitory error component which varies over occasions i and subjects j. The random intercepts are assumed to be independently normally distributed. For **Result 2**, the linear equation for wages paid and wages offered to workers is: $wage_{ijk} = \beta_0 + \beta_1 INVEST + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$, where $INVEST$ is equal to 1 if the worker invested and 0 otherwise and all other variables are defined as above. For **Result 3**, the linear equation for payoffs earned by workers is: $payoff_{ijk} = \beta_0 + \beta_1 TYPE + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$, where all variables are defined as above. For **Result 4**, the linear equation for profits earned by hiring employers is: $profit_{ijk} = \beta_0 + \beta_1 INVEST + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$, where all variables are defined as above. In all regressions, the estimate for β_1 can be interpreted as the difference in behavior between different types of the worker or employers receiving different signals. We use for computing significance levels $P > \mid t \mid$.

Table 2: Details and results of statistical tests for Results 1-4

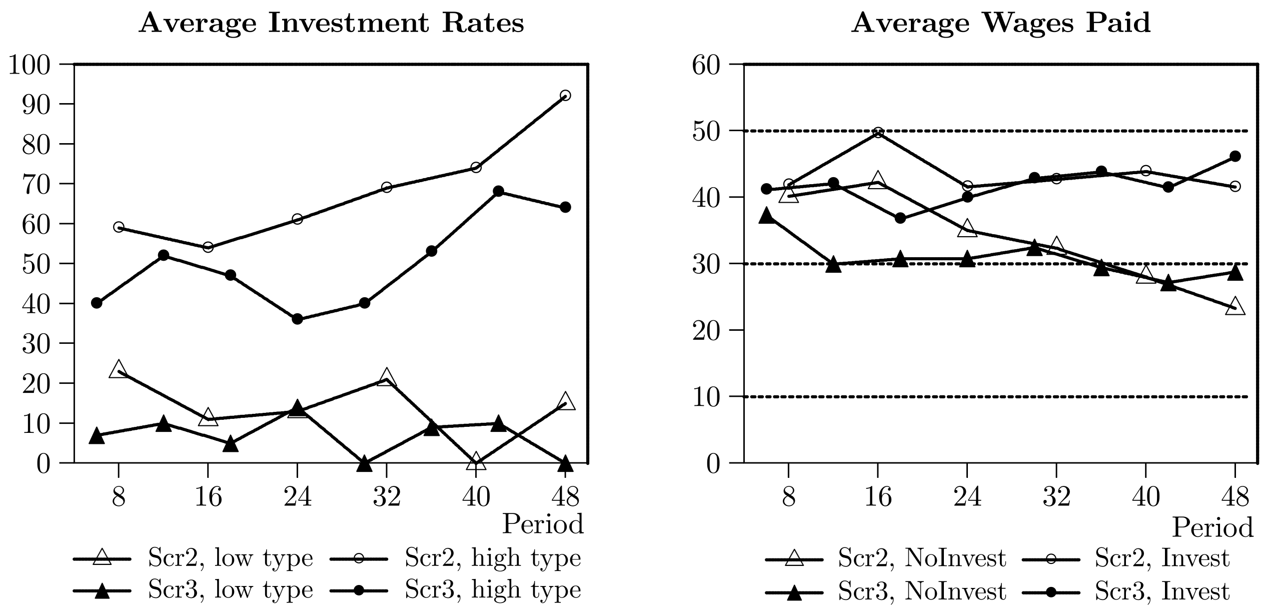

Figure 2: Evolution of investment rates and wages paid in treatments Scr2 and Scr3

In addition, the time trend is also in favor of the separating equilibrium (see again Figures 1 and 2). The wage spread significantly increases over time in all treatments (at the 1% level). The same significant time trend holds for wages offered.

Result 3 *High types of workers earn significantly higher payoffs than low types.*

For workers' payoffs, refer to Table 3. In the pooling equilibrium both types earn the same (30 points) as neither type invests. The separating equilibrium predicts that *high* types earn 41 points while *low* types earn 10 points. The table indicates that *high* types earn more than *low* types and this result is significant at the 1% level in all four treatments. However, the spread between the wages paid to a worker who invested and a worker who did not invest is much lower than predicted by the separating equilibrium (see Table 1). This is due to the fact that separation of *high* and *low* types is incomplete. We will elaborate on this below.

Turning to employers' profits we find

Result 4 *Employers' net profits are significantly higher when they employ a worker who has invested than when employing a worker who has not invested.*

Employers are predicted to compete in a Bertrand fashion, leading to zero expected profits.

Treat-ment	Rounds	Workers' payoff if the type is		Hiring employers' profit after employing a worker who did	
		low	*high*	*not invest*	*invest*
Sig2	All Data	11.47	18.1	7.82	16.2
		(2.34)	(2.07)	(1.66)	(2.06)
	Last Block	**12.92**	**20.52**	**4.42**	**20.62**
		(0.31)	(3.27)	(3.78)	(5.52)
Sig3	All Data	22.51	29.12	−5.54	5.98
		(4.43)	(2.31)	(3.24)	(2.79)
	Last Block	**18.39**	**29.73**	**−3.18**	**5.78**
		(6.07)	(2.71)	(7.09)	(2.76)
Scr2	All Data	26.49	36.41	−11.57	1.48
		(3.91)	(0.98)	(2.64)	(3.02)
	Last Block	**18.74**	**32.37**	**−9.01**	**4.48**
		(6.08)	(1.98)	(3.35)	(3.15)
Scr3	All Data	26.88	33.38	−6.33	6.63
		(3.98)	(3.13)	(1.81)	(6.07)
	Last Block	**25.50**	**37.49**	**−9.60**	**6.96**
		(5.20)	(3.86)	(4.70)	(4.08)

Notes: Averages of session averages of worker payoff and (hiring) employer profit. Standard deviation of the mean in parentheses. Predictions: in the pooling equilibrium both types earn 30; in the separating equilibrium *high* types earn 41, *low* types earn 10; employers earn zero throughout. Last block consists of rounds 41-48 in Sig2 and Scr2 and of rounds 43-48 in Sig3 and Scr3.

Table 3: Average payoffs of workers and average net profits of hiring employers.

Outcome	SIG2		SIG3		SCR2		SCR3	
Separating	53	(42)	54	(38)	43	(37)	39	(41)
Pooling	4	(5)	18	(15)	25	(7)	50	(9)
Other	43	(53)	28	(47)	32	(56)	11	(50)

Table 4: Percentages of outcomes in the last block (in all rounds).

Table 3 indicates that, with the exception of treatment SIG2, hiring employers' profits are negative[8] when employing an non-investing worker whereas they are positive when employing an investing worker. Result 4 summarizes the last column of Table 2 which shows that the difference in profits is significant. Thus, employer competition is softer for workers who invested than for workers who did not invest. We elaborate on the possible reasons for this finding in Section 4.3.

4.2 Separating versus pooling of types

The results of the previous section suggest that there is separating behavior in the data. In all treatments, *high* and *low* types of workers clearly display different investment behavior, and employers reward investing workers with higher wages. However, a number of observations are not consistent with the separating equilibrium: (A) Investment rates of *high* types of workers are below 100%, and it is fairly evident that separation of *high* and *low* types is incomplete. (B) We do not observe wages converging to the levels predicted by the separating equilibrium. (C) Employers earn higher profits when employing workers who invested than when employing workers who have not invested which is neither in line with the separating equilibrium nor with the pooling equilibrium.

To substantiate the claim that separation is incomplete, we identify "outcomes" defined as combinations of investment decisions and wage levels in the data. Table 4 provides information on the distribution of these outcomes in the last block of the experiment. We define separating and pooling outcomes here somewhat more broadly than the point predictions suggest. A separating outcome requires that the *low* type does not invest and earns a payoff of less than 20, or that the *high* type of worker invests and earns (weakly) more than 40 points. A pooling outcome occurs if either the *low* or the *high* type of worker does not invest and earns between 20 and 40 points. The category "other" includes all outcomes that do not fit into either the pooling or the separating category.[9] Based on Table 4, we conduct some tests for differences between treatments below. But

[8] Recall that employers received a fixed payment of 25 in every period, but we report *net* earnings here.

[9] The screening versions of the game do not have a pooling equilibrium. Nevertheless, we classify outcomes

first note that between 46 and 61 percent of all observed outcomes are not separating, based on data from the last block and given our rather lenient mode of classification. In general, the observation of separating behavior that does not fully converge to the separating equilibrium is consistent with results of other signaling experiments (see Miller and Plott, 1985, Potters and van Winden, 1996, Cooper, Garvin, and Kagel, 1997b).

How can this finding be explained in our data set? Note first that observations (A) and (B) are mutually consistent. Given that some *high* types do not invest, a wage higher than the predicted wage of 10 following no investment seems plausible. On the other hand, given that some *low* types invested early in the game (and a few even towards the end), it seems reasonable that many employers offer less than the separating equilibrium wage of 50. In turn, *high*-type workers sometimes experience that their investment does not pay which induces some of them to refrain from investing. Thus, such path dependence can explain the persistence of *high* types who do not always invest. By contrast, the investment never pays for a *low* type in our experiments, which explains why the *low* types' investment rates are close to the predicted level of zero in the last periods of the experiment.

Let us turn to observation (C). Why do employers earn higher profits when hiring investing workers? First note that employer collusion cannot fully account for the higher employer profits when an investing worker is hired. Collusion should also raise profits when the employer hires a non-investing worker which is not what we observe. For an alternative explanation, let us calculate employers' expected profits based on the experimental data. From previous average investment rates, the employer can compute the posterior belief via Bayesian updating. Assume for simplicity that players are in the last block of the experiment and that the belief about the probability of a type investing is given by workers' average play in the second-to-last block. Then, for example in SIG2, $Prob(s = 0 \mid type = low) = 0.89$ and $Prob(s = 0 \mid type = high) = 0.24$, and Bayes' rule implies $Prob(type = low \mid s = 0) = 0.79$ and $Prob(type = low \mid s = 1) = 0.13$. In this way, we can calculate the expected value of a worker for the employer after $s = 0$ and $s = 1$ for all four treatments, as presented in the first row of Table 5.

Table 5 also shows the expected profit given the average wage paid in the last block and its standard deviation. Risk aversion is consistent with strictly positive expected profits as observed in 6 of the 8 cases above. But note that profits of employers have a higher variance after $s = 0$

according to the above scheme that includes pooling outcomes also for the screening data because this enables us to better compare results across the two versions of the game.

	SIG2		SIG3		SCR2		SCR3	
	s=0	s=1	s=0	s=1	s=0	s=1	s=0	s=1
Exp. value of a worker	18.40	44.81	22.37	47.38	18.25	50.00	20.49	44.87
Exp. profit of employer	4.83	15.42	2.53	6.49	−4.02	8.70	−6.82	1.83
Std. dev. of profits	16.33	7.87	19.78	11.00	12.16	14.55	16.06	4.78

Table 5: Expected value of worker and expected profit of employer, based on experimental data

than after $s = 1$ in all treatments except in SCR2. If we were to find a utility function consistent with observed behavior it would have to account for the fact that the lottery after $s = 1$ has a lower variance but a higher expected value than the lottery after $s = 0$. While such utility functions can be constructed, they have to be quite steep in the loss domain. A higher sensitivity to losses than to gains (as in prospect theory, Tversky and Kahneman, 1992) implies that employers will bid relatively less for the $s = 1$ lottery where the possible loss is larger than for $s = 0$ (except for treatment SCR2).[10] Thus, prospect theory, encompassing loss aversion and probability weighting, is a natural candidate to explain our findings.[11]

Finally, it seems warranted to comment on the observation that *high*-type workers frequently make the costly investment. This is surprising as the wage premium paid to workers who invest in the first block does not cover the investment cost of 9 points (SIG2: 6.29; SIG3: 1.40; SCR2: 2.55) and is negative (−5.06) in treatment SCR3. If workers are assumed to be risk averse, this investment behavior becomes even more puzzling. But over time the wage spread increases (see the discussion of Result 2). Employers seem to learn what the signal means. This can be ascribed to the persistent efforts of *high*-ability workers to reveal their type. In the last block, investment of *high* types pays off on average in all four treatments because wage spreads are considerably higher

[10] An additional argument in favor of prospect theory is as follows. To ensure realism of the utility function, it is often insisted that it also makes good predictions regarding large-scale gambles. In our data, decision makers display high risk aversion over small stakes which implies very high levels of risk aversion over high stakes (see Rabin, 2000). For loss aversion in contrast, decision makers react to *changes* in wealth, rather than to *levels* of wealth because outcomes are evaluated relative to a reference point, e.g. zero profits in our context. Explaining the observed wage offers with loss aversion therefore avoids unrealistic consequences for high stake gambles.

[11] Applying the estimated parameter values of the value function derived by Tversky and Kahneman (1992), namely $\lambda = 2.25, \alpha = .88, \beta = .88, \gamma = .61$, and $\delta = .69$, to the data and assuming that subjects perceive the fixed payment of 25 points as part of their income in that round, yields almost identical valuations of the lottery after $s = 0$ and the lottery after $s = 1$. Thus, expected values differ for the two lotteries, but under prospect theory employers make wage bids which almost equalize the value of the two lotteries.

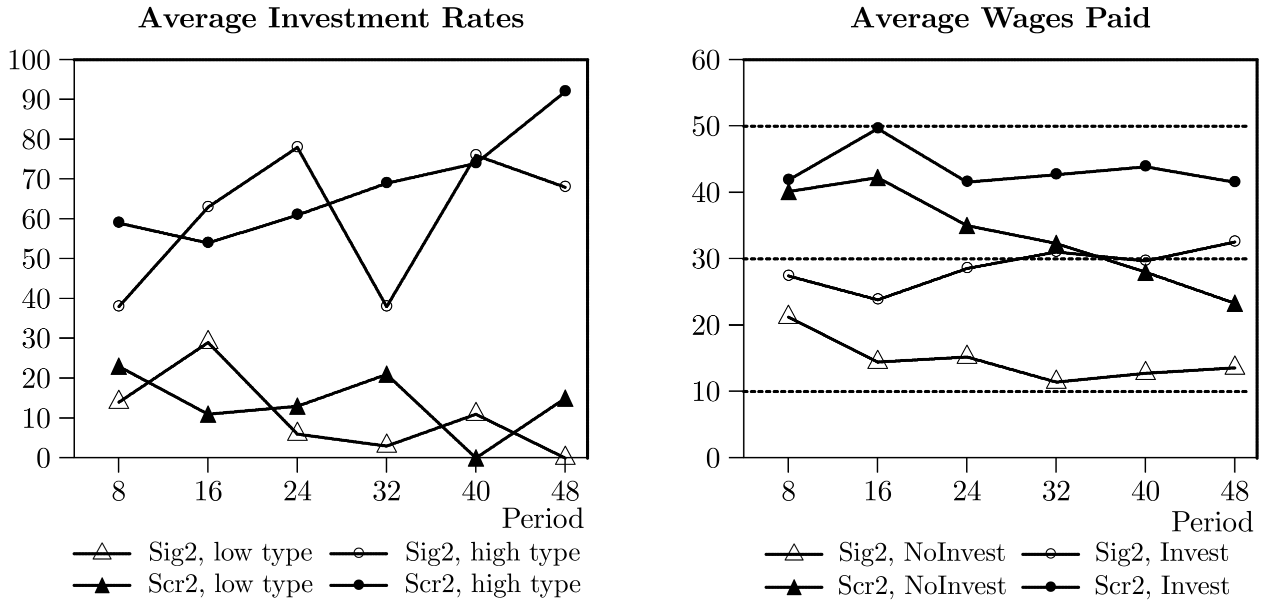

Figure 3: Evolution of investment rates and wages paid in treatments Sig2 and Scr2

than the investment cost (Sig2: 15.81; Sig3: 21.05; Scr2: 19.03; Scr3: 15.63).

4.3 Signaling versus Screening

In this and the next subsection, we present the results regarding the treatment variables, that is, the order of moves and the number of employers. Test results are shown in Table 6. We start by comparing behavior in the signaling and the screening experiments. Figure 3 shows the data of the signaling and screening treatments with two employers while Figure 4 shows the data with three employers.

The first result that can be taken from Figure 3 is that investment rates in the signaling and screening treatments are similar. There are no apparent differences with two employers. With three employers, Figure 4 suggests that there is a difference in investment behavior of *high*-type workers. However, tests based on all rounds indicate that these differences are not significant at any conventional level.

A second finding is that, with two employers, workers' wages are higher in the screening sessions than in the signaling sessions for both investment decisions. When comparing Sig2 with Scr2, the higher wages in Scr2 significantly increase the payoff of investing workers and significantly decrease profits of employers hiring investing or non-investing workers. Statistical tests

	Estimates for the coefficient β_1. H_0: $\beta_1 = 0$.							
	Workers				**Employers**			
	Investment		**Payoffs**		**Wages Paid**		**Profits**	
Comparison	if worker's type is				for the case of			
between	low	high	low	high	no invest	invest	no invest	invest
SIG2 and SIG3	−0.11	−0.48	−11.21***	−11.01***	−11.25***	−11.04***	13.51***	10.38***
SCR2 and SCR3	0.35	0.55	−0.15	2.80	3.35	5.72	−5.361**	−5.17
SIG2 and SCR2	−0.18	−0.22	−15.18***	−18.26***	−18.80***	−15.32***	19.32***	14.94***
SIG3 and SCR3	0.24	0.86	−4.18	−4.44	−3.98	1.26	0.34	−0.89

Notes: We conducted the comparisons between treatments separately for each worker type (Investment and Payoffs) or for each investment decision (Wages and Profits). In all regressions, the dummy variable $TREATM$ is coded such that it is equal to 1 for the first treatment mentioned in the first column of this table and it is equal to 0 for the second treatment in the first column of this table. As above, let i, j, and k be indices for measurement occasions, subjects and sessions, respectively. For **Investment**, the following probit estimation equation is used for workers' investment decisions: $invest_{ijk} = \beta_0 + \beta_1 TREATM + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$, where $TREATM$ is a dummy used to code the treatments included in the regressions and all other variables are defined as above (see Table 2). For **Payoffs**, the equation used for workers' payoffs is: $payoff_{ijk} = \beta_0 + \beta_1 TREATM + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$. For **Wages Paid**, the equation used for wages paid to workers is: $wage_{ijk} = \beta_0 + \beta_1 TREATM + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$. For **Profits**, the equation used for profits earned by employers is: $profit_{ijk} = \beta_0 + \beta_1 TREATM + \beta_2 SUBJ_{ijk} + \eta^{(2)}_{jk} + \eta^{(3)}_{k} + \zeta_j + \varepsilon_{ij}$. We report as p-levels $P > \mid t \mid$. *** (**) indicates significance at the 1% (5%) level.

Table 6: Details and results of statistical tests for Results 5-8

based on all rounds of the experiment (see Table 6) can be summarized as follows:

Result 5 *(i) With signaling and screening, investment behavior is the same, independent of the number of employers. (ii) Comparing* Sig2 *and* Scr2*, we find that screening significantly increases wages paid to both types of the worker, significantly increases payoffs of both types of the worker, and significantly decreases profits of employers hiring investing or non-investing workers. (iii) Comparing* Sig3 *and* Scr3*, we find no statistical differences in wages paid to workers or payoffs earned by workers and employers.*

It is noteworthy that, despite similar investment rates, wages are higher in the screening games. One explanation is that the signaling game facilitates some collusion among employers compared to the screening game. In the signaling game, employers choose a wage offer *after* observing the investment choice by the worker. In contrast, in the screening game employers offer a menu of wages for *every possible* investment level. The decision task in the screening games is thus similar to the task in sequential-move experiments where the so-called strategy-elicitation method is employed. Previous experimental findings (e.g., Kübler and Müller, 2002) suggest that the strategy method leads to less cooperation between players, which is consistent with the results described here. This explanation is also in line with the fact that the wage differences between screening and signaling are less pronounced (and not significant) in the three-employer treatments. In Sig3, there is less collusion and, accordingly, the difference to Scr3 is insignificant.

Comparing outcomes (that is, combinations of wages and investment decisions) in the signaling and the screening treatments in Table 4, we note an interesting effect. Screening *reduces* the share of separating outcomes (53% in Sig2 vs. 43% in Scr2; 54% in Sig3 vs. 39% in Scr3) and *increases* the share of pooling outcomes (4% in Sig2 vs. 25% in Scr2; 18% in Sig3 vs. 50% in Scr3).[12] If anything, we should have observed the opposite as the screening game has a unique equilibrium which is separating. The data also show that screening reduces the number of outcomes that are neither separating nor pooling. Chi-square tests reveal that the differences in outcomes are significant (Sig2 vs. Scr2: $\chi^2 = 17.86$, $d.f. = 2$, $p < 0.001$; Sig3 vs. Scr3: $\chi^2 = 24.89$, $d.f. = 2$, $p < 0.001$). Summarizing we state

Result 6 *Screening reduces the share of separating outcomes and increases the share of pooling outcomes relative to signaling.*

[12] These results do not depend on the selection of the last block. If instead all rounds of the second half of the experiment are selected the qualitative results are unchanged.

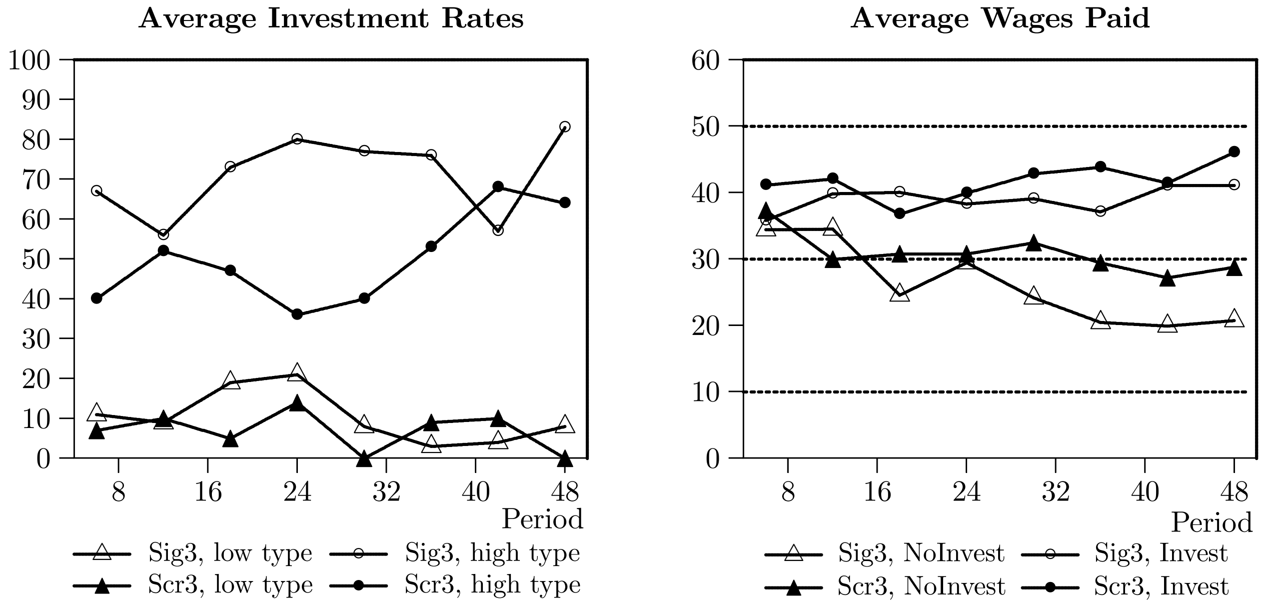

Figure 4: Evolution of investment rates and wages paid in treatments SIG3 and SCR3

A closer look at the outcome data reveals that an important reason for this finding is the higher wage level of *low* types in the screening sessions. This causes many non-investing *low* types to be categorized as pooling rather than separating (both with two and with three employers). On the other hand, screening leads to an increase of separating outcomes because there is a higher share of *high* types who invest and get a wage above 40, but this effect is much smaller than the increase in pooling of *low* types. Thus, the order of moves (SIG vs. SCR) has a decisive impact on the proportion of pooling and separating outcomes through the competitiveness of the wage game.

4.4 Two versus three employers

Finally, we analyze the effect of increased employer competition. Figure 1 displays the evolution of investment behavior and wages paid in treatments SIG2 and SIG3. Regarding investment decisions there is no significant difference between the signaling treatments with two and three employers (see Table 6). In the left panel of Figure 1 (investments) there are no apparent differences but, as shown in the right panel of this figure, wages paid in treatment SIG3 are shifted upwards compared to SIG2. As a result, adding a third employer reduces employer profits in the signaling game (which is significant for both worker types). This confirms the results in Fouraker and Siegel (1963) and Dufwenberg and Gneezy (2000). Note that wages after *both* investment decisions increase. Thus, the incentive to invest remains almost unchanged, and consequently, the wage increase has no effect on investment decisions.

Result 7 [SIG2 *vs.* SIG3] *Increased employer competition (i) does not significantly change investment behavior; significantly (ii) increases wages paid to both worker types; (iii) increases payoffs of both worker types; (iv) decreases employer profits both when hiring investing and non-investing workers.*

Now consider the screening sessions of the experiment and refer to Figure 2, which shows the evolution of investment behavior and wages paid in treatments SCR2 and SCR3. At first sight, adding a third employer appears to increase the investment rate of *high* types. However, this effect is not significant. It is noteworthy that employers who offer menus of wages (in the screening games) instead of single wages (in the signaling games) compete as fiercely when there are two competitors as when there are three. As mentioned before, implicit collusion among two employers can be more difficult to achieve when the strategy space has two dimensions.

Result 8 [SCR2 *vs.* SCR3] *Increased employer competition has no significant effect on workers' investment behavior, wages paid and payoffs. There is a significant increase in employer profits from hiring a non-investing worker due to increased competition.*

From Table 4 it is apparent that pooling outcomes become more frequent with three instead of two competitors in signaling games and that there is a decrease in "Other" outcomes. The difference in the proportions of outcomes between treatments SIG2 and SIG3 is significant ($\chi^2 = 12.09$, $d.f. = 2, p < 0.01$). A closer inspection of the outcome data reveals that almost all separating outcomes in treatment SIG2 are due to *low* types separating (that is, not investing and getting a wage less than 20). Increasing competition in the signaling game increases wages for both investment decisions. The increase in wages paid after no investment in SIG3 implies that many non-investing *low* types receive higher wages and are therefore categorized as pooling and not as separating. The increase in wages paid after investment in SIG3 implies that many investing *high* types also receive higher wages which leads to an increase in separating outcomes. In sum, the share of separating outcomes remains roughly the same. What we see though is a reduction in "Other" outcomes in Table 4. As in the signaling versions, adding a third employer in the screening game increases the pooling outcomes and decreases outcomes labeled "Other." The proportions of outcomes differ significantly between treatments SCR2 and SCR3 ($d.f. = 2$, $\chi^2 = 18.78$, $p = 0.001$).

Result 9 *Moving from two to three employers in signaling and screening increases the proportion of pooling outcomes and decreases non-categorized behavior.*

5 Summary and Conclusion

We analyze and compare both a signaling and a screening variant of the Spence education game, and investigate the effect of increasing the number of employers from two to three. In all four treatments of the experiment, we find that the less efficient workers only rarely choose the costly investment while the efficient types mostly do. Consistent with this finding, there is a significant wage spread, and workers who invest get significantly higher wages than those who do not invest. However, the separation of types is not complete in our data, as in most other signaling experiments. Wages for investing workers are too low and those for non-investing workers are too high compared to the prediction. Moreover, employers earn higher profits when hiring a worker who invested than when hiring a worker who has not invested.

As in previous signaling experiments, path dependence is an important aspect of behavior as the beliefs about other players are formed in the first rounds of the experiment. Investment behavior does not signal a worker's type perfectly and so the wage spread is smaller than predicted. This can be explained with some noisy behavior at the beginning of each session which leads to a persistent pattern of less than full separation. The finding that profits of employers who hire investing workers are higher than when employing a non-investing worker can be accounted for with risk aversion although prospect theory offers a more convincing explanation of the data.

The comparison of signaling and screening suggests that signaling and screening institutions work similarly if there is enough competition between employers. With three employers, the two institutions yield the same results with respect to wages and investment behavior (when studying these two variables separately). Though signaling sessions with two employers are less competitive in terms of wages than screening sessions with two employers, investment behavior is the same. Thus, the size of the welfare loss due to wasteful investments is independent of the order of moves and the competitiveness of the market.

When focusing on outcomes as combinations of wage levels and investment decisions, we observe significant differences between signaling and screening games. Most importantly, the share of separating outcomes is larger with signaling than with screening. Screening leads to more pooling although this is not an equilibrium of the screening game. We explain this observation by differences in wage setting of employers under signaling and screening institutions. Thus, the order of moves affects the amount of separating outcomes through the difference in the competitiveness of the market.

Increasing the number of firms from two to three only affects the results in the signaling treatments where we observe an increase in wages but no change in investment rates. Increased employer competition has no effect in the screening treatments. This is due to the fact that screening with two employers is already quite competitive such that the addition of a third employer does not change the results.

For future research it could be useful to elicit the beliefs of players in order to pin down the equilibrium more precisely.

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A. Proofs (not intended for publication)

This Appendix contains the proofs of the statements in the theory section above. Start with the separating equilibrium. To see that (4) is a perfect Bayesian equilibrium, note that for both worker types it does not pay to mimic the other type's behavior: If the *low* (*high*) type deviates by choosing $s = 1$ ($s = 0$), she earns a payoff of $50 - 45 = 5$ ($10 - 0 = 10$), given the employers' strategy and beliefs. The deviation payoffs are smaller than both types' equilibrium earnings. Now consider the employers' incentive to deviate. Given the other employer's strategy, it does not pay for an employer to offer a smaller wage as she would lose the worker to the other employer for sure, implying an expected payoff of 25. A deviation to a higher wage after observing some signal (say, to $50+\varepsilon$ after signal $s = 1$) is not optimal either since this yields a payoff of $25 - \varepsilon < 25$. Thus, deviation does not pay for employers either.

To see that the pooling equilibrium (3) is a perfect Bayesian Nash equilibrium, consider first the incentive for the two types of the worker to deviate. If the *low* type of the worker deviates by investing in education, she realizes payoff $30 - 45 = -15$ whereas the *high* type gets $30 - 9 = 21$. For both types, this is smaller than what the worker earns by playing according to (3). Next consider an employer's incentive to deviate. If one employer offers a wage lower than 30, she does not hire the worker in which case her expected payoff is 25, too. If she deviates to a wage $w = 30+\varepsilon$, $\varepsilon > 0$, she does hire the worker for sure but earns only $0.5 \times [25+10-(30+\varepsilon)]+0.5\times[25+50-(30+\varepsilon)] = 25-\varepsilon < 25$. Thus, deviation doesn't pay for employers either and we have a perfect Bayesian Nash equilibrium.

The pooling equilibrium (3) does not survive the application of Cho and Kreps' (1987) "intuitive criterion." Consider the out-of-equilibrium beliefs in this equilibrium, i.e., the belief of the employers after observing an investment ($s = 1$): Employers believe that each type of the worker is equally likely. This belief, however, is not "intuitive." To see this, recall that the *low*-ability type of the worker earns payoff 30 in equilibrium. The highest possible payoff this type could possibly earn by deviating to investing is $50 - 45 = 5 < 30$ (if an employer offers the highest wage that can be optimal). Thus, the *low*-ability type of the worker can under no circumstances gain from a deviation. On the other hand, the *high*-ability worker, who earns 30 in equilibrium, can potentially earn up to $50 - 9 = 41$ if he deviates by investing in education. Therefore, the only reasonable belief p of the employer after observing $s = 1$ should be one, i.e., $p = Prob(a = high \mid s = 1) = 1$. This belief, however, destroys the pooling equilibrium (3). The reason is that with this new belief employers would optimally offer a wage of 50 after the signal $s = 1$ which would cause the *high*-ability type of the worker to deviate.

It is easy to see that no other equilibria exist. Pooling with $s(low) = s(high) = 1$ is not incentive compatible for the *low*-ability type. The pooling wage would be 30 again in this equilibrium which does not cover the *low*-ability type's investment cost of 45. Deviating to no investment yields a non-negative profit no matter how the deviation is interpreted. Similarly, $s(low) = 1$, $s(high) = 0$ cannot be an equilibrium either. Hybrid equilibria where one of the worker types randomizes between investment and no investment can also be ruled out. For the sake of brevity, let us only consider two possible candidates. To see that the *high* type choosing $s = 1$ and the *low* type randomizing between $s = 0$ and $s = 1$ with $r = Prob(s = 1) \in [0, 1]$ is not an equilibrium, note that the equilibrium wage after an investment is $0.5(50 + 10r)$. For the *low* type to be indifferent between investment and no investment, we must have: $10 = 0.5(50 + 10r) - 45$, which leads to a contradiction. Similarly, consider the possibility that the *low* type never invests and the *high* type randomizes between $s = 0$ and $s = 1$ with $z = Prob(s = 0) \in [0, 1]$. The equilibrium wage after no investment is $0.5(10 + 50z)$, and the indifference condition for the *high* type becomes $50 - 9 = 0.5(10 + 50z)$, which cannot be satisfied.

Regarding the separating equilibrium of the screening variant, consider that both employers can directly target *high* and *low* types, and perfect wage competition leads to wage increases up to a level where employers break even: $w(0) = 10$, $w(1) = 50$. The worker simply chooses the payoff-maximizing education level which is $s(low) = 0$ and $s(high) = 1$. Employers' posterior beliefs are irrelevant as they move first. There is no pooling equilibrium here because if one employer tried to offer the pooling wage, the other employer would successfully target the high types by offering them slightly more than that wage.

B. Instructions for treatment Sig2 (not intended for publication)

Please read these instructions closely! Please do not talk to your neighbours and remain quiet during the whole experiment. If you have a question, please raise your hand. We will come up to you to answer it.

In this experiment you can earn varying amounts of money, depending on which decisions you and other participants make. Your earnings in the experiment are denoted by points. In the beginning of the experiment, every participant receives 200 points as an initial endowment. Your total payoff at the end of the experiment is equal to the sum of your own payoffs in each round plus your initial endowment. For every 150 points you will be paid £1.

Description of the experiment

In the experiment, three participants interact with each other: one participant in the role of an employee and two participants in the role of employers. The employee can be of "type 1" or of "type 2." The experiment consists of several rounds, and at the beginning of each round, a random draw determines the employee's type. The random draw is such that both possible types of employee ("type 1" or "type 2") are equally probable to be drawn (50:50). After the random draw, the employee is informed about his/her type. However, the employers are not informed about the type of the employee.

Knowing his or her type, the employee has to decide whether or not he/she wants to make an investment. The costs of the investment depend on the employee's type: The investment cost of an employee of type 1 is 9 points and the investment cost of an employee of type 2 is 45 points. After the employee's investment decision, the employers are informed about whether the employee has made an investment or not. Knowing the investment decision of the employee, the two employers simultaneously decide which wage they want to offer the employee. They can choose a wage between 0 and 60 points (if desired, up to two decimal places).

Given the two wage offers of the employers, the employee is hired by the employer who offered the higher wage. (If both employers make the same wage offer, the computer decides randomly and with equal probability which of the two employers hires the employee.)

It is important to understand that the profit of the employer who hires the employee depends both on the wage offered and on the employee's type, but not on the investment decision. This is explained in the following section.

Payoffs

The payoff of the employee at the end of each round is given as follows:

- If the employee has not invested, he/she is paid the higher wage offer, independently of his/her type.
- If the employee has invested, his/her payoff depends on the type:
  - If the employee is of type 1, his/her payoff is: higher wage offer minus 9 points.

– If the employee is of type 2, his/her payoff is: higher wage offer minus 45 points.

The payoff of the employer, who hired the employee, depends on the employee's type:

- If the hired employee is of type 1, the employer's payoff is: 50 points minus wage offer.
- If the hired employee is of type 2, the employer's payoff is: 10 points minus wage offer.

In addition, both employers (that is, also the employer who did not hire an employee) receive a payoff of 25 points in every round.
Please note that the employer who has hired the employee makes losses if the wage offer is greater than 50 and the employee is of type 1 or if the wage offer is greater than 10 and the employee is of type 2.
Please note also that the employee makes losses if the cost of investment (in case an investment has been made) is higher than both wage offers. That is, an employee of type 1 makes losses if he/she invests and the higher wage offer is below 9 points, and an employee of type 2 makes losses if he/she invests and the higher wage offer is below 45 points.
To give you a clearer sense of the rules, the timing of events can be summarized as follows:

1. The computer randomly determines the employee's type. With a 50% probability the employee is either of type 1 or of type 2. After the random draw, the employee is informed about his/her type, but the employers are not informed about it.

2. The two employers simultaneously decide on their individual wage offer (a number from the interval of 0 to 60).

3. The employee is automatically hired by the employer who made the higher wage offer. If both employers make the same wage offer, a random draw (50:50) decides which employer hires the employee.

4. The payoffs are given as described above.

Number of rounds and role assignment
The experiment consists of 48 rounds.
You will have to make decisions both as the employer and as the employee, alternating in the following way: The roles of all participants are randomly determined for 8 consecutive rounds. After 8 rounds new roles are assigned to all participants that remain in place for another 8 rounds. For example, a participant who had the role of the employee for the past 8 rounds, will have the role of the employer for the next 16 rounds (if the experiment is not over before this). Your computer screen shows you in every round which role you have in that round. At the end of each round, you are informed about the employee's type, the wage offers, and the payoffs of all three participants.
Please notice that in every round the groups of 3 players are randomly matched from the pool of all participants. We secure that it is always one employee and 2 employers who form one group.