

Addendum to Market Culture: How Rules Governing Exploding Offers Affect Market Performance¹

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I. Technical Appendix

Proposition 1: In the exploding offer treatment, when firms and applicants are all risk neutral, there is a perfect Bayesian equilibrium with efficient late matching. At this equilibrium, in period 7 firm j makes an exploding offer to the applicant of quality $j+1$, who accepts that offer.

Proposition 2: In the Open offer condition, there is a perfect Bayesian equilibrium with efficient late matching in which firm j matches to the applicant of quality $j+1$.

Proposition 3: In the Renege condition, there is a perfect Bayesian equilibrium with efficient late matching. At this equilibrium, in period 9, firm j makes an exploding offer to the applicant of quality $j+1$, who accepts that offer.

Proofs of Propositions:

To facilitate the presentation of the equilibrium strategies, we first introduce some notation.

Let σ be a permutation on $(1,2,3,4,5,6)$, with $\sigma = (\sigma(1),\sigma(2),\dots,\sigma(6))$, where $\sigma(i)$ is the quality of applicant i , and let S be the set of all such permutations σ .

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Let $p : S \rightarrow [0,1]$ s.t. $\sum_{\sigma} p(\sigma) = 1$ be a probability distribution over all possible outcomes, and let P be the set of all such probability distributions.

At any period $1 \leq t \leq 6$ let s_i be the sum of all signals that applicant i has received so far, s_{-i} the unknown signals the other applicants received, and let r be the remaining signal vector all applicants receive by period 7, so $s+r$ is the sum of the signals, which determines relative quality.

If at period t applicant i already has signals s_i , the probability distributions on quality that are still feasible are $p^{s_i} \in P$ such that $p^{s_i}(\sigma) > 0$ if and only if there exist s_{-i} , r such that $\forall 1 \leq k, j \leq 6 : \sigma(k) > \sigma(j) \Rightarrow s_k + r_k \geq s_j + r_j$. Let P^{s_i} be the set of all such feasible probability distributions over outcomes p^{s_i} . Let $q \in P^{s_i}$ be the applicants' subjective belief about the distribution over outcomes.

For each player i let $p_x(i) = \sum_{\sigma: \sigma(i)=x} p(\sigma)$ be the probability that applicant i has quality x and let $q_x(i) = \sum_{\sigma: \sigma(i)=x} q(\sigma)$ be applicant i 's beliefs about these probabilities.

Let F^M be the set of firms that are already matched and let $m(j)$ be the quality of the applicant matched to firm j .

Proof of Proposition 1 (late equilibrium in the exploding offer condition):

To specify the equilibrium we need to specify not only the strategies of the players, but also their beliefs at all information sets.

Firms and applicants believe that all unobserved offers are exploding offers, that is, they believe that no applicant holds an offer, and that all unmatched firms are able to make an offer.

At all information sets before period 7 in which no firm is matched, and at all nodes in period 7-9, the strategies of firms and applicants call for them to behave as follows:

In period $t < 7$, no firm j makes an offer.

In periods 7, 8 and 9 the k -highest unmatched firm makes an exploding offer to the k -highest unmatched applicant.

The applicant holds the highest of all open offers he receives, and, in case he did not accept an exploding offer before, accepts the highest available offer in period 9.

In period 7 and 8, the (unmatched) applicant of the k -highest quality among all unmatched applicants, accepts any exploding offer from a firm whose quality is equal to or higher than the k -highest unmatched firm, and in case of receiving multiple offers accepts the highest one as long as he does not hold an open offer from a higher quality firm.

In periods $t < 7$, suppose applicant i has received signals s_i so far and receives an exploding offer from firm j . The applicant believes that he is the only applicant to receive an offer, and that rejecting the offer has no impact on other applicants' behavior, as rejected offers are private information. The applicant forms as "favorable" beliefs as possible over the probability distribution of future qualities, and hence his expected payoff from rejecting the offer, that are consistent with receiving an offer from firm j . If there is no chance that firm j can do better by matching to applicant i than to wait for period 7 and match to the applicant of quality $j+1$, that is if

$\left\{ p : p \in P^{s_i} \text{ and } \sum_{\sigma} p(\sigma) \sigma(i) j > j(j+1) \right\} = \emptyset$ then the applicant forms beliefs

$q^{s_i} = \arg \max_p \left\{ \sum_{\sigma} p(\sigma) \sigma(i) (\sigma(i) - 1 - j) \mid p \in P^{s_i} \right\}$, which maximize the difference

between the expected profit of waiting and receiving in period 7 an assortative match, that is receiving $\sum_{\sigma} p(\sigma) \sigma(i) (\sigma(i) - 1)$ and accepting firm j 's offer and receiving

$\sum_{\sigma} p(\sigma) \sigma(i) j$. If $\left\{ p : p \in P^{s_i} \text{ and } \sum_{\sigma} p(\sigma) \sigma(i) j > j(j+1) \right\} \neq \emptyset$ the applicant forms

beliefs $q^{s_i} = \arg \max_p \left\{ \sum_{\sigma} p(\sigma) \sigma(i) (\sigma(i) - 1 - j) \mid p \in P^{s_i} \text{ and } \sum_{\sigma} p(\sigma) \sigma(i) j > j(j+1) \right\}$. The

applicant accepts the offer when $\sum_{\sigma} q^{s_i}(\sigma) \sigma(i) j > \sum_{\sigma} q^{s_i}(\sigma) \sigma(i) (\sigma(i) - 1)$, otherwise he rejects the offer.

Suppose there is a match in period $t < 7$. We assume that all unmatched firms and applicants believe that there are no outstanding open offers they are not aware of. The game consisting of the remaining firms and applicants starting from their current

information² has at least one perfect Bayesian equilibrium, and we assume that players use the strategies of one of these for every such continuation game. We do not need to specify these strategies exactly (beyond that they are equilibrium strategies), because these strategies do not affect the payoffs of the firms and applicants who have deviated by matching, and hence do not affect whether they find it profitable or not to deviate.

We now verify that these strategies form a perfect Bayesian equilibrium.

Along the equilibrium path, all firms j make an offer in period 7 to the respective applicant of quality $j+1$. A firm j cannot profitably deviate by making an offer to $j+2$, or j , and applicant i of quality $j+1$ cannot profitably deviate by rejecting firm j 's offer.

Along the equilibrium path: Assume all firms are still unmatched, and workers and firms believe that no applicant holds an open offer from a firm. Can firm j profit from deviating, by making an early exploding offer in period $t < 7$ to applicant i who has probabilities $p_x(i)$ to be of quality x ? This is profitable for firm j only if

$$\sum_{x=1, \dots, 6} j \cdot p_x(i) > j(j+1).$$

To verify that applicant i 's best response is to reject such an offer (and hence assure that in equilibrium no firm finds it profitable to deviate and make an early offer), we need to find beliefs $q_x(i)$ for applicant i such that he prefers to reject the offer and wait, i.e. $\sum_x j \cdot q_x(i) < \sum_x x(x-1) \cdot q_x(i)$, subject to $\sum_{x=1, \dots, 6} j \cdot q_x(i) > j(j+1)$ (that is the applicant believes that firm j has not made a mistake by making an early exploding offer) and $q \in P^{s_i}$, that is beliefs q are feasible given applicant i 's signal s_i .

We will show that such beliefs exist by showing at the same time that this perfect Bayesian equilibrium does not hinge on the applicants not knowing the true probabilities of being of various types, that is not observing the vector of signals s . Specifically, we show that, along the equilibrium path, when all firms $k \neq j$ play according to their strategies, there is no nontrivial probability distribution over applicants' qualities (i.e.

² To be precise, the information sets starting at period $t+1$ are not singletons, so the continuation of the game is not a subgame. But consider an auxiliary game $G(t)$, derived from the path of play in the original game in which there is a match at period $t < 7$. The players in the auxiliary game $G(t)$ are all those players who are not yet matched by period t . The game $G(t)$ begins at period t , and for that period only, firms may only make open offers. From period $t+1$ onward, the rules of the auxiliary game are those of the original game (i.e. both open and exploding offers may be made). Then the continuation strategies of the remaining (not yet matched) players in the original game are precisely equal to the strategies of players in the auxiliary game holding the same open offers.

such that $0 < p_x(i) < 1$ for some $1 \leq x \leq 6$), such that it is profitable for both the firm and applicant to deviate, that is the firm to make an early offer and the applicant to accept it.

► For a risk neutral firm j it is profitable to make an early offer (that is accepted) to applicant i of probabilities $p_x = p_x(i)$ to be of quality x whenever:

$$p_1 j + p_2 2j + p_3 3j + p_4 4j + p_5 5j + p_6 6j \geq j(j+1) \quad (\text{F})$$

The (risk neutral) applicant i with probabilities $p_x = p_x(i)$ to be of quality x , prefers to accept firm j 's offer whenever

$$\begin{aligned} p_1 0 + p_2 2 \cdot 1 + p_3 3 \cdot 2 + p_4 4 \cdot 3 + p_5 5 \cdot 4 + p_6 6 \cdot 5 \leq \\ p_1 j + p_2 2j + p_3 3j + p_4 4j + p_5 5j + p_6 6j. \end{aligned} \quad (\text{A})$$

We now show, for each firm j that (F) and (A) can only be fulfilled if $p_{j+1}(i) = 1$, as long as no applicant is yet matched.

It is clear that when $j = 5$, (F) cannot be fulfilled unless $p_6 = 1$.

For $j = 4$:

$$\text{Inequality (A) is } \begin{aligned} p_2 2 \cdot 1 + p_3 3 \cdot 2 + p_4 4 \cdot 3 + p_5 5 \cdot 4 + p_6 6 \cdot 5 \leq \\ p_1 4 + p_2 2 \cdot 4 + p_3 3 \cdot 4 + p_4 4 \cdot 4 + p_5 5 \cdot 4 + p_6 6 \cdot 4. \end{aligned}$$

$$\Leftrightarrow 4p_1 \geq -6p_2 - 6p_3 - 4p_4 + 4p_6.$$

$$\text{Inequality (F) is } 4p_1 + 8p_2 + 12p_3 + 16p_4 + 20p_5 + 24p_6 \geq 20$$

$$\text{We use that } \sum_i p_i = 1 \text{ and obtain } 4p_1 \leq -3p_2 - 2p_3 - p_4 + p_6.$$

$$\text{Combining (A) and (F) implies: } -3p_2 - 4p_3 - 3p_4 + 5p_6 \leq 0$$

Which implies that $-15p_2 - 10p_3 - 5p_4 + 5p_6 < 0$ if $p_i > 0$ for at least one i of $\{2,3,4\}$.

The last strict inequality, with (F) delivers that $20p_1 < 0$: contradiction.

If $p_i = 0$ for $i=2,3,4$, then the combination of (A) and (F) imply that $p_6 = 0$, which using (F) implies that $p_1 = 0$ that means $p_5 = 1$.

For $j = 3$:

$$\text{Inequality (A) is } \begin{aligned} p_2 2 \cdot 1 + p_3 3 \cdot 2 + p_4 4 \cdot 3 + p_5 5 \cdot 4 + p_6 6 \cdot 5 \leq \\ 3p_1 + 6p_2 + 9p_3 + 12p_4 + 15p_5 + 18p_6. \end{aligned}$$

$$\Leftrightarrow 3p_1 \geq -4p_2 - 3p_3 + 5p_5 + 12p_6.$$

Inequality (F) is $3p_1 + 6p_2 + 9p_3 + 12p_4 + 15p_5 + 18p_6 \geq 12$

We use that $\sum_i p_i = 1$ and obtain $3p_1 \leq -2p_2 - p_3 + p_5 + 2p_6$.

Combining (A) and (F) implies: $-p_2 - p_3 + 2p_5 + 5p_6 \leq 0$

Which implies that $-2p_2 - p_3 + p_5 + 2p_6 < 0$ if $p_i > 0$ for at least one i of $\{2,5,6\}$. The last strict inequality, with (F) delivers that $3p_1 < 0$: contradiction.

If $p_i = 0$ for $i=2,5,6$, then (F) implies that $p_3 = 0 = p_1$, which means $p_4 = 1$.

For $j = 2$:

Inequality (A) is
$$\frac{p_2 \cdot 2 \cdot 1 + p_3 \cdot 3 \cdot 2 + p_4 \cdot 4 \cdot 3 + p_5 \cdot 5 \cdot 4 + p_6 \cdot 6 \cdot 5}{2p_1 + 4p_2 + 6p_3 + 8p_4 + 10p_5 + 12p_6} \leq$$

$$\Leftrightarrow 2p_1 \geq -2p_2 + 4p_4 + 10p_5 + 18p_6.$$

Inequality (F) is $2p_1 + 4p_2 + 6p_3 + 8p_4 + 10p_5 + 12p_6 \geq 6$

We use that $\sum_i p_i = 1$ and obtain $2p_1 \leq -p_2 + p_4 + 2p_5 + 3p_6$.

Combining (A) and (F) implies: $-p_2 + 3p_4 + 8p_5 + 15p_6 \leq 0$

Which implies that $-p_2 + p_4 + 2p_5 + 3p_6 < 0$ if $p_i > 0$ for at least one i of $\{4,5,6\}$. The last strict inequality, with (F) delivers that $2p_1 < 0$: contradiction.

If $p_i = 0$ for $i=4,5,6$, then (F) implies that $p_2 = 0 = p_1$, which means $p_3 = 1$.

For $j = 1$:

Inequality (A) is
$$\frac{p_2 \cdot 2 \cdot 1 + p_3 \cdot 3 \cdot 2 + p_4 \cdot 4 \cdot 3 + p_5 \cdot 5 \cdot 4 + p_6 \cdot 6 \cdot 5}{p_1 + 2p_2 + 3p_3 + 4p_4 + 5p_5 + 6p_6} \leq$$

$$\Leftrightarrow p_1 \geq 3p_3 + 8p_4 + 15p_5 + 24p_6.$$

Inequality (F) is $p_1 + 2p_2 + 3p_3 + 4p_4 + 5p_5 + 6p_6 \geq 2$

We use that $\sum_i p_i = 1$ and obtain $p_1 \leq p_3 + 2p_4 + 3p_5 + 4p_6$.

Combining (A) and (F) implies: $2p_3 + 6p_4 + 12p_5 + 20p_6 \leq 0$

Which implies that $p_i = 0$ for $i=3,4,5,6$, then (F) implies that $p_1 = 0$, which means $p_2 = 1$. ◀

Proof of Proposition 2 (late equilibrium in the Open offer only condition):

The strategies and beliefs are as follows:

In period 7, 8 and 9, firm j , the k -highest unmatched firm makes an offer to the k -highest unmatched applicant. Firms believe that no other firm makes or made an open offer to that applicant.

- In periods $t < 9$ applicants hold the best offer they receive and in period 9 accept the best available offer. (Applicants can accept the offer of the highest remaining firm as soon as they receive it, specifically, they can accept the offer of firm 5, the highest quality firm, in period $t < 9$.)

Since offers are private, holding the best offer is always (weakly) better than accepting or rejecting it.

No firm has an incentive to make an early offer, as an applicant will simply hold any early offer, and accept it only if she didn't receive a better offer. This means, the firm will be matched with the applicant only if the applicant is of the quality the firm would make an offer to in period 7 anyway, or, of worse quality, in which case the firm is strictly worse off.

Firm j , the j -highest remaining firm in period 7, cannot gain by making an offer in period 7 to an applicant who is of a quality higher than the $j+1$ remaining applicant, as the applicant will receive a better offer in period 7. \diamond

Proof of Proposition 3 (late equilibrium in the Renege condition):

We introduce a bit more notation for the equilibrium strategies of proposition 3, to define to which applicant each unmatched firm should make an offer at every information set in period 9. Each unmatched firm should make an offer to the correspondingly ranked unmatched applicant, or the highest ranked matched worker who would renege on his previous acceptance and accept the firm's offer (given the other offers made simultaneously).

Let $of : F \setminus F^M \rightarrow C = \{1,2,\dots,6\}$ be the offer function defined by the following algorithm:

If firm $5 \in F \setminus F^M$ let $of(5) = 6 = \max\{c : c \in C = \{1,2,3,4,5,6\}\}$ and let $C^4 = C \setminus \{6\}$, if $5 \in F^M$ let $C^4 = C \setminus \{m(5)\}$.

In general, given C^k , for the firm of quality k the algorithm is: If firm $k \in F \setminus F^M$ let $of(k) = \max\{c : c \in C^k\}$ and let $C^{k-1} = C^k \setminus \{of(k)\}$, if $k \in F^M$ let $C^{k-1} = C^k \setminus \{m(k)\}$.

The algorithm stops at firm 1, and each firm in $f \in F \setminus F^M$ is assigned an applicant who is either unmatched or matched to a lower quality firm.

Let g^{F^M} be the generalized inverse offer function extended to matched as well as unmatched firms, that is $g^{F^M} : C = \{1,2,\dots,6\} \rightarrow F \cup \{0\}$ such that, given F^M , $g^{F^M}(c) = of^{-1}(c)$ for $c \in of(F \setminus F^M)$, $g^{F^M}(c) = f$ if $m(f) = c$, $c \notin of(F \setminus F^M)$ and $f \in F^M$, and $g^{F^M}(c) = 0$ for $c \notin (of(F \setminus F^M) \cup m(F^M))$.

The beliefs and strategies that constitute this equilibrium are as follows:

Firms and applicants believe that all unobserved offers are exploding offers, that is, they believe that no applicant holds an offer, and that all unmatched firm are able to make an offer.

In period 9, the unmatched firm j among all the unmatched firms $F \setminus F^M$ makes an exploding offer to the applicant of quality $of(j)$ as prescribed by the offer function of .

In periods $t < 9$ firms do not make offers.

The applicant holds the highest of all open offers he receives, and, in case he did not accept an exploding offer before, accepts the highest available offer in period 9.

In period 7 and 8, the applicant of quality c accepts any exploding offer from a firm whose quality is equal or higher than $g^M(c)$ (whether he is already matched or not), in case of receiving multiple offers he accepts the highest one.

In periods $t < 7$, suppose the applicant has received signals s_t so far and receives an exploding offer from firm j . The applicant believes that he is the only applicant to receive an offer, and that rejecting the offer has no impact on other applicants' behavior, as rejected offers are private information. Given the set of matched firms F^M , the applicant forms beliefs $q^{s_t} \in P^{s_t}$, so as to maximize the difference in expected payoff from accepting the offer and rejecting the offer, that is q^{s_t} maximizes, subject to $p \in P^{s_t}$,

$$Q = \left[\sum_{\sigma} p(\sigma) \sigma(i) \max(j, g^{F^M \cup \{j\}}(\sigma(i)) - 1 / \sigma(i)) \right] - \left[\sum_{\sigma} p(\sigma) \sigma(i) g^{F^M}(\sigma(i)) \right]. \quad \text{The}$$

applicant accepts the offer if $Q \geq 0$ and rejects it otherwise.

Given F^M , s and hence p we show that firm j has no incentive to make an exploding (or open) offer to applicant i , which the applicant would accept. (The firm knows whether the applicant would accept, and there are no incentives to make offers that are rejected.) If firm j makes an early offer that is accepted, the expected payoff is $\sum_{\sigma} p(\sigma) \sigma(i) j I$ where $I = 1$ if $j = \max\{j, g^{F^M \cup \{j\}}(\sigma(i))\}$ and 0 otherwise and where $g^{F^M \cup \{j\}}$ depends on σ .

If firm j does not make an early exploding or open offer (and no other firm does), then the expected payoff is $\sum_{\sigma} p(\sigma) j \cdot of(j)$, where of is the offer function, which depends on σ .

There are 3 possible outcomes:

1. $\sigma(i) = of(j)$. Then firm j is simply indifferent between hiring early or late.
2. $\sigma(i) < of(j)$. Then $j = \max\{j, g^{F^M \cup \{j\}}(\sigma(i))\}$ and firm j remains matched to $\sigma(i)$ and is strictly worse off from making an early offer.
3. $\sigma(i) > of(j)$. Then there exists a firm k such that $\sigma(i) = of(k)$, firm k will make an offer to applicant i in period 9, the applicant will renege and firm j will be unmatched, so, firm j is strictly worse off from making an early offer.

Therefore, firm j has no incentive to make an early offer.

Furthermore, in periods 7 or 8, firm j has no incentive to make an offer to an applicant of quality lower than $of(j)$, but also not to an applicant of quality higher than $of(j)$, as then in period 9 the firm expects the applicant to renege on the acceptance and hence to be strictly worse off.

The strategies of the applicants are also a best response given their beliefs. \diamond

II. Instructions

Instructions: Exploding Offers
Instructions EOni

WELCOME

Thank you for participating in this experiment about economic decision making. It is important that during the experiment you remain silent. If you have any questions, or need assistance of any kind, please raise your hand, and I will come to assist you. Thank you for your cooperation.

The decisions made in this experiment are hiring decisions. Accordingly, your role will be either “firm” or “applicant.” Your role, firm or applicant, will stay the same throughout the experiment. In other words, if you begin as a FIRM, you will remain a FIRM until the end of the experiment. Similarly, if you begin as an APPLICANT, you will remain an APPLICANT until the end of the experiment.

The experiment will have many “markets,” which will last nine “periods” each.

If you are a “firm,” to get a positive payoff in a given market of the experiment you will need to hire one, and only one, applicant in that market.

If you are an “applicant” you will need to accept one, and only one, job offer in each market of the experiment.

In each group, there are five firms and six applicants. The firms are numbered 1 through 5, and the applicants are numbered 1-6.

The firms and applicants are assigned “qualities.” Your payoff as a firm is your quality multiplied by the quality of the applicant you have hired. Similarly, your payoff as an applicant is the product of your quality and your employing firm’s quality. For example, if a firm of quality 3 hires an applicant of quality 4, both firm and applicant will receive a payoff of $3 \times 4 = 12$ points each.

Firms' qualities are simply their assigned participant number. In other words, if you are firm 3, your quality is 3. If you are firm 4, your quality is 4.

Applicants' "qualities," in contrast, have nothing to do with their assigned ID number and depend solely on the applicant's "grades" and "scores."

Exactly how are applicants' qualities determined?

In period 1, 4 and 7, each applicant receives a "grade," which is a number between 1 and 10, with 10 being the best possible grade and 1 being the worst possible grade. The computer generates these grades randomly, with each of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 having an equal chance of occurrence.

So, in period 1, each applicant has a grade between 1 and 10, which is the applicant's "1. score." In period 4 the applicant receives a second grade from 1 to 10. The sum of the first grade (from period 1) and the second grade (from period 4) is the applicant's "2. score." In period 7 each applicant receives a third grade between 1 and 10. The sum of the first, second and third grade is the applicant's "3. score."

The "3. score" determines the applicant's final quality, through its ranking relative to the other applicants' "3. scores". The applicant with the highest "3. score" has a quality of 6. The applicant with the second highest "3. score" has a quality of 5, and so on. The applicant with the lowest "3. score", has a quality of 1. In case of ties, that is, when two applicants have the same "3. score," the computer will break ties and randomly give one a higher quality than the other.

For example, let's say that applicant 5 receives in period 1 a grade of 2, so the "1. score" is 2. In period 4 applicant 5 receives 6, so the "2. score" is $2+6=8$. In period 7 the applicant receives a grade of 9 which means the "3. score" is $2+6+9=17$. Let's say that the other 5 applicants have "3. scores" of 22, 15, 15, 12 and 7. Then, our applicant 5 has the second highest "3. score" and is assigned quality 5. The two applicants with "3.

score” 15 get qualities 4 and 3 (they are the third and fourth highest). The computer will randomly determine which of the two receives quality 4 and which quality 3.

In the experiment you will see only the scores (not the grades from which they are composed), but now you know how they are determined. The “1. score” will be available at the beginning of period 1, the “2. score” will become known in period 4, and the final “quality” of each applicant will be known starting in period 7.

Making and accepting offers

Firms can make two types of offers:

An *exploding* offer is an offer that the applicant can only accept or reject right away, in the same period as the offer was made.

An *open* offer is an offer that the applicant can accept, reject or “hold”. An open offer can be held by the applicant until the last period, when he has to decide whether to accept or reject the offer. An open offer will remain open as long as the applicant holds it. (Each applicant who hasn’t already accepted an offer can hold no more than one offer at a time.) A firm with an open offer that is being held cannot make another offer: a firm can only have one offer outstanding at any time.

Firm’s decisions in each period

A firm that has not yet hired an applicant, and has no open offer being held by an applicant, has to decide whether to make an offer, and, if so, to which applicant. A firm may make at most one offer in a period. Once the firm types in the ID number of the applicant to whom the offer is made, the firm has to decide whether to make an open or exploding offer. An exploding offer is one the applicant has to accept or reject in this period. If the offer is open, the applicant can also choose to hold the offer, and postpone the decision whether to accept or reject it. A firm can only have one offer outstanding in each period, so a firm with an open offer that is held by an applicant cannot make another offer.

Applicants’ decisions in each period.

In each period the applicant sees all the offers she has received that period, including possibly an open offer she decided to hold from the previous period. The applicant has to decide whether to accept or reject her offers. If the offer is an open offer, the applicant can decide to hold this offer, which means this offer will be available for her also next period. (An open offer that was held from the previous period must be held again at this period if the applicant wants to continue to hold it.) In any period the applicant can only hold one offer. All the offers that are not accepted or held are automatically rejected. (In the last period, period 9, the applicant can only accept or reject offers). When an applicant accepts an offer from a firm, we say the applicant and the firm are matched to each other.

Once a firm and an applicant are matched, the firm cannot make any further offers, and the applicant cannot accept any further offers. The firms cannot make offers to applicants who are matched, so a matched applicant will not receive any further offers.

The information on the Screen of Applicants and Firms:

In the top left box you can see whether you are a firm or an applicant. Let's start by looking at a sample screen for one of the firms: we are looking at a screen of Firm 2.

The screen shot is from period 7, at which point all the information about applicants, their "1. score", their "2. score" and their final "quality" is available. (In periods 1-3 only the "1. score" is available, in periods 4-6 the "1. score" and the "2. score" are available, and the final quality is only available starting at period 7.)

If you are a firm, your ID number (and hence your quality) will remain fixed across markets.

In the top right you can see the current period in the market. Each market has 9 periods, and new information about the applicants becomes available in periods 1, 4 and 7. Any firm (and applicant) who is not matched by the end of period 9, remains unmatched in this market, and earns zero points.

On the bottom right there is a box called “Applicant’s Scores”. In this box is a list of applicants’ scores and qualities as they become available over time. The ordering is according to the applicants’ ID numbers (which are randomly assigned in every market). In the sample screen you can see that Applicant 1 has quality 5, while applicant 3 has quality 2.

On the top left the firm has a box called “Matchings” which shows which of the firms have already hired which applicant, at what period and with what score or quality. The entries are ordered by year of acceptance of the offer by the applicant. For firm 2, the entry that corresponds to firm 2, is marked by ** 2 ** instead of just 2 in the column labeled “hired by firm”.

On the bottom right the firm has a box that reminds them of the points they receive for a match.

All the boxes we discussed so far, are also available on the screen of the applicants. Now we discuss the part that is specific to firms.

The box headed “List of Applicants” shows for each applicant the relevant score or quality, and by which firm they are hired (where 0 means they are not hired by any firm yet). Note that on this list, applicants are listed in order of quality (or, before period 7, in order of their most recent score, with the highest scoring applicant listed at the top of the list, etc.). Thus on this screen, applicant 4 is listed first, with a quality of 6, applicant 1 is next, and so forth.

In the box below, the firm can choose to make an offer. To make an offer, the firm types in the ID of the applicant to whom the offer is directed, and then clicks on the choice of an “exploding” or “open” offer. To make the offer the firm has to click the “make offer” button. The firm cannot make an offer to an applicant who is already matched to another firm.

If the firm does not want to make an offer, or is already matched or has an open offer held by an applicant, the firm has to click the “No Offer” button.

On the left, in the middle, the firm can see if she is already matched (has already hired an applicant) and which one. The second line shows if the firm has an open offer and to which applicant. In period 7 the last line appears that shows the points the firm receives in this market, if she is already matched (it shows 0 points if she is unmatched). In our example, firm 2 and applicant 1 (of quality 5) are matched to each other, and hence firm 2 (and applicant 1) earn each $2 \times 5 = 10$ points in Market 1.

Below, on the bottom left, is a table that shows each firm all her offers that were rejected in this market. For example, Firm 2 made an exploding offer in period 1 to applicant 1 that was rejected in period 1.

The Applicant:

The screen shot is from applicant 2 in period 7 (as can be seen in the top 2 boxes). Each applicant will receive a new ID number in every market, which has nothing to do with the final quality that is determined throughout the market.

The table headed “The scores” lists your scores and qualities as they become available over time. Applicant 2 turns out to have quality 4 in this example; this means he has the third highest quality (the highest is 6, the lowest is 1).

The applicant has a box called “Matchings,” showing which of the firms have already hired which applicant, at what period. The entries are ordered by year of acceptance of the offer by the applicant.

Now we discuss boxes and choices that are only available to applicants.

On the right side the applicant has a table called “Your offers” that shows all the offers available (for this applicant) this period and whether the offer is exploding or open. (By the time you see this screen, firms have finished making their offers for this period, so

this screen shows all the offers you will receive in this period.) In the example, applicant 2 has one exploding offer, from firm 1. (Applicant 2 has to decide what to do with this offer, but he has no need to wait for further offers in this period, as all the firms have already finished making offers.) To accept an offer, the applicant has to first *click on the offer* and then the “Accept offer” button. Once an applicant accepted an offer, he is matched to that firm (i.e. hired by that firm) for this market, and will not receive any subsequent offers. The applicant can also decide to hold at most one open offer, by typing in the firm’s ID number (and hence the firms’ quality) that made him such an offer, and click the “Hold Offer” button. In that case the applicant will have this offer available in the next period. If an applicant holds an offer, all the other offers are automatically rejected. The applicant can also decide to reject all offers by clicking the Reject / Continue button. If the applicant received no offers, he nevertheless has to click the “Reject / Continue” button so the experiment can proceed. *Once you have made your decision, click the necessary button promptly, in order that the experiment will not take an excessively long time.*

The table in the middle left shows whether and to whom the applicant is matched, whether the applicant decided to hold an offer and from which firm. In period 7 the last line appears that shows the points the applicant receives in this market, if he is already matched (otherwise it shows 0 points).

The box in the bottom left shows the offers the applicant rejected in this market, ordered by the year in which they were rejected.

PAYMENT:

The payment you receive in this experiment has two components.

The first is based on your performance in the experiment: For each point you accumulate in the experiment, you receive \$ 0.10. The second component is independent of your performance in the experiment, and already determined in advance. It consist of the \$10 show up fee, and for some types of players (already determined) another fixed payment that is already determined now. That is, your behavior in the experiment influences your payoff only through the points you accumulate in the markets.

SUMMARY:

At the beginning of the experiment you learn whether you are a firm or an applicant. If you are a firm, you also learn your quality, which is your ID number that you will have throughout the whole experiment. If you are an applicant, you receive a new ID number in every market, and your ID number has nothing to do with your quality. In each Market there are 5 firms and 6 applicants.

Information about Applicants' qualities is revealed over several periods:

- Period 1: Each Applicant receives a grade between 1 and 10 (with each of 1,2,3,4,5,6,7,8,9,10 having an equal chance to occur) that is his "1. score".
- Period 4: each applicant receives another grade of 1,...,10, (each having the same chance of occurring) and the sum of the two grades constitute the "2. score".
- Period 7: Each applicant receives a third grade between 1,...,10 (each having the same chance of occurring), and the sum of all three grades constitute the "3. score". The applicant with the highest 3.score receives the highest quality of 6, the applicant with the second highest receives quality 5, and so on, until the applicant with the lowest score who receives quality 1.

To earn points in a market, a firm will need to hire one, and only one, applicant in that market, and an "applicant" will need to accept one, and only one, job offer. How is this done?

- In each period, each firm that has not yet hired an applicant, and has no open offer being held by an applicant, has to decide whether to make an offer, and, if so, to which applicant, and whether the offer should be exploding or open. Each firm can only have one outstanding offer in each period.
- An exploding offer is an offer to which the applicant must respond immediately. If he does not accept it right away (i.e. in the same period that it was made), the offer expires, and it is as if he had rejected it.
- An open offer is an offer the applicant can accept, reject, or hold. At most one offer can be held, in which case it will remain available in the next period.

- Once all the firms have made their offers, the applicants see the screen showing all the offers they received this period. (Once an applicant sees his offer screen, there will not be any further offers arriving in that period.)
- In each period, applicants who receive offers have to decide whether to accept the offer, reject the offer, or, if the offer is an open offer, the applicant can decide to hold (no more than one) offer.
- Once an applicant accepted an offer, he cannot accept another offer in the same market, and will no longer receive offers.
- Firms and Applicants that are not matched by the end of period 9 in a market remain unmatched and earn zero points.
- Firms and applicants that are matched to each other each earn points equal to the product of the applicant's quality and the firm's quality.
- After period 9, a completely new market begins, and everyone is free to try to match once again.

Screen of Firm 2

You are Firm 2	Applicants' ID numbers: 1, 2, 3, 4, 5, 6 Firms' ID (=quality): 1, 2, 3, 4, 5	You are in Period 7 in Market 1																													
Matchings		List of all Applicants																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Applicant</th> <th style="width: 15%;">hired by firm</th> <th style="width: 15%;">in period</th> <th style="width: 15%;">Quality</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>** 2 **</td> <td>6</td> <td>5</td> </tr> </tbody> </table>	Applicant	hired by firm	in period	Quality	1	** 2 **	6	5	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Applicant</th> <th style="width: 33%;">Quality</th> <th style="width: 33%;">Hired by firm</th> </tr> </thead> <tbody> <tr><td>4</td><td>6</td><td>0</td></tr> <tr><td>1</td><td>5</td><td>2</td></tr> <tr><td>2</td><td>4</td><td>0</td></tr> <tr><td>6</td><td>3</td><td>0</td></tr> <tr><td>3</td><td>2</td><td>0</td></tr> <tr><td>5</td><td>1</td><td>0</td></tr> </tbody> </table>		Applicant	Quality	Hired by firm	4	6	0	1	5	2	2	4	0	6	3	0	3	2	0	5	1	0
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6	3	0																													
3	2	0																													
5	1	0																													
<p>You are matched to Applicant 1. You have no open offer</p> <p>Your profits in this market are 10 points.</p>	<p>Make an offer to Applicant <input style="width: 100px;" type="text"/></p> <p>The type of the offer is <input type="radio"/> exploding (only open this period) <input type="radio"/> open (until the end of this market)</p> <p style="text-align: right;">Make Offer</p>																														
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Appl.	1. Score	2. Score	Quality																												
1	10	16	5																												
2	3	12	4																												
3	2	6	2																												
4	8	17	6																												
5	10	11	1																												
6	3	7	3																												

Screen of Applicant 2

You are Applicant 2				Applicants' ID numbers: 1, 2, 3, 4, 5, 6 Firms' ID (=quality): 1, 2, 3, 4, 5			You are in Period 7 in Market 1	
The Scores				Matchings			Your offers	
Applicant	Quality	2. Score	1. Score	Applicant	hired by firm	in period	Firm	offer deadline
** 2 **	4	12	3	1	2	6	1	exploding
<p>You are not matched yet. Last period you decided to hold no offer</p> <p>Your profits in this market are 0 points.</p>								
The offers you rejected in this market								
Period of offer	from Firm	Deadline	Rejected in period					
							Accept Offer	
							Hold offer from Firm <input style="width: 50px;" type="text"/>	
							Hold Offer	
							Reject / Continue	
<p>The points you earn from a match are the quality of the firm with whom you are matched (from 1 to 5) x your final quality (from 1 to 6), which is determined in period 7.</p> <p>If you are not matched you earn 0 points.</p>								

Open Offer Instructions

Instructions Oni

WELCOME

Thank you for participating in this experiment about economic decision making. It is important that during the experiment you remain silent. If you have any questions, or need assistance of any kind, please raise your hand, and I will come to assist you. Thank you for your cooperation.

The decisions made in this experiment are hiring decisions. Accordingly, your role will be either “firm” or “applicant.” Your role, firm or applicant, will stay the same throughout the experiment. In other words, if you begin as a FIRM, you will remain a FIRM until the end of the experiment. Similarly, if you begin as an APPLICANT, you will remain an APPLICANT until the end of the experiment.

The experiment will have many “markets,” which will last nine “periods” each.

If you are a “firm,” to get a positive payoff in a given market of the experiment you will need to hire one, and only one, applicant in that market.

If you are an “applicant” you will need to accept one, and only one, job offer in each market of the experiment.

In each group, there are five firms and six applicants. The firms are numbered 1 through 5, and the applicants are numbered 1-6.

The firms and applicants are assigned “qualities.” Your payoff as a firm is your quality multiplied by the quality of the applicant you have hired. Similarly, your payoff as an applicant is the product of your quality and your employing firm’s quality. For example, if a firm of quality 3 hires an applicant of quality 4, both firm and applicant will receive a payoff of $3 \times 4 = 12$ points each.

Firms' qualities are simply their assigned participant number. In other words, if you are firm 3, your quality is 3. If you are firm 4, your quality is 4.

Applicants' "qualities," in contrast, have nothing to do with their assigned ID number and depend solely on the applicant's "grades" and "scores."

Exactly how are applicants' qualities determined?

In period 1, 4 and 7, each applicant receives a "grade," which is a number between 1 and 10, with 10 being the best possible grade and 1 being the worst possible grade. The computer generates these grades randomly, with each of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 having an equal chance of occurrence.

So, in period 1, each applicant has a grade between 1 and 10, which is the applicant's "1. score." In period 4 the applicant receives a second grade from 1 to 10. The sum of the first grade (from period 1) and the second grade (from period 4) is the applicant's "2. score." In period 7 each applicant receives a third grade between 1 and 10. The sum of the first, second and third grade is the applicant's "3. score."

The "3. score" determines the applicant's final quality, through its ranking relative to the other applicants' "3. scores". The applicant with the highest "3. score" has a quality of 6. The applicant with the second highest "3. score" has a quality of 5, and so on. The applicant with the lowest "3. score", has a quality of 1. In case of ties, that is, when two applicants have the same "3. score," the computer will break ties and randomly give one a higher quality than the other.

For example, let's say that applicant 5 receives in period 1 a grade of 2, so the "1. score" is 2. In period 4 applicant 5 receives 6, so the "2. score" is $2+6=8$. In period 7 the applicant receives a grade of 9 which means the "3. score" is $2+6+9=17$. Let's say that the other 5 applicants have "3. scores" of 22, 15, 15, 12 and 7. Then, our applicant 5 has the second highest "3. score" and is assigned quality 5. The two applicants with "3.

score” 15 get qualities 4 and 3 (they are the third and fourth highest). The computer will randomly determine which of the two receives quality 4 and which quality 3.

In the experiment you will see only the scores (not the grades from which they are composed), but now you know how they are determined. The “1. score” will be available at the beginning of period 1, the “2. score” will become known in period 4, and the final “quality” of each applicant will be known starting in period 7.

Making and accepting offers

The type of offer firms can make is what can be called *open* offers. These are offers that the applicant can accept, reject or “hold”. An offer can be held by the applicant until the last period, when he has to decide whether to accept or reject the offer. An offer will remain open as long as the applicant holds it. (Each applicant who hasn’t already accepted an offer can hold no more than one offer at a time.) A firm with an open offer that is being held cannot make another offer: a firm can only have one offer outstanding at any time.

Firm’s decisions in each period

A firm that has not yet hired an applicant, and has no open offer being held by an applicant, has to decide whether to make an offer, and, if so, to which applicant. A firm may make at most one offer in a period. A firm can only have one offer outstanding in each period, so a firm with an open offer that is held by an applicant cannot make another offer.

Applicants’ decisions in each period.

In each period the applicant sees all the offers she has received that period, including possibly an offer she decided to hold from the previous period. The applicant has to decide whether to accept, reject, or hold her offers, which means this offer will be available for her also next period. (An offer that was held from the previous period must be held again at this period if the applicant wants to continue to hold it.) In any period the applicant can only hold one offer. All the offers that are not accepted or held are

automatically rejected. (In the last period, period 9, the applicant can only accept or reject offers). When an applicant accepts an offer from a firm, we say the applicant and the firm are matched to each other.

Once a firm and an applicant are matched, the firm cannot make any further offers, and the applicant cannot accept any further offers. The firms cannot make offers to applicants who are matched, so a matched applicant will not receive any further offers.

The information on the Screen of Applicants and Firms:

In the top left box you can see whether you are a firm or an applicant. Let's start by looking at a sample screen for one of the firms: we are looking at a screen of Firm 2.

The screen shot is from period 7, at which point all the information about applicants, their "1. score", their "2. score" and their final "quality" is available. (In periods 1-3 only the "1. score" is available, in periods 4-6 the "1. score" and the "2. score" are available, and the final quality is only available starting at period 7.)

If you are a firm, your ID number (and hence your quality) will remain fixed across markets.

In the top right you can see the current period in the market. Each market has 9 periods, and new information about the applicants becomes available in periods 1, 4 and 7. Any firm (and applicant) who is not matched by the end of period 9, remains unmatched in this market, and earns zero points.

On the bottom right there is a box called "Applicant's Scores". In this box is a list of applicants' scores and qualities as they become available over time. The ordering is according to the applicants' ID numbers (which are randomly assigned in every market). In the sample screen you can see that Applicant 1 has quality 4, while applicant 5 has quality 2.

On the top left the firm has a box called “Matchings” which shows which of the firms have already hired which applicant, at what period and with what score or quality. The entries are ordered by year of acceptance of the offer by the applicant. For firm 2, the entry that corresponds to firm 2, is marked by ** 2 ** instead of just 2 in the column labeled “hired by firm”.

On the bottom right the firm has a box that reminds them of the points they receive for a match.

All the boxes we discussed so far, are also available on the screen of the applicants. Now we discuss the part that is specific to firms.

The box headed “List of Applicants” shows for each applicant the relevant score or quality, and by which firm they are hired (where 0 means they are not hired by any firm yet). Note that on this list, applicants are listed in order of quality (or, before period 7, in order of their most recent score, with the highest scoring applicant listed at the top of the list, etc.). Thus on this screen, applicant 6 is listed first, with a quality of 6, applicant 4 is next, and so forth.

In the box below, the firm can choose to make an offer. To make an offer, the firm types in the ID of the applicant to whom the offer is directed, and then has to click the “make offer” button. The firm cannot make an offer to an applicant who is already matched to another firm.

If the firm does not want to make an offer, or is already matched or has an open offer held by an applicant, the firm has to click the “No Offer” button.

On the left, in the middle, the firm can see if she is already matched (has already hired an applicant) and which one. The second line shows if the firm has an open offer and to which applicant. In period 7 the last line appears that shows the points the firm receives in this market, if she is already matched (it shows 0 points if she is unmatched). In our

example, firm 2 and applicant 1 (of quality 4) are matched to each other, and hence firm 2 (and applicant 1) earn each $2 \times 4 = 8$ points in Market 1.

Below, on the bottom left, is a table that shows each firm all her offers that were rejected in this market. For example, Firm 2 made an offer in period 1 to applicant 1 that was rejected in period 1.

The Applicant:

The screen shot is from applicant 2 in period 7 (as can be seen in the top 2 boxes). Each applicant will receive a new ID number in every market, which has nothing to do with the final quality that is determined throughout the market.

The table headed “The scores” lists your scores and qualities as they become available over time. Applicant 2 turns out to have quality 3 in this example; this means he has the fourth highest quality (the highest is 6, the lowest is 1).

The applicant has a box called “Matchings,” showing which of the firms have already hired which applicant, at what period. The entries are ordered by year of acceptance of the offer by the applicant.

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On the right side the applicant has a table called “Your offers” that shows all the offers available (for this applicant) this period. (By the time you see this screen, firms have finished making their offers for this period, so this screen shows all the offers you will receive in this period.) In the example, applicant 2 has one offer, from firm 1. (Applicant 2 has to decide what to do with this offer, but he has no need to wait for further offers in this period, as all the firms have already finished making offers.) To accept an offer, the applicant has to first *click on the offer* and then the “Accept offer” button. Once an applicant accepted an offer, he is matched to that firm (i.e. hired by that firm) for this market, and will not receive any subsequent offers. The applicant can also decide to hold at most one offer, by typing in the firm’s ID number (and hence the firms’ quality) that

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The payment you receive in this experiment has two components.

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SUMMARY:

At the beginning of the experiment you learn whether you are a firm or an applicant. If you are a firm, you also learn your quality, which is your ID number that you will have throughout the whole experiment. If you are an applicant, you receive a new ID number in every market, and your ID number has nothing to do with your quality. In each Market there are 5 firms and 6 applicants.

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To earn points in a market, a firm will need to hire one, and only one, applicant in that market, and an "applicant" will need to accept one, and only one, job offer. How is this done?

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- After period 9, a completely new market begins, and everyone is free to try to match once again.

Screen of Firm 2

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<p>You are matched to Applicant 1. You have no open offer</p> <p>Your profits in this market are 8 points.</p>	<p style="text-align: center;">Make an offer to Applicant <input style="width: 50px; height: 20px;" type="text"/></p> <p style="text-align: right;">Make Offer</p>																																							
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Period	offer to	Rejected in																																						
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		<p>Points for a Match: 2 x Applicant's final quality.</p> <p>The Applicant's final quality (from 1 to 6) is determined in Period 7.</p> <p>Unmatched firms earn 0 points.</p>																																						

Screen of Applicant 2

You are Applicant 2		Applicants' ID numbers: 1, 2, 3, 4, 5, 6		You are in Period 7 in Market 1					
		Firms' ID (=quality): 1, 2, 3, 4, 5							
The Scores			Matchings			Your offers			
Applicant	Quality	2. Score	1. Score	Applicant	hired by firm	in period	Firm		
** 2 **	3	11	8	1	2	6	1		
<p>You are not matched yet.</p> <p>Last period you decided to hold no offer</p> <p>Your profits in this market are 0 points.</p>						<p style="text-align: right;">Hold offer from Firm</p> <div style="border: 1px solid black; width: 50px; height: 15px; margin: 0 auto;"></div>			
The offers you rejected in this market						<div style="border: 1px solid black; width: 100%; height: 20px; background-color: #f00; text-align: center; color: white; font-weight: bold;">Accept Offer</div>			
Period of offer	from Firm		Rejected in period			<div style="border: 1px solid black; width: 100%; height: 20px; background-color: #f00; text-align: center; color: white; font-weight: bold;">Hold Offer</div>			
						<div style="border: 1px solid black; width: 100%; height: 20px; background-color: #f00; text-align: center; color: white; font-weight: bold;">Reject / Continue</div>			
						<p>The points you earn from a match are the quality of the firm with whom you are matched (from 1 to 5) x your final quality (from 1 to 6), which is determined in period 7.</p> <p>If you are not matched you earn 0 points.</p>			

Reneg Instructions

Instructions EORni

WELCOME

Thank you for participating in this experiment about economic decision making. It is important that during the experiment you remain silent. If you have any questions, or need assistance of any kind, please raise your hand, and I will come to assist you. Thank you for your cooperation.

The decisions made in this experiment are hiring decisions. Accordingly, your role will be either “firm” or “applicant.” Your role, firm or applicant, will stay the same throughout the experiment. In other words, if you begin as a FIRM, you will remain a FIRM until the end of the experiment. Similarly, if you begin as an APPLICANT, you will remain an APPLICANT until the end of the experiment.

The experiment will have many “markets,” which will last nine “periods” each.

If you are a “firm,” to get a positive payoff in a given market of the experiment you will need to hire one, and only one, applicant in that market.

If you are an “applicant” you will need to accept one, and only one, job offer in each market of the experiment.

In each group, there are five firms and six applicants. The firms are numbered 1 through 5, and the applicants are numbered 1-6.

The firms and applicants are assigned “qualities.” Your payoff as a firm is your quality multiplied by the quality of the applicant you have hired. Similarly, your payoff as an applicant is the product of your quality and your employing firm’s quality. For example, if a firm of quality 3 hires an applicant of quality 4, both firm and applicant will receive a payoff of $3 \times 4 = 12$ points each.

Firms' qualities are simply their assigned participant number. In other words, if you are firm 3, your quality is 3. If you are firm 4, your quality is 4.

Applicants' "qualities," in contrast, have nothing to do with their assigned ID number and depend solely on the applicant's "grades" and "scores."

Exactly how are applicants' qualities determined?

In period 1, 4 and 7, each applicant receives a "grade," which is a number between 1 and 10, with 10 being the best possible grade and 1 being the worst possible grade. The computer generates these grades randomly, with each of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 having an equal chance of occurrence.

So, in period 1, each applicant has a grade between 1 and 10, which is the applicant's "1. score." In period 4 the applicant receives a second grade from 1 to 10. The sum of the first grade (from period 1) and the second grade (from period 4) is the applicant's "2. score." In period 7 each applicant receives a third grade between 1 and 10. The sum of the first, second and third grade is the applicant's "3. score."

The "3. score" determines the applicant's final quality, through its ranking relative to the other applicants' "3. scores". The applicant with the highest "3. score" has a quality of 6. The applicant with the second highest "3. score" has a quality of 5, and so on. The applicant with the lowest "3. score", has a quality of 1. In case of ties, that is, when two applicants have the same "3. score," the computer will break ties and randomly give one a higher quality than the other.

For example, let's say that applicant 5 receives in period 1 a grade of 2, so the "1. score" is 2. In period 4 applicant 5 receives 6, so the "2. score" is $2+6=8$. In period 7 the applicant receives a grade of 9 which means the "3. score" is $2+6+9=17$. Let's say that the other 5 applicants have "3. scores" of 22, 15, 15, 12 and 7. Then, our applicant 5 has the second highest "3. score" and is assigned quality 5. The two applicants with "3.

score” 15 get qualities 4 and 3 (they are the third and fourth highest). The computer will randomly determine which of the two receives quality 4 and which quality 3.

In the experiment you will see only the scores (not the grades from which they are composed), but now you know how they are determined. The “1. score” will be available at the beginning of period 1, the “2. score” will become known in period 4, and the final “quality” of each applicant will be known starting in period 7.

Making and accepting offers

Firms can make two types of offers:

An *exploding* offer is an offer that the applicant can only accept or reject right away, in the same period as the offer was made.

An *open* offer is an offer that the applicant can accept, reject or “hold”. An open offer can be held by the applicant until the last period, when he has to decide whether to accept or reject the offer. An open offer will remain open as long as the applicant holds it. (Each applicant who hasn’t already accepted an offer can hold no more than one offer at a time.) A firm with an open offer that is being held cannot make another offer: a firm can only have one offer outstanding at any time. An applicant can reject an offer at no cost, even after holding it. Once an offer has been accepted, it can still be later cancelled by the applicant, but at a cost of 1 point.

Firm’s decisions in each period

A firm that has no accepted offer, and no open offer being held by an applicant, has to decide whether to make an offer, and, if so, to which applicant. A firm may make at most one offer in a period. Once the firm types in the ID number of the applicant to whom the offer is made, the firm has to decide whether to make an open or exploding offer. An exploding offer is one the applicant has to accept or reject in this period. If the offer is open, the applicant can also choose to hold the offer, and postpone the decision whether to accept or reject it. A firm can only have one offer outstanding in each period, so a firm with an open offer that is held by an applicant cannot make another offer. Similarly, a

firm whose open or exploding offer is accepted cannot make another offer, unless and until the applicant cancels his acceptance.

Applicants' decisions in each period.

In each period the applicant sees all the offers she has received that period, including possibly an open offer she decided to hold from the previous period. The applicant has to decide whether to accept or reject her offers. If the offer is an open offer, the applicant can decide to hold this offer, which means this offer will be available for her also next period. (An open offer that was held from the previous period must be held again at this period if the applicant wants to continue to hold it.) In any period the applicant can only hold one offer. All the offers that are not accepted or held are automatically rejected. (In the last period, period 9, the applicant can only accept or reject offers). When an applicant accepts an offer from a firm, we say the applicant and the firm are matched to each other. If the applicant later cancels the acceptance, the firm and applicant are no longer matched. (In that case, the firm can make new offers.) An applicant who has accepted an offer cancels the acceptance by accepting or holding another offer (and paying a 1 point cancellation fee).

When a firm and an applicant are matched, the firm cannot make any further offers. Whenever a firm is in a position to make an offer, it can make it to any applicant, including an applicant who is presently matched to another firm.

The information on the Screen of Applicants and Firms:

In the top left box you can see whether you are a firm or an applicant. Let's start by looking at a sample screen for one of the firms: we are looking at a screen of Firm 2.

The screen shot is from period 7, at which point all the information about applicants, their "1. score", their "2. score" and their final "quality" is available. (In periods 1-3 only the "1. score" is available, in periods 4-6 the "1. score" and the "2. score" are available, and the final quality is only available starting at period 7.)

If you are a firm, your ID number (and hence your quality) will remain fixed across markets.

In the top right you can see the current period in the market. Each market has 9 periods, and new information about the applicants becomes available in periods 1, 4 and 7. Any firm (and applicant) who is not matched by the end of period 9, remains unmatched in this market, and earns zero points.

On the bottom right there is a box called “Applicant’s Scores”. In this box is a list of applicants’ scores and qualities as they become available over time. The ordering is according to the applicants’ ID numbers (which are randomly assigned in every market). In the sample screen you can see that Applicant 1 has quality 5, while applicant 3 has quality 1.

On the top left the firm has a box called “Matchings” which shows which of the firms have already hired which applicant, at what period and with what score or quality. The entries are ordered by year of acceptance of the offer by the applicant. For firm 2, the entry that corresponds to firm 2, is marked by ** 2 ** instead of just 2 in the column labeled “hired by firm”.

On the bottom right the firm has a box that reminds them of the points they receive for a match.

All the boxes we discussed so far, are also available on the screen of the applicants. Now we discuss the part that is specific to firms.

The box headed “List of Applicants” shows for each applicant the relevant score or quality, and by which firm they are hired (where 0 means they are not hired by any firm yet). Note that on this list, applicants are listed in order of quality (or, before period 7, in order of their most recent score, with the highest scoring applicant listed at the top of the list, etc.). Thus on this screen, applicant 2 is listed first, with a quality of 6, applicant 1 is next, and so forth.

In the box below, the firm can choose to make an offer. To make an offer, the firm types in the ID of the applicant to whom the offer is directed, and then clicks on the choice of an “exploding” or “open” offer. To make the offer the firm has to click the “make offer” button.

If the firm does not want to make an offer, or is presently matched or has an open offer held by an applicant, the firm has to click the “No Offer” button.

If the firm was previously matched to an applicant who has now cancelled his acceptance, the box right next to the “No Offer” button will show the message “YOUR APPLICANT CANCELLED.” In the picture, this is what Firm 2 sees in period 3, when applicant 1 cancels a previously accepted offer.

On the left, in the middle, the firm can see if she is already matched (has already hired an applicant) and which one. The second line shows if the firm has an open offer and to which applicant. In period 7 the last line appears that shows the points the firm receives in this market, if she is already matched (it shows 0 points if she is unmatched). In our example, firm 2 and applicant 1 (of quality 5) are matched to each other, and hence firm 2 (and applicant 1) earn each $2 \times 5 = 10$ points in Market 1.

Below, on the bottom left, is a table that shows each firm all her offers that were rejected or cancelled in this market. For example, Firm 2 made an exploding offer in period 1 to applicant 1 that was cancelled in Period 2. (This means that applicant 1 had accepted the offer in period 1, but then in period 2 decided to either hold or accept an offer from a different firm.)

The Applicant:

The screen shot is from applicant 2 in period 7 (as can be seen in the top 2 boxes). Each applicant will receive a new ID number in every market, which has nothing to do with the final quality that is determined throughout the market.

The table headed “The scores” lists your scores and qualities as they become available over time. Applicant 2 turns out to have quality 6 in this example; this means he has the highest quality (the highest is 6, the lowest is 1).

The applicant has a box called “Matchings,” showing which of the firms have already hired which applicant, at what period. The entries are ordered by year of acceptance of the offer by the applicant.

Now we discuss boxes and choices that are only available to applicants.

On the right side the applicant has a table called “Your offers” that shows all the offers available (for this applicant) this period and whether the offer is exploding or open. (By the time you see this screen, firms have finished making their offers for this period, so this screen shows all the offers you will receive in this period.) In the example, applicant 2 has one exploding offer, from firm 1. (Applicant 2 has to decide what to do with this offer, but he has no need to wait for further offers in this period, as all the firms have already finished making offers.) To accept an offer, the applicant has to first *click on the offer* and then the “Accept offer” button. Once an applicant accepted an offer, he is matched to that firm (i.e. hired by that firm) for this market, and will remain so unless he cancels the offer. When an already matched applicant decides to accept, or hold, the offer of another firm, his prior acceptance is cancelled, and he pays a cancellation fee of 1 point. The applicant can decide to hold at most one open offer, by typing in the firm’s ID number (and hence the firms’ quality) that made him such an offer, and click the “Hold Offer” button. In that case the applicant will have this offer available in the next period. If an applicant holds an offer, all the other offers are automatically rejected. The applicant can also decide to reject all offers by clicking the Reject / Continue button. If the applicant received no offers, he nevertheless has to click the “Reject / Continue” button

so the experiment can proceed. *Once you have made your decision, click the necessary button promptly, in order that the experiment will not take an excessively long time.*

The table below the scores shows the cost of canceling an acceptance (1 point) and the cancellation costs the applicant has accumulated so far in this market. In the picture, Applicant 2 has not cancelled any offers, and so has paid 0 costs.

The table in the middle left shows whether and to whom the applicant is matched, whether the applicant decided to hold an offer and from which firm. In period 7 the last line appears that shows the points the applicant receives in this market, if he is already matched (otherwise it shows 0 points).

The box in the bottom left shows the offers the applicant rejected in this market, ordered by the year in which they were rejected.

PAYMENT:

The payment you receive in this experiment has two components.

The first is based on your performance in the experiment: For each point you accumulate in the experiment, you receive \$ 0.10. The second component is independent of your performance in the experiment, and already determined in advance. It consist of the \$10 show up fee, and for some types of players (already determined) another fixed payment that is already determined now. That is, your behavior in the experiment influences your payoff only through the points you accumulate in the markets.

SUMMARY:

At the beginning of the experiment you learn whether you are a firm or an applicant. If you are a firm, you also learn your quality, which is your ID number that you will have throughout the whole experiment. If you are an applicant, you receive a new ID number in every market, and your ID number has nothing to do with your quality. In each Market there are 5 firms and 6 applicants.

Information about Applicants' qualities is revealed over several periods:

- Period 1: Each Applicant receives a grade between 1 and 10 (with each of 1,2,3,4,5,6,7,8,9,10 having an equal chance to occur) that is his “1. score”.
- Period 4: each applicant receives another grade of 1,...,10, (each having the same chance of occurring) and the sum of the two grades constitute the “2. score”.
- Period 7: Each applicant receives a third grade between 1,...,10 (each having the same chance of occurring), and the sum of all three grades constitute the “3. score”. The applicant with the highest 3.score receives the highest quality of 6, the applicant with the second highest receives quality 5, and so on, until the applicant with the lowest score who receives quality 1.

To earn points in a market, a firm will need to hire one, and only one, applicant in that market, and an “applicant” will need to accept one, and only one, job offer. How is this done?

- In each period, each firm that has not yet hired an applicant, and has no open offer being held by an applicant, has to decide whether to make an offer, and, if so, to which applicant, and whether the offer should be exploding or open. Each firm can only have one outstanding offer in each period. Firms can make offer to applicants that are already matched.
- An exploding offer is an offer to which the applicant must respond immediately. If he does not accept it right away (i.e. in the same period that it was made), the offer expires, and it is as if he had rejected it.
- An open offer is an offer the applicant can accept, reject, or hold. At most one offer can be held, in which case it will remain available in the next period.
- Once all the firms have made their offers, the applicants see the screen showing all the offers they received this period. (Once an applicant sees his offer screen, there will not be any further offers arriving in that period.)
- In each period, applicants who receive offers have to decide whether to accept the offer, reject the offer, or, if the offer is an open offer, the applicant can decide to hold (no more than one) offer.
- Applicants who are matched can cancel their acceptance by accepting or holding the offer from another firm. An applicant who cancels an offer has to pay one point cancellation fee.

- Firms and Applicants that are not matched by the end of period 9 in a market remain unmatched and earn zero points.
- Firms and applicants that are matched to each other each earn points equal to the product of the applicant's quality and the firm's quality.
- After period 9, a completely new market begins, and everyone is free to try to match once again.

Screen of Firm 2 Period 3

You are Firm 2		Applicants' ID numbers: 1, 2, 3, 4, 5, 6 Firms' ID (=quality): 1, 2, 3, 4, 5		You are in Period 3 in Market 1		
Matchings			List of all Applicants			
Applicant	hired by firm	in period	1. Score	Applicant	1. Score	Hired by firm
				1	10	0
				2	10	0
				5	6	0
				6	6	0
				3	5	0
				4	1	0
<p>You are not matched yet.</p> <p>You have no open offer</p>			<p>Make an offer to Applicant <input type="text"/></p> <p>The type of the offer is <input type="radio"/> exploding (only open this period) <input type="radio"/> open (until the end of this market);</p> <p>Make Offer</p>			
Your offers that were rejected in this market			YOUR APPLICANT CANCELLED		No Offer	
Period	offer to	Deadline	Response	in		
1	1	exploding	cancel	2		
			Applicant's Scores		<p>Points for a Match: 2 x Applicant's final quality. The Applicant's final quality (from 1 to 6) is determined in Period 7. Unmatched firms earn 0 points.</p>	
Applicant	1. Score					
1	10					
2	10					
3	5					
4	1					
5	6					
6	6					

Screen of Firm 2 Period 7

You are Firm 2	Applicants' ID numbers: 1, 2, 3, 4, 5, 6 Firms' ID (=quality): 1, 2, 3, 4, 5	You are in Period 7 in Market 1																													
Matchings <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 15%;">Applicant</th> <th style="width: 15%;">hired by firm</th> <th style="width: 15%;">in period</th> <th style="width: 15%;">Quality</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>** 2 **</td> <td>6</td> <td>5</td> </tr> </tbody> </table>		Applicant	hired by firm	in period	Quality	1	** 2 **	6	5	List of all Applicants <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 30%;">Applicant</th> <th style="width: 30%;">Quality</th> <th style="width: 40%;">Hired by firm</th> </tr> </thead> <tbody> <tr><td>2</td><td>6</td><td>0</td></tr> <tr><td>1</td><td>5</td><td>2</td></tr> <tr><td>4</td><td>4</td><td>0</td></tr> <tr><td>5</td><td>3</td><td>0</td></tr> <tr><td>6</td><td>2</td><td>0</td></tr> <tr><td>3</td><td>1</td><td>0</td></tr> </tbody> </table>	Applicant	Quality	Hired by firm	2	6	0	1	5	2	4	4	0	5	3	0	6	2	0	3	1	0
Applicant	hired by firm	in period	Quality																												
1	** 2 **	6	5																												
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Appl.	1. Score	2. Score	Quality																												
1	10	16	5																												
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3	5	11	1																												
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6	6	7	2																												
	Points for a Match: 2 x Applicant's final quality. The Applicant's final quality (from 1 to 6) is determined in Period 7. Unmatched firms earn 0 points.																														

Screen of Applicant 2

You are Applicant 2		Applicants' ID numbers: 1, 2, 3, 4, 5, 6		You are in Period 7 in Market 1				
		Firms' ID (=quality): 1, 2, 3, 4, 5						
The Scores			Matchings			Your offers		
Applicant	Quality	2. Score	1. Score	Applicant	hired by firm	in period	Firm	offer deadline
** 2 **	6	18	10	1	2	6	1	exploding
Costs of cancelling: 1 Costs in this Market 0								
You are not matched yet. Last period you decided to hold no offer								
Your profits in this market are 0 points.								
The offers you rejected in this market								
Period of offer	from Firm	Deadline	which you	in period				
					<input type="button" value="Accept Offer"/>			
					Hold offer from Firm <input type="text"/>			
					<input type="button" value="Hold Offer"/>			
					<input type="button" value="Reject / Continue"/>			
The points you earn from a match are the quality of the firm with whom you are matched (from 1 to 5) x your final quality (from 1 to 6), which is determined in period 7. If you are not matched you earn 0 points. Accepting or holding an offer cancels any previous acceptances and costs 1 point.								