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*Competitive Pressure and Job Interview Lying:
A Game Theoretical Analysis*

Competitive Pressure and Job Interview

Lying: A Game Theoretical Analysis

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Abstract: We consider a job contest in which candidates go through interviews (cheap talk) and are subject to reference checks. We show how competitive pressure - increasing the ratio of "good" to "bad" type candidates - can lead to a vast increase in lying and in some cases make bad hires more likely. As the number of candidates increases, it becomes harder to induce truth-telling. The interview stage becomes redundant if the candidates, a priori, know each others' type or the result of their own reference check. Finally, we show that the employer can benefit from committing not to reject all the applicants. *JEL Code:* D82; L20.

1. Introduction

A job interview process in which a number of candidates are interviewed about their experience and abilities proceeds most hiring decisions. In this context, it is crucial that the candidates tell the truth in order to identify the most suitable person for the job. This is clearly in the employer's interest and also for society as a whole as the interview process affects how a country allocates its human resources. According to recent surveys, polls, and news articles, job interview lying and resume fraud are widespread.¹ A survey from Society for Human Resource Management (2010) shows that around 75 percent of the 433 responding members conduct reference or background checks on all of its job candidates. Moreover, 40-50 percent answer that they "always" or "sometimes" discover inaccuracies in what the candidates presented during interviews with respect to former employers, job responsibilities, and schools, colleges, or universities attended. These figures regarding inaccuracies have all increased compared to 2004 when this survey was conducted for the first time.

A popular explanation behind the prevalence of interview lies is that the current economic crisis and high unemployment in the United States and Europe "pushes" the applicants into lies and embellishments.² In sectors such as banking and finance and manufacturing many skilled people with up

¹See, for instance, Prior (Wall Street Journal, April 25, 2010), Dunleavey (CNN Money, September 21, 2010), Boggan (The Guardian, October 10, 2006), or Management Line (The Sydney Morning Herald, August 6, 2010).

²As an example, when referring to a survey from 2009 indicating that more than a quarter of employees have lied in job interviews, the managing director of the recruitment company Monster UK says: "Today's tough job market understandably heightens the temptation for job seekers to lie in interviews. Competition is fierce and we are aware of the increased need to stand out." (HRmagazine.co.uk, february 2009).

to date experience have become unemployed at a time with few job openings. As the number of "high quality" job seekers increases, less qualified applicants recognizes that unless they fake qualities or job experience they are facing minimal chances of success.

This article considers a job interview situation in which lying is a purely strategic act that is chosen by candidates depending on the benefits (a higher chance of success if undetected) and costs (certain rejection if caught) involved. In line with the above intuition, we find that increasing the ratio of high (good) type to low (bad) type candidates may cause a drastic increase in lying. Surprisingly, we find cases where bad hires become more likely as the ration of high types increases.

In our model, a recruiter interviews several job candidates concerning an open position. Each candidate can be one of two types (high or low). A high type possess a certain qualification that is key to the employer whereas the low type lacks this feature. For example, the recruiter is looking for someone with experience in business-to-business collaboration or specific software competences. We can think of any pivotal qualification that is not addressed in a standard application form. Only the candidates know their type. During interviews the candidates talk to the recruiter about their type and we assume that a low type can perfectly and costlessly claim to be a high type. Meanwhile, the recruiter performs a couple of checks by contacting the candidates' previous employers. These signals are imperfect: A low type may obtain a positive or negative signal whereas a high type always receives a positive signal. One interpretation is that a fraction of the previous employers are biased in favor of their former employees.

There are two types of equilibria that never co-exists in the game with two candidates. In one type of equilibrium (pooling) both types claim to be high types and in the other equilibrium (separating) low types admit to be such. The recruiter strategy that can sustain a truth-telling equilibrium can be described as follows: If candidate i claims to be a high type and his signal is positive and candidate j admits to be a low type then i is hired for sure. However, if i 's signal is negative then j is hired with probability 1 (punishing i for lying). The candidates will be hired with probability one half if both claim to be low types or both claim to be high types and receive positive signals. By this, if the chances of being caught lying are substantial and j is likely to be a low type it pays for i to be truthful (similarly for j).

When the ex ante probability that the candidates are high types increases it becomes more attractive for the low type to copy a high type and we may "leap" into the pooling equilibrium: When i is the low type his only chance of success is when j is the low type, however, if i claims to be a high type then, given that he receives a positive signal, he may also be hired if j is a high type. The effect on the recruiter of a higher ratio of high types and shift from separating to pooling equilibrium is twofold. A direct positive effect arises from the fact that it is less likely that both candidates are low types. Second, there is a loss of communication as the recruiter cannot make any inference from what the candidates say in the interviews and she is left to base her decision on the signals. When this latter indirect effect dominates, the recruiter is made worse off and low type hires become more likely.

We next show that adding another contestant makes it harder for the recruiter to induce truth-telling. As the number of candidates increases, we

inevitably reach a point where a separating equilibrium cannot be upheld even for very strong signals. This result illustrates how conduct considered as unethical can be a consequence of keener competition rather than lowering moral standards, see Shleifer (2004) for several examples on this account.

We then consider what happens if the candidates, a priori, know their rival's type. In this case, the truthful equilibrium does not pertain and a low type who knows that his opponent is a high type will never be honest and the interview stage is redundant. Similarly, if the candidates know the value of their signal (result of reference check) before the interviews: A low type who knows that his signal is positive will always claim to be a high type. We initially assume that the recruiter cannot reject all the applicants, however, when this assumption is relaxed, we show that under some conditions the recruiter improves from committing *not* to reject all the candidates. The reason is that such a promise provides low types with an incentive to be honest and thereby the possibility of a truthful equilibrium which may benefit the recruiter.

The plan for the article is as follows. In Section 3, we develop a simple model of a job contest and in the following section we solve the model and perform comparative statics. We then consider the effects of adding more candidates to the game. In Section 5, we relax some of the main assumptions behind our model and discuss other applications. Section 6 concludes.

2. Related literature

This article comes under the literature on persuasion games. The term persuasion refers to situations of strategic communication where the informed

senders have interests that are independent of their type (state) whereas the uninformed decision maker's utility from different actions critically depends on the senders' types (state). Examples abound: Advertising, legislative bodies, financial disclosure, political campaigns, informational lobbying. To the best of our knowledge, this article is the first to consider cheap talk in a persuasion game with multiple senders where each sender possess information that is *not* shared with the other senders and the receiver has access to a signal whose realization is *unknown* to the senders. In the context of selection in a winner-take-all game the results we obtain on the effects of competitive pressure and the possible value of commitment are novel.

If we consider our model with pure cheap talk (no signals/reference checks), the recruiter would not be able to make any inferences from the interviews. This would be a special case of the classical setup in Crawford and Sobel (1982) with multiple senders and corresponds to Krishna and Morgan (2001) when the two experts have extreme biases in opposite directions. Chakraborty and Harbaugh (2010) show that credible and informative cheap talk can take place with state independent preferences. Unlike our setup, they consider a multi dimensional environment with only one sender. At the other end of the spectrum, Grossman (1981), Milgrom (1981), and Milgrom and Roberts (1986) consider persuasion when the informed parties can verify their type (the analogue to our model is when the signals are perfect). With perfect verifiability the decision maker can achieve full information revelation by adopting skeptical beliefs towards any person who is withholding evidence (the "unraveling argument").

There is a significant amount of literature on persuasion with partial

verifiability i.e. evidence exists but not enough to evoke the unraveling argument. Glazer and Rubinstein (2004, 2006) and Sher (2011) study properties of optimal rules of persuasion with a single sender. The main constraint is that there are limits on how much evidence can be disclosed (e.g. time constraints). Kamenica and Gentzkow (2011) examine Bayesian persuasion in a setting where the sender chooses an informative signal about the state of the world whose realization is observed only by the receiver. Shin (1994), Glazer and Rubinstein (2001), and Bourjade and Jullien (2011) consider issues of persuasion where the two senders cannot lie. Heidhues and Lagerlof (2003) analyze two-candidate electoral competition where candidates choose political platforms after observing a private signal about the true state. In Lipman and Seppi (1995), the senders are endowed with pieces of hard information and they can use both cheap talk and evidence to persuade. Contrary to our model, the senders share information about a common state of the world.

Jindapon and Oyarzun (2011) consider competition between senders in a winner-take-all environment. Each sender is neutral with same probability or biased with the residual probability. The neutral sender's interests are perfectly aligned with the receiver and the biased sender has state independent preferences (e.g. a job candidate who wants the job independent of his/her quality). A sender's quality and type (biased or neutral) are private information. In equilibrium neutral senders report their true quality which leaves room for the biased senders to persuade the receiver to believe that they are better than average. The senders' equilibrium strategies do not respond to competition (the number and expected quality of the contestants) and in this respect their results are different from ours.

Within the literature on costly signaling a related article is Moran and Morgan (2003). They consider a two-stage game where unqualified job candidates are eliminated by referees and the remaining applicants are ranked after interviews. The unique equilibrium entails costly falsification by candidates and referees, but despite this, the most qualified candidate is always selected. In our model, costly signaling would entail a direct (moral) cost on the low type if he claims to be a high type. For a sufficiently high cost of lying the low type will then find truth-telling optimal. To this end, the results of the present article are "free" of such psychological cost of lying.

3. The basic model

In the basic model, we consider two job candidates who are interviewed by a recruiter regarding a vacancy. Each candidate ($i = 1, 2$.) can be one of two types, $t_i \in \{H, L\}$, with the understanding that only type H possess the key qualification set up by the recruiter (e.g. a certain job experience or "know-how"). Let $p_H \in (0, 1)$ be the probability that candidate i is type H (high). The probability that i is type L (low) is then $1 - p_H$. Types are drawn independently. The recruiter does not observe types and candidate i knows his own type but not the type of his rival. We let the recruiter's hiring decision be denoted by a , where a is the probability that candidate 1 is hired. Hence, candidate 2 is hired with probability $1 - a$. The recruiter receives payoff 1 (0) from choosing a high (low) type and the applicants receive payoff 1 from being hired and payoff 0 otherwise.

During the interviews the candidates independently send a cheap talk message, $m_i \in \{\hat{H}, \hat{L}\}$, to the recruiter. Meanwhile, the recruiter receives

two independent signals about the candidates' types. The signals are imperfect: If applicant i is type H then signal i (s_i) takes value x with probability 1. Further, if applicant i is type L then signal i takes value $y \neq x$ with probability $\mu \in (0, 1)$ and value x with probability $1 - \mu$. Hence, the result $s_i = y$ is proof that applicant i is type L whereas the positive result, x , does not exclude that i is type L . One interpretation is that the recruiter contacts each candidate's previous employer to have feedbacks on types. Some employers are biased in favor of their former employees, a fraction $1 - \mu$ of them, and they will always tell that their former employee is a high type.

The timing of the game is as follows. At *Stage 1* Nature distributes types independently between the candidates. At *Stage 2* the candidates simultaneously send a message to the recruiter about their type. A strategy for candidate i specifies an action, $m_i \in \{\hat{H}, \hat{L}\}$, for each type of i . At *Stage 3* the recruiter observes the messages and signals and forms beliefs about each of the candidates type, $\beta_i(t_i|m_i, s_i)$. A strategy for the recruiter, σ_R , specifies an action, a , for any possible profile of messages and signals. Finally, at *Stage 4* one candidate is hired.

Our solution concept is sequential equilibrium. In equilibrium, i makes optimal choices for both types given the strategies of j and the recruiter. The recruiter's strategy is optimal given her beliefs about types. The beliefs on the equilibrium path are updated according to Bayes' rule. Out-of-equilibrium beliefs should be a limit point of a sequence of totally mixed strategies and associated sensible beliefs. We focus on pure strategy equilibria which is without loss of generality.³ In a pure strategy equilibrium, high types always

³From the proof of proposition 1 it follows that equilibria where the candidates are

send one message, whatever it is, we label it "telling the truth". Thus, if candidate i sends the same message for both types he is sending a "false" message when he is type L (lying). This gives us three types of equilibria to analyze. *Separating* equilibria where each candidate sends a unique message for each type. *Semi-separating* equilibria where candidate i sends a different message for each type and candidate j sends the same message for both types. *Pooling* equilibria where both candidates always send the same message.

We assume the following tie breaking rules for the ease of exposition. When candidate i is the low type and he is indifferent about which message to send, he tells the truth i.e. he sends the message that distinguishes him from the high type. Further, when the recruiter believes that both candidates are certainly type L and candidate i has been caught lying (i.e. i is pooling on type H and $s_i = y$) and j was honest (i.e. the message from j reveals that he is type L) she hires j with probability 1. Otherwise, if the recruiter believes that the candidates have type H with the same probability she chooses them with equal probability. This is in line with what is assumed in many standard economic models e.g. if two candidates chooses identical platforms they face the same chance of being elected (Hotelling-Downs model).

In the next section, we sometimes refer to the *lying rate* (given a particular equilibrium) as the probability that a randomly chosen candidate will lie about his type i.e. a low type who is mimicking a high type. If not otherwise stated, equilibrium payoffs are expressed in ex ante terms.

4. Equilibrium behavior

mixing would only exist in the special case where $\mu = \frac{1}{2-p_H}$.

In this section we solve the game for equilibria and discuss comparative statics. In Section 3.1 we make a similar exercise with more candidates. Our first proposition states that, despite the imprecision of the signals, it is possible for the recruiter to achieve full information revelation. When the signals are sufficiently strong and the ratio of high type to low types is low enough the unique equilibrium is separating. Intuitively, we need precise signals (high μ) as it increases the downside from lying i.e. a higher chance of being caught lying which will be sanctioned with sure rejection. Further, we need a relatively high proportion of low types as it increases the potential upside from being honest: The only way that the recruiter can (credibly) promise a truth-telling candidate of type L a chance of success is in the event that the recruiter believes that the other candidate is a low type. On the other hand, when the signals become weaker and high types more dominant the unique equilibrium involves pooling on type H .

Proposition 1.

- (i) When $\mu \geq \frac{1}{2-p_H}$ all equilibria are separating.
- (ii) When $\mu < \frac{1}{2-p_H}$ all equilibria are pooling.
- (iii) In any equilibrium the candidates' expected payoff equals one half.

In the separating equilibrium the recruiter's payoff is:

$$\Pi^{sep} = 1 - (1 - p_H)^2 \tag{1}$$

and in the pooling equilibrium the recruiter's payoff is:

$$\Pi^{pol} = 1 - (1 - p_H)^2 - p_H(1 - p_H)(1 - \mu). \quad (2)$$

Proof. *Separating equilibria.* Suppose we have a separating equilibrium where low types send \hat{L} and high types send \hat{H} (the same applies for any other separating "mirror" equilibrium). The recruiter's posterior beliefs can be determined using Bayes' rule except when candidate i send \hat{H} and $s_i = y$. In this case, the notion of consistent beliefs in sequential equilibrium require that the recruiter attach probability zero to i being type H . With these beliefs and the tie breaking rules we can determine the recruiter's equilibrium strategy, σ_R^* : (A) Following $[(m_i, m_j) = (\hat{H}, \hat{L}), (s_i, s_j) = (x, \cdot)]$ applicant i is hired with probability 1. (B) Given $[(m_i, m_j) = (\hat{H}, \hat{H}), (s_i, s_j) = (y, x)]$ or $[(m_i, m_j) = (\hat{H}, \hat{L}), (s_i, s_j) = (y, \cdot)]$ candidate j is hired with probability 1. (C) Otherwise, $a = 1/2$. Point (A) is immediate given that the recruiter maximizes her chances of selecting a high type. Point (B) follows from optimality of the recruiter strategy plus the tie breaking rule that the recruiter hires j if she believes that both have type L and i was caught lying and j not. Part (C) covers all the other cases of recruiter indifference where the tie breaking rule says that the candidates will be hired with equal probability.

Clearly, the candidates do not want to deviate when they have type H . Consider i when he is type L . Sending \hat{L} yields $\frac{(1-p_H)}{2}$. That is, only if j sends \hat{L} (happens with probability $1 - p_H$) will i be hired with positive probability (equal randomization). If i deviates and send \hat{H} his expected payoff is $(1 - \mu)(1 - p_H) + \frac{p_H(1-\mu)}{2}$. The first term follows from the fact

that i will be hired for sure when he is lucky with his signal (happens with probability $1 - \mu$) and j sends \hat{L} (this occurs with probability $1 - p_H$). Further, when j send \hat{H} and $s_i = x$ then i will be hired with probability $1/2$, which explains the second term. Under any other circumstance j will be hired for sure. Comparing, we obtain that truth-telling is optimal if, and only if, $\frac{(1-p_H)}{2} \geq (1 - p_H)(1 - \mu) + \frac{p_H(1-\mu)}{2}$. Simplified, if $\mu \geq \frac{1}{2-p_H}$. Given that the candidates are ex ante identical the same applies to j . Concluding, a separating equilibrium exists if, and only if, $\mu \geq \frac{1}{2-p_H}$.

Pooling equilibria. Suppose we have a pooling equilibrium where the candidates always send \hat{H} . The recruiter's beliefs on the equilibrium path can be derived from Bayes' rule: We obtain $\beta_i(H|\hat{H}, x) = \frac{p_H}{1-\mu(1-p_H)}$ and $\beta_i(H|\hat{H}, y) = 0$. Given the consistency requirement, in the unexpected event that $m_i = \hat{L}$ and $s_i = y$ we have $\beta_i(H|\hat{L}, y) = 0$. It remains to determine $\beta_i(H|\hat{L}, x)$.

Suppose first that $\beta_i(H|\hat{L}, x) < \frac{p_H}{1-\mu(1-p_H)}$. With these beliefs we know the following about the recruiter's strategy (remember the tie breaking rules). If both send \hat{H} and the candidates obtain the same signals they will be hired with equal probability. However, if they receive different signals the candidate with a positive signal will be hired for sure. In case i send \hat{L} and j send \hat{H} then, independently of the realization of s_i , candidate i will be hired if, and only if, $s_j = y$. Moving on to the candidates, it is immediate that type H does not want to deviate. Consider i when he is type L . Sending \hat{H} yields $\frac{(1-p_H)+p_H(1-\mu)}{2}$. The term $\frac{(1-p_H)}{2}$ follows from the fact that i will be hired with probability $1/2$ when j is also type L . The term $\frac{p_H(1-\mu)}{2}$ is because i will be

hired with probability $1/2$ when j is type H and $s_i = x$. Deviating yields $(1 - p_H)\mu$. That is, the only chance for i to be hired is when j is detected in lying. Thus, lying is optimal if, and only if, $\frac{(1-p_H)+p_H(1-\mu)}{2} \geq (1 - p_H)\mu$. Simplified, if $\mu \leq \frac{1}{2-p_H}$. Hence, with these recruiter beliefs the pooling equilibrium exists if and only if $\mu < \frac{1}{2-p_H}$.

Suppose instead $\beta_i(H|\hat{L}, x) > \frac{p_H}{1-\mu(1-p_H)}$. In this case, given optimal recruiter responses, both types have a strict incentive to deviate and we have a contradiction. Now, if $\beta_i(H|\hat{L}, x) = \frac{p_H}{1-\mu(1-p_H)}$ the low type is indifferent and given our tie breaking rule he will be honest and thereby deviate. Concluding all together, a pooling equilibrium exists if, and only if, $\mu < \frac{1}{2-p_H}$.

Semi-separating equilibria. Suppose we have a semi-separating equilibrium where i send \hat{H} for both types and j send \hat{H} when type H and \hat{L} when type L . Hence, the recruiter will infer the type of j and $\beta_i(H|\hat{H}, x) = \frac{p_H}{1-\mu(1-p_H)}$. This enable us to determine the recruiter's optimal responses for some paths of the game. Whenever j send \hat{H} and $s_j = x$ we obtain that j is hired. Also, given $[(m_i, m_j) = (\hat{H}, \hat{L}), (s_i, s_j) = (y, \cdot)]$ we have that j is hired for sure (candidate i has been detected in lying). Following $[(m_i, m_j) = (\hat{H}, \hat{L}), (s_i, s_j) = (x, \cdot)]$ i will be chosen with probability 1.

Suppose $\mu > 1/2$ and consider i when he is type L . Sending \hat{H} yields $(1 - \mu)(1 - p_H)$. That is, i will be hired if, and only if, $s_i = x$ and $m_j = \hat{L}$. By deviating, i will be hired with at least probability $1/2$ in case $m_j = \hat{L}$: Even if the recruiter attributes the deviation to type L the tie breaking rule ensures that i will be chosen with probability $1/2$.⁴ Since $\mu > 1/2$ the de-

⁴Note that in equilibrium the recruiter's beliefs about j will not be affected by i 's

viation is profitable. Suppose $\mu \leq 1/2$ and consider j when he is type L . Sending \hat{L} gives expected payoff $(1 - p_H)\mu$ (i.e. j will be hired if, and only if, i is disproven) whereas deviating yields $1 - \mu$ (i.e. j will be selected unless he is disproven). Since $\mu \leq 1/2$ the deviation is profitable. Taken together, we can conclude that no semi-separating equilibrium exists.

Part (iii). Given the symmetry of the game and strategies in equilibrium, it is immediate that candidate i 's expected payoff equals one half. In the separating equilibrium, the recruiter obtains the maximum possible payoff and she hires a low type if, and only if, both candidates have type L , which explains equation (1). In the pooling equilibrium, the recruiter hires a low type with probability 1 if both candidates have type L and with probability $1/2$ if i is type L and j is type H and $s_i = x$. Otherwise, she selects a high type. Hence, the recruiter's expected payoff equals $1 - (1 - p_H)^2 - \frac{1}{2}p_H(1 - p_H)(1 - \mu) - \frac{1}{2}(1 - p_H)p_H(1 - \mu) \square$

The recruiter strategy supporting a separating equilibrium is intuitive. This strategy, called σ_R^* in the proof, favors candidates with positive signals who claim to be high types and punishes candidates claiming to be high types with contradictory signals. For example, if i says that he is a high type and his signal is positive and j admits to be low type then i is hired for sure. However, if instead i 's signal is negative then j is hired with probability 1. The candidates will be hired with equal probability if both claim to be low

message which follows from the belief consistency requirement in sequential equilibrium, types are drawn independently, and i has no information about j 's type.

types or they claim to be high types and receive positive signals. Hence, if the chances of being caught lying are substantial and j is likely to be a low type then it is optimal for i to be truthful. Similarly from j 's perspective.⁵ In the truthful equilibrium, the recruiter learns the candidates' types and she hires a high type unless both candidates have type L . From equation (1) we see that in the separating equilibrium the recruiter benefits from increases in p_H and she is unaffected by changes in μ .

Differently, when the candidates are likely to be high types and reference checks are weak signals (to be exact when $\mu < \frac{1}{2-p_H}$) then lying becomes the candidates unique equilibrium action when they are "low". In other words, hoping that your previous employer covers for you is a better option when many employers are biased and your rival is probably a high type. In fact, when the previous employers are more likely to be biased than unbiased (i.e. $\mu < 1/2$) the pooling equilibrium prevails independent of p_H . An increase in p_H makes the low type's success probability decrease. This happens both if the low type of i is honest and if he lies (notice when p_H increases it becomes more likely that j 's signal is positive). However, the negative effect from the increase in p_H is bigger if i is honest: If j receives a positive signal then i will be rejected for sure even if i 's signal is positive (had he lied he would have been hired with probability one half when $s_i = x$).

From inspection of equation (2), it follows that in the pooling equilibrium the recruiter benefits from increases in both p_H and μ , which is also intuitive. Notice, the difference between equations (1) and (2), which equals $p_H(1 -$

⁵For simplicity we have assumed that the candidates are ex ante identical. Letting $p_H^i \neq p_H^j$ one can verify with the proof of proposition 1 that a separating equilibrium exists if, and only if, $\mu < \frac{1}{2-p_H^{max}}$ where $p_H^{max} = \max\{p_H^i, p_H^j\}$.

$p_H)(1 - \mu)$, represents the potential value of communication (or the loss from being in a pooling versus a separating equilibrium). In the pooling equilibrium, the recruiter makes mistakes by sometimes hiring a low type when the other candidate is a high type. This happens with probability one half when i is type H and j is type L and $s_j = x$.

We now consider in more detail what happens when changes in p_H causes a move from one type of equilibrium to the other. In particular, we wish to highlight the conditions under which a stronger pool of candidates (in expected terms) causes a jump in the frequency of lies and certain cases where the recruiter is affected negatively from a higher ratio of high types.

Proposition 2. Increasing p_H from p_H to p'_H , ceteris paribus, makes the

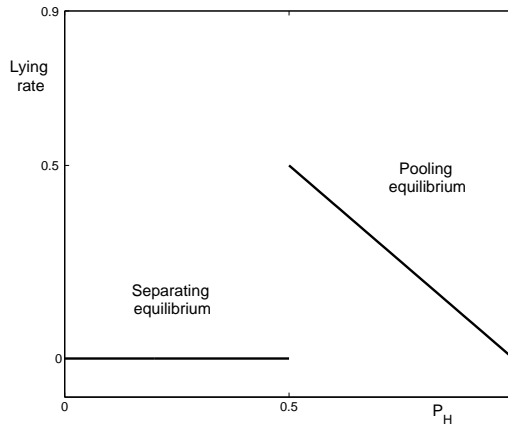
(i) lying rate increase from zero to $1 - p'_H$ when $\frac{1}{2-p_H} \leq \mu < \frac{1}{2-p'_H}$ (the increase in p_H generates a shift from a separating to a pooling equilibrium). When $\mu \geq \frac{1}{2-p'_H}$ the lying rate remains at zero and if $\mu < \frac{1}{2-p_H}$ the lying rate decreases from $1 - p_H$ to $1 - p'_H$.

(ii) recruiter worse off if, and only if, $\frac{1}{2-p_H} \leq \mu < \frac{1}{2-p'_H}$ (the increase in p_H causes a shift from a separating to a pooling equilibrium) and $1 - (1 - p_H)^2 > 1 - (1 - p'_H)^2 + p'_H(1 - p'_H)(1 - \mu)$ (the increase in p_H is not so large that it compensates the recruiter for the loss of communication).

The discussion below verifies proposition 2. In a separating equilibrium the lying rate is zero whereas in the pooling equilibrium it is $1 - p_H$. As al-

ready mentioned, when competition intensifies and the candidates conjecture that their opponent is a high type we move in the direction of the pooling equilibrium. Thus, if the increase in p_H crosses the "discontinuity" we will experience a sharp rise in interview lying. Ironically, by increasing the number of high types, who are by definition truth-tellers, we obtain more dishonesty. However, as presented in the introduction, such a relationship confirms the intuition that prevails in the recruitment business that competitive pressure pushes the job candidates into lies and embellishments. To illustrate, in figure 1 we show the lying rate as a function of p_H when $\mu = 2/3$.

Figure 1: The lying rate

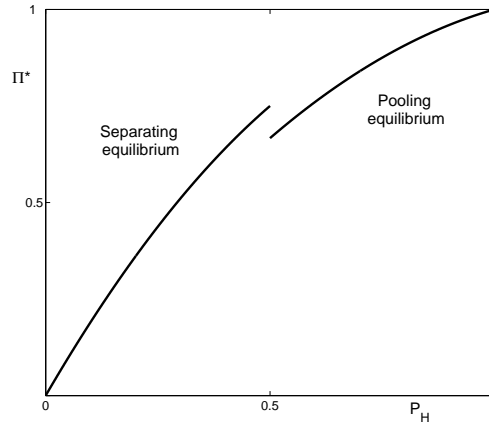


The rule is that the recruiter benefits from increases in p_H , however, there are exceptions which is surprising. From the results in proposition 1 we can express the recruiter's equilibrium payoff like this:

$$\Pi^* = \begin{cases} 1 - (1 - p_H)^2 & \text{if } \mu \geq \frac{1}{2-p_H}, \\ 1 - (1 - p_H)^2 - p_H(1 - p_H)(1 - \mu) & \text{if } \mu < \frac{1}{2-p_H}. \end{cases} \quad (3)$$

The function Π^* is discontinuous at $\mu = \frac{1}{2-p_H}$ and the jumps in the recruiter's payoff reflects changes in p_H and μ that causes a shift from one type equilibrium to the other. We know that increasing p_H let us towards the pooling equilibrium. Thus, not too far from the "discontinuity" we can have that increases in p_H affects the recruiter negatively. More precisely, when the increase in p_H , from p_H to p'_H , is such that $\frac{1}{2-p_H} \leq \mu < \frac{1}{2-p'_H}$. Large increases in p_H will favor the recruiter modestly and compensate her for the loss of communication: When $1 - (1 - p_H)^2 < 1 - (1 - p'_H)^2 + p'_H(1 - p'_H)(1 - \mu)$. To make an example let $\mu = 2/3$ and $p_H = 0.495$. In this case, we obtain $\Pi^* = 0.745$ (a high type is hired with a probability close to $3/4$). Now, increasing the probability that the candidates are high types by one percentage point, and again letting $\mu = 2/3$, we get $\Pi^* = 0.672$ (a high type is hired with a probability around $2/3$). In figure 2 we depict the recruiter's payoff for $\mu = 2/3$ and varying p_H .

Figure 2: The recruiter's payoff



4.1. More candidates. Another aspect of competition in the job contest is the number of candidates invited for interviews. In this section, we consider our model with N candidates (for the most part $N = 3$). In the N -candidate game the recruiter receives N independent signals about types and the hiring decision, a , is now a vector of probabilities where the i 'th entry denote the probability that applicant i is hired ($i = 1, \dots, N$). These probabilities must add to one. Otherwise, the game described in Section 3 extends in a straightforward manner.

The main insight from proposition 3 below is that adding another contestant makes it harder for the recruiter to sustain a truthful equilibrium and we may experience more lying. In the separating equilibrium, when candidate i is the low type his chances of success hinges on the slim probability that *all* his opponents are low types. However, when i considers the lying deviation (pooling on type H) then, conditional on receiving a positive signal, he is not only facing sure success in the event that all his rivals are low types but a positive probability of being hired for *any* type profile of his rivals. In sum, the additional competitor takes away more "success probability" following i 's truthful strategy than from his lying deviation. Proposition 3 (ii) states that if a separating equilibrium exists with three candidates it also exists for two candidates whereas the reverse is not always true. As the number of candidates increases further we eventually reach a point where a separating equilibrium cannot be upheld even for a very large μ (see proposition 3 (iii)).

The derivative of the right-hand-side of (4) in proposition 3 (i) is positive for $p_H \in (0, 1)$ and thus increasing the expected quality of the pool of candidates lead us away from the separating equilibrium. As in the two candidate

game this effect can be offset by more reliable reference checks.

Proposition 3.

(i) For $N = 3$ a separating equilibrium exists if, and only if,

$$\mu \geq \frac{2 - p_H}{3 - 3p_H + p_H^2}. \quad (4)$$

(ii) If a separating equilibrium exists for $N = 3$ it also exists for $N = 2$, however, the reverse is not always true (comparing the necessary and sufficient conditions in propositions 1 and 3 one can easily verify that $\frac{1}{2-p_H} < \frac{2-p_H}{3-3p_H+p_H^2}$ for $p_H \in (0, 1)$).

(iii) There exist \bar{N} such that for $N \geq \bar{N}$ no separating equilibrium exists.

Proof. Let $N = 3$ and suppose we have a separating equilibrium where high types send \hat{H} . Thus, the recruiter perfectly infers the candidates types and in the unexpected event that i send \hat{H} and $s_i = y$ the recruiter attach zero probability to i being type H . From these beliefs together with the tie breaking rules (which naturally extends to the N -candidate game) we can uniquely determine the recruiters optimal strategy, σ_R^{**} , which is a generalization of σ_R^* : (A) If at least one candidate, i , sends \hat{H} and $s_i = x$ then i is hired with probability $1/m$, where m is the total number of candidates sending \hat{H} and receiving positive signals. (B) If $m = 0$ then any candidate, i , sending \hat{L} will be hired with probability $1/z$, where z is the total number of applicants sending \hat{L} . (C) Otherwise, $a_i = 1/N$ for all $i = 1, \dots, N$.

The players do not want to deviate when they have type H . Consider i when he is type L . Sending \hat{L} yields $\frac{(1-p_H)^2}{3}$. In words, the only chance for i to be hired is when the other candidates send \hat{L} and in this case i is hired with probability $1/3$. Sending \hat{H} gives $(1-\mu)(1-p_H)^2 + (1-\mu)(1-p_H)p_H + \frac{(1-\mu)p_H^2}{3}$. The first term follows from the fact that i will be hired for sure if the other candidates are low types and $s_i = x$. Further, i will be hired with probability $1/2$ if candidate j (k) is type H and k (j) is type L (happens with probability $2(1-p_H)p_H$) and $s_i = x$. Finally, i will be hired with probability $1/3$ if both his rivals are high types and $s_i = x$. Comparing truth-telling to lying, we get (after rearranging and simplifying) that sending \hat{L} is optimal if, and only if, $\mu \geq \frac{2-p_H}{3-3p_H+p_H^2}$. Similarly for candidates j and k . Hence, our initial supposition is confirmed if, and only if, $\mu \geq \frac{2-p_H}{3-3p_H+p_H^2}$.

Part (ii) is immediate. Part (iii). We know that in a separating equilibrium where high types send \hat{H} the recruiter's strategy is σ_R^{**} (if we consider a separating equilibrium where some high types send \hat{L} it is straightforward to derive the equivalent to σ_R^{**}). It follows that candidate i 's expected payoff from sending \hat{L} when he is type L is $\frac{(1-p_H)^{N-1}}{N}$ (i.e. his only chance of being hired is the equal randomization when all the applicants send \hat{L}). If i choose to lie he obtains at least $(1-\mu)(1-p_H)^{N-1}$ (i.e. if he is lucky with his signal he will be hired for sure if $-i$ send \hat{L}). Dividing both terms by $(1-p_H)^{N-1}$ we obtain that lying is optimal if $\frac{1}{N} < 1-\mu$. Hence, there exist \bar{N} such that for $N \geq \bar{N}$ lying is optimal and no separating equilibrium exists \square

5. Comments

5.1. *When the candidates know each others' type.* One plausible situa-

tion that we have not considered is when the candidates know each others' type e.g. the candidates are from the same company or connected via some community/network. Proposition 4 states that in this case the recruiter's equilibrium payoff never departs from the payoff she receives in the pooling equilibrium and thus provides a rationale for why employers typically withhold information about the candidates' identity. The problem is, when i is the low type and he knows that j is the high type then i correctly anticipates that being honest will result in rejection for sure.

Proposition 4. If the candidates know each others' type at the interview stage the separating equilibrium never obtains and the recruiter's equilibrium payoff corresponds to what she receives in a pooling equilibrium.

Proof. Assume the applicants observe their rival's type at Stage 1. A strategy for i specifies a message, $m_i \in \{\hat{H}, \hat{L}\}$, for each possible type profile. Suppose the candidates send \hat{H} when they have type H . Consider a possible equilibrium where i send \hat{L} when the type profile is $(t_i, t_j) = (L, H)$. Sending \hat{L} will lead to sure rejection for i : Candidate j sends \hat{H} and receives a positive signal and in equilibrium the recruiter rightly infers that i is type L . However, by sending \hat{H} candidate i will be hired with positive probability: From the tie breaking rule we know that if i is lucky with his signal the candidates will be hired with equal probability. Contradiction. It then follows that in equilibrium the candidates send \hat{H} for the type profiles $(t_1, t_2) \in \{(H, H), (H, L), (L, H)\}$ and thus the recruiter hires a low type when both candidates have type L and she hires a low type with probability

1/2 when i is type H and j type L and $s_j = x$ (the same as in the pooling equilibrium previously considered) \square

5.2. What if the candidates know the value of their own signal? Another counterpart to our model is when the candidates, prior to the interviews, know the result of their reference check. In this case, not surprisingly, a low type with a positive signal will claim to be a high type and the separating equilibrium never obtains. Proposition 5 below suggests that employers make sure that job candidates are not informed about the results of their background/reference checks prior to the interviews and they have a policy that reference letters are sealed. According to the U.S. federal Fair Credit Reporting Act, employers are required to give employees a copy of their file (obtained from outside screening agencies) only if they are planning to make an adverse decision. However, at state level more rights may be granted and in e.g. California job applicants have the right to immediately receive a copy of their report (possibly before interviews).⁶

Proposition 5. If the candidates know the value of their own signal at the beginning of Stage 2 the separating equilibrium never obtains and the recruiter's equilibrium payoff is the same as in the pooling equilibrium.

Proof. Assume the candidates observe the value of their own signal at Stage 2. A strategy for i specifies a message, $m_i \in \{\hat{H}, \hat{L}\}$, for each possible type and signal realization for i . Assume the candidates send \hat{H} when

⁶<http://www.privacyrights.org/fs/fs16-bck.htm>.

they have type H . Suppose there exists an equilibrium where i send \hat{L} when $(t_i, s_i) = (L, x)$. When i send \hat{L} the recruiter will infer that he is type L , however, by sending \hat{H} the recruiter will make a positive inference regarding i following $s_i = x$. Hence, independent of (m_j, s_j) , there will be no circumstances under which i strictly benefits from sending \hat{L} and it is strictly optimal for i to send \hat{H} when e.g. j send \hat{H} and $s_j = x$. Contradiction. Thus, in equilibrium the candidates send \hat{H} when they receive positive signals and the recruiter hires a low type when both candidates are low and she hires a low type with probability $1/2$ when i is type H and j is type L and $s_j = x$ \square

5.3. When the recruiter can reject both candidates. Until now we have assumed that the recruiter does not have the option to reject both candidates. This can be justified on several accounts e.g. the employer is in a hurry to fill in the position or the costs associated with another call for applications are high. Another reason is that the employer wants to maintain a reputation for hiring within the initial opening. With such a reputation the candidates know that admitting to be a low type leads to a positive (possibly small) probability of winning. In fact, as we show, the recruiter can benefit from such commitment. In the following, we derive the recruiter's equilibrium payoff when she has the option to reject both candidates. We then compare this to the original game and evaluate when the recruiter is better off without the outside option i.e. when she improves from committing to make a hire.

Consider the game described in Section 3 with the modification that the recruiter has the option to reject both candidates. Following "reject both" the risk neutral recruiter receives a payoff equal to $\alpha \in (0, \frac{p_H}{1-\mu(1-p_H)})$ and

the candidates obtain payoff zero. Thus, if the recruiter believes that the applicants are surely type L it is optimal to reject both. Further, if she believes that i is type H with probability $p \geq \frac{p_H}{1-\mu(1-p_H)}$ then hiring i is optimal with respect to rejecting both. By letting $\alpha > \frac{p_H}{1-\mu(1-p_H)}$ we would simply obtain that in equilibrium the recruiter never makes a hire (note that the probability that i is type H conditional on $s_i = x$ is $\frac{p_H}{1-\mu(1-p_H)}$). Assuming that the candidates send \hat{H} when they have type H we can deduce that in equilibrium they also send \hat{H} when they have type L : Sending \hat{H} results in a strictly positive probability of success whereas sending \hat{L} leads to rejection for sure. We can now state the recruiter's equilibrium payoff as: $[1 - (\mu(1 - p_H))^2] \frac{p_H}{1-\mu(1-p_H)} + (\mu(1 - p_H))^2 \alpha$. The first term captures the probability of selecting a high type when at least one candidate receives a positive signal and the second term is when the signals proves that both applicants are low types and the recruiter chooses "reject both".

If the recruiter commits to hire (assuming that she can) we are back in the original game and the results of proposition 1 applies. Hence, if the recruiter commits and the equilibrium is pooling (i.e. $\mu < \frac{1}{2-p_H}$) she is clearly worse off. Now, if a separating equilibrium exists the recruiter receives payoff $1 - (1 - p_H)^2$ and possibly this is strictly more than what she obtains without restraining herself from the option to "reject both". This happens when α is not too large. Proposition 6 summarizes on the above and states when the recruiter improves from committing to hire.

Proposition 6. When $\mu \geq \frac{1}{2-p_H}$ and $1 - (1 - p_H)^2 > [1 - (\mu(1 - p_H))^2] \frac{p_H}{1-\mu(1-p_H)} + (\mu(1 - p_H))^2 \alpha$ the recruiter benefits from committing to

hire.

5.4. Other applications. Our model was framed as a job market contest, however, the insights provided are relevant to a larger class of problems involving persuasion with multiple competing senders. Three examples follow below.

Congressional hearings. A hearing committee must decide on a yes/no issue that affects two interest groups with opposite agendas. Each interest group, represented by a lobbyist, will testify and provide information in front of the committee. The lobbyists are experts in different areas and possess soft information not available to the other part. When testifying, a lobbyist can lie or be silent about aspects that he deems to be negative.⁷ The committee conducts an investigation of their own which may shed light on facts relevant to the case. As parts in the hearing each interest group can obtain pre-hearing discovery and learn about the results of the committees' investigation and their opponent's plan for witnesses and oral testimony. Our findings from Propositions 4 and 5 suggest that it may not always be in the benevolent committee's interest to permit pre-hearing discovery. As we show, this type of information benefits interest groups with weak arguments (low types).

Procurement of innovation. Fixed prize tournaments are a widely used and well documented method to procure research and development, see Ding and Wolfstetter (2011). Our model translates into the following variation of a research contest. A procurer wishes to buy an innovation from one of two short-listed innovators. The winner of the contest receives a fixed money

⁷Most U.S. Congressional hearings does not require testimonies under oath.

prize. Initially, the innovators privately draw an innovation. Before submitting the innovations, which are not perfectly verifiable, the innovators decide whether to report their true draw or add fictitious elements that "beautifies" their invention. After receiving the innovations the procurer obtains a couple of signals regarding the true quality of the inventions. Finally, the procurer selects the winner.

Project funding inside firms. Our model can be framed as one in which a CEO is deciding on which of several projects to fund within distinct divisions of the firm. Each division manager speaks in favor of his own project while disregarding the expected return on alternative uses of the money. The CEO has limited time and with some probability she will detect serious shortcomings, if there are any, when going through the proposals. The CEO's objective is to single out a project with above normal expected return. As we show, this does not necessarily entail a contest where every division participates and it can backfire if the CEO creates an environment that makes the division managers believe that their rivals have promising projects.

6. Conclusion

We have analyzed a job interview game where the candidates face a risk of being caught if they lie about some skill or qualification that is key to the employer. We find that increased competition - more candidates and a higher ratio of "good" types - makes it harder to induce truth-telling. A tough job market with many qualified unemployed people and few new positions can exacerbate the problems with interview lying. We even found cases where the employer becomes worse off from an increase in the expected

quality of the contestants. One immediate solution to these concerns is that employers insist on thorough background checks and based on our findings employers should keep the results of reference checks secret (and reference letters must be sealed) until the final decision. Moreover, employers should not disclose the identity of the interviewees to avoid the candidates learning their opponents' types. Finally, we provided a rationale for why employers may want to have a reputation for hiring within the initial opening.

Our analysis has been carried in a simple model, where the candidates have only two types and the signals determines the probability of lies being detected. In future research, one may wish to extend the analysis to a framework with many types (and dimensions of cheap talk), introduce asymmetries, and consider a larger class of signal technologies. Another array for further research is to test the results and implications of our simple model in a laboratory experiment.

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