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## Employee Screening: Theory and Evidence

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# Employee Screening: Theory and Evidence<sup>#</sup>

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## ABSTRACT

Arguably the fundamental problem faced by employers is how to elicit effort from employees. Most models suggest that employers meet this challenge by monitoring employees carefully to prevent shirking. But there is another option that relies on heterogeneity across employees, and that is to screen job candidates to find workers with a stronger work ethic who require less monitoring. This should be especially useful in work systems where monitoring by supervisors is more difficult, such as teamwork systems. We analyze the relationship between screening and monitoring in the context of a principal-agent model and test the theoretical results using a national sample of U.S. establishments, which includes information on employee selection. We find that employers screen applicants more intensively for work ethic where they make greater use of systems such as teamwork where monitoring is more difficult. This screening is also associated with higher wages, as predicted by the theory: The synergies between reduced monitoring costs and high performance work systems enable the firm to pay higher wages to attract and retain such workers. Screening for other attributes, such as work experiences and academic performance, does not produce these results.

JEL codes: M51, M54, J30.

Key words: *Employee Screening, Monitoring, Work Ethic, High Performance Work Practices, Principal-Agent Model.*

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# 1. Introduction

Principal-agent models have been central to much of the work in economics, and they have been especially useful in understanding employment relationships. A considerable amount of research has been directed at understanding and addressing the inherent moral hazard problem associated with employment in principal-agent frameworks -- the incentives for individual employees to pursue their own interests at the expense of those of their employer. Virtually all that research focuses on economic governance schemes that provide incentives to induce employees to act in the interests of their employers (See, e.g., Gibbons 1998 and Prendergast 1999). These models begin with the definition of appropriate performance, include monitoring to measure performance, and conclude with economic rewards -- in some cases punishments -- to motivate employees. These agency-based models have been most extensively used in the context of executive employment where the agents have considerable control over their performance and where the effects of their performance can be readily observed, albeit at the firm-level. It may be fair to say that agency models have been used somewhat less for understanding production or hourly employment where job performance may be less within the control of the individual (e.g., more paced by machines or supervisors) and where individual performance may be more difficult to measure. Models that are directed especially at hourly workers include efficiency wage approaches and others that rely on punishment (e.g., the loss of premiums). They also require monitoring and many have a strong agency feel to them.

There is a second way to address the moral hazard problems associated with principal-agent frameworks in employment, however. That approach relies on heterogeneity across employees in their abilities, specifically their interest in working hard, that is sometimes included under the heading of “unobserved human capital.” Under this view, some job applicants are simply better workers than others. Specifically, they may be willing to work harder for the same rates of pay and/or are less inclined to shirk their responsibilities, requiring less monitoring and supervision as a result. The complication for the firm is first that while the applicants know their own capabilities, it is difficult for the employer, short of hiring them, to tell. Hence the unobserved problem. Second, applicants who are not hard workers may have an incentive to pretend that they are, especially if regimes of low monitoring make it easier for them to shirk and if the

jobs pay premiums of the kind that might be associated with having better workers.

The models used to provide solutions to moral hazard problems from this perspective often rely on self-selection: Potential applicants typically sort themselves out across opportunities such that those who lack the unobserved human capital associated with hard work do not apply for jobs that will require it while those that have it do. The complication with extending these models more broadly is that they require reasonably unique and sometimes complicated reward structures to create the separating equilibrium that attracts hard workers and scares away lazy ones, such as piece rate systems or back-loaded compensation where workers have to demonstrate their performance in advance of the reward.

An alternative approach to self-selection is screening. Rather than requiring applicants to sort themselves out, the employer attempts to use proxies or other clues to identify which applicants have unobserved human capital in the form of a strong work ethic. The screening approach is easily applied to a wide range of unobserved human capital beyond work ethic and does not require that the applicant even be aware of their relevant attributes (e.g., first-time applicants have no relevant experience with which to ascertain all of their unobserved human capital).

In practice, virtually all employers use some level of applicant screening. It is a fundamental part of the human resources function in most firms as well as the basis of a substantial consulting industry. Further, screening and other forms of addressing the moral hazard problem are not mutually exclusive, and most employers make use of both screening and post-employment economic incentives (see, for example, Ichniowski, Shaw, and Prennushi 1997, Morduch 1999, and Nagin et al. 2002). Among popular screening practices are interviews, reference letters, obtaining the agent's past histories through credit bureaus or hiring detectives, written tests to uncover work attitudes and personality type, etc. (see Rynes and Cable 2003 for a review). Employers differ substantially in the extent to which they make use of applicant screening, however (see Wilk and Cappelli 2003), an issue that merits explaining.

**Work Ethic and Employment Practices.** Although different kinds of jobs may require different attributes, arguably the most fundamental attribute and the one that cuts across virtually all jobs can be described as work ethic, what we might think of as the

ability to work hard independent of monitoring by employers or of reward. The seminal discussion of work ethic related it to social norms – the “Protestant Ethic” (see Weber 2002) - but in the context of understanding variations across individuals, it is more appropriate to think about factors that are intrinsic to an individual. The field of industrial/organizational psychology is devoted in large measure to understanding work-related differences across individuals, and there is extensive research there on the attributes of employees who appear to have strong work ethics. While there are several attributes that relate to this behavior, the closest match is with the personality construct known as "conscientiousness." This attribute has been found to be a reliable and consistent dimension of personality that can be identified and measured across individuals. It also relates strongly to job performance across types of jobs (Schmidt and Hunter 1998). Further, it appears to have a dispositional element that is stable across jobs and contexts. That is, conscientiousness is a characteristic of individuals, and those with it perform at a high level across situations (see, e.g., Judge and Ilies 2002 for a survey).

The research on conscientiousness suggests that there is something very tangible to the notion of work ethic, that it is an attribute of individuals and affects performance across a range of settings. As a result, employers can expect to benefit from hiring conscientious workers and should be willing to make investments to do so. While it may be possible in some situations to create circumstances that cause applicants to sort themselves according to their work ethic, these circumstances are far from universal. In general, employers can be expected to have a keen interest in screening employees for work ethic. The effects of employees' intrinsic motivation on firm performance are discussed by Kandel and Lazear (1992), Kreps (1997), La Porta et al. (1997), and Rob and Zemsky (2002), among others.

Screening applicants for conscientiousness or work ethic involves costs, and firms therefore have to decide how much to spend on screening. There may well be a trade-off between screening and efforts to monitor employees: Greater use of screening can lead to a more conscientious work force that can perform at a given level with less monitoring, oversight, and performance-related incentives. Another option, in contrast, is to spend very little on screening but rely on intensive monitoring to maintain performance.

We might also expect relationships between the monitoring/screening decision

and the choice of work systems. For example, employers with teamwork-based systems and those that rely on employee empowerment where monitoring by supervisors is more difficult should make greater investments in screening.

Because information about conscientiousness is not readily or accurately available in the market (employers have to screen to find it), conscientiousness does not necessarily raise one's market wage. Once workers with these characteristics are hired, however, they contribute value by reducing the need for monitoring costs, saving money for employers. In order to retain these conscientious workers, employers may be motivated to pay them higher compensation through rent sharing arrangements. We should therefore expect a positive relationship between employer screening for work ethic and employee compensation. Alternatively, a regime of lower screening requires more intensive monitoring, which in turn makes it possible to hire less conscientious workers. They can be paid less than the more conscientious workers because there is no particular interest in retaining them.

Recent empirical research on high performance work systems has focused attention on arrangements where work organization makes extensive use of teamwork and employee involvement practices. These systems have drawn attention because they appear to be more productive (MacDuffie 1996, Ichniowski et al. 1997). The central element of these arrangements is that employees are more involved in decision making (Cappelli and Neumark 2001), which reduces the need for supervision. But because monitoring is lower, these arrangements require employees who are more committed to the organization, hence the alternative phrase for these arrangements, high commitment work systems (see Applebaum and Batt 1994 for a survey).

Although some observers believe that work systems which increase employee empowerment make all workers more productive, an important part of these systems in practice appears to be screening employees carefully in order to identify those with unobserved human capital and dispositions that are consistent with the strong work ethic required in high commitment systems. Most of the research on employee screening in these contexts is anecdotal and based on case studies of individual companies such as NUMMI, the joint venture between Toyota and General Motors (Keller 1989), Saturn (Kochan and Rubenstein 2000), and Southwest Airlines (Hoffer-Gittel 2002). While more

systematic studies of the relationship between applicant screening and other work practices seem largely neglected (see Wilk and Cappelli 2003 for an exception), descriptive findings like those above suggest that regimes with lower levels of employee monitoring should go together with practices of high investments in applicant screening.

Arguments about complementarities between screening and the use of high performance practices associated with regimes of low employee monitoring would contribute to existing research on the synergies among work and human resource practices (Holmstrom and Milgrom 1991; Ichniowski et al. 1997). Hamilton, Nickerson, and Owan (2001), for example, estimate the effects of teamwork on worker productivity in a garment plant and find that team-based systems make greater use of collaborative skills, which are less valuable in individual production. The above arguments also suggest a rationale for the empirical findings where high performance practices are often associated with higher wages and employee productivity even when they are not associated with higher profits for firms (Lynch and Black 2004, Cappelli and Neumark 2001, Appelbaum, Bailey, and Berg 2000, Cappelli and Carter 2000, Freeman and Kleiner 2000). More generally, these arguments complement the recent work in labor economics showing that non-cognitive skills are important elements for individual earnings (Heckman 2000, Bowles, Gintis, and Osborne 2001, Persico, Postlewaite, and Silverman 2004).

The paper also contributes to the social preference literature by showing that the level of conscientiousness among employees has substantial influences on a firm's screening and monitoring intensities as well as its wage levels. Though a worker's conscientiousness in our context has more flavor of self-discipline towards making effort than others-regarding in the sense of social preferences used in the literature, it is in essence a kind of social preference since it works as if the worker 'cares about' the employer's benefits and it leads to outcomes that exhibit in a gift-exchange situation where workers make extra effort warranted from the explicit incentives and get rewarded by firms with higher wages (Akerlof 1982). A new insight that our model brings to the gift-exchange rationale, especially in the light of recent negative evidence from field experiments (Gneezy and List 2006), is that screening for more conscientious employees is crucial for the gift-exchange relationship being mutually beneficial and sustainable.

This insight is also linked with studies on organization identity (Akerlof and Kranton 2005). On the empirical side, our results are estimated based on a representative national sample of U.S. firms, which complement the recent work by Bandiera, Barankay, and Rasul (2005), who use an individual firm's data to demonstrate the effects of social preferences on worker productivity.

In the section that follows, we derive more formal hypotheses for the arguments above using a simple principal-agent model, which we then test empirically.

## 2. A Principal-Agent Model with Screening and Monitoring

**Technology.** A principal hires an agent to complete a project. The outcome is stochastic. If the agent makes the appropriate effort, he produces  $h$  with probability  $q_h$  and 0 with probability  $1 - q_h$ , where  $h > 0$  and  $q_h \in (0,1)$ . If the agent shirks, the probability of getting  $h$  is  $q_l \in [0,1)$ , where  $q_l < q_h$ . The cost of making effort is  $c$ , while shirking has zero cost involved. We assume  $hq_h - c > hq_l$  so that making effort is the social optimal choice. The parameter  $h$  can be interpreted as the cognitive ability of an agent.

**Agent Type.** There is a continuum of agents indexed by  $i \in [0,1]$ . Agents are heterogeneous in their levels of conscientiousness or work ethic, which we see as including a disposition to work hard and cooperate with others in pursuing the employer's goals. More specifically, an agent  $i$  has a degree of conscientiousness  $\alpha_i \in \{0, \alpha\}$  that measures the amount of guilt he feels if he shirks, whether caught or not by the principal. He is called a *cooperative type* if  $\alpha_i = \alpha > 0$ , or a *selfish type* if  $\alpha_i = 0$ . The proportion of cooperative type agents in the population is  $\rho$ . A person's level of conscientiousness may be regarded as a type of non-cognitive skills in the light of recent development of labor economics literature (e.g., Heckman 2000, Bowles et al. 2001); it is also a common modeling assumption in studies on social preferences and trust (e.g., Fehr and Schmidt 1999, Rob and Zemsky 2002).

Principals are identical with unit mass. The reservation wage of agents and the alternative return for principals are normalized to zero. Agents are risk averse. To reduce



shirking, a principal may use monitoring, incentive wages, and screening.

**Monitoring.** A principal chooses monitoring intensity  $m_i \in [0,1]$  so that an agent who shirks is caught by the principal with probability  $p(m_i)$ , where  $p' > 0$  and  $p'' < 0$ . The total monitoring cost is  $m_i k_m$ , where  $k_m$  measures the unit cost of using monitoring technologies such as operating video cameras in the workplace or hiring supervisors.

**Wage.** The compensation of an agent with  $\alpha_i$  contains two components: one is the basic wage  $b_i$  an agent always gets regardless of his effort choice, the other is the incentive pay  $d_i$  that has to be forsaken when shirking is confirmed. Both the incentive pay  $d_i$  and the monitoring intensity  $m_i$  are extrinsic incentives provided by the principal, and their substitution relationship has already been extensively studied in the literature (see, e.g., Dickens et al. 1989). Since our focus in this paper is the relationship between screening for intrinsic motivation  $\alpha_i$  and monitoring  $m_i$ , we assume without much loss of generality that

$$(A1) \quad d_i = d$$

for some constant  $d > 0$  to simplify exposition.<sup>1</sup> So the total income of the agent is  $w_i = b_i + d$ , the sum of the basic wage and the incentive pay.

**Utility Function.** The utility of an agent with a conscientious level  $\alpha_i$  is

$$U(b_i, d, m_i, \alpha_i) = \begin{cases} (1 - p(m_i))u(d) + v(b_i) - \alpha_i, & \text{if agent } i \text{ shirks;} \\ u(d) + v(b_i) - c, & \text{if not;} \end{cases}$$

where  $u' \geq 0$ ,  $u'' \leq 0$ ,  $v' \geq 0$ . It is easy to check that, in any given match, an agent will not shirk if the sum of his internal discipline  $\alpha_i$  and the external punishment  $p(m_i)u(d)$  imposed by the principal is not smaller than the cost of effort  $c$ :

$$(1) \quad \alpha_i + p(m_i)u(d) \geq c.$$

In other words, the more conscientious an agent is, the less likely he will shirk given the same incentive package. For an agent whose conscientiousness is so high that  $\alpha_i \geq c$ , no monitoring is needed at all. To focus on the more common case where even a cooperative

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<sup>1</sup> An earlier version of the paper did not impose this assumption and the main results remain the same.

type agent needs some explicit incentives to make effort, we assume  $\alpha < c$ .

Let  $\underline{m}$  denote the lowest monitoring intensity that deters shirking for cooperative type agents, and  $\bar{m}$  for selfish type agents. By the non-shirking condition (1) we get

$$\underline{m} = p^{-1} \left( \frac{c - \alpha}{u(d)} \right), \quad \text{and} \quad \bar{m} = p^{-1} \left( \frac{c}{u(d)} \right).$$

It is obvious that  $\underline{m} < \bar{m}$ , implying that if a selfish agent does not shirk, then a cooperative one would not shirk either.

**Screening.** Suppose the probability of correctly detecting a selfish type agent is  $r \in [0, 1]$ , and the probability of misjudgment is  $1 - r$ , while a cooperative type agent is always revealed after being screened.<sup>2</sup> A screening principal hires the first job applicant who is perceived to be of cooperative type and rejects others. This screening scheme implies all cooperative type agents are to be hired after being screened, while a selfish agent has a probability  $1 - r$  to pass the screening and be hired. So conditional on being hired by a screening principal, the probability of an agent being cooperative type is

$$s \equiv \frac{\rho}{\rho + (1 - r)(1 - \rho)}.$$

Note that  $s$  indicates the screening intensity, and it is a positive transformation of  $r$ . The screening cost is  $g(s)k_s$ , where  $g' > 0$ ,  $g'' < 0$ , and  $k_s$  is a parameter representing the cost of screening technologies.

**Time Line.** The time line of this game is as follows. Principals first decide whether to screen or not. Those who choose to screen announce their screening intensity  $s$ , the monitoring intensity  $m_s$  and compensation  $d + b_s$  for agents that are hired, while those who do not screen would adopt  $m_n$  and  $d + b_n$  respectively. Agents then decide where to apply for jobs. If an agent is indifferent among many principals, he randomly selects one; if multiple candidates apply for one job opening, they are randomly queued for screening or hiring purpose: A screening principal screens job candidates, hires the first one perceived to be of cooperative type and rejects others. A non-screening principal hires whoever comes first. The matching process is frictionless and transparent,

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<sup>2</sup> Imperfect screening for cooperative type would not affect the main results.

where the screening and hiring results are publicly observed. So each agent is screened at most once: a cooperative type screened is hired immediately, while a selfish type screened is either hired immediately or rejected once for all since his failure reveals his type.<sup>3</sup> An agent that has not been screened can queue again waiting for the screening of another principal that is still hiring, while a rejected selfish agent has no choice but to work for a non-screening principal. Matching goes on until all principals and agents are paired.

After matching is finished, agents consume their basic wages if any, and then choose whether to make effort or shirk. Principals monitor agents, pay the incentive wage  $d$  if no shirking is found, and pay 0 if otherwise. The game then ends.

**Strategies.** A principal's strategy includes two actions: whether to screen or not, and the incentive package  $(s, m_s, b_s)$  if screening, and  $(m_n, b_n)$  if not screening. An agent's strategy also includes two actions: where to apply for jobs, that is, choosing the screening or the non-screening principals, and whether to shirk or not once in a match.

**Equilibrium.** The competitive equilibrium is reached when principals maximize profits, agents maximize utilities, and the labor market is clear. In other words, in equilibrium all principals stick to their screening choices, everyone is matched and there is no partner-changing, and once in a match, nobody wants to deviate from their decisions.

Depending on the parameter values, there are different equilibrium results. To focus on the more interesting and realistic cases, we assume that the screening cost parameter  $k_s$  is neither too high nor too low so that some principals do choose to screen agents in equilibrium with  $s^* \in (0,1)$ . In specific, the assumption is

$$(A2) \quad k_s \in \left( \frac{hq_h - hq_l - p(\underline{m})}{g'(1)}, \frac{hq_h - hq_l - p(\bar{m})}{g'(0)} \right).$$

Similarly, we also assume that the unit monitoring cost  $k_m$  is not too high:

$$(A3) \quad k_m \leq \bar{k} \equiv \frac{hq_h - hq_l - d}{m}.$$

The equilibrium results under assumptions A1-A3 are described by the proposition below.

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<sup>3</sup>Since all screened are no longer in the pool of job candidates for screening principals, those remained in the pool have the same composition of the two types as in the original population.

**Proposition.** *In the equilibrium: (i) A proportion  $\frac{\rho}{s^*}$  of principals screen job candidates with intensity  $s^*$ , while others do not screen. The optimal solution  $(s^*, m_s^*)$  is uniquely determined, where*

$$\partial s^* / \partial m_s^* < 0.$$

*(ii) The basic wage offered by a screening principal is  $b_s^* > 0$ , while  $b_n^* = 0$  is offered by a non-screening principal. So we have*

$$w_s^* > w_n^*$$

*where  $w_s^* = b_s^* + d$  and  $w_n^* = b_n^* + d$ . The principals make the same profit in equilibrium regardless of their screening choices.*

*(iii) Both types of agents prefer to work for screening principals. A cooperative type agent makes effort while a selfish one shirks if hired by a screening principal, while neither shirks under a non-screening principal.*

**Proof.** In the Appendix.

This proposition has two implications that are to be tested later in the paper:

*Result 1: Employers who monitor employees less tend to screen them more of work ethic.*

*Result 2: Employers who screen employees more of work ethic pay them higher wages.*

The first result is quite intuitive. The non-shirking condition (1) implies that the cooperative type agents require less explicit monitoring and incentive payment to make effort, since their intrinsic motivation plays the same role of discouraging shirking. When the cost of screening is not too high, principals may find it beneficial to screen agents and hire only those perceived to be of cooperative type. That is, principals substitute screening for monitoring to take advantage of an agent's work ethic in order to reduce monitoring costs and incentive wages.

The second result, in contrast, seems counter-intuitive at first sight: Given that a cooperative type agent needs less extrinsic incentives to make effort than the selfish agent, why should a principal pay him more? It seems that the screening principals should pay less to their cooperative type agents; actually this is often found in a typical principal-agent model (for an example see Alger and Renault 2007). The problem in such an argument is that it ignores the competition among principals and hence is not an

equilibrium result. Specifically, agents with better work ethic require lower governance expenditures so that all principals prefer to hire them; but then competition among principals would bid up the basic wage for these agents and hence their total compensation in equilibrium. In other words, to attract cooperative type agents to work for them, screening principals must provide a generous basic wage  $b_s^*$  in addition to the contingent pay. Such a compensation package, however, is even more attractive to selfish agents, who thus also prefer to work for screening principals. Since self-selection does not work in this context, principals have to rely on careful employee screening to separate the conscientious agents from the selfish ones,<sup>4</sup> and then choose monitoring intensities accordingly. In short, the competition among principals for agents with better work ethic and the adverse selection problem jointly lead to the positive correlation between more intensive screening and higher wages, which is an innovative prediction of the model.

These two predictions are robust to various model specifications. For example, when the conscientiousness of agents is continuously distributed, the essence of the non-shirking condition (1) is still valid in that the more conscientious ones need less monitoring. This implies firms with more selective screening processes would again match with agents that are more conscientious on average and hence need less monitoring and earn higher wages. Labor market frictions such as searching costs may discourage selfish agents from fully mimicking the cooperative ones, and hence help screening principals hire cooperative agents. In the extreme case where the searching cost is so high that selfish agents cannot afford to apply jobs at screening principals, complete separating equilibrium may happen where screening principals are matched exclusively with cooperative type agents. But even in this case the equilibrium screening intensity must be positive in order to discourage selfish agents from mimicking cooperative ones in the matching process, and our main predictions would still remain true. Another kind of market friction involves matching processes that are not as transparent as assumed in the model. This may decrease the efficiency of the screening process and allow more selfish agents to be matched with screening principals. The positive searching costs, however,

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<sup>4</sup> Note that the perfect competition among principals, which forces the equal profit in equilibrium, also eliminates any benefit for principals to free-ride on others' screening results: If one principal can offer a slightly higher wage to a worker already screened, then many other principals can do the same, which eventually drives away any potential benefit in doing so.

may mitigate these effects by preventing a selfish agent from trying too many principals. Even in cases where a few cooperative agents are hired by non-screening principals, the qualitative results would still be similar as in our model (Huang 2006).

When there are no frictions in the labor market and no heterogeneity among principals, as assumed in the current model, the cooperative agents get all the rent of their conscientiousness in the form of basic wage, while the principals earn the same profit regardless of their screening choices. When these assumptions do not hold, rent-sharing between principals and agents may happen where principals also benefit from hiring conscientious agents. So the general result is that *principals screening more intensively earn profits at least as high as, though not necessarily higher than those who screen less*. This is another innovative prediction of the model, which may shed light on the puzzling empirical results mentioned in Introduction that firms adopting high performance work practices do not necessarily earn higher profits (see, e.g., Freeman and Kleiner 2000).

### **3. Data Description**

The main results of the model are tested using data from the 1997 National Employer Survey (NES97), an establishment level survey of employment practices conducted by the US Bureau of Census. It is a nationally representative sample of private establishments with more than twenty employees. In terms of criteria such as representativeness, response rate, and breadth of questions about work practices and organizational characteristics, it appears to be the broadest and best data available on employer practices and, therefore, for testing our results (see Cappelli 2001 for an extensive description of the NES). The summary statistics of relevant variables are listed in Table 1.

#### **3.1 Measurement of Screening Intensity**

The number of candidates interviewed for the job opening of a typical production employee, denoted as *Candidates#*, seems to be a close measure of the screening intensity in the model, since a higher level of screening intensity leads to more candidates screened per job opening. In NES97 data, firms on average interview about 7 candidates for each production job opening; about 90% of the firms interview between 2 and 10 candidates, while very few (2.6%) firms interview only one candidate.

There is a potential drawback in using Candidates#, however, since it may capture the scarcity of other aspects of human capital, such as appropriate academic training and relevant work experiences, in addition to a firm's selectivity on the right work ethic or conscientiousness that our model is emphasizing. The noisiness of this variable is not a fatal problem as long as it is conceptually difficult to link higher screening intensity in those other aspects with less monitoring. In this case, any statistically significant negative relationship between screening and monitoring still serves as evidence for the story we propose. It is, however, a big problem in testing the effect of screening for work ethic on higher wages, since presumably both relevant work experiences and better academic performance would contribute to higher wages.

Luckily, the NES97 data contains indirect measures of screening intensity in all the three aspects of human capital that firms may be concerned of, namely, work ethic, academic performance, and work experiences. This enables us to find cleaner evidence that it is indeed the screening selectivity on work ethic that induces lower monitoring and higher wages.

The NES97 asks a series of questions about how the employer selects employees - what type of information about applicants they collect and how important is each in their hiring decision. The stem of the question asks the plant or office manager: "After you have established your applicant pool and obtained information about potential [production or front-line job title provided earlier by the respondent] employee, what characteristics or attributes are most critical in making your hiring decision?" The importance scale ranges from 1 to 5, indicating respectively "no value", "some value", "important", "very important", and "essential". Respondents use this scale to assess twelve general characteristics and attributes about applicants.

The most important screening criterion reported by employers is an applicant's attitude, which seems specifically oriented toward the goal of identifying intrinsic work ethic, the unobserved human capital that would be necessary for workers to be productive in a regime of low supervision and monitoring. It presumably captures a range of work-related attributes other than ability, such as motivation and willingness to work hard (see Cappelli 1995). Though it may still be quite broad in range, some evidence suggests conscientiousness is probably the most important element in a job candidate's attitude

that firms care about. For example, Schmidt and Hunter (1998) after summarizing thousands of research studies in personnel selection over 85 years and involving millions of employees conclude that a combination of a general mental ability test “and an integrity test (which measures mostly conscientiousness) has the highest validity (.65) for predicting job performance.” Consistent with the above evidence, almost all firms (98%) consider worker attitude important, among them 34% think it “very important”, and 56% treat it as an “essential” criterion in selecting production employees. The importance of applicant attitude, called *Attitude Screening*, is the alternative measure of screening intensity for work ethic, which has a mean of 4.4 (standard deviation .78), the highest among the twelve criteria used by all firms.

The remaining eleven criteria can be easily divided into two groups. The average importance of the following five criteria, including high-quality performance at previous job, previous full-time work experience, communication skills, previous after-school or summer work experience, and industry-based credentials, measures the screening intensity in work-related performance, labeled as *Work Experience Screening*; its mean is 3.42 (SD .72). In 84% of the firms work experience is an important criterion in hiring production employees, while only less than 1% consider it as “essential”; this is in stark contrast with *Attitude Screening*. The average importance of the remaining six criteria – an applicant’s education level (years completed), school reputation, high academic performance in school, course work in technical areas, course work in general subjects, and extra-curricula activities - measures the screening intensity of academic skills, denoted by *Academic Performance Screening*. It has a mean of 2.48 (SD .79), where only about 32% of firms consider the academic performance important in hiring production or frontline employees.

The three selectivity variables, namely, Attitude Screening, Work Experience Screening, and Academic Performance Screening are indeed positively and significantly correlated with each other (and also with Candidates#), where the latter two will be used as further controls to estimate the impact of a firm’s monitoring level on the screening intensity of work ethic, and to single out the unique effect of work ethic screening on wages of production employees.

### **3.2 Measurement of Monitoring Intensity**



The employee-supervisor ratio is an often-used inverse indicator of monitoring intensity (Leonard 1987, Gordon 1994); the assumption is that a lower ratio allows for closer supervision and monitoring by managers. In NES97, the *Employee-Supervisor Ratio* is measured by the average number of employees that report to each front-line supervisor, where higher ratios mean lower monitoring intensity. Across all firms in the sample, a supervisor is in charge of 19 employees on average with a standard deviation of 21.

On closer inspection, however, this measure has several drawbacks as a proxy for monitoring. Monitoring may take place through ways other than one's immediate supervisor, the relationship measured by supervisory ratios. And supervisors perform tasks in addition to monitoring. For example, about 20 percent of supervisors' time is devoted to providing informal training (see 1994 NES survey). They may also perform some of the tasks that their supervisees perform, especially if the supervisor operates in the mode of a lead worker. If the supervisory ratio captures in part efforts to train and instruct the workforce and perform some work tasks, it may be driven in part by factors other than the interest in monitoring employees. For example, supervisory ratios may be higher for less skilled workers, independent of work ethic, because supervisory training is substituting for employee skill.

In an effort to address these concerns, we need some variable to directly measure the extent of low monitoring environment, which is associated with high performance work systems. Self-managed teams, where the team takes over much of the traditional responsibilities of supervisors, may be the most intensive application of a low monitoring environment. The NES97 survey explicitly describes teams as having “some degree of responsibility and discretion over such decisions as methods of work, task schedules, assignment of members to different tasks, and feedback about group performance.” About 41% firms adopt self-managed teams; on average about 39% of their employees are participating in teams, while 17% of these firms involve all their production employees in teams. We use the percentage of production employees involved in self-managed teams in a firm as an inverse measure of its monitoring intensity, denoted by *Teamwork*. It indicates the extent of a firm's reliance on employee self-management rather than monitoring by supervisors to induce work effort. As expected, *Teamwork* is positively and significantly correlated with *Employee-Supervisor Ratio*.

### 3.3 Other Variables

Many questions in NES97 survey are focused on front-line production employees; this greatly narrows the range of possible jobs being examined in our estimation and helps control for exogenous sources of variation. Detailed industry and size dummies are also used to control for potential variations in the important aspects of production functions and in the costs or ability to screen and monitor employees (e.g., scale economies). Other potentially relevant factors are the average years of schooling for production employees, their weekly working hours, the usage of computers on the job by supervisors and employees, the length of time for a new hire to reach job proficiency, and union strength. These variables are used as controls to account for the remaining elements in the model that may influence a firm's monitoring and screening choices as well as wage levels.

## 4. Estimation Results

### 4.1 Screening Selectivity and Monitoring Intensity

Results of the analysis examining the relationship between screening for work ethic and monitoring intensity are presented in Table 2. The relevant econometric equation is:

$$\text{ScreenSelectivity} = \beta_0 + \beta_m (\text{MonitorIntensity})^{-1} + \beta_s \text{Controls} + \varepsilon_s.$$

According to the theoretic model,  $\beta_m > 0$  should hold due to the substitutive relationship between screening intensity for work ethic and monitoring intensity. The basic set of control variables is listed above in Section 3.3.

We first use `Candidates#` defined above as the measure of screening intensity, and `Employee-Supervisor Ratio` as the measure of the inverse of monitoring intensity. The estimation results are presented in the left half of Table 2. The coefficients of `Employee-Supervisor Ratio` are positive and significant at 5% level or above across various specifications. The first column contains the OLS regression results with the basic set of control variables. Two more controls, `Work Experience Screening` and `Academic Performance Screening`, are added in the second column to absorb the effect of general selectivity in recruiting other than the screening intensity of work ethic. The coefficient of `Academic Performance Screening` is positive and significant, while that of `Work Experience Screening` is of a much smaller size and insignificant; however, their total

influence on the coefficient of Employee-Supervisor Ratio is negligible, which seems to suggest that the negative relationship between the monitoring intensity and screening selectivity is not affected by a firm's recruiting selectivity on other aspects of employees' human capital than work ethic.

Since the monitoring intensity may be determined endogenously, the next two columns present results of the 2SLS method, where Employee-Supervisor Ratio is first regressed on exogenous variables. The instrumental variable used is the percentage of non-managerial and non-supervisory employees that are involved in job rotation. We test its weak exogeneity in the regression of Candidates# using the control variable method (Vella 1993); it indeed passes the test and hence can be treated as a weak exogenous variable. The coefficient of Employee-Supervisor Ratio in the 2SLS regression is again positive and significant at 1% level. This result is maintained in the fourth column where Work Experiences and Academic Performance are added as further controls. In both columns, the F-statistics in the first stage regressions are large enough to rule out the concerns of weak instrument problems. Based on estimates in the fourth column, a firm with a standard deviation increase in employee-supervisor ratio has to interview 6 more job candidates for each production job opening, which is 72% of a standard deviation of Candidates#. This suggests the tradeoff between monitoring and screening is quite substantial.

The right half of Table 2 shows results from a similar set of regressions where Attitude Screening is the measure of screening intensity. The first column presents a probit regression using a dummy variable constructed from the screening criterion on employee attitude: it is 1 if the firm considers employee attitude as "essential" in hiring decision, and 0 if not, where 55% of all firms treat it as an essential criterion. The coefficient of Employee-Supervisor Ratio is again positive and significant. The OLS results are shown in the second column, which also includes the two extra controls, Work Experience Screening and Academic Performance Screening, to absorb the potential effect of general screening selectivity. Not surprisingly, the coefficients of these two screening variables are both positive and significant, which indicates the existence of a common element in a firm's selectivity in recruiting. The OLS estimate of the coefficient of Employee-Supervisor Ratio is insignificant, which is probably biased due to the

endogeneity problem. Indeed, the 2SLS estimates of the coefficient are positive and significant at 1% level in the next two columns, which adopt the same specifications as in the corresponding columns in the left half of the table where Candidates# is used as the screening measure. Again, controlling for the two screening variables on work experience and academic performance makes essentially no difference in both the size and significance level of the coefficient of Employee-Supervisor Ratio; these results lend strong support to our theoretical result that it is indeed the screening selectivity for work ethic that is negatively correlated with monitoring intensities. Based on the 2SLS estimates in the fourth column, a standard deviation increase in employee-supervisor ratio increases the importance level of attitude screening by about .55, or 70% of its standard deviation; this result is strikingly similar to what was obtained above when Candidates# is the measure of screening intensity, suggesting strong consistence across these two specifications.

The same set of regressions described above is repeated using Teamwork as the alternative measure of monitoring intensity; the estimation results, presented in the bottom part of Table 2, are very similar to, and in many cases have higher significant levels than, those in the upper part of Table 2: The coefficients of Teamwork are positive and significant at 5% level or above across all specifications, which are essentially not affected by controlling the two screening variables on work experience and academic performance. Based on the 2SLS estimates in the fourth columns under both dependent variables, a standard deviation increase in the percentage of employees involved in teamwork increases the number of job candidates to be interviewed per job opening by 3.24 (39% SD of Candidates#) and the importance level of attitude screening by .33 (42% SD of Attitude Screening), which are again strikingly similar to each other, though lower than those in the upper part of Table 2 where Employee-Supervisor Ratio is used to measure the monitoring intensity.

These results suggest that there is a strong synergy between screening employees for work ethic consistent with cooperative behavior and the use of low-monitoring work practices that make use of such behavior. In other words, these human resource practices are complementary. More generally, the results are consistent with the notion that there

may be a trade-off between management approaches that rely on conscientious workers and empowered working arrangements versus those that rely on high levels of monitoring.

**Robustness Check.** The estimation results are robust to various specifications. The exact regression results are not reported but available from the authors. Note that both Employee-Supervisor Ratio and Teamwork are the inverse measures of monitoring intensity. Actually the estimation results of the substitutive relationship between monitoring and screening are robust if we invert the employee-supervisor ratio or use 1-Teamwork as direct measures of monitoring intensity and redo the regressions with the following specification

$$\text{ScreenSelectivity} = \beta_0 + \beta_m(\text{MonitorIntensity}) + \beta_s \text{Controls} + \varepsilon_s$$

The estimated coefficients of both direct measures of monitoring intensity are indeed negative and significant under the various specifications in Table 2.

To check the robustness of 2SLS results that use Job Rotation as the instrumental variable for the two measures of monitoring intensity, we construct the industry average Employee-Supervisor Ratio and Teamwork for the 21 industries in the sample, excluding the individual firm's levels in calculating the averages, and use them as the alternative instrumental variables to redo the estimation. The results are again similar, where the coefficients of both monitoring variables are significant, though their scales are more similar to the OLS results and hence lower than the 2SLS results reported in the table.

## 4.2 Wages and Screening Selectivity

The results examining the relationship between wages and screening selectivity are presented in Table 3. They are based on the following econometric equation:

$$\text{Logwage} = \phi_0 + \phi_s \text{ScreenSelectivity} + \phi_w \text{Controls} + \varepsilon_w$$

Since screening principals offer higher wages to their agents who are more likely to have better work ethic, the theoretic model predicts  $\phi_s > 0$ .

The screening selectivity of work ethic is again measured by two variables, Candidates# and Attitude Screening; their associated regression results are presented respectively in the left and right parts of Table 3. The basic set of control variables includes the average years of schooling of production employees and their working hours per week, computer usage by supervisors and production employees, union representation,

the ratios of minority and women in the permanent employees, and the average number of employee benefits provided by the firms. The coefficients of these control variables (not reported) are strikingly similar across various OLS specifications and almost always statistically significant at conventional levels with intuitively correct signs.

In the first column where only the basic set of control variables is included, the coefficient of *Candidates#* is positive and statistically significant. To rule out the effects of other potential reasons for higher selectivity in recruiting, the screening intensities on work experiences and academic performance are further controlled in the second column; their influence on the coefficient of *Candidates#* is negligible, though the coefficient of *Work Experience Screening* is significant. The next two columns '(1C)' and '(2C)' present regression results using the control function method to treat the potential endogeneity of *Candidates#* (Vella 1993). Their specifications are exactly the same as the corresponding columns '(1)' and '(2)', except that the residual of *Candidates#* is further included in the regressions.<sup>5</sup> The coefficient of *Candidates#* in column (1C) has a much larger size and significant level than that in column (1); its residual is also significant, implying that *Candidates#* is indeed endogenous in the OLS specification. Similar results are obtained in column (2C) where the screening intensities on work experiences and academic performance are controlled; the coefficients of these two screening variables are not significant. These results suggest that, once the basic set of control variables is included and the endogeneity of *Candidates#* is taken into account, the positive effect of screening selectivity on wages does not seem to be transmitted through the channel of selecting frontline/production employees by work experiences or academic performance.

These results are further strengthened in the right half of Table 3 where *Attitude Screening* is the measure of screening selectivity in work ethic. The coefficient of *Attitude Screening* is positive and significant in column (3) where only the basic control variables are included. Its size and significance are slightly reduced in column (4) when the other two screening selectivity variables are further controlled; however, their coefficients are not significant. When the residual of *Attitude Screening*, obtained in the

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<sup>5</sup> The residual of *Candidates#* is obtained by regressing on the basic set of control variables plus the average years of schooling and average working hours per week of other employees in the same firm (including managers/professionals, supervisors, technical staff, and office, clerical, sales, or customer service staff). Adding these variables in the OLS specifications does not make any difference to estimation results.

same way as that of Candidates# above, is included in columns (3C) and (4C) to treat the endogeneity problem, the coefficients of Attitude Screening are much larger than before, while those of Work Experience Screening and Academic Performance Screening, still insignificant, become negative. The residual of Attitude Screening is significant in both columns, suggesting that Attitude Screening is indeed endogenous under the two OLS specifications. These results indicate that it is indeed the screening selectivity of work ethic, rather than that of working experiences or academic performance, that increases the wages of frontline or production employees.

The main implication of the above results is quite clear: screening for work ethics is associated with higher wages. This result supports and extends the notion that wages are higher where firms use high performance work practices because those practices demand more from employees. What they demand, though, are competencies associated with a strong work ethic rather than cognitive ability or related work experiences.

## **5. Conclusions**

We analyze the relationship between screening selectivity and monitoring intensity in the context of a principal-agent model and test the theoretical results using a national sample of U.S. establishments. We find that more selective screening for work ethic, but not for working experiences or academic performance, is indeed related to less monitoring and greater use of high involvement work practices that require cooperative employee behavior. It also leads to higher wages. The underlying intuition is that a screening firm hires conscientious workers who are willing to work hard with less monitoring; these employers can then make use of practices that involve workers more and monitor them less; reduced monitoring costs allow the firm to share rents in the form of higher wages in order to attract and retain these good workers.

The optimal combination of screening and monitoring adopted by a firm is ultimately determined by their relative costs and the prevalence of work ethic in the workforce. In future work, it would be interesting to examine these elements in more detail. For example, when the dismissal cost in the labor market is made higher by labor policies, firms may find it beneficial to screen job candidates more carefully and hence a lower monitoring intensity is warranted. If the average job in economy becomes more

knowledge intensive over time so that workers have to be given more autonomy on how to perform their jobs, the relative cost of monitoring goes up, and as a result firms may switch to the combination of more screening and less monitoring of employees; this may be a reason underlying the increasing adoption of high performance work practices in the recent several decades. The training of competent workforce is also important in shaping the choice of firms between screening and monitoring, where monitoring is obviously more effective in eliciting effort when many employees lack the adequate work ethic, and screening plus empowering work practices fares relatively better when most workers are equipped with the right work ethic.



Table 1: Summary Statistics, NES97

Variable Names	Mean (SD)	Obs.
<i>1. Screening Selectivity on Work Ethic:</i>		
<b>Candidates#</b> interviewed for each production job opening	6.71 (8.29)	2557
<b>Attitude Screening</b>	4.40 (0.78)	2746
<i>Two Other Screening Variables:</i>		
<b>Work Experiences Screening</b>	3.50 (0.68)	2739
<b>Academic Performance Screening</b>	2.48 (0.79)	2734
<i>2. Monitoring Intensity:</i>		
<b>Employee-Supervisor Ratio</b> On average, how many employees report to each front-line supervisor?	19 (21)	2771
<b>Teamwork</b> What percent of non-managerial and non-supervisory employees are currently involved in self-managed teams?	16 (30)	2928
	27322	2495
3. <b>Wage:</b> the average pay for the full-time production employees	(12230)	
<i>4. Control Variables:</i>		
<b>Schooling</b> for production employees	12 (1.3)	2663
<b>Working hours per week</b> for the production employees	43.05 (6.02)	2740
<b>Computer usage (supervisors):</b> percent using computers in their jobs	.82 (.28)	2732
<b>Computer usage (production employees)</b>	.45 (.38)	2699
<b>Union ratio:</b> percent of non-managerial, non-supervisory employees covered by a collective-bargaining agreement	.20 (.36)	2943
<b>Months to reach job proficiency</b> for a typical new hire	7.42 (10.76)	2696
<b>Ratio of women:</b> percent among permanent employees	.39 (.26)	2883
<b>Minority ratio:</b> percent among permanent employees	.27 (.26)	2829
<b>Job rotation:</b> percent of non managerial/supervisory employees currently involved	.20 (.31)	2935
<b>Average schooling</b> for		
Office/clerical/sales/customer service	12.64 (1.05)	2700
Technical/technical support supervisors	14.30 (1.66)	2129
Management/professionals	13.31 (1.48)	2415
	15.35 (1.48)	2801
<b>Working hours per week</b> for		
Office/clerical/sales/customer service	40.69 (3.41)	2780
Technical/technical support supervisors	43.72 (5.33)	2192
Management/professionals	45.99 (5.55)	2481
	47.39 (6.36)	2878
<b>Average employee benefits</b> the establishment contributes toward any of the following employee benefits (1 if yes, 0 if no): Pension plan, Severance plan, Medical or health insurance, Dental care benefits, Child care benefits, Family leave, Life insurance, Sick pay, Paid vacation/holidays, Stock options or profit sharing.	.70 (.19)	2855
Five size dummies and 21 industry dummies	-	3081

Table 2: Screening Selectivity and Monitoring Intensity

	Screening Selectivity							
	Candidates#				Attitude Screening			
	OLS (1)	OLS (2)	2SLS (1)	2SLS (2)	Probit	OLS	2SLS (1)	2SLS (2)
Employee-supervisor ratio	.020** (.009)	.019** (.009)	.298*** (.112)	.283** (.112)	.0025* (.0015)	.0004 (.0008)	.027*** (.010)	.026*** (.0097)
Work experience screening		.155 (.339)		.231 (.401)		.277*** (.029)		.280*** (.035)
Academic performance screening		1.05*** (.291)		.773** (.357)		.082*** (.025)		.055* (.032)
Observations	2049	2037	2031	2020	2156	2145	2134	2123
R-squared	.044	.054	–	–	.052	.149	–	–
F-stat in 1 <sup>st</sup> stage regression	–	–	73.34	9.72	–	–	10.21	75.65

Alternative tests with the same specifications as above.

Teamwork	.013** (.006)	.013** (.006)	.118*** (.040)	.108*** (.040)	.003*** (.001)	.0009* (.0005)	.012*** (.0038)	.011*** (.0036)
Work experience screening		.132 (.316)		.008 (.346)		.283*** (.028)		.265*** (.032)
Academic performance screening	–	.958*** (.271)		.895*** (.290)		.086*** (.024)		.081*** (.027)
Observations	2102	2091	2085	2074	2217	2205	2195	2183
R-squared	.045	.055	–	–	.053	.154	–	–
F-stat in 1 <sup>st</sup> stage regression	–	–	6.84	28.98	–	–	30.58	30.17

Notes: Standard deviations are in the parentheses. \*\*\* p<.01, \*\* p<.05, \* p<.1. The data are from 1997 National Employer Survey (NES97) in the US. The dependent variable is screening selectivity of work ethic, measured by Candidates# and Attitude Screening alternatively. The two measures for the inverse of monitoring intensity are Employee-supervisor ratio and Teamwork. The control variables include the average years of schooling of production employees and their working hours per week, computer usage by supervisors and production employees, union representation, and months to reach job proficiency for a typical new hire as well as five size dummies and twenty-one industry dummies.

Table 3: Wages and Screening Selectivity

OLS	(1)	(2)	(1C)	(2C)	(3)	(4)	(3C)	(4C)
Candidates#	.0020** (.0008)	.0019** (.0008)	.021*** (.0073)	.019*** (.0073)				
Attitude Screening					.031** (.013)	.025* (.013)	.361** (.16)	.340** (.25)
Work experience screening		.026** (.011)		.015 (.015)		.017 (.011)		-.002 (.015)
Academic performance screening		.003 (.010)		.014 (.013)		.004 (.010)		-.020 (.013)
Residual of Candidates#			-.019*** (.007)	-.018** (.0073)				
Residual of Attitude Screening							-.352** (.160)	-.335*** (.161)
Observations	1882	1876	1241	1238	1963	1957	1287	1284
R-squared	.59	.59	.54	.55	.58	.58	.54	.54

Notes: Standard deviations are in the parentheses. \*\*\* p<.01, \*\* p<.05, \* p<.1. The data are from 1997 National Employer Survey (NES97) in the US. The dependent variable is log wage. Candidates# and Attitude Screening are the two alternative measures for screening selectivity of work ethic. The control variables include the average years of schooling of production employees and their working hours per week, computer usage by supervisors and production employees, union representation, the ratios of minority and women in the permanent employees, and the average number of employee benefits provided by the firms as well as five size dummies and twenty-one industry dummies.

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### Appendix: Proof of the Proposition.

The game is solved backwards. We first find the optimal solutions after the match between a principal and an agent is formed, then check the market clearing conditions.

(A) *A Screening Principal's Optimal Choice.*

The constraint

$$p(m_s)u(d) \geq c - \alpha \quad (2)$$

is actually the non-shirking condition (1) for  $\alpha_i = \alpha$ . When the equality holds,  $m_s = \underline{m}$ , which is the least costly package that induces a cooperative agent to make effort, though it cannot prevent a selfish agent from shirking. The alternative package  $\bar{m}$  prevents both types of workers from shirking, which is derived from the equality in (1) for  $\alpha_i = 0$ . It is more expensive since it does not take advantage of the effect of screening in reducing the shirking behavior, and thus cannot be optimal for screening principals who have incurred positive screening costs. So we have

$$\bar{m} > m_s^* \geq \underline{m}. \quad (3)$$

Recall that the agent hired by a screening principal can be either the cooperative type or the selfish type. Given the constraint (2), a cooperative agent will exert effort and produce  $hq_h$ , which happens with probability  $s$ , while a selfish agent always shirks and produces  $hq_l$ , which happens with probability  $1 - s$ . So a screening principal's objective function is

$$Q_s^* - b_s \equiv \max_{s, m_s} s(hq_h - d) + (1 - s)(hq_l - (1 - p(m_s))d) - m_s k_m - g(s)k_s - b_s$$

subject to (2), where  $b_s$  is to be determined in equilibrium.

The Lagrangian condition is

$$L = s(hq_h - d) + (1 - s)(hq_l - (1 - p(m_s))d) - m_s k_m - g(s)k_s + \lambda(p(m_s)u(d) - c + \alpha) - b_s$$

The FOC for  $s^*$  is:

$$hq_h - hq_l - p(m_s^*)d - g'(s^*)k_s = 0, \text{ if } s^* > 0, \quad (4)$$

$$hq_h - hq_l - p(m_s^*)d - g'(0)k_s < 0, \text{ if } s^* = 0,$$

$$hq_h - hq_l - p(m_s^*)d - g'(1)k_s > 0, \text{ if } s^* = 1. \quad (5)$$

To get an interior solution  $s^* \in (0, 1)$ , the two conditions  $k_s \leq (hq_h - hq_l - p(m_s^*)d)/g'(0)$  and  $k_s \geq (hq_h - hq_l - p(m_s^*)d)/g'(1)$  have to be satisfied, which are indeed so given assumption (A2) and  $\bar{m} \geq m_s^* \geq \underline{m}$  in (3).

The FOCs for  $m_s^*$  and  $\lambda$  are

$$\begin{aligned} (1 - s^*)p'(m_s^*)d - k_m + \lambda^*p'(m_s^*)u(d) &= 0, \\ p(m_s^*)u(d) &= c - \alpha, \text{ if } \lambda^* > 0, \\ p(m_s^*)u(d) &> c - \alpha, \text{ if } \lambda^* = 0, \end{aligned} \quad (6)$$

When  $m_s^* = \underline{m}$  holds, (6) becomes  $(1 - s_h^*)p'(\underline{m})d - k_m + \lambda^*p'(\underline{m})u(d) = 0$  and  $\lambda^* > 0$  must be true, which implies  $k_m > (1 - s_h^*)p'(\underline{m})d$ , where  $s_h^*$  is the corresponding optimal screening intensity determined by (4) that is rewritten as

$$hq_h - hq_l - p(\underline{m})d - g'(s_h^*)k_s = 0. \quad (7)$$

When the optimal value of  $m_s^*$  is larger than  $\underline{m}$ , we know  $p(m_s^*)u(d) > c - \alpha$  so that  $\lambda^* = 0$ ; thus  $m_s^*$  is determined by

$$(1 - s^*)p'(m_s^*)d - k_m = 0. \quad (8)$$

together with (4). Plugging  $s^* = 1 - \frac{k_m}{p'(m_s^*)d}$  from (8) into (4) we get

$$hq_h - hq_l - p(m_s^*)d - g'\left(1 - \frac{k_m}{p'(m_s^*)d}\right)k_s = 0,$$

which uniquely determines  $m_s^*$  since the SOC  $-p'(m_s^*)d - g''(m_s^*)\frac{\partial s^*}{\partial m_s^*}k_s < 0$  holds due to assumptions  $p' > 0$ ,  $g'' < 0$ , and

$$\frac{\partial s^*}{\partial m_s^*} = \frac{p''(m_s^*)k_m}{p'(m_s^*)^2d} < 0.$$

(B) *A Non-Screening Principal's Optimal Choice.*

If a non-screening principal chooses a positive monitoring intensity,  $m_n^* = \bar{m}$  must hold such that both types of agents are prevented from shirking, since  $m_n > \bar{m}$  is wasteful,  $m_n \leq \underline{m}$  is useless, while  $\underline{m} \leq m_n < \bar{m}$  is optimal only for  $s^* > 0$ . So a non-screening principal's profit with some monitoring is  $hq_h - d - \bar{m}k_m - b_n^*$ . The alternative is imposing no external incentives (zero monitoring plus reservation wage that is normalized at zero). In this case, an agent will shirk and hence produce  $hq_l$  on average, leaving the principal a profit  $hq_l$ . So the maximal profit of a non-screening principal is  $Q_n^* \equiv \max\{hq_l, hq_h - d - \bar{m}k_m - b_n^*\}$ , where  $hq_l$  is smaller when  $k_m \leq \bar{k}$  by (A3) and when  $b_n^* = 0$ .

(C) *Both types of agents prefer to work for screening principals.*

Any agent can get  $u(d) + v(b_n^*) - c$  by working for a non-screening principal, but only those who pass the screening process can obtain a utility level  $u(d) + v(b_s^*) - c$  if he is of cooperative type and  $u(d)(1 - p(m_s^*)) + v(b_s^*)$  if he is selfish. When cooperative agents prefer to work for screening principals, then

$$u(d) + v(b_s^*) - c \geq u(d) + v(b_n^*) - c \quad (9)$$

must hold, which is equivalent to  $v(b_s^*) \geq v(b_n^*)$ ; but this is true since  $b_s^* > b_n^* = 0$ . Selfish agents prefer to work for non-screening principals if

$$u(d)(1 - p(m_s^*)) + v(b_s^*) < u(d) + v(b_n^*) - c$$

holds; this can be true only when  $u(d)p(m_s^*) > c$ , which contradicts (3) where  $u(d)p(m_s^*) < u(d)p(\bar{m}) = c$ . So selfish agents also prefer to work for screening principals.

(D) *A proportion  $\rho/s^*$  of principals screen job candidates with intensity  $s^*$ , while others do not screen;  $Q_s^* - b_s^* = Q_n^*$ , and  $b_n^* = 0$ .*

The above two optimization problems have proved that once in a match, nobody benefits from deviation. Now we prove that no beneficial deviation exists in the choice of screening. First we prove  $b_n^* = 0$ . Given that both types of agents prefer to work for screening principals, those who are hired by non-screening principals must have been rejected by screening principals and hence do not have better alternatives. So the non-screening principals will set  $b_n^* = 0$  to maximize their net profit.

Suppose there is a proportion  $n_s$  of principals who decide to screen at the intensity  $s^*$ , then  $n_s^* = \rho/s^*$  must hold in equilibrium, where  $\rho/s^* = \rho + (1 - r)(1 - \rho)$  is the proportion of agents who are perceived to be of cooperative type after being screened. If  $n_s > n_s^*$ , then there are  $n_s - n_s^*$  principals who spend a positive screening expenditure but cannot find an agent that passes the screening process; these principals can be better off by choosing not to screen and earn a profit  $Q_n^*$  instead. So this cannot be true in equilibrium. Similarly, when  $n_s < n_s^*$ , there are  $n_s^* - n_s$  agents who can be better off if their principals have chosen to screen and given them a higher payoff, and these principals are indifferent in doing so since they obtain the same profit  $Q_s^* - b_s^* = Q_n^*$  anyway. So  $n_s^* = \rho/s^*$  must be true to clear the labor market.

Now we prove  $Q_s^* - b_s^* = Q_n^*$ . If  $Q_s^* - b_s^* > Q_n^*$ , then it is profitable for a non-screening principal to screen; if  $Q_s^* - b_s^* < Q_n^*$ , then screening yields a lower profit than non-screening so all principal should have chosen not to screen at all. But none of them can be true in the equilibrium where  $\rho/s^*$  principals have optimally chosen to screen; so there is no profitable deviation with regard to the screening choice.