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Bonding, shirking and adverse selection

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Abstract

The most serious theoretical difficulty regarding shirking-type efficiency wage models is that the introduction of the so-called bonding scheme eliminates involuntary unemployment. This paper develops a shirking-adverse selection model where the resulting key feature is that labor quality within an individual firm negatively depends on the average amount of bonds in the market. Under this situation, a larger bond required by an individual firm will lower the firm's labor quality and will discourage it from bonding its employees to the limit. This adverse selection problem gives rise to the possibility that bonding cannot eventually eliminate involuntary unemployment. Moreover, a larger bond required by a firm also worsens the labor quality within all other firms (negative externalities). The presence of these negative externalities implies that the profit-maximizing size of bonds required by individual firms in the market may be too large from the viewpoint of social welfare. This opens a possible role for bonding legislation to achieve an equilibrium Pareto superior to the competitive equilibrium.

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1. Introduction

One of the well-received theories explaining the existence of involuntary unemployment is the efficiency wage hypothesis. Among the various versions of such a hypothesis, the most popular and controversial development is the shirking view-

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point. The key idea behind shirking models is the existence of asymmetric information with regard to the worker's effort. This asymmetric information forces the manager to pay a wage that exceeds the worker's opportunity cost so as to prevent the worker from shirking, thereby giving rise to a difference between the utilities of the employed and unemployed. Such a difference makes the equilibrium unemployment 'involuntary'.[1]

All these shirking models suffer from a similar theoretical criticism, as pointed out by Akerlof and Yellen (1986, pp. 3–4): 'Employment contracts that are more ingenious than the simple wage schemes considered, can reduce or eliminate involuntary unemployment'.[2] The most famous example is the so-called bonding scheme: workers post bonds when initially hired and these are forfeited if the workers are caught shirking. Since paying premium wages is costly and bonding is costless to the firm, the threat of forfeiting the posted bonds then substitutes for paying efficiency wages in terms of creating work incentives. The competition among workers for jobs thus allows firms to charge an amount for the bonds until there is no difference between employment and unemployment, and so there will be no involuntary unemployment.

Devices that function in similar ways as with bonding include employment fees, deferred wage payments, and tournaments. Carmichael (1985) suggests that unemployed workers would be willing to pay a fee to gain employment, and that the competition among workers for jobs raises such fees until all involuntary unemployment disappears. Lazear (1981) demonstrates that workers can be paid a wage less than their marginal productivity when they are first hired with a promise that their earnings will later exceed their marginal productivity. This upward wage profile provides a penalty for shirking and eliminates involuntary unemployment. Lin and Yang (2001a) explore the macroeconomic implications of tournaments as a worker discipline device in the vein of shirking models. It is shown that tournaments can act as a bonding scheme, and if the full exploitation of tournaments is feasible, then there will be no involuntary unemployment.

The introduction of a bonding scheme or other such devices can eliminate involuntary unemployment, making obsolete unemployment as a worker discipline device. It is no wonder that the bonding issue has been emphasized as *the most serious theoretical difficulty regarding efficiency wage models* (Akerlof and Yellen, 1986, p. 8).

In response to the critics, Dickens et al. (1989, 1990) argue that by requiring workers to post large bonds or submit to other forms of punishment, firms could virtually eliminate monitoring expenditures. The empirical evidence, however, shows that a sizeable fraction of the monitoring of employees by employers is directed at deterring worker malfeasance. The pervasiveness of monitoring outlays makes it apparent that some consideration of fundamental importance is omitted from the formation of the existing models. *What are the limitations that constrain the ability*

[1] A canonical shirking model is provided by Shapiro and Stiglitz (1984).

[2] The origin of this critique can be stretched back to Becker and Stigler (1974) and Salop and Salop (1976). The same theoretical objection to the prediction of involuntary unemployment can also be applied to the labor turnover model of Salop (1979).

of firms to bond workers? This is a puzzle for shirking models (Romer, 1996, p. 461).

Several authors have made attempts to resolve the issue by pointing out the limitations of bonding. For example, Eaton and White (1982) indicate that there will be limits to bonding if the amount required for bonds exceeds workers' assets. Ritter and Taylor (1994) demonstrate the limits of bonding by appealing to firms' heterogeneity with regard to the chances of bankruptcy.

This paper develops a model that synthesizes both the shirking and adverse selection viewpoints of the efficiency wage hypothesis to provide one possible reason why bonding may not eliminate involuntary unemployment. The adverse selection feature of this model is closely related to the works of Akerlof (1970), Weiss (1980) and Drazen (1986) and Lin and Yang (2001b).

The idea of adverse selection can be traced back to Akerlof (1970). In a seminal paper, Akerlof considers an asymmetric information model where sellers possess superior information over buyers regarding the quality of used cars. Buyers do not know the precise quality of a particular car, but they know that the higher the market price is, the better will be the average quality of cars that are supplied to the market. Akerlof finds that the informational problem may be sufficient enough to result in the disappearance of the market for second-hand cars. Weiss (1980) applies Akerlof's idea to explain the existence of persistent involuntary unemployment. Due to asymmetric information regarding workers' ability, offering a higher wage is an effective way of attracting more able job candidates. This leads to a positive relationship between labor quality (productivity) and wages, which is central to the efficiency wage hypothesis. Weiss shows that firms may find it profitable to set the wages higher than the workers' opportunity costs, resulting in equilibrium unemployment.

By extending the Weiss model where labor quality within an individual firm is determined solely by the firm's own wage offer, Drazen (1986) considers a labor market in which labor quality within an individual firm is dependent upon the average wage in the market. Under this setting, a higher market wage can attract more able job applicants, which benefits all firms in the market (positive externalities). Drazen assumes that individual firms are atomistic, taking quality as being given and completely independent of their wage offers. Each firm thus has an incentive to undercut the wage to the market-clearing level. The result is that the labor market equilibrium is characterized by full employment and the market-clearing wage is lower than the market wage preferred by the firms as a whole. Drazen's analysis provides a possibility for the imposition of a minimum wage to achieve a Pareto superior outcome.

Labor quality within an individual firm is determined solely by its own wage offer in the Weiss model, whereas it is completely independent of its own wage offer in the Drazen model. Labor market equilibrium is characterized by involuntary unemployment without positive labor quality externalities in the Weiss model, while full employment with positive externalities will result in the Drazen model. Lin and Yang (2001b) develop a synthetic model of Weiss (1980) and Drazen (1986), in which labor quality within an individual firm is determined *partially* by the firm's

own wage offer. The resulting key feature of the model is that labor market equilibrium may be characterized by involuntary unemployment with positive externalities. The presence of these positive externalities opens a possible role for minimum wage legislation to improve labor quality, and thus it increases the employment of low-skilled and high-unemployment-rate workers.

Following this line of the literature, this paper extends the adverse selection model of Lin and Yang (2001b) to a shirking-adverse selection model so as to examine the bonding issue. The resulting key feature is that the expected labor quality within an individual firm negatively depends on the average wage and bond in the labor market, and the labor market equilibrium may be characterized by involuntary unemployment.

Under this situation, a larger bond required by the firm that lowers its own labor quality will discourage that firm from bonding its employees to the limit. This gives rise to the possibility that bonding cannot eventually eliminate involuntary unemployment. Moreover, a larger bond required by an individual firm also worsens the labor quality within all other firms (negative externalities). The presence of these negative externalities implies that the profit-maximizing size of bonds required by individual firms in the market may be too large from the viewpoint of social welfare. This opens a possible role for bonding legislation to achieve an equilibrium Pareto superior to the competitive equilibrium in terms of increasing the profits of firms and the wage, and employment of workers.

The rest of the paper is organized as follows. Sections 2 and 3 introduce a simple shirking-adverse selection model, paving the way for the analysis of a regulation on bonding in Section 4. Section 5 provides concluding remarks.

2. The worker's choice

In this model there are two information problems regarding labor productivity—the workers' moral hazard problem as well as the adverse selection problem. The moral hazard problem is concerned with the workers' hidden actions (effort), while the adverse selection problem is related to the workers' hidden characteristics (labor quality). To incorporate the adverse selection viewpoint into a simple shirking model embodying the bonding issue, this section sets up a simple shirking-adverse selection model. The virtue of this model lies in the extreme simplicity with which it captures the negative effect of bonding workers on labor quality. In the following analysis, we first discuss the workers' decisions regarding whether to shirk or not (the shirking problem), and then turn our attention to explore the workers' choices regarding whether to enter the labor market to search for jobs (the adverse selection problem).

2.1. The shirking problem

Consider a very simple one-period model where a representative firm hires a number of workers to produce a single commodity. A worker, when hired, must decide whether to shirk or not. The firm cannot accurately observe an individual

worker's effort (*hidden action*) due to imperfect information. Since workers dislike putting forth effort and monitoring is imperfect, there must be some probabilistic penalty to discourage shirking. The incentive devices that this paper focuses on include both the threat of firing (and at the same time paying the efficiency wage) and bonding.

At the beginning of the period, workers are required to post an upfront bond. If workers do not shirk (effort e where $e=1$) or shirk ($e=0$) but do not get caught, then they receive the wage w and the bonds posted are returned to them. If workers shirk and get caught, then they lose their bonds and receive the reservation wage, which is normalized to zero. The worker's utility function is:

$$U(C, e)=C+(1-e), \tag{1}$$

where C denotes income or consumption, and $1-e$ is on-the-job leisure.

According to many shirking-type efficiency wage models, employers set up a minimum acceptable effort level r, and discharge any employee whose observed effort level fails to meet the requirement.[3] More precisely, a typical firm observes $e+\varepsilon$ from a worker who does not shirk ($e=1$) and observes ε from a worker who shirks ($e=0$), where the error term ε is a random variable with a cumulative distribution function F. The probabilities that non-shirkers and shirkers may be fired are $p^{n}=F(r-e)=\text{prob}(e+\varepsilon<r)$ and $p^{s}=F(r)=\text{prob}(\varepsilon<r)$, respectively. It is obvious that $p^{s}>p^{n}$.

2.2. The no-shirking condition

A worker will choose not to shirk only if the expected utility of being a non-shirker is not smaller than that of being a shirker. Dismissed workers are paid nothing and their posted bonds are forfeited, while all others are paid w and the bonds posted are returned to them. The no-shirking condition (NSC) turns out to be:

$$(1-p^{n})(w+b)\geq(1-p^{s})(w+b)+e, \tag{2}$$

where b is the size of the performance bond. The lowest or no-shirking wage that prevents employees from shirking (where $e=1$ has been imposed) is:

$$w=\frac{1}{p^{s}-p^{n}}-b; \quad w_{b}=-1. \tag{3}$$

This result $w_{b}=-1$ indicates that, to induce workers not to shirk, an increase in the size of the performance bond decreases the no-shirking wage by an equal amount. In other words, the wage and the performance bond are perfect substitutes in inducing a higher level of work effort.

[3] See Levine (1989), Carter (1992) and Carter and De Lancey (1997) for relevant discussions.

2.3. The adverse selection problem

In a standard principal–agent model, the no-shirking condition in Eq. (3) corresponds to the so-called *incentive compatibility* constraint, which says that the wage and bonding scheme adopted by the employer should make the worker willing to exert a high, rather than low, degree of effort. The other typical constraint is the so-called *individual rationality* or *participation* constraint, in this paper, which requires that the wage and bonding scheme be set such that a worker prefers to enter the labor force to search for a job instead of staying at home.

A key assumption regarding the worker's adverse selection problem in this paper is that whether or not workers decide to enter a labor market is dependent upon the expected wages in the market. This assumption can be traced back to Drazen (1986) who states that: 'Quality might depend on average market wages when workers must decide whether or not to enter a labor market before they can sample and obtain specific job offers.' Some reasons for this include: (i) the choice of which profession to enter at the beginning of the education process; (ii) skilled labor markets that require a significant amount of costly training before employment is possible; and (iii) migration into labor markets, say, from rural to urban areas. The expected wage in the market is thus relevant to workers' decisions with regard to which market to enter.

The concept that relative wages across market sectors affect people's occupational choice is intuitively appealing and has strong empirical support. In a pioneer work, Freeman (1971) studies the labor market for college graduates and finds that the supply of engineering, accounting and business students is closely related to the average starting salaries in these professions. Pashigian (1977) finds that periods of rapid growth in real gross national product (the major determinant of the demand for legal services) will attract more students to the study and practice of law. Flyer (1997) provides evidence that indicates the existence of a strong positive relationship between an occupation's expected earnings and the likelihood that college graduates will enter that occupation.

To capture the heterogeneity with respect to the worker's reservation wage, we let λ be an idiosyncratic indicator which stands for the worker's opportunity cost (the amount that type λ workers could receive if they leave their current jobs). In other words, workers in this model are heterogeneous in the sense that λ is idiosyncratic and varies across workers. For simplicity, λ is supposed to be a uniform distribution with support on $[0, 1]$. The firm knows the distribution of λ, but cannot identify the *hidden characteristic* λ associated with a particular worker due to asymmetric information. Consequently, the firm cannot pay workers differential wages on the basis of λ.

In sum, we adopt:

Assumption 1. Whether or not workers decide to enter a labor market is dependent upon the expected income in the market.

A type λ risk-neutral worker will enter the labor market to seek a job if (note that all those employed will be non-shirkers in equilibrium in Eq. (2)):

$$(1-p^{n})(W+B)-B \geq \lambda, \tag{4}$$

where W and B are the average wage and the average bonding in the market, respectively. They are defined as:

$$W=\frac{w}{m}+\frac{m-1}{m}\tilde{w}; \quad W_{w}=\frac{1}{m} \tag{5}$$

$$B=\frac{r}{m}+\frac{m-1}{m}\tilde{b}; \quad B_{b}=\frac{1}{m}, \tag{6}$$

where $\tilde{w}$ and $\tilde{b}$ are, respectively, the (average) wage offered and the (average) bond required by all the other identical firms, and m is the total number of firms in the market. Since there are m identical firms in the market, this explains why an increase in the wage (the size of the performance bond) of an individual firm only contributes $1/m$ to the average wage (the average size of the performance bond) in the market.

2.4. The average labor quality in the market

Let $\hat{\lambda} \equiv (1-p^{n})(W+B)-B$, that is, $\hat{\lambda}$ denotes the marginal type of workers who are indifferent between entering the labor market to search for jobs and staying at home. Since the reservation wage λ is supposed to be a uniform distribution with support on [0, 1], $\hat{\lambda}$ happens to represent the number of workers whose participation constraints are not violated and who so choose to enter the labor market. The reservation wage $\hat{\lambda}$ also stands for the market labor supply (total labor force), and so from Eq. (4) we obtain:

$$\hat{\lambda}=(1-p^{n})W-p^{n}B. \tag{7}$$

If we let n to be the labor demand of a typical firm, then mn is the market demand of all firms. When $mn \leq \hat{\lambda}$, this means that there are $\hat{\lambda}-mn$ workers who are willing to work at the current market wage but cannot gain a job, and thus they become unemployed involuntarily. In line with the efficiency wage literature, we focus on the situation where the labor market equilibrium is characterized by involuntary unemployment.

In line with Weiss (1980) and Drazen (1986), we adopt:

Assumption 2. Workers are heterogeneous in terms of ability, and ability and reservation wages are positively correlated.

The reservation wage λ can, therefore, be regarded as an index of the individual's ability. Since λ is distributed uniformly, the average quality of the labor force in the

market, q, under $\hat{\lambda}$ is:

$$q(W,B)=\frac{\hat{\lambda}}{2}=\frac{(1-p^{n})W-p^{n}B}{2};\quad q_W=\frac{(1-p^{n})}{2}>0;\quad q_B=-\frac{p^{n}}{2}<0. \tag{8}$$

That is, an increase in the average wage or a decrease in the average size of the performance bonds is effective in attracting more able job candidates into the market.

Now we are ready to investigate the effect of a change in a single firm's bond size on the average labor quality in the market. From Eq. (8) we obtain:

$$q_b=\frac{1}{m}\left[q_B(W,B)-q_W(W,B)\right]<0. \tag{9}$$

Here the results $w_b=-1$, $W_w=1/m$ and $B_b=1/m$ from Eqs. (3), (5) and (6) have been imposed. Eq. (9) indicates that, unless the number of firms is infinite ($m\to\infty$), a larger size of bond required by an individual firm will decrease the expected labor quality in the market through two channels. The first channel (q_B/m) is that an individual employer's larger size of a bond will decrease the workers' expected income by increasing the expected value of forfeited bonds. The second channel ($-q_W/m$) states that a firm's greater bond size will decrease the expected income by decreasing the no-shirking wage. Higher-quality job candidates will thus refuse to enter the market and the expected labor quality will decrease. Again, since the average labor quality in the market depends upon the average wage and performance bond of all m identical firms, this explains the appearance of the term $1/m$ in Eq. (9).

The result in Eq. (9) can be summarized as:

Proposition 1. Unless the number of firms is infinite, an increase in the size of an individual firm's performance bond will decrease the expected labor quality in the market.

3. The firm's choice

As mentioned above, in this model, firms are faced with the workers' shirking (effort) and adverse selection (labor quality) problems. The possible combinations of wage and bonding policies that induce workers not to shirk have been described in the NSC in Eq. (3). The relationship between the wage and bonding policies and the expected labor quality when workers do not shirk is captured in Eq. (8). Employers cannot distinguish among different types of workers, and they recruit their employees from the labor market at random. Therefore, a typical firm recruiting n workers expects the average labor quality to be $q(W, B)$, and the corresponding effective labor force is $q(W, B)n$. The price of the firm's output is taken to be the

numeraire and normalized to unity. A representative firm is assumed to face the following program:[4]

$$\max_{n,w,b} \ \pi = f(q(W,B)n) - wn; \quad f' > 0 \ \text{and} \ f'' < 0, \tag{10}$$

$$\text{s.t.} \ \ w \geq \frac{1}{p^{\mathrm{s}} - p^{\mathrm{n}}} - b, \tag{3'}$$

where π is the typical firm's profit function and $f(.)$ represents the production function with the usual property of diminishing marginal returns.

The firm's profit-maximizing problem can be solved by differentiating π by n and b, and the corresponding first-order conditions are:

$$\pi_n = q \ f'(qn) - w = 0, \tag{11}$$

$$\pi_b = \frac{1}{m}(q_B - q_W)n \ f'(qn) + n = q_b n f' + n = 0, \tag{12}$$

where the results $W_w = 1/m$, $B_b = 1/m$ and $w_{\mathrm{b}} = -1$ have been imposed. Eq. (11) is the usual marginal condition in relation to the firm's employment in efficiency wage models. Eq. (12) is the marginal condition for the optimal size of a profit-maximizing firm's required bond, and the term $1/m$ arises due to the negative externalities. The second-order conditions for an interior solution ($q^2 f'' < 0$ and $q q_{bb} n f' f' > 0$) are assumed to be satisfied. Some interesting results below can be deduced from Eq. (12).

First, when labor quality has nothing to do with W and B (i.e. $q_W = q_B = 0$), then Eq. (12) becomes $\pi_b = n > 0$. This means that when labor quality is given (there is no adverse selection problem), but there is a shirking problem, then a performance bond that is as large as possible will be charged, and the wage will be set as low as it can be set, resulting in no wage premium. Without a wage premium, there will be, by definition, no involuntary unemployment in equilibrium. This result is consistent with the usual criterion that employment contracts that are more ingenious than simple wage schemes considered in the shirking model of efficiency wages can eliminate involuntary unemployment. We thus obtain:

Proposition 2. When there is no adverse selection problem, but there is a shirking problem, then the firm will charge a performance bond that is as large as possible and set the wage as low as it can, resulting in no wage premium and no involuntary unemployment.

[4] Due to the concavity of the production function and the sampling of workers by the firm, Eq. (10) is an approximation rather than an exaction; see Weiss (1980) for details. Moreover, once a bond is posted, firms may have a strong incentive to label a worker a shirker and to claim the bond. To exclude such a moral hazard problem, it is assumed that the bond when forfeited will be given to a third party (e.g. the Red Cross) rather than become a source of the firm's revenue.

Measures to deter shirking in this model may be achieved by paying premium wages and/or threatening to forfeit the posted bonds. To the firm, the threat of forfeiting the posted bonds is costless (when labor quality is given), whereas paying premium wages is costly. This explains why firms will impose as large a performance bond as they can and will set the wage at its lower bound, resulting in no involuntary unemployment. It is no wonder the argument that the introduction of the bonding scheme can eliminate involuntary unemployment has been widely considered to be the most serious theoretical difficulty for shirking-type efficiency wage models.

Second, when the number of firms is finite ($m < \infty$), labor quality within an individual firm will be related to its own required bond ($q_b = (q_B - q_W)/m < 0$). Given n, we may solve for an optimal and limited size of bond from Eq. (12). The rationale behind this is that an increase in the firm's size of bond lowers the no-shirking wage (benefit) as well as the average labor quality (cost). A self-interested firm will trade off the cost of and the benefit from adjusting its required bond to determine its own optimal size. The firm will, therefore, not raise the size of the bond to its limit. This adverse selection problem may provide a possible explanation as to why the firm will not use a bonding scheme to completely eliminate involuntary unemployment. This leads to:

Proposition 3. When labor quality within an individual firm is negatively dependent upon the size of its own performance bond, a self-interested employer may neither charge the posted bond to its limit nor set the wage at the workers' reservation wage to eliminate all involuntary unemployment.

To reduce shirking, the firm may pay premium wages and/or threaten to forfeit the posted bond. Paying higher wages is indicative of a forthright and positive management style. It is effective in inducing higher work effort and attracting better quality workers. Threatening to forfeit the posted bond to discourage shirking is an unkind and negative management style. Recruited workers will leave when they can and potential workers will hesitate to apply for a job with these firms. Because of these negative effects on productivity, it is no wonder that the firm will not bond workers to the limit. In fact, very few cases of explicit bonding, employee fees and other negative incentive devices are observed in the real world.[5]

Third, when there is not only a single firm and labor quality within an individual firm depends negatively on the average size of bonds in the market, bonding here is a 'pure public bad' by nature. The same damage affects all the firms. In this setting, engaging in bonding is like a voluntary provision of public bads. It is well known that voluntary provisions of public bads typically result in inefficient allocation with overprovision.

[5] For example, after interviewing a large number of business people and labor leaders, Bewley (1999, p. 110) reports that managers 'thought of punishment (firing) only as an extreme measure for dealing with antisocial behavior and said that the best results were obtained with a forthright and positive management style.' Mobley (1982, p. 95) and Telly et al. (1971) find that harsh supervision increases turnover. Sims (1980) suggests that rewards have a stronger effect on employee performance than punishments.

One would expect that the overprovision problem in relation to the average size of performance bonds would become more serious as the number of firms increases. The result of a comparative statics analysis from Eqs. (11) and (12) under the symmetric assumption $b=\tilde{b}=B$ confirms the expectation, that is:[6]

$$B_m=\frac{q_b q^2 n^2 f' f''}{m^2 D}>0. \tag{13}$$

Moreover, when the number of firms increases continuously to the extreme case ($m\to\infty$), the free-rider problem is too significant, such that the size of the performance bond will be increased to its limit (because $q_b\to 0$ in Eq. (9) and $\pi_b=n>0$ in Eq. (12)). In this situation, as in Drazen (1986), individual firms are atomistic, taking labor quality as being given and being completely independent of their personnel policies. The result is that each firm has no incentive to restrain itself from increasing the size of the performance bond to its upper limit, and the labor market equilibrium will result in full employment. Therefore, we obtain:

Proposition 4. When there is not only a single firm, and labor quality within an individual firm depends negatively on the average size of the performance bonds in the market, bonding is a 'pure public bad' by nature. Voluntary provisions of public bads will result in inefficient allocation with overprovision, and the problem in relation to average bonding will become more serious as the number of firms increases.

4. The imposition of bonding regulations

In order to seek explanations as to why money wages and salaries seldom decline during recessions, despite high unemployment and intense competition for jobs, Bewley (1999) interviewed more than 300 businesspeople, labor leaders, counselors of the unemployed, and business consultants in the North-eastern United States during the recession of the early 1990s.[7] One request in his interviews with many businesspeople was for a reaction to the bonding issue in the shirking model of efficiency wages. Bewley (1999, chapter 8) in his findings reports that managers dismissed the idea of bonding workers. One important reason for this is that employers consider employment bonds to be illegal. For example, in Connecticut performance bonds are really illegal and prohibited. An immediate question to ask is what is the rationale behind the prohibition on pledged performance bonds.

[6] Here we impose a symmetry condition $b=\tilde{b}=B$ and the second-order conditions for an interior solution $\pi_{nn}=q^2f''<0$ and $D\equiv\pi_{nn}\pi_{rr}-\pi_{nr}\pi_{rn}=mq^2q_{rr}nf'f''-m(m-1)\times(q_rf'+qq_rnf'')^2+(m-1)\times(q_rf')^2>0$ are assumed to be satisfied.

[7] After these interviews, Bewley (1999) reaches a commonsense explanation regarding downward wage rigidity, which is that employers are restrained from cutting pay by the belief that doing so hurts worker morale and decreases labor productivity. For a brief review regarding Bewley's contribution, please see Bewley (1998) and Howitt (2002).

Dickens et al. (1990, p. 168) point out: 'The two most plausible limits on bonding that we have identified—the potential negative impact of bonds on employee morale and the government's unwillingness to enforce contracts with explicit bonds—are sense-related. Both are connected to notions of fairness that lie outside of conventional treatments of the economics of agency and incentives'.[8] In other words, Dickens et al. (1990) suggest that the consideration of fairness is the reason for the government's unwillingness to enforce contracts with explicit bonds. In what follows, this paper provides another rationale based on the view that it is economic efficiency (the negative externalities of bonding), rather than fairness, that is the reason why explicit bonds may not be enforced by the government.

A resulting key feature of this model is that there exist these negative externalities regarding bonding among firms. The presence of the negative externalities implies that the profit-maximizing size of bonds required by individual firms in the market may be too large. Therefore, we expect that a moderate decrease in the size of bonds will increase rather than decrease firms' profits and employment. This can be shown as follows:

The representative firm's profit function under the imposition of bonding ($\bar{b}$) is:

$$\pi = f'\left(q\left(w(\bar{b}),\bar{b}\right)\, n(\bar{b})\right) - w(\bar{b})\, n(\bar{b}), \tag{14}$$

where $w(\bar{b})$ is the no-shirking wage under $\bar{b}$, and $n(\bar{b})$ is the firm's optimal employment solved from Eq. (11) under $\bar{b}=b=\tilde{b}=B$. Applying the envelope theorem from Eq. (14), and using Eqs. (3) and (9), we obtain:

$$\pi_{\bar{b}} = (q_W w_{\bar{b}} + q_B) n f'(qn) - w_b n = m q_b n f' + n. \tag{15}$$

At the profit-maximizing level of bonding, substituting Eq. (12) in Eq. (15) yields:

$$\pi_{\bar{b}} = (m-1) q_b n f' \le 0; \quad \text{under } m \ge 1. \tag{16}$$

That is, in the absence of the negative externalities ($m=1$), the regulation that mandates a marginal decrease in the size of the performance bond will leave the firm's profits unchanged ($\pi_{\bar{b}}=0$). However, as long as the negative externalities exist ($m>1$), the firm's profits will increase ($\pi_{\bar{b}}=(m-1)q_b n f'<0$), and the profit-increasing effect will be greater as the overprovision problem becomes more serious ($\pi_{\bar{b}m}=q_b n f'<0$).

Under bonding regulations, the firm's optimal employment is determined by Eq. (11) under $\bar{b}=b=\tilde{b}=B$. It is:

$$\pi_n = q\left(w(\bar{b}),\bar{b}\right) f'\left(q\left(w(\bar{b}),\bar{b}\right)n\right) - w(\bar{b}) = 0. \tag{17}$$

[8] A similar conclusion also appears in Dickens et al. (1989).

Simple calculation leads to (by using Eqs. (9), (12) and (16)):

$$n_{\bar{b}} = -\frac{mn}{q}q_b + \frac{(m-1)f'}{q^2 f''}q_b = -\frac{mn}{q}\bar{q}_b - \frac{\pi_{\bar{b}}}{q^2 n f''} \gtrless 0. \tag{18}$$

Without these externalities ($m=1$), $\pi_{\bar{b}}=0$, and Eq. (18) becomes:

$$n_{\bar{b}} = -\frac{n}{q}q_b > 0. \tag{18'}$$

In the absence of negative externalities ($m=1$), Eq. (18′) or the first term in Eq. (18) under $m=1$ indicates that bonding regulations interfering with managers' personnel policies will raise the employers' personnel costs and result in decreased employment. In the presence of the externalities, employment may increase. This is because bonding regulations mandate that all firms in the market shall reduce the size of the performance bonds. A smaller bond size required by other firms reduces negative externalities, and so enhances labor quality, which benefits the firm in question by increasing its profits. This results in higher labor productivity and profits, and hence encourages the firm to expand its employment. Each firm facing bonding regulations will reduce other firms' negative externalities according to the symmetry assumption. The presence of these negative externalities implies that the profit-maximizing size of the performance bond required by individual firms may be too large from the viewpoint of employment. This gives rise to the possibility that the introduction of bonding legislation may increase employment. This profit-enhancing effect is captured by the second term in Eq. (18).

Proposition 5. In the absence of negative externalities, the regulation that mandates a marginal decrease in the required bond will leave the firm's profits unchanged, but will lower its employment. In the presence of negative externalities, the regulation may increase the firm's profits and employment.

Since a moderate decrease in the size of the performance bond will increase the (no-shirking) wage and improve labor quality, then by combining this with the above result where the firm's profits and employment may increase, we thus conclude that the introduction of bonding regulations may result in a Pareto improvement over the competitive equilibrium. We conclude that:

Proposition 6. When labor quality within an individual firm is negatively dependent upon the expected income in the market, the regulation on bonding may lead to an increase (rather than decrease) in the wage, labor quality, employment and profits, and result in an equilibrium Pareto superior to the competitive equilibrium.

5. Concluding remarks

From the above analysis, workers care about bonding solely due to their concern about their expected income. However, it is well known that workers place a value

on pecuniary as well as non-pecuniary rewards, and that non-pecuniary rewards include work atmosphere, work morale, and the relationships and interactions among workers, supervisors, and even bosses. Workers may regard the introduction of a bonding scheme and the forfeiture of bonds posted as an intrusion on fairness since the punishment exceeds the crime and signifies a lack of trust in them. A large body of evidence indicates that reciprocity is a powerful determinant of human behavior. People have the desire to be kind to those who have been kind to them, and to be not nice to those who have been unkind to them.[9] Bohnet et al. (2001) and Fehr and Gachter (2000) and Gneezy and Rustichini (2000) all find in their experiments that explicit incentives involving punishments may have counterproductive effects. In terms of this model, the counterproductive effect resulting from the introduction of punitive bonds is best thought of as 'crowding out' the better workers from among the job candidates. This rationale enhances our argument as to why workers place value on the bonding policy of their potential employers.

The insight to be gained from this paper is that when labor quality matters and depends on the expected income in the market, regulations (or even social norms or customs) that restrain the utility of the performance bonds may result in an increased (rather than decreased) wage, labor quality, employment and profits, and lead to a Pareto improvement over the competitive equilibrium. It is worth emphasizing that this paper does not claim that the positive relationship between labor quality and the expected income assumption made in this paper will hold in reality for all types of labor markets. However, as soon as this assumption is met, the results we derive may be applicable. Moreover, one may argue that bonding regulations may be disadvantageous in the short run where labor quality is almost fixed, while the moral hazard problem may become more serious as the law regulates the firm's ability to bond workers. In the long run, the advantages of attracting better quality labor into the market may surpass the disadvantages associated with the moral hazard problem, and bonding regulations may be an effective way at increasing efficiency.

The model in this paper is admittedly rudimentary. In particular, it does not explicitly distinguish between a short-run and a long-run analysis. Whether or not this shirking model can be supported by empirical evidence or laboratory experimental results is also set aside. Nevertheless, it is hoped that the model presented here may well serve as a useful alternative in which the reason why bonding cannot eventually eliminate involuntary unemployment can be potentially explained.

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[9] See Fehr and Gachter (1998, 2000) and the relevant references they cited.

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