Finnish Economic Papers – Volume 11 – Number 2 – Autumn 1998

SCREENING CONTRACTS WHEN INSTITUTIONS MATTER: AN EXAMPLE*

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Based on the notion of affiliation a model is developed which suggests that laws which restrict the firm's flexibility to adjust its employment force resume in higher requirements on potential employees. The paper demonstrates the interaction between the legal structures and individual firm's decision making, herein hiring practices. (JEL D44, D81, K31)

1. Introduction

It is common knowledge that institutions (constraints which operate outside the price system) which impair on the price mechanism can impose constraints on the firm's employment practices (Lazear 1990, 1995). This paper demonstrates the interaction between the legal structures and individual firm's decision making. The aim is to analyze how an introduction of a law that restrains the firm's ability to fire workers affects the firm's requirements on the quality of potential employees.

In 1974 The Employment Act was implemented in Sweden in an attempt to secure the employees on-the-job situation, by offering permanent contracts and enforcing the first in last out principle by law.[1] Empirical evidence suggests that the Employment Act decreased the number of new hires (Holmlund 1978), augmented the transaction costs, and raised the requirements on potential employees (Agell and Lundborg, 1993, 1995).[2] Evidence from Swedish manufacturing firms (a sample of 300 firms) suggests that The Employment Act raises the recruiting costs, makes the employers more careful in screening potential employees and lowers the firm's propensity to higher more individuals in an economic boom (Agell and Lundborg, 1993). In a recent comparative study of employment protection in Sweden and Denmark (Funch, 1998) it is shown that in Denmark the employers have discretion over who to fire in the case of scarcity of work, and in Sweden layoffs are enforced by the first in last out principle unless there have been previous negotiations between the union and the employer. The law in Sweden is semidispositive, which means that there is some freedom as to the implementation of the law but there is not complete free-

* *I wish to thank Paul Milgrom for helpful discussions. I have also benefited from the comments from an anonymous referee. Financial support from STINT is gratefully acknowledged.*

[1] *Some revisions of the law were implemented in 1982. These enabled short term contracts under specific restrictions.*

[2] *Edin and Holmlund (1993) find weak evidence of a decline in the flow of hirings. Bentolila and Bertola (1990) argue that firing costs can reduce both the incentives to hire and to fire workers.*

dom as in the Danish case (or the cases in Norway and Finland).

Herein we develop a model, which is based on the notion of affiliation (Milgrom 1981, Milgrom and Weber, 1982). The model captures how a law which impairs on the firm's flexibility to adjust employment affects the employer's requirements on potential employees.[3] It is shown that under the new law regime the firm hires workers whose quality requirements are higher than before the law. Since the firm's flexibility to adjust its workforce has been limited more is required from the workers the firm hires. The firm's maximization model becomes more constrained in the new law regime. The basic modelling technique is between the quality of a worker and output and is of the same nature as in the 1982 Harris and Holmstrom paper, with the difference that in this paper the learning is different, because learning is coming through affiliation. Other papers which examine the employees first period performance are, for example, Laffont and Tirole (1988) and Garella and Manasse (1996).

2. The Model

Affiliation implies that individual pieces of information can be ordered by favorableness, where a signal is "good news" if it is more favorable than another signal. Affiliation is based on the likelihood ratio property. Monotonicity is assumed. Hence, if a worker is a good quality worker in an initial screening period it is likely that he/she is a good worker in coming periods (Milgrom, 1981). Let a law which impairs on the firm's flexibility to adjust the employment force be enforced. The firm's hiring strategy is assessed by a three period, two-regime model, a before-law and an after-law regime. Period one is a hiring period, period two is a screening period, and period three refers to permanent employment.[4] Assume that the wage is rigid, e.g. preset to some fixed minimum level. Hence, the firm is concerned with the ability to adjust its employment force. In either regime the firm cannot observe the true worker quality at the time of a hire. It offers a short term contract with the option of on-the-job screening.[5] In the before-law regime the worker is either laid off or retained after screening. In the after-law regime the option is to retain the worker. Let R be the decision of retention (retention rule) before the law and $\hat{R}$ the retention decision after the law. Denote the wage ω and the worker ability $\tilde{\theta}$. The worker ability is the quality of the worker at the firm and it is assumed to be a random variable which is associated with firm characteristics and job design. The quality, $\tilde{\theta}$ is assumed to be normally distributed with mean μ and variance $\sigma_{\tilde{\theta}}^2$,

$$(1) \quad \tilde{\theta} \sim N(\mu, \sigma_{\tilde{\theta}}^2)$$

The worker's output X_t in each period, t, is a noisy measurement of the quality

$$(2) \quad X_t = \tilde{\theta} + \varepsilon_t$$

where ε_t is a random variable, which is normally distributed with mean 0 and variance σ_ε^2,

$$(3) \quad \varepsilon_t \sim N(0, \sigma_\varepsilon^2).$$

[3] *The model presented beneath is a first illustration to capture the effects of laws similar to the Employment Act. Simple in its nature and its intuition it can be developed in future work, for example, by treating the wage as an endogenous variable. For simplicity in the exposition the wage is treated exogenously in this paper. However, this assumption is not unfair in a Swedish framework. In practice it is shown that "while underbidding is a necessary prerequisite for flexible wages in the downward direction, it is clearly not a sufficient one. Firms must also be willing to hire them, an occurrence which seems less likely. Among the firms that had at least sometimes in the past been approached by underbidding blue collar workers, 93 percent had always or nearly always rejected the offer. Among the firms that had been approached by underbidding white collar workers, 84 percent had always or nearly always rejected the offer" (Agell and Lundborg, 1993, p. 12). The most common reasons given for the underbidding were that paying lower wages would violate the firm's wage policy and that such workers were considered to have lower skills. What foremost seems to matter in the hiring procedure is the level of skills.*

[4] *The problem investigated here is similar to the case of giving tenure.*

[5] *For models which examine the dynamics of incentive contracts in which the agent's first period performance is examined see for example Laffont and Tirole (1988) and Garella and Manasse (1996). An overview of the theory of contracts is found in Hart and Holmstrom (1987).*

The Optimal Retention Rule

The firm's objective in both regimes is to maximize expected profits. Denote the firm's expected profit at time t, V_t.

• *Before-law regime*

At $t = 1$, an applicant is hired (retained) if $V_1 > 0$, not hired (retained) if $V_1 \leq 0$. At $t = 2$, an applicant is retained if $V_2 > 0$, not retained if $V_2 \leq 0$.

• *After-law regime*

At $t = 1$, an applicant is hired if $\hat{V}_1 > 0$, not hired if $\hat{V}_1 \leq 0$.

In the after-law regime the firm is constrained in its maximization problem. Under the above assumptions, the firm's expected profit at the end of each period can be expressed in terms of X_1, X_2 and w. At $t = 2$, the expected profit of the third period in the before-law regime is

$$(4) \quad V_2(X_1, X_2) = \max[0, \mathrm{E}\{X_3 - w \mid X_1, X_2\}],$$

which is an increasing function of X_1 and X_2. The firm's profit when it fires a worker is zero. By keeping a worker the value is $\mathrm{E}\{X_3 - w \mid X_1, X_2\}$. At t = 1, the firm's expected profit from periods two and three in the same regime is

$$(5) \quad V_1(X_1) = \max[0, \mathrm{E}\{X_2 - w \mid X_1\} + \mathrm{E}\{V_2\}].$$

The assumption that X_t is normally distributed implies that the X_t's are affiliated over time (Milgrom and Weber, 1982), i.e. higher values of X_1 make higher values of X_2 relatively more likely.

Proposition 1: If the variables X_1 and X_2 are affiliated and f is an increasing function, then $\mathrm{E}\{f(X_1, X_2) \mid X_1 = x_1\}$ is an increasing function of x_1.

Then by affiliation $V_1(X_1)$ in (5) is an increasing function of X_1. In the after-law regime at $t = 1$, the expected profit of periods two and three is

$$(6) \quad \hat{V}_1(X_1) = \max[0, \mathrm{E}\{X_2 - w + X_3 - w \mid X_1\}]$$

and at $t = 2$,

$$(7) \quad \hat{V}_2(X_1, X_2) = \mathrm{E}\{X_3 - w \mid X_1, X_2\}.$$

The threshold, R is the firm's requirement when applying the retention (hiring) rule. The firm's problem is to find a retention decision R_1, R_2 in the before-law regime and $\hat{R}_1$ in the after-law regime. The worker is retained after periods one and two in the before-law case and period one in the after-law case. We wish to show that the retention decision is increasing in X_1 and X_2 and further, that the retention decision is monotone in worker output in period t.

Proposition 2: In the before-law regime, the retention rule is of the form retain if $X_1 > R_1$ at $t = 1$ and, $X_1 + X_2 > R_1 + R_2$ at $t = 2$ where $R_1 + R_2 = [w - b\mu]/a$. In the after-law regime, the rule is of the form $X_1 > \hat{R}_1$ at $t = 1$, where $\hat{R}_1 = \dfrac{w - \hat{b}\mu}{\hat{a}}$.

Proof: The proof is given in several steps.

Before-law regime

The firm retains a worker if $V_2(X_1, X_2) > 0$. This is true if,

$$(8) \quad \begin{aligned} \mathrm{E}\{X_3 - w \mid X_1, X_2\} &= \mathrm{E}\{\tilde{\theta} + \varepsilon_3 \mid X_1, X_2\} - w \\ &= \mathrm{E}\{\tilde{\theta} \mid X_1, X_2\} - w > 0 \end{aligned}$$

where ε_t and $\tilde{\theta}$ are independently distributed. Thus, the conditional expectation must be greater than the wage. It is shown in Appendix A that

$$(9) \quad \mathrm{E}\{\tilde{\theta} \mid X_1, X_2\} = a(X_1 + X_2) + b\mu$$

where $a = \dfrac{\sigma_\theta^2}{\sigma_\varepsilon^2 + 2\sigma_\theta^2}$ and $b = \dfrac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 2\sigma_\theta^2}$. It then follows that,

$$(10) \quad X_1 + X_2 > [w - b\mu]/a = R_1 + R_2$$

which proves one part of our theorem.

The worker is hired at $t = 1$ if $V_1(X_1) > 0$. This implies,

$$(11)\quad \mathrm{E}\{X_2 - w \mid X_1\} + \mathrm{E}\{V_2\}$$
$$= \mathrm{E}\{\tilde{\theta} + \varepsilon_2 \mid X_1\} - w$$
$$+ \mathrm{E}\{\max[0, a(X_1 + X_2) + b\mu - w]\}$$
$$= \bar{a}X_1 + \bar{b}\mu - w$$
$$+ \mathrm{E}\{\max[0, aX_1 + aX_2 + b\mu - w]\}$$
$$= \bar{a}X_1 + \bar{b}\mu - w$$
$$+ \int_{X_2 = \frac{w - aX_1 - b\mu}{a}}^{\infty} (aX_1 + aX_2 + b\mu - w) \times$$
$$\times f_{X_2}(X_2)\, dX_2$$

$$(12)\quad > 0,$$

where $\bar{a} = \dfrac{\sigma_\theta^2}{\sigma_\varepsilon^2 + \sigma_\theta^2}$ and $\bar{b} = \dfrac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_\theta^2}$. The expression in (12) defines R_1. In general, an explicit expression cannot be obtained since X_2 is a normally distributed random variable. However, since $V_1(X_1)$ is an increasing function, $V_1(X_1)$ is positive if and only if $X_1 > R_1$. Thus, the rule is of the form $X_1 > R_1(\sigma_\theta, \sigma_\varepsilon, w)$.

After-law regime

The worker is hired if $\hat{V}_1(X_1) > 0$. Then,

$$(13)\quad \mathrm{E}\{X_2 - w + X_3 - w \mid X_1\}$$
$$= \mathrm{E}\{\tilde{\theta} + \tilde{\theta} \mid X_1\} - 2w =$$
$$= \mathrm{E}\{\tilde{\theta} \mid X_1\} + \mathrm{E}\{\tilde{\theta} \mid X_1\} - 2w$$
$$= 2(\bar{a}X_1 + \bar{b}\mu) - 2w > 0.$$

Thus, $X_1 > \dfrac{(w - \bar{b}\mu)}{\bar{a}} = \hat{R}_1$. This completes our proof.

Proposition 3: The reservation quality in the after-law regime is greater than in the before-law regime, $\hat{R}_1 > R_1$.

Intuitively this proposition is always true. The employer sets a higher reservation quality in the after-law regime than in the pre-law regime, because all hired workers are retained after the screening period 2.[6] Next, we compare the two regimes, by comparing $V_1(X_1)$ with $\hat{V}_1(X_1)$. It is crucial to our model that the worker in the after-law regime cannot be fired. In our model at $t = 1$, the value of the firm in the before-law period is

$$(14)\quad V_1(X_1) = \max[0, \mathrm{E}\{X_2 - w \mid X_1\}$$
$$+ \mathrm{E}\{\max[0, \mathrm{E}\{X_3 - w \mid X_1, X_2\}]\}$$
$$= \max[0, \mathrm{E}\{X_2 - w \mid X_1\}$$
$$+ \mathrm{E}\{\max[0, \mathrm{E}\{X_3 - w \mid X_1, X_2\}] \mid X_1\}],$$

where expression (4) has been substituted into expression (5). In the after-law regime at $t = 1$, the expected value is

$$(15)\quad \hat{V}_1(X_1) = \max[0, \mathrm{E}\{X_2 - w + X_3 - w \mid X_1\}$$
$$= \max[0, \mathrm{E}\{\mathrm{E}\{X_2 - w + X_3 - w \mid X_1, X_2\}\}]$$
$$= \max[0, \mathrm{E}\{X_2 - w \mid X_1\}$$
$$+ \mathrm{E}\{\mathrm{E}\{X_3 - w \mid X_1, X_2\} \mid X_1\}].$$

This is obtained through a substitution of expression (7) into expression (6). Comparing (4) and (7), the firm's expected value at $t = 2$ in the before-law case exceeds the value in the post-law regime, thus $V_2 > \hat{V}_2$. Comparing (14) and (15) it also follows that $V_1 > \hat{V}_1$. Since V_1 and $\hat{V}_1$ are increasing functions and $V_1 > \hat{V}_1$ it follows that $\hat{R}_1 > R_1$ which proves Proposition 3. In the after-law regime sharpened hiring requirements restrict the firm's hiring/firing options and encourage flexible screening device contracts. Then, the reservation quality should be higher in comparison with the before-law situation.[7]

[6] *If we consider the marginal worker, then any information that induces a change in the employment flexibility is valuable to the firm. Anything that adds to uncertainty will sustain this condition.*

[7] *For a numerical example see Appendix B. Further our results are valid given the assumption that the wage is the same under both regimes. However, if the wage is allowed to be adjusted it is likely to be lower for potential low quality workers. Under riskaversion the workers may be willing to accept a lower wage under the premises of guaranteed job safety theoretically, although as previously argued this scenario is unlikely in a Swedish framework. Finally, although the results from our model seem intuitively highly plausible given the setup of the model, we argue that the learning through affiliation is a simple, sustainable and innovative characteristic in the model. Further, it is the first attempt to give a theoretical approach to the empirical findings with respect to the introduction of the Employment Act in Sweden.*

3. A Concluding Remark

The presence of institutional restrictions, which impair on the firm's employment flexibility can give rise to higher requirements on labor quality. It is shown here that under the presence of the Swedish Employment Act with a strict implementation of the layoff rules, the firm hires workers whose quality requirements are higher than before the law. Paradoxically, the law which intended to provide benefits to the employees seems only to benefit individuals who either are already hired, or are higher quality workers. Higher quality workers increase their chances of being hired. The new regime is likely to decrease the welfare of those with poor qualifications and deprive them from entering the labor market. Hence, the welfare of workers and firms in a "welfare state" may decrease under the introduction of a law like the Employment Act.

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Appendix A

The conditional density function of θ given X_1 and X_2 is

$$(16)\quad f_{\theta \mid X_1,X_2}(\theta) = \frac{f_{\theta,X_1,X_2}(\theta,x_1,x_2)}{f_{X_1,X_2}(x_1,x_2)} = \frac{f_\theta(\theta) f_{X_1,X_2 \mid \theta}(x_1,x_2)}{\int_{-\infty}^{\infty} f_{\theta,X_1,X_2}(\theta,x_1,x_2)d\theta}$$

ε_1 is independent of ε_2, thus

$$(17)\quad f_{\theta \mid X_1,X_2}(\theta) = \frac{f_\theta(\theta) f_{X_1 \mid \theta}(x_1) f_{X_2 \mid \theta}(x_2)}{\int_{-\infty}^{\infty} f_\theta(\theta) f_{X_1 \mid \theta}(x_1) f_{X_2 \mid \theta}(x_2)d\theta}.$$

Examine

$$(18)\quad f_\theta(\theta) f_{X_1 \mid \theta}(x_1) f_{X_2 \mid \theta}(x_2) = \frac{1}{\sigma_\theta\sqrt{2\pi}} e^{\frac{-(\theta-\mu)^2}{2\sigma_\theta^2}} \frac{1}{\sigma_\epsilon\sqrt{2\pi}} e^{\frac{-(x_1-\theta)^2}{2\sigma_\epsilon^2}} \frac{1}{\sigma_\epsilon\sqrt{2\pi}} e^{\frac{-(x_2-\theta)^2}{2\sigma_\epsilon^2}}$$

$$= \frac{1}{2\pi\sigma_\epsilon\sqrt{\sigma_\epsilon^2 + 2\sigma_\theta^2}\sqrt{2\pi}\bar{\sigma}} e^{\frac{-(\theta-\bar{\mu})^2}{2\bar{\sigma}^2}} e^{-\bar{c}} = Cg(\theta)$$

here

$$(19)\quad \bar{\mu} = \frac{\mu\sigma_\epsilon^2 + (x_1 + x_2)\sigma_\theta^2}{\sigma_\epsilon^2 + 2\sigma_\theta^2}$$

$$(20)\quad \bar{\sigma}^2 = \frac{2\sigma_\theta^2\sigma_\epsilon^2}{\sigma_\epsilon^2 + 2\sigma_\theta^2}.$$

and C is independent of θ;

$g(\theta)$ is a normal density with mean $\bar{\mu}$ and variance $\bar{\sigma}^2$. Thus,

$$(21)\quad \begin{aligned} \mathrm{E}\{\theta \mid X_1, X_2\} &= \int_{-\infty}^{\infty} f_{\theta \mid X_1, X_2}(\theta) \\ &= \frac{C\int_{-\infty}^{\infty}\theta g(\theta)d\theta}{C\int_{-\infty}^{\infty} g(\theta)d\theta} = \bar{\mu}. \end{aligned}$$

Appendix B

We have already shown how the two regimes, before-law and after-law regime, encourage employers to adopt different recruitment behavior. Next we compare the expected values given by expressions (14) and (15) in more detail. Let the random variable X_1 be the outcome in the first period. To make a comparison between the two regimes we assume a certain distribution. The distribution is the same in both regimes in order to undertake a comparison in the same state of the world. Then it is sufficient to compare

$$(22)\quad \mathrm{E}\{\max[0, \mathrm{E}\{X_3 - w \mid X_1, X_2\}]\}$$

the before-law value with

$$(23)\quad \mathrm{E}\{\mathrm{E}\{X_3 - w \mid X_1, X_2\}\}$$

the after-law value. Since $\mathrm{E}\{X_3 - w \mid X_1, X_2\}$ is a random variable ξ that is normally distributed with mean μ and variance σ^2, $N(\mu, \sigma)$, we compare $\mathrm{E}\{\max[0, \xi]\}$ with $\mathrm{E}\{\xi\}$.

Thus,

$$(24)\quad \begin{aligned} \mathrm{E}\{\max[0,\xi]\} &= \int_{-\infty}^{\infty} \max[0,\xi] f(\xi)d\xi = \int_0^{\infty} \xi f_{N(\mu,\sigma)}(\xi)d\xi \\ &= \int_{-\frac{\mu}{\sigma}}^{\infty} (\sigma\xi + \mu) f_N(0,1)(\xi)d\xi \\ &= \sigma f_{N(0,1)}(-\frac{\mu}{\sigma}) + \mu(1 - F_{N(0,1)}(-\frac{\mu}{\sigma})) \\ &= \sigma f_N(0,1)(\frac{\mu}{\sigma}) + \mu(1 - F_{N(0,1)}(-\frac{\mu}{\sigma})) \end{aligned}$$

where $f_{N(\mu,\sigma)}(\xi) = \dfrac{1}{\sqrt{2\pi\sigma}}\, e^{-\frac{(\xi-\mu)^2}{2\sigma^2}}$ and $F_{N(\mu,\sigma)}(t) = \int_{-\infty}^{t} f_{N(\mu,\sigma)}(\xi)d\xi$.

In Figure 1, $E\{\max[0, \xi\}$ is plotted versus $E\{\xi\}$, comparing $\frac{E\{\max[0, \xi]\}}{\sigma}$ with $\frac{E(\xi)}{\sigma}$. The numerical solution has been obtained using a normal distribution approximation (Drake, 1967).[8] Suppose we have a case where the mean is negative, relative to some nominal value. This implies a low X_1, which means that the worker is a low performance worker. In the before-law case, this worker could have been fired. In the after-law case, this option is not available to the employer and the employee is retained. If on the other hand the worker is a high performance worker the difference between the two regimes is small. In the after-law regime, it is beneficial to the employer to set higher requirements in order to eliminate some uncertainty in making a hiring decision. However, it is shown here that the expected profit of the firm in the before-law regime still will exceed the expected profit in the after-law regime. This is in particular the case when the employer hires a low productivity worker.

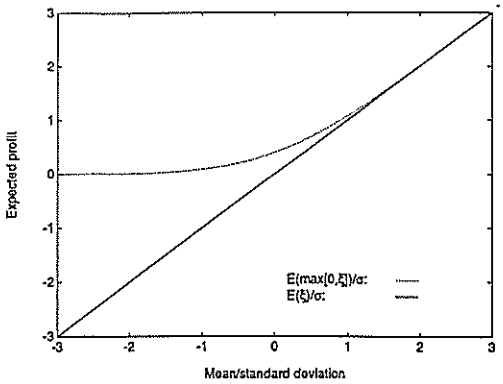

Figure 1. Evaluation of $\frac{E\{\max[0,\xi]\}}{\sigma}$ and $\frac{E(\xi)}{\sigma}$.

[8] *This approximation is of the form:*

(25) $P(x) = 1 - Z(x)(b_1 t + b_2 t^2 + \ldots b_5 t^5]$, $t = \frac{1}{1 + px}$,

and $|\varepsilon(x)| < 7.5 \times 10^{-8}$, *where* P, b_1, b_2, b_3, b_4, b_5 *as given in Abromowitz and Stegun (1972).*