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The Optimal Level of Privacy Protection in Job Applications

Name student: S.H. Huang

Student ID number: 413619

Supervisor: B.S.Y. Crutzen

Second assessor: J.J.A. Kamphorst

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Abstract What are the costs and benefits associated with privacy? How much disclosure of personal information is desirable? This paper investigates the privacy trade-off in a setting of job applications. The paper develops a model that shows how privacy protection affects the profits of an employing firm. The main finding of the model is that there is a positive relationship between the productivity of job applicants and the optimal level of privacy protection.

1. Introduction

Privacy concerns heavily take part of the current century's public debate. Individuals tend to care about the privacy of their personal information and are sometimes even willing to incur costs to conceal such information. However, personal information is often valuable to firms – that is, firms are sometimes willing to incur costs to discover such information.

This paper applies the issue of privacy concerns to a setting of job applications. When determining the optimal level of privacy protection in job applications, employing firms face a certain trade-off. On the one hand, increasing the privacy protection decreases the availability of personal information from job applicants. This could make it more difficult for employers to select employees that match the firm well. On the other hand, increasing privacy protection might make the employing firm more attractive to job applicants that have privacy concerns. As privacy protection allows job applicants to share less personal information, job applicants with privacy concerns derive more utility from a higher level of privacy protection.

To examine the optimal level of privacy for employing firms, the paper starts with investigating the effect of privacy protection on the participation constraint of workers. Afterwards, the paper examines the effect of privacy protection on the assessment of job applicants. To find an expression for the optimal level of privacy protection, I look into the maximization problem of employing firms.

The paper finds that increasing the level of privacy protection has an ambiguous effect on firm profits. First, it lowers the wage rates that employing firms have to offer to job applicants to meet their participation constraint. Second, the efficiency of the employing firm might go down because it is more likely that less suitable workers are hired. The main finding of the model is that the higher the share of suitable workers among the job applicants, the more optimal it becomes for an employing firm to choose a higher level of privacy protection.

The rest of this paper is structured as follows. Section 2 presents the related literature. Section 3 introduces the model. The model consists of three parts. The first two parts examine the effect of privacy protection on employees and employing firms. The third part presents the maximization problem of employing firms when choosing the level of privacy protection. Section 4 contains the results of the model. Section 5 discusses the modelling assumptions and the results. Section 6 provides the conclusion of the paper and provides recommendations for future research.

2. Related literature

In the late 1970s and early 1980s, privacy was introduced in the field of economics by 'the Chicago School of Economics'[1]. The earliest economic analyses of privacy mainly considered privacy as a source of economic inefficiency. Both Posner (1978) and Stigler (1980) argue that the protection of privacy leads to the concealment of possible relevant information, which could cause inefficiencies in the marketplace.

[1] The Chicago School of Economics is a neoclassical school of economic thought that originated at the University of Chicago in the 1940s. The main principle of the Chicago School is that free markets will lead to optimal allocations of resources and that government intervention should be minimal. For an extensive discussion of the Chicago School, see, for example, Emmett (2010).

Hence, they concluded that privacy regulation is not needed – the free market will result in the optimal equilibrium between privacy protection and information sharing.

Recent research also focuses on the advantages of privacy protection. For instance, Hui and Png (2006) point out that the critique on privacy from the Chicago School of Economics ignores the increase in utility that individuals derive from privacy protection. By overlooking the negative externalities associated with the use of personal information, the free market approach from the Chicago School of Economics might not lead to the presumed optimal allocation of it. Gradwohl and Smorodinsky (2017) theoretically show that when privacy concerns are taken into account, maintaining privacy could indeed lead to an increase in welfare.

The main point of view in the recent literature on the economics of privacy is that privacy protection has both advantages and disadvantages. The paper of Acquisiti, Taylor and Wagman (2016) discusses that issues of privacy are present in widely diverse contexts, and hence, the effect of privacy protection on welfare differs between situations.

In the situation of hiring decisions, employers face a fundamental economic problem that stems from asymmetric information. Potential employees could have an incentive to misrepresent their qualifications, which makes it more difficult for employers to select the most suitable job applicants. For instance, it is common that potential employees polish resumes by overstating experiences (Oyer & Schaefer, 2010). Because much of the characteristics of job applicants are unknown, employers face difficulties when they select job applicants to fill vacant positions.

There are many hiring strategies that firms use to overcome the difficulties from selecting the 'right' employee. For instance, firms try to induce self-selection of employees (see, for example, Salop & Salop (1976)) or make use of labour-market intermediaries (see, for example, Autor (2009)). In this paper I focus on using a low level of privacy protection to make the right hiring decisions.

Privacy protection allows job applicants to conceal potentially relevant information for employers, and hence, it might create inefficiencies in the marketplace (see, for example, Posner (1981)). For instance, it is easier for job applicants to misrepresent their background and exaggerate their expertise to hiring firms if their personal information is protected. A lower level of privacy protection allows the employer to obtain more information from job applicants. Thus, employers are better able to determine which job applicants suit the firm the best if the level of privacy protection is lower.

3. Model

This section presents the model of the paper. The first part shows how privacy protection affects the participation constraint of job searchers by incorporating disutility from a low level of privacy protection in the utility function of a worker. The second part shows how privacy protection affects the accuracy of the screening process. The third part incorporates the effect of privacy protection in the maximization problem that employing firms face when choosing the level of privacy protection in job applications.

3.1 The Participation Constraint of the Worker

Suppose that there is an individual that is seeking employment, a job searcher. Assume that the job searcher faces privacy costs c^p when he applies for a job. The privacy costs represent the disutility that job searchers derive from having to share personal information during job applications. By setting 'a level of privacy protection', firms ensure that the job searcher's costs of privacy are bounded from above. Hence, the privacy costs depend on the level of privacy protection $p \in [0,1]$ of the firm that the job searcher applies to. The lower the level of privacy protection, the more personal information the applicant has to share with the firm. Assuming that individuals dislike sharing personal information during job applications,[2] there is a negative relationship between the level of privacy protection and the privacy costs that a job applicant incurs,

Assumption 1. $\frac{\partial c^p(p)}{\partial p} < 0.$

More specifically, assume that the costs of privacy are given as,

$$c^p(p) = \frac{(1-p)^2}{2}. \tag{1}$$

Once a job searcher finds a vacancy, he observes the wage rate and the level of privacy protection of the employing firm. Then, the job searcher decides whether he wants to apply to the vacancy or not. Assume that the job searcher can derive the privacy costs accompanying the level of privacy protection of the hiring firm, i.e. the job searcher knows the cost function of privacy given in equation (1).

[2] For example, Westin (2001) supports this assumption by providing empirical evidence that individuals are indeed concerned about their privacy.

In the standard model of agency theory, a worker's utility function is usually modelled as a function of the wage and the exerted effort, where a worker is assumed to dislike effort exertion (see, for example, Lazear (1995)). Next to the wage and costs of effort, I include the privacy costs in the utility function of a worker. Denote the utility (U) that a job searcher derives from a job as the wage offer (w) minus the costs of effort (c^e) and the costs of privacy (c^p).

$$U = w - c^p - c^e \tag{2}$$

Assume that the job searcher's outside option is 0. A job searcher applies for a particular job once the utility that he derives from that job is higher than the utility from the outside option. Hence, a worker's participation constraint for a particular job is denoted as,

$$U \geq 0, \tag{3}$$

$$w - c^p - c^e \geq 0. \tag{4}$$

The participation constraint shows that firms have to compensate a worker with a higher wage rate if the privacy costs of a worker increases. An increase in the level of privacy protection therefore allows firms to offer a lower wage rate to workers.

3.2 The Assessment of a Worker's Productivity

Suppose that there are two types of job applicants: a high-productivity worker and a low-productivity worker. The job applicant's type is given by $\theta \in \{\theta_H, \theta_L\}$, where θ_H is the high-productivity worker and θ_L is the low-productivity worker. An employer cannot observe the type of a job applicant, but he knows that a job applicant is a high-productivity type (θ_H) with probability α and a low-productivity type (θ_L) with probability $1-\alpha$. Suppose that workers of type θ_H produce q units of output, whereas workers of type θ_L produce none. Employing firms want to hire high-productivity workers because they are productive and help the firm with generating profits.

Whenever firms are matched to a job applicant, a screening process follows. After the screening process, firms receive a 'signal' s about the worker's type. Assume that the probability that the signal is correct depends on the level of privacy protection.

$$x^H(p) = \Pr(s = \theta_H | \theta = \theta_H) \tag{5}$$

$$x^L(p) = \Pr(s = \theta_L | \theta = \theta_L) \tag{6}$$

The probability that a firm correctly assesses the job applicant as a high-productivity type is denoted by x^H, and the probability that the firm correctly assesses the job applicant as a low-productivity type is denoted by x^L. The higher the level of privacy protection, the more difficult it is for the firm to assess the job applicant's type. This implies that there is a negative relationship between the level of privacy protection and the accuracy of a job applicant's productivity assessment.

Assumption 2. $\frac{\partial x^H(p)}{\partial p} < 0$ and $\frac{\partial x^L}{\partial p} < 0$.

More specifically, denote the probability that the assessment of a job searcher's type is correct as,

$$x^H(p) = 1 - p, \tag{7}$$

$$x^L(p) = 1 - p. \tag{8}$$

Firms only offer a job applicant a job contract once they receive a signal that the worker is of the high-productivity type. The hiring strategy of employing firms has the following form.

$$\text{Hiring strategy}\begin{cases} \text{hire if } s = \theta_H \\ \text{do not hire if } s = \theta_L \end{cases} \tag{9}$$

Then, the chance that a firm hires a high-productivity worker is,

$$\Pr(\theta = \theta_H | s = \theta_H) = \frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)p}. \tag{10}$$

The derivation of equation (10) is provided in the appendix. As the signal is more accurate when privacy protection is low, the chance that a firm hires a high-productivity worker decreases in the level of privacy protection. This is shown as the first derivate of the probability that a firm hires a high-productivity worker is negative.

$$\frac{\alpha(\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^2} \leq 0 \tag{11}$$

3.3 The Maximization Problem of Employing Firms

Assume that employing firms have all the bargaining power, which implies that the firms receive all rent from the transaction. Thus, employing firms can put workers on their participation constraint (equation (4)), such that the job contract that they offer satisfies,

$$w - c^p - c^e = 0. \tag{12}$$

Combining equation (1) and (12), the wage that the firm offers to a worker satisfies,

$$w = \frac{(1-p)^2}{2} + c^e. \quad (13)$$

Similar as in the model of Hermalin and Katz (2006), denote the profits that an employing firm gets by hiring a certain employee as,

$$\pi = \theta q - w, \quad (14)$$

where $\theta \in \{\theta_H, \theta_L\}$ is the realized type of the hired worker, q denotes the marginal revenue product and w denotes the wage rate. Combining equations (13) and (14), and given that firms only offer a job contract to applicants for whom they receive a signal that the job applicant is a high-productivity type, I denote the expected profits that an employing firm gets from the hired employee as,

$$\pi = \frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)p} q - \frac{(1-p)^2}{2} - c^e. \quad (15)$$

Assume that there are more high-productivity job applicants than low-productivity job applicants. That is, the probability that a job applicant is a high-productivity type is restricted to the range $\left[\frac{1}{2}, 1\right]$.

Assumption 3. $\alpha \in \left[\frac{1}{2}, 1\right]$.

To ensure that profits are positive in equilibrium, this implies that employing firms are looking for workers who satisfy,

$$q \geq \frac{1-p}{2} + \frac{c^e}{1-p}. \quad (16)$$

The derivation of equation (16) is provided in the appendix.

To choose the optimal level of privacy protection, firms maximize the profit function in equation (15) with respect to the level of privacy protection p. The first-order condition for profit maximization when setting a level of privacy protection is as follows,

$$\frac{\alpha(\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^2} q = p - 1. \qquad (17)$$

The derivation of the first-order condition is provided in the appendix.

To check whether the first-order condition indeed maximizes firm profits, the second-order condition of profit maximization must be satisfied as well.

$$\frac{2\alpha(\alpha-1)(2\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^3} q < 1 \qquad (18)$$

The derivation of the second-order condition is provided in the appendix. Note that the second-order condition is satisfied as α is restricted to $\alpha \in \left[\frac{1}{2}, 1\right]$.

4. Results

The profit maximizing condition in equation (17) shows that firms face a trade-off when choosing the level of privacy protection in job applications. On the one hand, an increase in the level of privacy protection allows firms to set a lower wage, which leads to higher profits for the firm. On the other hand, an increase in the level of privacy protection makes it more difficult for firms to assess a job applicant's productivity, which leads to more wrong hiring decisions being taken, and hence, to lower profits.

The main finding of the model is that there is a positive relationship between the share of high-productivity job applicants (α) and the optimal level of privacy protection (p). The more high-productivity job applicants compared to low-productivity applicants, the more optimal it becomes to choose a higher level of privacy protection. The intuition is as follows, if the share of high-productivity job applicants increases, it becomes easier for the firms to select the high-productivity workers, even with high privacy protection. Hence, the benefits from lowering privacy protection become less important compared to the benefits of increasing privacy protection (being able to offer lower wages). This makes it more optimal to choose a higher level of privacy protection if the pool of high-productivity job applicants is large.

Next, consider the specific case where the probability that a job applicant is a low-productivity type is the same as the probability that a job applicant is a high-productivity type ($\alpha = \frac{1}{2}$). In this case it is optimal for the firm to set the level of privacy protection such that $p = \max\{0, 1 - q\}$. The more productive a high-productivity worker is, the lower the optimal level of privacy protection. The intuition is as follows, the higher the productivity of a high-productivity worker, the more important it becomes to select high-productivity workers because they contribute more to the profits. This translates to an increase in the benefits of a low level of privacy protection compared to the costs, and hence, the higher the productivity of high-productivity workers, the more important it becomes to select high-productivity workers than it is to save on the wage costs.

Another specific case is when a job applicant is always a high-productivity type ($\alpha = 1$). The findings for this case are quite straightforward as decreasing the level of privacy protection does not increase the chance of hiring a high-productivity worker. As there are no benefits from decreasing privacy protection, it is optimal to maximize the level of privacy protection ($p = 1$), such that the employing firm can minimize the wage costs.

5. Discussion

The model of the paper makes several assumptions that have implications for the interpretation of the results. First, the model assumes for simplicity that employing firms have all the bargaining power. This might hold for firms that are a monopsony in the labour market, but in reality employers often face competition from other employers when hiring workers. The wage offer in the model of the paper is therefore likely to be lower than in real case scenarios. However, the relationship between privacy protection and the share of high-productivity workers that the paper finds is likely to be still the same when employing firms are assumed not to have all the bargaining power.

Second, the findings of the model are restricted to $\alpha \in \left[\frac{1}{2}, 1\right]$ to satisfy the second-order condition for profit maximization. That is, the findings of the model only apply to employing firms that are able to select more high-productivity job applicants than low-productivity job applicants. As recruitment departments of firms strive to only select suitable employees for the application rounds, the findings are still likely to be relevant for most employing firms.

6. Conclusion

This paper studied the maximization problem of an employing firm when choosing the level of privacy protection in job applications. The main finding of the paper is that it becomes more optimal for firms to choose a higher level of privacy protection once the share of high-productivity job applicants is higher. This suggests that employing firms should try to select high-productivity workers for the application process, such that they can increase the level of privacy protection, which in turn allows them to offer lower wage rates. For future research it could therefore be interesting to investigate recruitment strategies to attract high-productivity workers to a firm.

Furthermore, it is recommended for future research to investigate whether the findings in this paper are supported by empirical evidence. For instance, it could be interesting to analyse whether higher levels of privacy protection are observed at firms that have stricter recruitment procedures, or whether there indeed is a negative relationship between firm profits and the level of privacy protection.

Lastly, this paper does not look at welfare implications. Although the paper takes the utility that job applicants might derive from a higher level of privacy into account, the model focuses on the profit maximization of a firm which might have different results from welfare maximization. For future research it could be interesting to extend the analysis of this paper to the relationship between social welfare and the level of privacy protection in job applications.

Appendix

Derivation of Equation (10)

The probability that the firm hires a high-productivity worker is derived by using Bayes' rule (Bayes & Price, 1763).

$$\Pr(\theta = \theta_H | s = \theta_H) = \frac{\Pr(s = \theta_H | \theta = \theta_H)\Pr(\theta = \theta_H)}{\Pr(s = \theta_H)}$$

$$= \frac{\Pr(s = \theta_H | \theta = \theta_H)\Pr(\theta = \theta_H)}{\Pr(s = \theta_H | \theta = \theta_H)\Pr(\theta = \theta_H) + \Pr(s = \theta_H | \theta = \theta_L)\Pr(\theta = \theta_L)}$$

$$= \frac{\alpha(1-p)}{\alpha(1-p) + (1-\alpha)p}$$

Derivation of Equation (16)

The profit function of an employing firm is given in equation (15).

$$\pi = \frac{\alpha(1-p)}{\alpha(1-p) + (1-\alpha)p} q - \frac{(1-p)^2}{2} - c^e$$

Assuming that $\alpha \in \left[\frac{1}{2}, 1\right]$, it is ensured that the profit function is positive in equilibrium once the profit function is positive for the specific case $\alpha = \frac{1}{2}$. For $\alpha = \frac{1}{2}$, the profit function equals,

$$\pi = (1-p)q - \tfrac{(1-p)^2}{2} - c^e.$$

Then, the profit function is positive if,

$$(1-p)q - \tfrac{(1-p)^2}{2} - c^e \geq 0,$$

$$(1-p)q \geq \tfrac{(1-p)^2}{2} + c^e,$$

$$q \geq \tfrac{1-p}{2} + \tfrac{c^e}{1-p}.$$

Derivation of the First-Order Condition in Equation (17)

The profit function of an employing firm is given in equation (15).

$$\pi = \frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)p}q - \frac{(1-p)^2}{2} - c^e$$

Take the first derivative of the profit function with respect to the level of privacy protection p.

$$\frac{\partial\pi}{\partial p} = \frac{-\alpha(\alpha(1-p)+(1-\alpha)p) - \alpha(1-p)(-2\alpha+1)}{(\alpha(1-p)+(1-\alpha)p)^2}q - (p-1)$$

$$= \frac{-\alpha(\alpha-\alpha p+p-\alpha p) - \alpha(-2\alpha+1+2\alpha p-p)}{(\alpha(1-p)+(1-\alpha)p)^2}q - p + 1$$

$$= \frac{-\alpha^2+\alpha^2 p-\alpha p+\alpha^2 p+2\alpha^2-\alpha-2\alpha^2 p+\alpha p}{(\alpha(1-p)+(1-\alpha)p)^2}q - p + 1$$

$$= \frac{\alpha^2-\alpha}{(\alpha(1-p)+(1-\alpha)p)^2}q - p + 1$$

$$= \frac{\alpha(\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^2}q - p + 1$$

To find the first-order condition, set the first derivative equal to zero.

$$\frac{\partial\pi}{\partial p} = 0$$

$$\frac{\alpha(\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^2}q - p + 1 = 0$$

$$\frac{\alpha(\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^2}q = p - 1$$

Derivation of the Second-Order Condition in Equation (18)

The first derivative of the profit function with respect to the level of privacy protection p is given in the derivation above.

$$\frac{\partial\pi}{\partial p} = \frac{\alpha(\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^2}q - p + 1$$

The second derivative of the profit function with respect to the level of privacy protection is,

$$\frac{\partial^2 \pi}{\partial p^2} = -\frac{\alpha(\alpha-1)\cdot 2(\alpha(1-p)+(1-\alpha)p)(1-2\alpha)}{(\alpha(1-p)+(1-\alpha)p)^4} q - 1$$

$$= -\frac{\alpha(\alpha-1)\cdot 2(1-2\alpha)}{(\alpha(1-p)+(1-\alpha)p)^3} q - 1 = \frac{2\alpha(\alpha-1)(2\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^3} q - 1$$

Then, the second-order condition requires the second derivative to be negative.

$$\frac{\partial^2 \pi}{\partial p^2} < 0$$

$$\frac{2\alpha(\alpha-1)(2\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^3} q - 1 < 0$$

$$\frac{2\alpha(\alpha-1)(2\alpha-1)}{(\alpha(1-p)+(1-\alpha)p)^3} q < 1$$

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