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Promotion Policies at Different Firms

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Abstract

A large body of research shows that in an economy characterized by asymmetric learning, promoting a worker serves as a signal of his ability. In the present paper, we show that the signals generated by promotion by two firms differ if those firms have different production functions since those firms promote workers of different abilities. Hence, if the production function differs across sectors then workers have different wages following a promotion, different probabilities of being promoted and different wages prior to the promotion stage in each sector. These differences do not arise in an economy without asymmetric information.

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1. Introduction

A large body of empirical evidence shows the existence of wage differentials by sector (Gibbons et al., 2005; Heckman and Scheinkman, 1987; Kruger and Summers, 1987; Gibbons and Katz, 1992 and Caju et al. (2010)).

Several theoretical justifications for the observed sectorial wage gaps appeared in the economic literature. Gibbons and Katz (1992) and Abowd et al. (1999) show that a portion of inter-industry wage differentials result from differences in workers' unobserved abilities. Neumuller (2013) shows that the volatility of shocks to wages varies inversely with inter-industry wage differentials. Krueger and Summers (1987) argue that those differences are the result of non-competitive environments which result in rent sharing or efficiency wage. Gibbons et al. (2005) show that high ability workers move from sectors with low return to ability to sectors with high return to ability when their ability becomes observable.

In this paper, we use the Waldman (1984) and Waldman and Zax (2016) structure that was previously used to analyze promotion decisions taking into account the information revealed by the hierarchy level of a worker.[1] We examine the promotion process in an environment populated by firms of different sectors with different production functions. We show that the wage gap is the result of differences in promotion policies which result from different production functions. The main implication of the promotion policy is that promoted workers in different industries have different expected abilities which results in different alternative wages. Non-promoted workers, in turn, receive higher wages to compensate them for a lower promotion rate.

We also show that the equilibrium assignment of workers across sectors is not efficient. The intuition behind this result is the following: workers sort across sectors such that the

[1] There is an extensive theoretical literature on this topic. Some of the other papers in this literature include Ricart i Costa (1988), Waldman (1990), Bernhardt (1995), Zax (2012), DeVaro and Waldman (2012), Jin and Waldman (2016), Mukherjee and Vasconcelos (2015), Dato, Gruewald, Krakel and Muller (2016), and Waldman (2016).

expected lifetime income (which equals the worker's expected output) is the same in all sectors. Since expected output differs from the efficient output due to the observation that promotion policy is not efficient, we obtain that the assignment of workers across sectors is not efficient.

2. Multiple Sectors with wage differentials by sector

The analyzed economy is composed of two sectors. There is free entry of firms into each sector and a firm in each sector employs either one or zero workers. Worker *i*'s ability is denoted θ_i, where θ_i is a random draw from a probability density function $f(\theta)$ on the support $[\theta_L, \theta_H]$. At the beginning of period 1 each worker's ability level is unknown. Each firm can assign a worker to either of two jobs, denoted 1 and 2, where assigning a worker to job 2 who was previously in job 1 is referred to as a promotion.

Individual *i*'s output (in each sector) equals:

$y_1=c_1+d_1\theta_i$ if he is assigned to job 1.

$y_2=c_2+d_2\theta_i$ if he is assigned to job 2 and if this is the first period he has been employed by his current employer.

$y_2=c_2+d_2\theta_i+\Delta_j(\theta_i)$ if he is assigned to job 2, employed in sector *j* and if this is the second period he has been employed by his current employer.

Hence, $\Delta_j(\theta_i)$ denotes the amount of acquired specific human capital. We assume $c_1>c_2$, $0\leq d_1<d_2$, and θ' is such that $c_1+d_1\theta'=c_2+d_2\theta'$. In other words, if $\theta_i<(>)\theta'$, then it is efficient to assign worker i to job 1(2). Job 1 is thus the low level job and job 2 the high level job, where as in Rosen (1982) and Waldman (1984) there is a larger return to ability in the high level job. Let $E(\theta)$ be the expected ability level of workers in the population. We assume that $c_1+d_1E(\theta)>c_2+d_2E(\theta)$, i.e., a worker of average ability is efficiently assigned to job 1 rather than job 2. And we further assume that $\theta_L<\theta'<\theta_H$. That is, low ability workers are more efficiently assigned to job 1 and high ability workers to job 2.

We also assume that there is a cost associated with switching sectors and as a result of that cost, individuals do not switch sectors. The price of the good produced in sector 1 is normalized to 1, and the price of the good produced in sector 2, *p*, is calculated below.

The timing of the full game is as follows. At the beginning of period 1 firms simultaneously make wage offers and each worker chooses a firm to work for. Each firm with a worker then assigns the worker to a job, production takes place and workers are paid, and then at the end of the period each firm privately observes the ability level of its period 1 worker.

The wage determination process in the second period allows for counteroffers. At the beginning of the second period a worker's first period employer assigns the worker to a job. Other firms observe this job assignment and make wage offers. The first period employer then observes those offers and makes a wage counteroffer, where we assume that the worker stays if the first period employer matches the market wage offer and that the first period employer matches if it is indifferent between matching and not matching.

After each worker chooses a firm to work at in period 2, workers produce, and get paid. Our focus is on pure strategy Perfect Bayesian equilibria where beliefs concerning off-the-equilibrium path actions are consistent with each such action being taken by the type with the smallest cost of choosing that action. This assumption concerning off-the-equilibrium path actions is similar to the notion of a Proper Equilibrium first discussed in Myerson (1978).

We start with a benchmark analysis that concerns what happens in the second period when there is symmetric learning and worker's ability becomes public information at the end of the first period. We assume that the price of the good produced in each sector is 1[2]. We obtain that in period 2 worker i is assigned to job 1(2) if $\theta_i<(>)\theta'$, is paid his alternative wage which equals his output with an outside employer, $\max(c_1+d_1\theta_i, c_2+d_2\theta_i)$ (recall that the acquired human capital is firm-specific and does not change the worker's output if he switched

[2] As discussed below, prices differ in equilibrium between sectors. However, we make this assumption to emphasize the role of asymmetric learning.

employers), and the worker remains with the first period employer. Hence, in an economy without asymmetric information, there are no sectorial wage differences at the second period.

We now consider equilibrium behavior when there are two sectors as described above.

Proposition 1: *If each worker's ability is privately observed at the end of period 1 by the worker's first period employer and there are two types of employers which differ in the amount of specific human capital acquired by workers employed by them, then i) through iv) describe equilibrium behavior.*

i) Each worker is assigned to job 1 in period 1 and is paid $w_Y > c_1 + d_1 E(\theta)$*. First period wage differs across sectors.*

ii) There exists a value, θ^+_1*, such that in period 2 worker i who is employed in sector 1 is not promoted (is promoted) if* $\theta_i < \theta^+_1$ $(\theta_i > \theta^+_1)$*, is paid* $c_1 + d_1\theta_L$ $(max\{c_1 + d_1\theta^+_j, c_2 + d_2\theta^+_1\})$ *and each worker remains with the first period employer.*

iii) There exists a value, θ^+_2*, such that in period 2 worker i who is employed in sector 2 is not promoted (is promoted) if* $\theta_i < \theta^+_2$ $(\theta_i > \theta^+_2)$*, is paid* $p(c_1 + d_1\theta_L)$ $(p(max\{c_1 + d_1\theta^+_j, c_2 + d_2\theta^+_2\}))$ *(recall that p denotes the price of the good produced in sector 2) and each worker remains with the first period employer.*

iv) The distribution of workers across sectors is inefficient.

The logic behind part ii of the above proposition is the following. Second period wages are calculated using the winner's curse which arises for the following reason. If a prospective employer offers a worker assigned to job 1 a wage of $d_1 + c_1\theta_j$ (where $\theta_j > \theta_L$) in the second period and hires the worker, it must be the case that the ability of such worker is lower than θ_j. Because, otherwise the worker's first period employer would match the offer. Hence, the wage of a non-promoted worker equals the output (at a competing firm) of a worker with ability θ_L, $d_1 + c_1\theta_L$. Using the same arguments, we can show that the wage of a promoted worker equals

$max[d_2+c_2\theta^+_1, d_1+c_1\theta^+_1]$. Under the assumption that $max[d_2+c_2\theta^+_1, d_1+c_1\theta^+_1] = d_2+c_2\theta^+_1$, θ^+_1, the threshold for promotion, is given by the following equation

$$d_2+c_2\theta^+_1+\Delta(\theta_1^+)\text{-}\ (d_2+c_2\theta^+_1)= d_1+c_1\theta^+_1\text{-}(d_1+c_1\theta_L)$$

where the LHS represents the profits generated by promoting a worker with ability θ^+_1 while the RHS represents the profits generated by not promoting a worker with such ability. Hence, the profits generated by promoting a worker of ability θ^+_1 equal the profits generated by not promoting him while the profits generated by promoting a worker with ability higher (lower) than θ^+_1 are higher (lower) by promoting (not promoting) him, and we obtain that $\theta_1^+ = \frac{\Delta(\theta_1^+)}{c_1} - \theta_L$. Under the assumption that $max[d_2+c_2\theta^+_1, d_1+c_1\theta^+_1]=d_1+c_1\theta^+_1$ we obtain that $\theta_1^+ = \frac{d_1-c_1\theta_L-d_2-\Delta(\theta_1^+)}{-2c_1+c_2}$.[3] Using p, the price of the good produced in sector 2, and the arguments used in explaining part ii of the first proposition we can calculate wages paid in Sector 2 and θ^+_2, the promotion policy in that sector.

Hence, we obtain that the signal generated by assigning an individual to job 2 in sector 1 differs from the signal generated by assigning an individual to the same job in sector 2. Recall that workers acquire only firm-specific human capital and that a worker's wage equals his alternative wage (which is not a function of the acquired specific human capital).

First-period wages are calculated using the free entry assumption and the zero profits condition in each sector and are described in the appendix. Note that in equilibrium workers are indifferent between both sectors and lifetime wages are equal in both sectors. We use this condition to determine *p*, the price of the good produced on the second sector which is given in the appendix (recall that the price of the good produced on the first sector is normalized to

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[3] It is possible that $d_2 + c_2\theta^+ < d_1 + c_1\theta^+$ while $\Delta(\theta^+)$ is high enough such that a worker with ability θ^+ has a higher output in job 2 at his period-1 employer than at job 1 at his period-1 employer.

1).

Note that in equilibrium, each sector offers the same expected lifetime income. Since the promotion policy is not efficient, the expected output of each individual differs from the efficient output and the assignment of workers across firms is not efficient. We provide a formal proof in the appendix.

In the analyzed setup, we assume that the only difference between the production functions in both sectors is Δ_j. It can be shown that if d_2 and c_2 differ across sectors, the wage of promoted workers also differs across sectors.

Note that we obtain sectorial wage differences among individuals who are assigned to job 2 in the second period as well as among first-period workers. We can obtain sectorial wage differences among second-period workers who are not promoted by if c_1 and d_1 also differ across sectors.

3. Conclusions

Inter-industry wage differentials are well documented. In the present paper, we show that if industries have different production functions then the signal generated by promoting a worker in one industry differs from the signal generated by promoting a worker in another industry. Due to different signals, workers enjoy different wages. We also show that the assignment of workers across sectors is not efficient.

APPENDIX

Calculating first period wages and workers' assignments

Using the zero profits condition, we obtain that the first period wage in sector 1 equals

$$w_1 = c_1 + d_1E(\theta) + \int_{\theta_L}^{\theta_1^+}(c_1 + d_1\theta - c_1 + d_1\theta_L)\, d\theta + \int_{\theta_1^+}^{\theta^H}(c_2 + d_2\theta - c_2 + d_2\theta_1^+\,)d\theta$$

While the first period wage in sector 2 equals

$$w_2 = p\Big(c_1 + d_1E(\theta) + \int_{\theta_L}^{\theta_2^+}(c_1 + d_1\theta - c_1 + d_1\theta_L)f(\theta)\, d\theta + \int_{\theta_2^+}^{\theta^H}(c_2 + d_2\theta + \Delta_2(\theta) -$$

$$c_2 + d_2\theta_2^+\,)f(\theta)d\theta\Big).$$

p is calculated such that lifetime income is the same in both sectors and we obtain that

$$(A1) \qquad \frac{1}{p} = \frac{c_1 + d_1E(\theta) + \int_{\theta_L}^{\theta_2^+}(c_1 + d_1\theta)\, f(\theta)d\theta + \int_{\theta_2^+}^{\theta^H}(c_2 + d_2\theta + \Delta_2(\theta)\,)f(\theta)d\theta}{c_1 + d_1E(\theta) + \int_{\theta_L}^{\theta_1^+}(c_1 + d_1\theta)\, f(\theta)d\theta + \int_{\theta_1^+}^{\theta^H}(c_2 + d_2\theta + \Delta_1(\theta))f(\theta)d\theta}$$

note that if $\theta_2^+ = \theta_1^+$ then p=1.

In order to calculate the efficient distribution of workers across sectors, we normalize the number of workers to 1 and maximize the expected utility of the representative individual with respect to α, the amount of time he spends working in sector 1 while using the efficient promotion thresholds θ_1^e, θ_2^e .

Max $U(x_1,x_2)$

s.t.

$$x_1 = \alpha\left(c_1 + d_1 E(\theta) + \int_{\theta_L}^{\theta_1^e} (c_1 + d_1\theta)\, f(\theta) d\theta + \int_{\theta_1^e}^{\theta^H} (c_2 + d_2\theta + \Delta_1(\theta)) f(\theta) d\theta\right)$$

$$x_2 = (1-\alpha)\left(c_1 + d_1 E(\theta) + \int_{\theta_L}^{\theta_2^e} (c_1 + d_1\theta)\, f(\theta) d\theta + \int_{\theta_2^e}^{\theta^H} (c_2 + d_2\theta + \Delta_2(\theta)\,) f(\theta) d\theta\right)$$

Where x_j denotes the good produced in sector *j*, and we obtain that

(A2) $$\frac{U_1}{U_2} = \frac{c_1 + d_1 E(\theta) + \int_{\theta_L}^{\theta_2^O} (c_1 + d_1\theta) f(\theta)\, d\theta + \int_{\theta_2^O}^{\theta^H} (c_2 + d_2\theta + \Delta_2(\theta)\,) f(\theta) d\theta}{c_1 + d_1 E(\theta) + \int_{\theta_L}^{\theta_1^O} (c_1 + d_1\theta) f(\theta)\, d\theta + \int_{\theta_1^O}^{\theta^H} (c_2 + d_2\theta + \Delta_1(\theta)) f(\theta) d\theta}.$$

where Ui denotes the first derivative of U with respect to i.

Using Equations (A1) and (A2) and the observation that $\theta_1^e \neq \theta_1^+$ and $\theta_2^e \neq \theta_2^+$ we obtain that the distribution of workers across sectors is not efficient.

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