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### The Brother in Law Effect

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# The Brother in Law Effect<sup>1</sup>

**David K. Levine, Federico Weinschelbaum and Felipe Zurita<sup>2</sup>**

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**Abstract:** Ordinarily labor market equilibrium implies that the marginal worker is indifferent to employment, and that the employer is indifferent between equally productive employees. When the marginal worker is indifferent to employment, employer preferences do not matter. If, however, the marginal worker strictly prefers to be employed, the employer can give favors, and may wish to do so even at some cost to efficient production. Not only may inefficient workers be employed, but the employer may also choose to employ too many workers. We refer to this as the *brother-in law effect*. When the brother-in-law effect is due to unionization, employment of brothers-in-law leads to increased employment – under some circumstances leading even to over employment relative to the workforce that would be employed without unionization. If the employment effect is strong – because brothers-in-law are relatively good workers – nepotism improves efficiency. If the employment effect is weak – including in principal-agent models where there are informational rents – nepotism is inefficient.

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## **1. Introduction**

It is often the case that per worker output increases and the number of workers decreases after monopolies, either private or public, are ended. This suggests that monopolies employ less than competent workers and employ too many of them. It is puzzling for a private firm, as it implies that the hiring decisions are not profit maximizing. It is also puzzling in the public sector, for it implies that more services and transfers could be provided with the same budget, or that taxes could be cut without affecting the current level of services and transfers, whereby the ruling party could attract more support.

Examples of increases in per worker output and declines in employment include the case of Codelco – a public Chilean copper company – that occurred when competition from the privately-owned copper mine La Escondida started operation in the late 80s.<sup>3</sup> Shleifer and Vishny (1994) and Galiani, Gertler, Schargrodsky and Sturzenegger (2005) provide another set of examples. Perhaps the best documented case is that of iron ore production in the U.S. midwest found in Galdon-Sanchez and Schmitz Jr. (2002).

The goal of this paper is to examine whether the presence of less than competent workers and overemployment can be explained by nepotism. Nepotism should be understood in the widest possible sense, that is, managers or public officials favoring family members, political party comrades, friends or any person from whose gratitude they could benefit.

The key to nepotism lies not in whether the product market is monopolized, but rather in circumstances in the labor market – which may or may not be correlated with product market monopoly. Specifically, we show that whenever there exists a gap between the wage paid to the marginal worker and his reservation wage the incentives for nepotism are in place regardless of the cause of that gap. Suppose that there is such a gap and the owner of the firm hires his “brother-in-law” – our figurative term for the class of favored individuals. Then the brother-in-law receives a rent from employment, while the cost to the owner is the difference between the brother-in-law’s productivity and the going wage. If the brother-in-law is close in productivity to the marginal worker, the productivity loss is much smaller than the surplus received by the brother-in-law. If the

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<sup>3</sup> See for example Tilton (2002).

owner of the firm finds it in his interest to make this favor to his brother-in-law – because of the expectation of future favors, or simply because he likes his sister – then he would prefer to hire him even if he is not the most productive worker for that job. If this is the case, meritocracy fails and the firm hires the “wrong” workers in that sense, with the end result of output not being produced at the lowest cost, that is, X-inefficiency.

Consequently, the existence of a wage gap or rent to the marginal worker makes awarding employment a cheap method to the employer of making transfer payments; this private benefit of employing a brother-in-law can also lead the employer to employ too many workers.

When there is competition in the labor market we show that nepotism will not occur. When there are labor market frictions – either unionization or moral hazard, we show that nepotism is possible. We explore also the consequences for welfare. Under the assumption that welfare weights are calibrated so that transfer payments are neutral, we find that banning nepotism leads to a welfare improvement with moral hazard. However, it may lead to a welfare decrease with unionization. Because brothers-in-law are cheaper per unit of output for the firm to employ – on account of their non-pecuniary benefit outweighing their inefficiency as workers – the firm will produce more output with a union of brothers-in-law than a union of normal workers. Hence, banning nepotism will reduce output reducing welfare. If brothers-in-law are almost as productive as normal workers, this output effect will more than offset the effect of replacing inefficient workers with efficient ones, and welfare will decline. If brothers-in-law are inefficient workers – so that the firm is near indifference between employing them and normal workers, then the output effect is small, and welfare is improved by banning nepotism.

## **2. The Model**

There is a single firm which employs two types of worker: normal workers ( $L_1$ ) and brothers-in-law ( $L_2$ ). We assume that both sets of would-be workers are large enough so that it is always possible to hire more workers of each kind, and all workers have the same reservation wage  $w$ .

The brother-in-law is distinguished by being a person whose income figures positively into his employer’s utility. This includes such things as managers or public officials caring about family members, political party comrades, friends or any person or

institution who they value, or from whose gratitude they could benefit. In particular we assume that each dollar that a brother-in-law gets increases the utility of the employer by  $\beta \in (0,1)$ . Note that we assume  $\beta < 1$ , meaning that the employer will never transfer money on a 1-1 basis to the brother-in-law. There is a large literature on altruism – discussed for example in Andreoni and Miller (2002) – suggesting that while 1-1 transfers are not common, many people are willing to make transfers on a better than 1-1 basis, that is, give up a dollar so that the recipient will receive more than a dollar. Here the employer is willing to give up a dollar provided the brother-in-law receives at least  $1/\beta$  dollars. We note also that this model of a brother-in-law assumes that the benefit to the employer comes at no cost to the brother-in-law. In many cases – an actual brother-in-law, the employment of individuals who are already political supporters – this is the right assumption. We do not consider the case of “kickbacks” in which the benefit to the employer comes at some cost to the brother-in-law. We also suppose that the only consumption externality is between the employer and the brother-in-law.

This paper studies the consequences of the existence of “brothers-in-law” in various types of labor markets. We regard the “brother-in-law effect” as a form of nepotism in the widest possible sense. This phenomenon has been studied by Goldberg (1982) and Prendergast and Topel (1996). Goldberg examines how racial wage differentials can survive in competitive equilibrium in the long-run and short-run. By way of contrast we focus on market frictions, and not on perfect competition; Prendergast and Topel examine how favoritism has an impact on the flow of information within an organization and can lead to bureaucratic structures.

We consider two production functions. In the certainty model

$$q = f(L_1 + \eta L_2)$$

where  $f$  is either linear or exhibits decreasing returns. In the moral hazard model the choice is whether to employ a single worker, and the output for the worker employed is a stochastic function of effort:

$$q = \begin{cases} q_1 & \text{with probability } \eta_i \pi(e) \\ q_0 & \text{with probability } 1 - \eta_i \pi(e) \end{cases}$$

where  $e \in \{e_L, e_H\}$  is the level of effort exerted and  $\eta_1 = 1$  for a normal employee and  $\eta_2 = \eta$  for a brother-in-law. We assume high effort has a cost to the worker of  $\psi$ , and low effort of zero.

Let  $p$  be the output price, and  $W$  the wage paid. In general price is a non-increasing function of output  $p = p(q)$ . We will consider various models of the determination of  $W$ .

### 3. The Certainty Model with Unions

We start by considering the simplest case: production follows the certainty model  $q = f(L_1 + \eta L_2)$ , and a union contract specifies a wage  $W > w$ , but hiring is left to the firm. The objective function for the firm is then

$$\Pi = \max_{\{L_1, L_2, q\}} (pq - W(L_1 + L_2)) + \beta(W - w)L_2.$$

We assume that the revenue function  $p(f(L))f(L)$  is concave in the aggregate labor employed  $L$ , so that this problem has a unique solution characterized by first-order conditions. We further assume that the optimal output is positive.

**Theorem 3.1:** *Set*

$$\eta^* = 1 - \beta \frac{W - w}{W}.$$

*If  $\eta > \eta^*$  the firm prefers to hire brothers-in-law; that is, the optimum is  $L_1 = 0, L_2 > 0$ , and conversely if  $\eta < \eta^*$  the firm prefer not to hire brothers-in-law; that is the optimum is  $L_1 > 0, L_2 = 0$ .*

*Proof:* The Kuhn-Tucker conditions are

$$\frac{\partial \Pi}{\partial L_1} = (p'(q)q + p)f'(L_1 + \eta L_2) - W \leq 0 \quad w.c.s. \quad L_1 \frac{\partial \Pi}{\partial L_1} = 0$$

$$\frac{\partial \Pi}{\partial L_2} = (p'(q)q + p)f'(L_1 + \eta L_2)\eta - W + \beta(W - w) \leq 0 \quad w.c.s. \quad L_2 \frac{\partial \Pi}{\partial L_2} = 0$$

Observe from the second condition that  $L_2^* = 0$  whenever

$$(p'(q)q + p)f'(L_1 + \eta L_2)\eta - W + \beta(W - w) < 0$$



In this case the first condition must hold with equality, and substituting that equality into the second condition gives

$$\beta(W - w) < W(1 - \eta)$$

Rearranging to solve for  $\eta$  gives  $\eta < \eta^*$ . Similarly from the first condition  $L_1^* = 0$  whenever

$$(p'(q)q + p)f'(L_1 + \eta L_2) - W < 0$$

So the second condition must hold with equality. Using these conditions we get

$$\beta(W - w) > W(1 - \eta)$$

Which, again, rearranging and solving for  $\eta$  gives  $\eta > \eta^*$ .

☑

If this is the case, In other words, as soon as the wage-gap is positive,  $W - w > 0$ , then sufficiently productive brothers-in-law will be exclusively employed, despite the fact they are less productive than normal workers. Notice that a necessary condition for brothers-in-law to be employed is  $\eta \geq 1 - \beta$ .

**Theorem 3.2:** *Output is higher when the firm is allowed to hire brothers-in-law.*

*Proof:* Recall that the firm weakly prefers to hire brothers-in-law if and only if  $\eta \geq \eta^*$ .

In this case, the employment level is obtained from the first order condition

$$(p'(q)q + p)f'(\eta L_2)\eta = W^*,$$

where  $W^* \equiv W(1 - \beta) + \beta w$ . Hence,

$$L_2 = \frac{1}{\eta} f'^{-1} \left( \frac{W^*}{\eta(p'(q)q + p)} \right).$$

If, on the other hand, only regular workers can be employed, employment is obtained from  $(p'(q)q + p)f'(L_1) = W$  so that

$$L_1 = f'^{-1} \left( \frac{W}{(p'(q)q + p)} \right).$$

If

$$\eta = \eta^* = \frac{W^*}{W},$$

then

$$\eta^* L_2 = f^{-1}\left(\frac{W}{(p'(q)q + p)}\right) = L_1$$

so that output is the same regardless of which kind of worker is hired. If  $\eta \geq \eta^*$ ,

$$\eta^* L_2 = f^{-1}\left(\frac{W^*}{\eta(p'(q)q + p)}\right) \geq f^{-1}\left(\frac{W}{(p'(q)q + p)}\right) = L_1$$

because  $f^{-1}(\cdot)$  is a non-increasing function from the weak concavity of  $f(L_1 + \eta L_2)$ . ☑

### Overemployment

We turn next to overemployment. Suppose that  $\eta > \bar{\eta}$ , and let  $L_2^*$  be the optimal number of brothers-in-law employed; also let  $L_1^C$  be the optimal number of normal workers employed when there is no wage gap  $W = w$ . By overemployment we mean  $L_2^* > L_1^C$ , that is when the wage gap is eliminated, for example, because the union is busted, the number of workers employed declines. Note that without the brothers-in-law effect, the elimination of a wage gap will increase employment. The possibility of overemployment can be shown by considering a simple example with linear demand.

Suppose that demand is linear  $p = a - bq$  and that there are constant returns to scale so that suitably normalized,  $f(L) = L$ . We work out the demand for labor when brothers-in-law are hired from the second of the first order conditions in Theorem 3.1:

$$L_2 = \frac{a\eta - W + \beta(W - w)}{2b\eta^2}.$$

By way of contrast, if the labor market is perfectly competitive  $W = w$ , so no brothers-in-law are hired, and

$$L_1 = \frac{a - w}{2b}.$$

Solving for  $L_2 / L_1 = 1$  yields a quadratic in  $\eta$  with the two positive roots  $\eta^+ > \eta^-$  for which  $L_2 / L_1 > 1$  in between the roots. We may compute the roots as

$$\eta^+ = \frac{a + \sqrt{a^2 - 4(a - w)[W - \beta(W - w)]}}{2(a - w)}$$

$$\eta^- = \frac{a - \sqrt{a^2 - 4(a - w)[W - \beta(W - w)]}}{2(a - w)}.$$

If  $a - 2w > 0$  the larger root is smaller than one, so the condition for overemployment is that  $\eta$  is between both roots and larger enough that the firm wishes to hire brothers-in-law, that is,  $\eta > \eta^*$ . If  $w = 0$  and  $\beta = 1$ , then  $\eta^+ = 1, \eta^- = 0, \eta^* = 0$  so these bounds are by no means vacuous.

Notice that regardless of the production technology, and provided demand is not perfectly elastic  $w = 0$  and  $\beta = 1$  imply that  $\eta^* = 0$ , and that the first order condition for the employment of brothers-in-law is

$$(p'(q)q + p)f'(L_1 + \eta L_2)\eta = 0,$$

which holds if and only if  $q$  is chosen to maximize revenue  $p(q)q$ . The same condition determines output in the competitive labor market case, so, since brothers-in-law are less efficient workers, and the same output is produced, strictly more brothers-in-law must be employed. In other words, if altruism  $\beta$  is high and the ratio of union to competitive wages  $W/w$  is high, then there will be overemployment.

By way of contrast, suppose output markets are perfectly competitive. Although it is still possible to have overemployment, it is “less likely” in the sense that with a homogeneous (Cobb-Douglas) production function, it cannot happen.

**Theorem 3.3:** *If demand is competitive  $p(q) = p$  and  $f(L) = L^\alpha$  then  $L_2^* \leq L_1^C$ , that is, there is no overemployment.*

*Proof:* In the competitive case we have

$$L_1^{1-\alpha} = \alpha p / w$$

while with brothers-in-law and the union, we have

$$L_2^{1-\alpha} = \frac{\alpha \eta^\alpha p}{W^*}.$$

So

$$\left(\frac{L_1}{L_2}\right)^{1-\alpha} = \frac{1}{\eta^\alpha} \frac{W^*}{w} \geq 1,$$

since  $\eta \leq 1$  and  $W^* \geq w$ .

☑

### *Worker Heterogeneity*

We have assumed that all normal workers are identical. This simplifying assumption does not have important economic consequences. To see this, suppose that in addition to normal workers, there is a limited supply of “highly productive” workers who are more productive than normal workers. If the productivity gap is large enough, highly productive workers might not get replaced with brothers-in-law even though normal workers do. In other words, the effect of worker heterogeneity is that normal workers are gradually replaced as the union wage increases or productivity gap decreases, rather than being abruptly replaced.

Worker heterogeneity does, however, have political consequences for the union. Consider first the case in which normal workers are homogeneous. Suppose that  $\eta \geq 1 - \beta$ , so that it is possible for brothers-in-law to be hired. From Theorem 3.1, if the union wage satisfies

$$W \geq \frac{\beta w}{\eta + \beta - 1}$$

then the normal workers will be replaced with brothers-in-law. Naturally a union of homogeneous normal workers will not choose to set the wage this high. In other words, the presence of brothers-in-law may cause the union to be less aggressive in its demands. Notice also that brothers-in-law face no such constraint, and the employer may prefer not to have a union of brothers-in-law who will not be so restrained in their wage demands.

With heterogeneous normal workers, the situation changes. Again, consider a limited supply of “highly productive” workers. If they constitute more than half the work force, then they will happily vote the wage high enough that normal workers will be replaced by brothers-in-law, but not so high that they will be replaced themselves. In general, we would not expect a union subject to majority rule to push the wage so high that more than half the work force would be brothers-in-law. In practice then, we are likely to see the employment of brothers-in-law, but also that their presence has a disciplining effect on union wage demands.

### *Efficiency*

Finally, we examine the issue of efficiency. We go back now to the previous setting where the wage is exogenously given. Note that we continue to assume that the

only consumption externality is the one linking the employer to the brother-in-law. We first consider the conceptual experiment of eliminating the union. Our Pareto analysis runs as follows. Suppose that  $\eta > \eta^*$  so that by Theorem 3.1 the employer prefers to employ brothers-in-law, and let  $L_2^*$  be the number of brothers-in-law employed. Suppose instead that the union is eliminated so that  $W = w$  and that a lump sum  $(W - w)L_2^*$  is taken from the employer and given to the brothers-in-law who were formerly employed. The regular employees are indifferent, since they get their opportunity wage under either arrangement; the brothers-in-law are indifferent since their lump sum gives them exactly what they received with the union. Profits to the firm under unionization are

$$\Pi_2 = p_2q_2 - WL_2^* + \beta(W - w)L_2^*$$

while under competition they are

$$\Pi_1 = p_1q_1 - wL_1 + \beta(W - w)L_2^*.$$

Consider also the problem of unionization without the brother-in-law, giving profits

$$\hat{\Pi}_1 = \hat{p}_1\hat{q}_1 - W\hat{L}_1.$$

We know that  $\hat{\Pi}_1 < p_1q_1 - wL_1$ , that is all else equal, raising the wage lowers profits. We also know that  $\hat{\Pi}_1 > p_2q_2 - WL_2^*$ , since  $\hat{\Pi}_1$  maximizes that particular function by definition, and the brother-in-law solution does not. So we may conclude that

$$\Pi_1 - \Pi_2 > 0,$$

that is, the employer is better off simply paying the brother-in-law and dumping the union.

Notice, however, that even without the brother-in-law effect, abolishing the union would lead to a welfare improvement. So the question arises, is there an additional welfare loss from the brother-in-law effect beyond that from that from unionization itself? To answer this, we compute welfare under unionization when nepotism is not allowed, with welfare under unionization where brothers-in-law can be hired. Note that this is only interesting if the firm chooses to hire brothers-in-law, so that we restrict attention to that case.

A pure welfare analysis does not make much sense here. Banning nepotism makes the employer and brothers-in-law worse off, but the normal workers better off. However, transfer payments are not neutral, so we should look at a specific welfare criterion. It

does not make sense, however, to assign equal weight to everyone. In this model, a dollar taken from the employer and given to a brother-in-law generates  $1 + \beta$  dollars of benefits – one dollar to the brother-in-law and  $\beta$  dollars to the employer. So we would conclude that we should simply transfer as much as possible from employer and normal workers to brothers-in-law. In particular, competitive equilibrium is not efficient in this setup. If we want to work with particular welfare weights, as implicit in the usual consumer plus producer surplus shorthand, we should take the weight on the brother-in-law to be  $1 - \beta$  so that transfers to the brother-in-law are welfare neutral. Under these weights the perfectly competitive benchmark is efficient.

Whether banning nepotism is a good or bad idea relative to this welfare criterion turns out to depend on the productivity of the brothers-in-law. There are two effects. First, the effective cost of labor to the employer is smaller with brothers-in-law, so he chooses to increase output if he can hire brothers-in-law. This partially counteracts the output-reducing effect of the union. Second, brothers-in-law are less productive and have the same opportunity cost than normal workers, so the social cost of production is higher when they are employed.

First suppose that brothers-in-law are just as productive as normal workers, so  $\eta = 1$ . In this case the only consequence of allowing nepotism is a welfare neutral transfer from normal workers to brothers-in-law, and an increase in output. This is welfare improving, since with the union output is inefficiently low.

On the other hand, when the productivity of brothers-in-law makes the employer exactly indifferent between hiring them or normal workers, so

$$\eta^* = 1 - \beta \frac{W - w}{W}$$

output is the same whether normal workers or brothers-in-law are hired, so there is a welfare neutral transfer and no welfare improvement from increased output. Banning nepotism simply forces the firm to hire the more productive workers instead, increasing welfare.

#### 4. Competition and Informational Rents

We turn now to the case of moral hazard. We consider the traditional principal agent problem, with moral hazard and limited liability.<sup>4</sup> We assume that both the firm (principal) and worker (agent) are risk neutral. Recall that a single worker is to be employed, that there are two levels of effort  $e \in \{e_L, e_H\}$  and two possible levels of output  $q \in \{q_0, q_1\}$  and that the probability of output is given by

$$q = \begin{cases} q_1 & \text{with probability } \eta_i \pi(e) \\ q_0 & \text{with probability } 1 - \eta_i \pi(e) \end{cases}$$

We assume that output price  $p$  is independent of whether  $q_0$  or  $q_1$  is produced, and is sufficiently high that the principal will choose to produce output – we focus then on cost minimization.

Denote by  $\pi_L, \pi_H$  respectively the probability of high output for a normal worker with a low and high level of effort. High level of effort implies higher probability of reaching the high level of output, so  $\pi_L < \pi_H$ . This is why the principal is interested in implementing  $e_H$ . However  $e_H$  has an additional cost for the agent of  $\psi$ . Recall that the opportunity wage is  $w$ . We assume limited liability: that the principal cannot pay less than  $\theta \leq w$  regardless of the level of output. When the employee has no assets, this represents the subsistence wage. If the employee has assets, it represents the difference between the subsistence wage and his assets, and may be negative if the employee has enough assets to live on.

The model can be summarized in the form of a maximization problem for the principal who wants to implement high effort from a type  $i$  worker using payment  $t_0, t_1$  when output is low and high respectively. Let  $\beta_i = 0$  if the normal worker is chosen and  $\beta_i = \beta$  if the brother-in-law is chosen. The maximization problem is:

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<sup>4</sup> See for example Laffont and Martimont (2001) p. 155.

Maximize over  $t_0, t_1, i$

$$\eta_i \pi_H (q_1 - t_1) + (1 - \eta_i \pi_H)(q_0 - t_0) + \beta_i (\eta_i \pi_H t_1 + (1 - \eta_i \pi_H) t_0 - w - \psi)$$

subject to:

$$\eta_i \pi_H t_1 + (1 - \eta_i \pi_H) t_0 - \psi \geq \eta_i \pi_L t_1 + (1 - \eta_i \pi_L) t_0 \quad [\text{IC}]$$

$$\eta_i \pi_H t_1 + (1 - \eta_i \pi_H) t_0 - \psi \geq w \quad [\text{P}]$$

$$t_1, t_0 \geq \theta \quad [\text{LL}]$$

The employment of brothers-in-law requires that the cost of effort be high relative to the gap between the reservation wage and the limited liability wage. In particular, if the limited liability constraint does not bind, then the worker earns no rent, and there is no incentive to hire the brother-in-law. Specifically, we have the following result on employing brothers-in-law:

**Theorem 4.1:** *Set*

$$\bar{\psi} = \frac{(w - \theta)(\pi_H - \pi_L)}{\pi_L},$$

$$\bar{\eta} = 1 - \frac{\pi_L \beta \psi}{(\pi_H - \pi_L)(q_1 - q_0) \pi_H} + \frac{\beta(w - \theta)}{\pi_H(q_1 - q_0)}, \text{ and}$$

$$\bar{\bar{\eta}} = \frac{\pi_L}{\pi_H} + \frac{(\pi_H - \beta \pi_L) \psi}{(\pi_H - \pi_L)(q_1 - q_0) \pi_H} - \frac{(w - \theta)(1 - \beta)}{\pi_H(q_1 - q_0)}$$

a) *If  $\psi \leq \bar{\psi}$  brothers-in law are never employed, while*

b) *If  $\psi > \bar{\psi}$  and  $\eta \geq \max\{\bar{\eta}, \bar{\bar{\eta}}\}$  the firm prefers to hire brothers-in-law instead of normal workers. Moreover, if in addition  $\bar{\bar{\eta}} < \bar{\eta}$  the firm induces high effort even though it would not without the presence of brothers-in-law.*

*Proof:*

a) The incentive constraint [IC] gives us a lower bound for the difference between the payment in the high level of output against the low one, that is:



$$t_1 - t_0 \geq \frac{\psi}{\eta_i(\pi_H - \pi_L)}$$

while the participation constraint [P] gives us a lower limit to the average payment:

$$\eta_i \pi_H t_1 + (1 - \eta_i \pi_H) t_0 \geq w + \psi.$$

The solution is to choose  $t_1$  so that the incentive constraint exactly binds, and choose  $t_0$  as small as possible. It is easy to check that the participation constraint will be binding if

$$\psi \leq \frac{(w - \theta)(\pi_H - \pi_L)}{\pi_L} = \bar{\psi}.$$

In that case the agent is not getting rents so the principal would choose only the most productive agents.

b) When  $\psi > \bar{\psi}$ , it is the limited liability constraint that binds (the participation constraint does not), and the solution is  $t_0 = \theta$  and

$$t_1 = \theta + \frac{\psi}{\eta_i(\pi_H - \pi_L)}.$$

This solution implies rents to the worker above opportunity cost of

$$\frac{\pi_H \psi}{\pi_H - \pi_L} + \theta - (w + \psi),$$

and with  $\beta_i = 0$  a profit to the firm of

$$\Pi = \eta_i \pi_H q_1 + (1 - \eta_i \pi_H) q_0 - \theta - \frac{\pi_H \psi}{\pi_H - \pi_L}$$

Differentiating this with respect to  $\eta_i$  we find that – absent any brother-in-law effect,

$$\frac{d\Pi}{d\eta_i} = \pi_H [q_1 - q_0] > 0$$

implying the firm would always prefer to hire the normal worker rather than the brother-in-law.

In contrast, when  $\beta_i = \beta > 0$ , it is easy to see that the optimal contract remains the same, but the maximized profit becomes

$$\eta_i \pi_H q_1 + (1 - \eta_i \pi_H) q_0 - \theta - \left( \frac{\pi_H \psi}{\pi_H - \pi_L} \right) (1 - \beta) - \beta (w + \psi - \theta)$$

From the comparison of the profit functions for  $\beta = 0$  and  $\eta_i = 1$  with  $\beta > 0$  and  $\eta_i = \eta$ , both with high and low effort, we obtain the cutoff points  $\bar{\eta}$  and  $\bar{\bar{\eta}}$ .

☑

Checking that the bounds are not vacuous, take  $\theta = w$  so that the limited liability constraint is quite strong, take  $\pi_H = 0.75, \pi_L = 0.25, \beta = 0.5, \psi = 0.1$  and suppose that  $q_1 - q_0 = 1$ . Then we can compute  $\bar{\psi} = 0, \bar{\eta} = 29/30, \bar{\bar{\eta}} = 17/30$ , so provided that brothers-in-law are relatively efficient – that is  $\eta > 29/30$ , the employer prefers his brother-in-law. Note that if we make the cost of effort  $\psi$  larger, then less efficient brothers-in-law will be employed.

It is interesting to observe that the firm would never want to hire a brother-in-law to have him exert low effort. The key intuition to this result lies at the heart of the brother-in-law effect: without a wage gap (rent), favoring brothers-in-law is too expensive for the entrepreneur. It is the informational rent what makes it possible to prefer brothers-in-law. Hence, we have:

**Theorem 4.2:** *If inducing low effort is optimal for the principal, then no brother-in-law is hired.*

*Proof:* Simply observe that the profit with low effort is  $\Pi = \eta_i \pi_L q_1 + (1 - \eta_i \pi_L) q_0 - w$ . The strength of the externality  $\beta$  plays no role in it because there is no wage gap. Hence, brothers-in-law have lower productivity and represent no benefit to the firm.

☑

One consequence of this result is that to hire brothers-in-law it is necessary that their productivity with high effort is higher than that of normal workers with low effort. Otherwise it would not be optimal to induce brothers-in-law to exert a high effort, and if they exert low effort, the Theorem shows that they will not be employed. Note also that brothers-in-law are paid more in the high-output state than normal workers. This is necessary if they are to exert high effort, because the difference in the probability of getting the high pay, between high and low effort, is smaller than the one of normal workers. Their expected wage is, however, the same.

### *Efficiency*

It is natural to think in a principal-agent model that the outcome is necessarily efficient. Certainly the utility of the principal is always maximized subject to the constraints of the problem. In the usual case – no choice of whether to employ brothers-in-law, in this risk neutral setting, maximizing the principal’s utility also maximizes the sum of the principal and agent’s utilities. That is, changes in the payment scheme  $t_0, t_1$  simply transfer expected money on a 1-1 basis between principal and agent, and so are welfare neutral. Indeed, the optimal scheme here achieves the first best.

With the welfare weight under which transfer payments are neutral – one for the principal and normal worker, and  $1 - \beta$  for the brothers-in-law, the situation changes. Here the employment of brothers-in-law involves a transfer payment – but that is by assumption welfare neutral. In addition, an efficient normal worker is replaced by an inefficient brother-in-law leading to a reduction in expected output at the same social cost of employing the one worker. Here there are no employment effects to offset the inefficiency of the brother-in-law, so the welfare effect of banning nepotism is always positive.

The fact that the brother-in-law is only hired to provide high effort is interesting as well: it appears that the stereotype of the lazy brother-in-law who does little or no work is not the consequence of moral hazard.

### **5 Efficiency Wages**

In a static model of moral hazard limited liability plays a key role. In practice much of “limited liability” arises because the employer cannot punish the employee so much that he would choose to leave the firm. If output is not verifiable and the game between employer and employee is repeated, then the underlying moral hazard problem leads to an efficiency wage of the type considered in Shapiro and Stiglitz (1982) in which the employee is paid a premium so that being fired represents a punishment.

We now suppose that the game is infinitely repeated with discounting and common discount factor  $\delta$ . The employer cannot base the wage on output. We focus on stationary strategies in which the employer pays a fixed wage  $t$  and whenever low output is observed fires the worker with probability  $\lambda$  and replaces her with another identical

worker. Given this strategy, the worker's effort decision is the solution to the dynamic programming problem with value function  $v$ .

$$\begin{aligned} v(q_1) &= \max \begin{cases} (1 - \delta)(t - \psi) + \delta(\eta_i \pi_H v(q_1) + (1 - \eta_i \pi_H)v(q_0)) \\ (1 - \delta)t + \delta(\eta_i \pi_L v(q_1) + (1 - \eta_i \pi_L)v(q_0)) \end{cases} \\ v(q_0) &= (1 - \lambda)v(q_1) + \lambda w \end{aligned}$$

Assuming that high effort is provided, we can plug in  $v(q_0)$  to solve and find

$$v(q_1) = \frac{(1 - \delta)(t - \psi) + \delta(1 - \eta_i \pi_H)\lambda w}{1 - \delta + \lambda\delta(1 - \eta_i \pi_H)}.$$

It is indeed optimal to provide high effort, then, if and only if the first expression in the maximum is greater than or equal to the second when evaluated at this value of  $v(q_1)$ . Rearranging this inequality, the necessary and sufficient condition for providing high effort is

$$\delta\eta_i(\pi_H - \pi_L)(t - w) \geq \left[ \frac{1 - \delta}{\lambda} + \delta(1 - \eta_i \pi_L) \right] \psi.$$

The employer wishes to minimize the cost  $t$  of this effort; from the necessary and sufficient condition, we see that the inequality should be chosen to hold with equality, and that  $\lambda$  should be chosen as large as possible, that is,  $\lambda = 1$  and punishment should be certain at the optimum for the employer. Substituting in for the optimal  $\lambda$ , we find the minimum wage gap consistent with high effort

$$t - w = \frac{1 - \delta\eta_i\pi_L}{(\pi_H - \pi_L)\eta_i\delta} \psi$$

As in the principal-agent case, the wage gap must be higher for brothers-in-law than for normal workers, and because of the same reasons.

Once again, this rent may affect the firm's decisions and the firm would never want to hire a brother-in-law to have him exert low effort.

**Theorem 5.1:** *Set*

$$\bar{\psi} = \frac{(q_1 - q_0)(\pi_H - \pi_L)(\eta - 1)\eta\delta\pi_H}{1 - \eta - \beta + \beta\delta\eta\pi_H}$$

$$\bar{\bar{\psi}} = \frac{(q_1 - q_0)(\eta\pi_H - \pi_L)\eta\delta(\pi_H - \pi_L)}{1 - \eta\delta\pi_L - \beta + \beta\delta\eta\pi_H} \text{ and}$$

$$\tilde{\psi} = \frac{(q_1 - q_0)(\pi_H - \pi_L)^2 \delta}{1 - \delta\pi_L}$$

a) If inducing low effort is optimal for the principal, then no brother-in-law is hired.

b) If  $\eta > \max\left\{\frac{1 - \beta}{1 - \beta\delta\pi_H}, \frac{\pi_L}{\pi_H}\right\}$  and  $\bar{\bar{\psi}} \leq \psi \leq \bar{\psi}$  the firm prefers to hire brothers-in-law instead of normal workers.

c) If  $\eta < \max\left\{\frac{1 - \beta}{1 - \beta\delta\pi_H}, \frac{\pi_L}{\pi_H}\right\}$  then no brother-in-law is hired.

d) If in addition to b),  $\psi > \tilde{\psi}$  the firm induces high effort even though it would not have done so in the absence of brothers-in-law.

*Proof:* The profit function when the firm induces high effort is given by:

$$\Pi_H(\beta_i, \eta_i) = \eta_i\pi_H q_1 + (1 - \eta_i\pi_H)q_0 - w - \frac{1 - \delta\eta_i\pi_L}{(\pi_H - \pi_L)\eta_i\delta} \psi(1 - \beta_i) - \beta_i\psi.$$

On the other hand, when inducing low effort it is given by:

$$\Pi_L(\beta_i, \eta_i) = \eta_i\pi_L q_1 + (1 - \eta_i\pi_L)q_0 - w.$$

Hence, when inducing high effort hiring a brother-in-law yields  $\Pi_H(\beta, \eta)$  while hiring a normal worker yields  $\Pi_H(0, 1)$ , and when inducing low effort hiring a brother-in-law yields  $\Pi_L(\beta, \eta)$  and a normal worker  $\Pi_L(0, 1)$ .

a) Observe that  $\Pi_L(0, 1) - \Pi_L(\beta, \eta) = (1 - \eta)\pi_L(q_1 - q_0) > 0$ , so the assertion follows.

b) By a), if the brother-in-law is hired he is to exert high effort. It can readily be verified that  $\Pi_H(\beta, \eta) > \Pi_L(0, 1)$  if and only if  $\psi < \bar{\bar{\psi}}$ , and that  $\Pi_H(\beta, \eta) > \Pi_H(0, 1)$  if and only if  $\psi > \bar{\psi}$  and

$$\eta > \frac{1 - \beta}{1 - \beta\delta\pi_H}.$$

Moreover,  $\bar{\bar{\psi}} > 0$  only if

$$\eta > \frac{\pi_L}{\pi_H}.$$

c) If

$$\eta < \frac{\pi_L}{\pi_H}$$

then  $\bar{\psi} < 0$ , that is, hiring normal workers to exert low effort is preferred to hiring brothers-in-law to exert high effort. On the other hand, if

$$\eta < \frac{1 - \beta}{1 - \beta\delta\pi_H}$$

then to induce high effort is better to do it with normal workers rather than with brothers-in-law.

d)  $\Pi_L(0,1) > \Pi_H(0,1)$  if and only if  $\psi < \tilde{\psi}$ , so that the employer would not induce high effort in the absence of brothers-in-law.

☑

## 6. Conclusion

Competition in the labor market prevents nepotism. When there are labor market frictions – either due to unionization or moral hazard, we have shown how nepotism can lead to an X-inefficiency resulting in lower output per worker. Strikingly, the inefficiency in per worker productivity that occurs if unionization is combined with nepotism can also be accompanied by an increase in employment over the competitive level.

It is interesting to observe that the phenomenon of nepotism can also arise as part of an optimal delegation contract. Suppose the owner does not have a brother-in-law, but the manager does. Two contracts could be written between them: (1) paying the manager an amount of money slightly over his reservation wage, or (2) compensating him with less money, but giving him the power to hire his own brothers-in-law. The second contract may be preferred, since it may be cheaper for the firm. Hence, nepotism is not necessarily something that the principal would want to fight, provided that the labor market has a previous distortion.

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