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Institutions, Bargaining Power and Labor Shares

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Benjamin Bental* and Dominique Demougin†‡

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Abstract

We use a static framework characterized by both moral hazard and holdup problems. In the model the optimal allocation of bargaining power balances these frictions. We examine the impact of improved monitoring on that optimal allocation and its impact upon effort, investment, profits and rents. The model's predictions are consistent with the recent evolution of labor shares, wages per efficiency units and the ratio of labor in efficiency units to capital in several OECD countries. The model suggests further that improvement in monitoring may also play a key role in understanding opposition to institutional reforms in the labor market.

KEYWORDS: moral hazard, hold up, bargaining, labor share

JEL: D02, D24

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1 Introduction

Institutions have been recognized by many to greatly affect the performance of economies. In particular, it has often been argued that institutions affecting labor relations and regulations thereof are important (see, e.g., Botero, Djankov, La Porta, Lopez-de-Silanes and Shleifer (2004), Caballero, Covan, Engel and Micco (2004)). In this paper we present a model where the relationship between institutions and economic performance can be explicitly analyzed. Specifically, we view institutions as mitigating inefficiencies resulting from asymmetric information in labor relations and incomplete contracts afflicting firms. Here we capture the institutional design through the bargaining power of labor. We show how the allocation of bargaining power may affect productivity through its impact on the incentivation of effort and through it effect on investment. As the informational asymmetry weakens, the optimal institutional design adjusts and reduces the bargaining power of labor. An important consequence of this change is a reduction in the labor share of output which is in fact observed in many OECD countries (see, e.g., Blanchard (1997) and Jones (2003), Figure 1).[1] We show further that our model is consistent with some additional facts, documented by Blanchard (2006) for the French economy, that are puzzling from the point of view of a neoclassical theory.[2]

To achieve our goal, we combine different strands of literature. First, we adopt the Nash-bargaining mechanism of wage setting as is commonly used in the labor literature (e.g. Pissarides (2000) and the literature therein). Second, workers' effort is assumed non-contractible. Thereby we introduce moral hazard into the bargaining environment. In such a framework firms and workers bargain over wage contracts rather than wage rates. These contracts not only affect the allocation of rents between the parties, but also the workers' effort.[3] Third, we assume that firms have to determine their

[1] Figure 1 in Jones (2003) does not include the U.S. However, in Table 1 Jones reports trends of capital shares in many industries in the U.S. There too the tendency is towards increasing capital shares (and therefore decreasing labor shares). Our own computations for the manufacturing sector of the U.S. (based on data available in http://www.bls.gov/fls/prodsupptabletoc.htm) confirm these findings.

[2] France has been at the focuss of analyses comparing the performance of the European economies to that of the U.S.A. In addition to Blanchard's extensive work in this field, see also recent work by Prescott (2004) and Alesina and Glaeser (2005).

[3] Demougin and Helm (2005) extend the well know result by Binmore, Rubinstein and Wolinsky (1986) to Nash bargaining over incentive contracts. Specifically, it is verified that just as in the standard negotiation case over a fixed pie, cooperative Nash bargaining can be justified as the outcome of a non cooperative negotiation a la Rubinstein (1982) in a moral hazard environement.

capital investment prior to the contract bargaining stage. This introduces a holdup problem on the side of the firms (e.g., Grossman and Hart (1986)).

As is well known from the existing literature, in a holdup environment both parties get just a fraction of the quasi-rent generated by their relationship, thereby reducing firms' incentives to invest. An increased bargaining power of labor exacerbates the negative effect on the capital investment by firms. On the other hand, it mitigates the moral hazard problem. Holding capital constant, the increased bargaining power of labor forces the firm to leave more rent to the workers, thereby making it optimal to the parties to agree on a contract with stronger incentives, thereby increasing labor efficiency.[4]

We assume that the bargaining power embodies the institutional setup of the economy. Accordingly, the mechanism relating bargaining power to efficiency may be exploited by a benevolent regulator who recognizes that it can indirectly impact the level of investment and the labor contract by changing the economy's underlying institutions. In practice, the allocation of bargaining power is influenced by the institutional setup dictating labor contract negotiations through employment laws (regulating dismissal procedures and employment conditions), collective relation laws (co-determination, conflict resolution mechanisms) and social security laws.[5]

In our paper, we assume that the benevolent regulator allocates bargaining power so as to maximize output net of effort and capital costs. The optimal allocation balances the conflicting interests of the firms and workers. At the social optimum, the regulator trades off the cost of providing bargaining power to workers, manifested by an inefficient investment level, with the benefit of an increase in labor efficiency.

Specifically, due to the moral hazard problem, firms use proxy variables to align incentives. The strength of the association between these variables and the workers' effort determines the inefficiency resulting from moral hazard. Improved monitoring means that the proxy variables better reflect effort, thereby increasing the efficiency of the labor contract. This, in turn, decreases the optimal amount of bargaining power which the regulator should allocate to labor, affecting also the resulting choices of labor contracts, leading to increased effort and capital investment. An additional consequence of the decreased labor bargaining power is a reduction in labor share.

There is evidence that monitoring has indeed improved during the last century, and that the process has accelerated during the last two decades

[4]See Demougin and Helm (2005). For similar results in different contexts see also Balkenborg (2001) and Pitchford (1998).

[5]See Botero, Djankov, La Porta, Lopez-de-Silanes and Shleifer (2004) for an extended list of policy measures (Table I).

due to the rapid development of ICT (information and communication technologies).[6] Furthermore, there are indications that effort has increased. For example, Green (2004) exploits British survey data over the last two decades where managers were asked to assess whether "there has been any change in this workplace compared with five years ago in how hard people work here". Green reports that the use of performance-related pay schemes has increased and that work has intensified.

As argued above, in response to the improved monitoring technologies, a benevolent regulator should change the institutional setup in a way that reduces the bargaining power of labor. This, in turn, should be reflected in declining labor shares, providing a non-technological rationale to the observed reduction in these shares in most OECD countries over the past twenty years.[7] Furthermore, our model suggests an explanation to some additional phenomena documented by Blanchard (2006). Blanchard presents French data showing declining trends in the labor share, the wage per efficiency unit of labor, and, the ratio between labor in efficiency units and capital. These trends are not unique to France. Similar trends are present in Italy, Belgium, Austria, Australia Germany and Denmark.[8] As pointed out by Blanchard, these common trends are puzzling from a neoclassical point of view since with cheaper effective labor, one would expect an increase, rather than a reduction, in the ratio of effective labor to capital. In our model the co-movement follows from the reduction in the bargaining power of labor. That reduction relaxes the holdup problem faced by the firms, inducing them to increase investment. The latter dominates the "neoclassical effect". Blanchard's observations are puzzling yet in another respect. As is well known, labor productivity has been increasing for an extended period of time. Assuming a Harrod-neutral technological progress as a reason for that, the wage per efficiency unit should have remained constant and not decreased. Under a given monitoring technology this is also true in our model. However, in our setup improvements in monitoring affect labor contracts, thereby raising

[6] To make a point, one may find the following advertisement of a typical producer of computerized monitoring technology enlightening: "The internet can be a great productivity tool, but it's obvious today that many employees do not always use it for productive reasons - and dozens of studies and statistics back that up. TrueActive's customers have seen huge productivity increases from implementing our tools along with clearly communicated computer use policies to their employees. Productive employees never mind being held to high and accountable standards."

[7] Note that in the neoclassical framework labor shares reflect the production technology. Specifically, under the standard Cobb-Douglas specification, labor shares are constant and equal to the output elasticity with respect to labor input.

[8] For the sake of space, we represent below the different trends for only three of these countries; Australia, France and Germany.

their power. As a consequence incentives increase and wages per efficiency unit decrease. While our results are derived assuming a perfect regulatory response to the changes in the monitoring environment, the same trends will obtain as long as some partial adjustment takes place.

Our model is also consistent with the intensive political debates in many European countries concerning labor market institutions. Countries such as the U.K., the Netherlands and Denmark have already enacted reforms amounting to a reduction in the power of labor. In other countries, like France and Germany, similar reforms are still being debated. The model predicts resistance to such reforms because the gap between the welfare maximizing bargaining power of labor and that which workers would prefer on their own grows, as the quality of monitoring improves. In addition, with sufficiently effective monitoring, further improvements decrease workers' rents while profits keep growing. One would expect that such developments would raise fairness issues.

2 Model

We analyze an environment populated by risk neutral agents. Firms own a technology that employs capital and labor. The physical labor input of every worker is normalized to be one. However, the effectiveness of capital and labor depends on the respective workers' effort, which is assumed not perfectly contractible, leading to a moral hazard problem. Specifically, we assume that production per-worker takes the form

$$F(e,k) = e^{\nu} f(k) \ , \tag{1}$$

where k denotes capital per worker and e is the worker's effort, $e, \nu \in [0,1]$. We assume that $f(\cdot)$ is an increasing concave function, with $f(0) = 0$. Output is also assumed not contractible.[9] Instead, the firm is assumed to costlessly observe a contractible measure of the worker's effort, $s \in \{0,1\}$, where $s = 1$ is a favorable signal.[10] The probability of observing the favorable signal depends on the worker's effort and the precision of an underlying monitoring technology that detects the measure.[11] We assume that the probability of detecting a favorable measure is

$$p(e) = e^{\theta} \ , \tag{2}$$

[9] Otherwise, the moral hazard problem could be trivially resolved.

[10] See Milgrom (1981).

[11] To fix ideas, suppose the firm observes many signals about the worker's effort. Given the risk neutrality of the parties, it has been shown (Kim (1997)) that the signals will be aggregated into a binary measure.

where $\theta \in [0,1]$ reflects the precision of the monitoring device. In particular, θ is the elasticity of the probability of observing the favorable signal with respect to effort, so that an increase in θ should be interpreted as an improvement of the monitoring technology.[12]

In this kind of environment it has been shown that the optimal contract will be linear (e.g. Kim (1997)), consisting of a fixed payment A and a bonus B that is paid if and only if a favorable signal is detected. Accordingly, the expected compensation to a worker who exerts effort e is $A + Bp(e)$. Finally, we impose a financial constraint on the workers, specifically requiring that payments are non-negative in all states, i.e. $A, A + B \geq 0$. The second requirement will be irrelevant given $A \geq 0$. Indeed, B will be strictly positive to provide effort incentives to the worker. The zero boundary is purely arbitrary. Other conditions would work just as well provided the constraint prevents the outright selling of the production technology to the worker.[13] Exerting effort is costly to the worker in terms of utility. This cost, specified in monetary equivalent, is assumed to be linear, taking the form[14]

$$c(e) = c \cdot e \ . \tag{3}$$

We model the interaction between firms and their workers in the following way. In the first stage of the game, firms hire capital per-worker at a given rental rate, r.[15] In the second stage each worker is matched with a unit of "capital per-worker". Each worker bargains individually over the surplus created by the match. We assume that the outcome of the bargaining stage can be represented by a Nash bargaining game, where α represents the bargaining power of labor, which is taken as given by the parties. At the bargaining stage, we assume that the outside option of both parties is zero. Finally, the contract is executed, workers exert effort, s is observed and payments are made.

While α is not controlled by the parties, it is a societal choice variable. In our framework, any α chosen by society should be small enough to guarantee that the non-negativity constraint on A is binding. The intuition is as follows. As long as $A = 0$, the game generates a trade-off between effort and capital. For a given level of capital, higher bargaining power for labor induces higher

[12] To simplify, we do not model the firm's choice of precision (see Bental Demougin (2006) for an analysis where this choice plays a crucial role).

[13] Obviously this is an artifact of the risk neutrality assumption.

[14] The linear specification is less restrictive than it may appear. As can be verified, any cost function of the form $c \cdot e^{\zeta}$ where $\zeta > 1$ is equivalent to the specification in the text, with an appropriate change of variables.

[15] Implicitly, we assume that the capital stock is fixed, and that there exists an alternative technology that converts capital into output at a rate of $1 : r$.

effort. However, due to the holdup situation, firms adjust ex-ante the level of capital downwards. In contrast, when α is sufficiently large, the rent workers extract becomes so large that it forces $A > 0$. Given k, it can be shown that in this situation effort reaches its first-best level.[16] Nevertheless, choosing such a "large" α cannot be optimal since in this region the trade-off between effort and capital disappears.[17] Therefore, below we impose $A = 0$ and once we calculate the optimal solution, we verify that the above intuition holds.

3 Effort and capital choices

Applying backward induction, we start with the worker's effort choice. At this stage, the labor contract is already specified. Accordingly, the worker maximizes his rent:

$$R = \max_{\widehat{e}} \; Bp(\widehat{e}) - c(\widehat{e}) \tag{4}$$

Using (2) and (3), the first order condition of (4) yields the worker's effort choice as a function of the bonus and the underlying parameters:

$$e = \lambda^{\frac{1}{1-\theta}} B^{\frac{1}{1-\theta}}, \text{where } \lambda = \frac{\theta}{c} \tag{5}$$

Equation (5)reflects the incentive effect of the bonus on effort. As B increases, the power (measured by the expected bonus) increases thereby raising effort. Furthermore, effort is also increasing as monitoring becomes more effective.

Moving to the bargaining stage, the parties negotiate the labor contract anticipating that it will induce effort. At this stage of the game, the capital labor ratio is already determined. From the assumption on the negotiation game, the resulting labor contract maximizes the Nash product.[18] Thus, it

[16] We outline the proof of the above claim in footnote 18 just after the introduction of the Nash bargaining problem. For a thorough discussion, see Demougin and Helm (2005).

[17] Observe that marginally reducing α would not affect effort efficiency, while capital efficiency would increase.

[18] Consider introducing a negotiation including A. Denoting the firm's cost to induce effort e of the worker by $C^P(e) = \frac{p(e)}{p'(e)} c'(e)$, the Lagrangian resulting from the maximization of the Nash product becomes

$$\left[F(e,k) - A - C^P(e)\right]^{1-\alpha} \left[A + C^P(e) - c(e)\right]^{\alpha} + \xi A$$

where ξ is the multiplicator of the constraint $A \geq 0$. It is easily verified that with $A > 0$ (i.e. with $\xi = 0$) the first order condition on effort implies $F_e(e,k) = c'(e)$ and effort is first best given k.

solves:

$$\Pi = \max_{B,e} \; [F(e,k) - Bp(e)]^{1-\alpha} [Bp(e) - c(e)]^{\alpha} \quad (6)$$
$$s.t. \; (5)$$

Substituting the functional forms and the incentive compatibility condition (5) allows us to eliminate the effort variable and reformulate the Nash-bargaining problem:

$$\Pi = \max_{B} \; \left[\lambda^{\frac{\nu}{1-\theta}} B^{\frac{\nu}{1-\theta}} f(k) - \lambda^{\frac{\theta}{1-\theta}} B^{\frac{1}{1-\theta}}\right]^{1-\alpha} \left[(1-\theta)\, \lambda^{\frac{\theta}{1-\theta}} B^{\frac{1}{1-\theta}}\right]^{\alpha} \quad (7)$$

Taking the derivative with respect to B and solving, yields a closed-form solution for the bonus:

$$B = [(1-\alpha)\nu + \alpha]^{\frac{1-\theta}{1-\nu}} \, \lambda^{\frac{\nu-\theta}{1-\nu}} f(k)^{\frac{1-\theta}{1-\nu}} \quad (8)$$

The bonus is clearly positively affected by the bargaining power of labor. Intuitively, the worker's bargaining power provides him a share of the quasi rent. In addition, once forced to yield a fraction of the quasi rent, the parties find it optimal to induce effort. Another positive effect is that of capital. This is due to the fact that higher levels of capital increase the marginal benefit of effort. Finally, the quality of monitoring has two opposite effects. For a given level of effort, from (5), raising θ reduces the bonus. Accordingly, at that initial effort level, the marginal cost of inducing effort decreases. Therefore, the firm would like to increase effort requiring the bonus to rise. The combined effect on B is ambiguous.

Substituting back into (1) the induced effort, e, and the optimal bonus, B, we obtain output:

$$y = \lambda^{\frac{\nu}{1-\nu}} \, [(1-\alpha)\nu + \alpha]^{\frac{\nu}{1-\nu}} \, f(k)^{\frac{1}{1-\nu}} \quad (9)$$

Notice that for production the impact of improved monitoring is unambiguously positive. Note further that in the "reduced form" expression for output, the underlying production technology, $f(\cdot)$, is raised to a power that is larger than unity.

Equation (9) implies that according to our model the usual "growth accounting" exercises need to be modified. First, in our model labor share is not equal to the marginal product of labor. Therefore, factor shares cannot be used to assess the value of $f'(\cdot)$.[19] Second, ν is further affecting the contribution of capital growth to output growth, and its value needs to

[19] For a further discussion of this point, see Bental and Demougin (2005).

be estimated. These observations suggest that the computations of TFP growth rates should be revised. Our model predicts that such revised estimates would be correlated with changes in monitoring and the institutional environment captured by α.

Going one further step back, we turn to the firm's decision concerning its capital choice. Assuming that the firm anticipates the outcome of the contract negotiation and its impact of the worker's effort, we obtain:[20]

$$\pi = \Phi(\alpha, \theta) f(k)^{\frac{1}{1-\nu}} - rk \tag{10}$$

where

$$\Phi(\alpha, \theta) = \lambda^{\frac{\nu}{1-\nu}} \left[(1-\alpha)\nu + \alpha\right]^{\frac{\nu}{1-\nu}} \left[(1-\nu)(1-\alpha)\right] \tag{11}$$

From (10) we obtain the first order condition with respect to the capital choice:

$$\frac{1}{1-\nu} \Phi(\alpha, \theta) f(k)^{\frac{\nu}{1-\nu}} f'(k) - r = 0 \; . \tag{12}$$

This implicitly defines $k(\alpha, \theta)$. To satisfy the second order condition, additional constraints on the parameters of the underlying technology are required. For example, in the Cobb-Douglas case where $f(k) = k^{\gamma}$, the parameters need to satisfy $\gamma + \nu < 1$.

Anticipating the analysis of the social conflict further below, we examine next how the parties would individually want to allocate bargaining power, and compare their preferred allocation to the societal optimum.

3.1 Bargaining power from the point of view of the firm

Suppose firms could determine the bargaining power of workers on their own. That bargaining power has two conflicting effects on profits. Increasing α raises the workers' share in output. This clearly has a direct negative impact on profits. However, from (8) we know that the bonus is increasing in α, and from (5) effort increases in the bonus. Therefore, α has a positive effect on the worker's effort and potentially also on profits.

To assess the overall effect of α on profit, we apply the envelope theorem on the firm's optimization problem to compute:

$$\pi_{\alpha} = \Phi_{\alpha} f(k)^{\frac{1}{1-\nu}} \; , \tag{13}$$

[20] In the sequel we omit the dependence of the various expressions on α and θ, except where that dependence is essential for comprehension.

where:

$$\Phi_\alpha = -\alpha\lambda^{\frac{\nu}{1-\nu}} \left[(1-\alpha)\nu + \alpha\right]^{\frac{\nu}{1-\nu}-1} (1-\nu) < 0. \tag{14}$$

Clearly, this indicates that the firm would like to drive the bargaining power of workers to zero.[21] Furthermore, the negative impact of α on Φ also implies that increasing α would reduce the capital labor ratio. Specifically, we have:

$$k_\alpha = -\frac{\Phi_\alpha f(k) f'(k)}{\Phi \frac{\nu}{1-\nu} \left[f'(k)\right]^2 + \Phi f(k) f''(k)} < 0 \ , \tag{15}$$

where the denominator of (15) is negative due to the second order conditions. Increasing labor's bargaining power exacerbates the holdup problem while raising labor efficiency. In our setup, the former effect dominates.

3.2 Bargaining Power from the Point of View of Labor

From the point of view of labor, increases in their bargaining power can be decomposed into three separate effects already identified above. First, it raises workers' share in output. Second, in the negotiation game workers are induced to exert more effort. Third, capital investment decreases. To assess the overall impact of these effects on the workers' utility, we compute their rent (see (4)), using the optimal effort and bonus:

$$R = \Omega(\alpha, \theta) f(k)^{\frac{1}{1-\nu}}, \tag{16}$$

where

$$\Omega(\alpha, \theta) = (1-\theta)\, \lambda^{\frac{\nu}{1-\nu}} \left[(1-\alpha)\nu + \alpha\right]^{\frac{1}{1-\nu}} \ . \tag{17}$$

Denoting the workers' preferred level of bargaining power by α_L, we argue that $0 < \alpha_L < 1$. First we note that at $\alpha = 1$ the workers' rent is zero since at this point firms do not invest in capital (as $\Phi(1, \theta) = 0$) and there is no output.[22] Second, at the other extreme, with $\alpha = 0$, the rent is positive. This is the standard result for moral hazard situations with limited liability, reflecting the fact that workers still need to be incentivized. Furthermore, as can be easily seen, $\Omega_\alpha(0, \theta) > 0$ while $k_\alpha(0) = 0$. Thus, starting at $\alpha = 0$, workers would initially like to increase their bargaining power, but clearly not to the extreme. Intuitively, the workers trade off their "share of the pie" in order to increase the "size of the pie".

[21] This corner solution is due to the fact that the holdup problem is one-sided. If workers are investing in relationship-specific human capital, the firms would want to share the quasi-rent with the workers albeit to a lesser extent than is socially optimal.

[22] We consider $\alpha = 1$ for purely technical reasons. As noted above, society never chooses this value as it would violate the requirement of $A = 0$.

3.3 Bargaining Power from the Point of View of Society

Defining social welfare as the sum of the firm's profit and the worker's rent, we obtain:[23]

$$W = \left[\Phi(\alpha,\theta) f(k)^{\frac{1}{1-\nu}} - rk\right] + \Omega(\alpha,\theta) f(k)^{\frac{1}{1-\nu}} \ . \tag{18}$$

From this definition, it can be seen that a benevolent regulator balances the conflicting interests of the workers and the firms. Consequently, the socially optimal level of bargaining power will be somewhere between that favored by either party on its own.

Taking the derivative of (18) with respect to α, yields:

$$\begin{aligned} W_\alpha \quad = \quad & \frac{\Phi_\alpha}{1-\nu}(1-\theta)\left[(1-\alpha)\nu+\alpha\right] \cdot \\ & \left\{\left(\frac{1-\nu}{(1-\theta)\left[(1-\alpha)\nu+\alpha\right]} - \frac{1}{\alpha}\right) - \left(\frac{1}{1-\alpha}\right) X\right\} f(k)^{\frac{1}{1-\nu}} \end{aligned} \tag{19}$$

where

$$X = \frac{\left[f'(k)\right]^2}{\nu\left[f'(k)\right]^2 + (1-\nu) f(k) f''(k)} \ . \tag{20}$$

From the second order condition of the firm's optimization problem, we know that X must be negative. Therefore, to satisfy $W_\alpha = 0$, at an interior solution, α^*, the following inequality must hold:

$$\frac{1-\nu}{(1-\theta)\left[(1-\alpha)\nu+\alpha\right]} - \frac{1}{\alpha} < 0 \tag{21}$$

It is easily verifiable that this inequality can be rewritten as:

$$\alpha < \frac{(1-\theta)}{\theta} \frac{\nu}{(1-\nu)}. \tag{22}$$

The inequality implies that the set of admissible α shrinks as θ increases so that when $\theta \to 1$, i.e. the moral hazard problem disappears, we find $\alpha \to 0$.

For all other cases where moral hazard is relevant, we have $W_\alpha > 0$ at $\alpha = 0$. Thus, the social planner never chooses to endow the entire bargaining

[23] Remember (footnote 15) that capital can be used in an alternative technology that yields r per unit. Therefore the regulator needs to substract rk from output.

power to the firms. At the other extreme where $\alpha = 1$, we find $W_\alpha = -\infty$. Consequently the social planner never chooses to endow the entire bargaining power to the workers either.

Condition (22) implies that the initial restriction we have imposed on the contract, $A = 0$, is indeed not constraining the social planner's problem. As matter of fact, the same condition also guarantees that the effort level induced by the social planner is smaller than the first-best level (given k). Since the latter implies $A > 0$, the social planner chooses to set A to zero.

To sum, the essential result of our analysis is that society, faced with holdup in capital and moral hazard in the labor relationship, should balance the two frictions by allocating some bargaining power to labor. The resulting optimal bargaining power should be responsive to changes in the economic environment. Specifically, improved monitoring technology captured in our model by an increase in θ implies a reduction in α^*.

4 The Cobb-Douglas Technology

To gain further insights, we consider for the rest of the paper the Cobb-Douglas production technology. This specification allows us to run numerical experiments and match some phenomena observed in the data. Accordingly, we replace (1) by:

$$F(e, k) = e^\nu k^\gamma. \tag{23}$$

With this specification we obtain that (20) simplifies to:

$$X = \frac{\gamma}{\gamma + \nu - 1} \text{ where } \gamma + \nu - 1 < 0. \tag{24}$$

From (19) we reproduce the condition determining the regulator's optimal choice of α:

$$\left(\frac{1-\nu}{(1-\theta)\left[(1-\alpha)\nu + \alpha\right]} - \frac{1}{\alpha}\right) - \left(\frac{1}{1-\alpha}\right)\frac{\gamma}{\gamma+\nu-1} = 0 \tag{25}$$

Figure 1 depicts the relationship between the solution α^* and θ, holding ν and γ fixed at arbitrarily chosen values of 0.5 and 0.3, respectively:[24]

As can be seen, the emerging relationship is decreasing in θ. Intuitively, as monitoring improves, the moral hazard problem becomes less significant. As

[24] Clearly, (25) has two roots. It is easily verified that only one of them is relelvant. The shape of the corresponding curve is independent of the particular choices of ν and γ, as long as $\gamma + \nu - 1 < 0$.

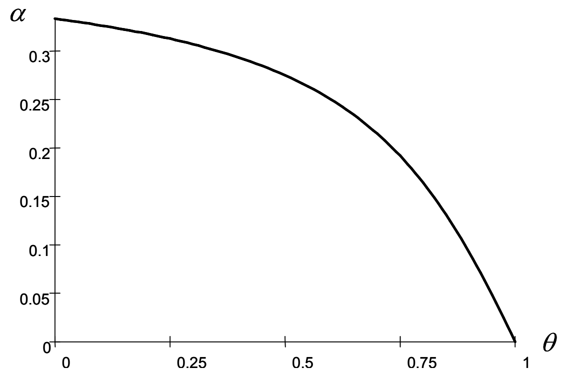

Figure 1: The optimal bargaining power

a result, at the social optimum the balance between the moral hazard problem and the holdup friction tilts towards the holdup problem. Consequently, the social planner finds it optimal to shift the allocation of bargaining power towards capital and away from labor. Note again that with $\theta = 1$, the moral hazard problem completely disappears and, not surprisingly, $\alpha^* = 0$.

5 Reinterpreting some stylized facts

We now use the above setup to interpret some stylized facts. Contrary to conventional wisdom, labor shares in many OECD countries have been decreasing for the last two decades (Blanchard (1997), Jones (2003) and Blanchard (2006)). We focus now on Blanchard (2006) analysis of French data which also reports the real wage per efficiency unit and the ratio between employment in efficiency units and capital (his Figure 14, reproduced by us here also for Australia and Germany for the period starting in 1980).[25] Blanchard associates the decline in all these measures over the last two decades in France with an "adverse shift in labor demand". He suggests that such a shift may have been caused by decreased labor hoarding. Such a shift would explain why the labor share decreased relative to its level in the early 1970s, despite the fact that in France the wage (per efficiency unit) returned at the end of the observed period roughly to its 1970 level. Blanchard points out that this line of reasoning leaves open the question as to why employment in

[25] Blanchard's computations use the value added generated by the business sector, business sector employment, wage payments and capital stocks. We follow exactly Blanchard's formulae to calculate the Solow residuals and the trends..

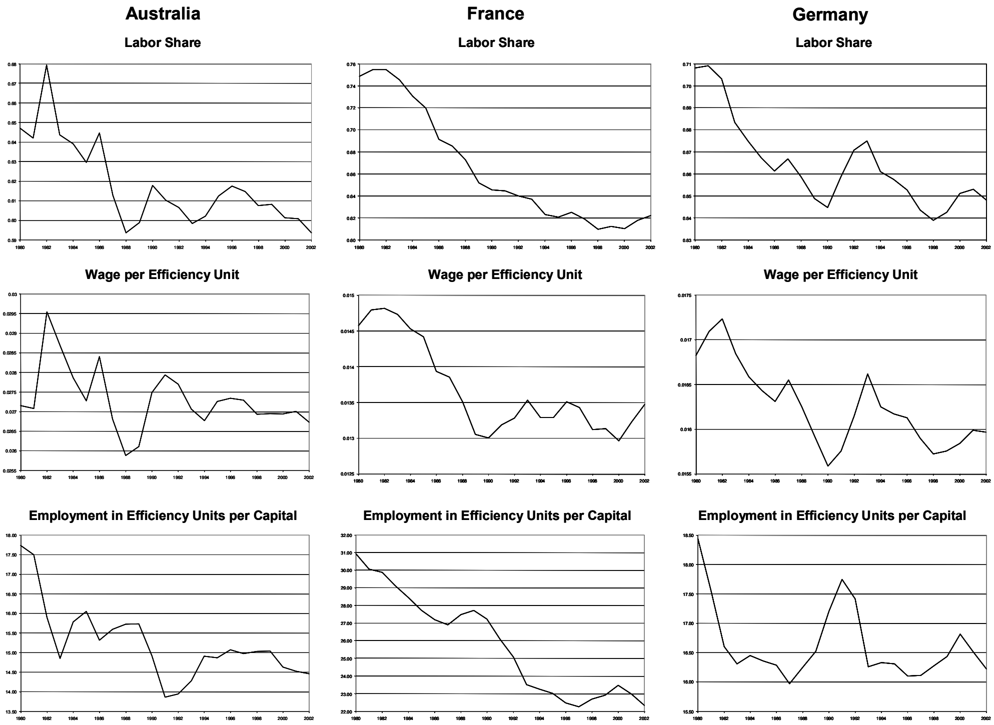

Figure 2: Australian, French and German data

efficincy units relative to capital stays well below its 1970 level.

Our model suggests a potential answer to the above puzzle. The problem is resolved by interpreting the observed phenomena as a response to improvement in monitoring and its impact on the allocation of bargaining power. As the puzzle concerns the observed trends of the last two decades, we focus on this period.[26]

We will show that all the features for that period displayed in Figure 2 are consistent with our model. Notwithstanding Blanchard's explanation whereby the drop in labor share results from a reduction in employment, we generate a decrease in the labor share with a fixed number of workers. We also generate a declining wage rate per efficiency unit despite the fact that capital remains high relative to labor measured in efficiency units. These trends are obtained by increasing θ, assuming that the regulator is optimally adjusting α in response. Therefore, if we associate the developments in ICT

[26]The change in labor markets that took place during the 1980s has already been used by others to explain structural breaks in these markets (see, e.g., Ljungqvist and Sargent (1998)).

over the relevant period with improved monitoring, our model provides an additional explanation to the observed trends.

Before addressing these facts, we discuss the factors affecting productivity in our model as it would be measured in a standard growth accounting exercise.[27] Clearly, total factor productivity here is given by e^{ν}. From (5), (8) and (12) we obtain:

$$e^{\nu} = \lambda^{\frac{\nu(1-\gamma)}{1-\gamma-\nu}} \left[(1-\alpha)\nu + \alpha\right]^{\frac{\nu(1-\gamma)}{1-\gamma-\nu}} (1-\alpha)^{\frac{\nu\gamma}{1-\gamma-\nu}} \left[\frac{\gamma}{r}\right]^{\frac{\nu\gamma}{1-\gamma-\nu}} \tag{26}$$

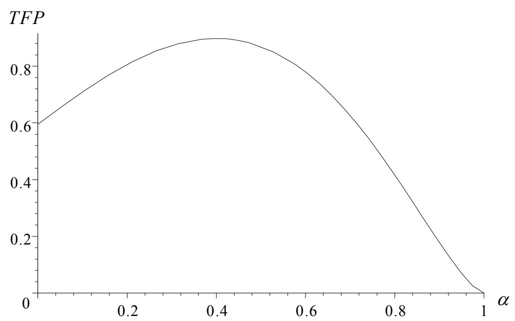

Figure 3: Productivity and bargaining power

We have seen in Figure 1 that an increase in θ reduces α^*. To understand the importance of the monitoring technology, we first show in Figure 3 that an exogenous reduction of α (holding $\lambda = \frac{\theta}{c}$ fixed arbitrarily at the value of 0.8) would *decrease* productivity over the relevant range of α (notice from Figure 1 that the relevant range is between 0 and approximately 0.35):[28]. Consider next the full effect of variations in θ on productivity, i.e. including the optimal adjustment of α^* as shown in Figure 4:[29]

[27] On page 9, we discussed how growth accounting should be carried out within our framework. Here our goal is to mimic Blanchard's findings, assuming that the data is generated by our model economy, but the measurements are performed in the standard way.

[28] Clearly the social planner chooses an α to the left of the point that maximizes TFP, since he also considers the negative impact of raising the bargaining power of labor on the firms' capital choice.

[29] For this calculation we set $c = 1.1$. This value guarantees that effort remains in the interior of $[0, 1]$. For smaller values of c, due to the linear specification of effort costs, we would need to introduce a boundary constraint.

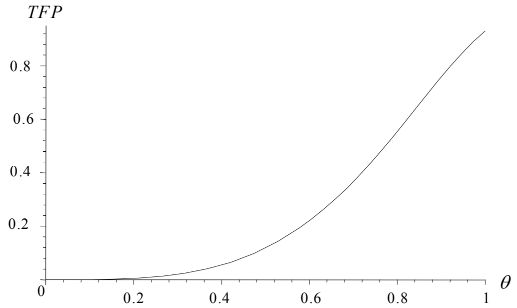

Figure 4: Productivity

From the above, we know that increasing θ has a direct positive productivity effect while simultaneously decreasing α^*. The figure shows that the direct effect of improved monitoring on productivity is dominant.

To match the last two rows of Figure 2, we introduce "efficiency units", E. Specifically, thinking of a Harrod-neutral productivity factor that affects labor efficiency, the Cobb-Douglas technology implies:

$$e^{\nu}k^{\gamma} = k^{\gamma}E^{1-\gamma}. \tag{27}$$

Therefore, total factor productivity translates into labor efficiency units as follows:

$$E = e^{\frac{\nu}{1-\gamma}} \tag{28}$$

Consider first row of Figure 2 In our framework, the labor share, LS, is captured by the ratio of expected bonus over output. Taking the relevant variables from the output, effort and bonus equations ((9), (8) and (5)), we obtain the labor share:[30]

$$LS = [(1-\alpha)\nu + \alpha] \tag{29}$$

Clearly, the labor share is increasing in α.[31] Since α^* is itself decreasing in θ, we obtain a negative relationship between the quality of monitoring and the labor share, as drawn in Figure 5:

[30] Observe that this result is independent of the Cobb-Douglas specification of the production function.

[31] Unlike the common practice, here the labor share is independent of production technology paramaters (such as γ in the Cobb-Douglas case) in any direct way (see also Bental and Demougin (2005)). However, production technology parameters enter indirectly through α^*.

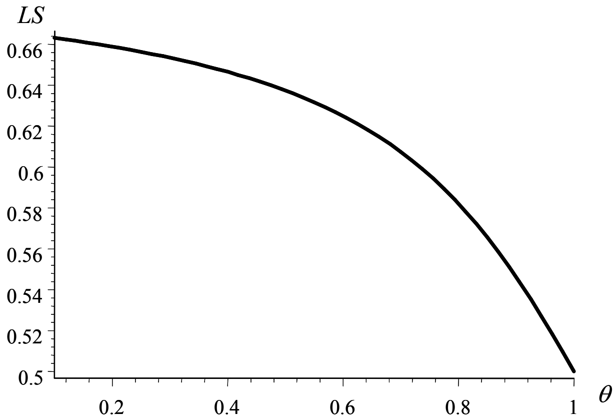

Figure 5: Labor share

Accordingly, if the quality of monitoring has improved over the past two decades and bargaining power of labor has been reduced, one would expect labor share in France to have decreased.

Next we examine the wage per efficiency unit (the second row of Figure 2). Applying the definitions of labor compensation and efficiency units, the "real wage per efficiency unit" becomes:

$$\frac{pB}{E} = [(1-\alpha)\nu + \alpha]\,(1-\alpha)^{\frac{\gamma}{1-\gamma}} \left[\frac{\gamma}{r}\right]^{\frac{\gamma}{1-\gamma}} \tag{30}$$

Figure 6 depicts the "real wage per efficiency unit" for the above parameter

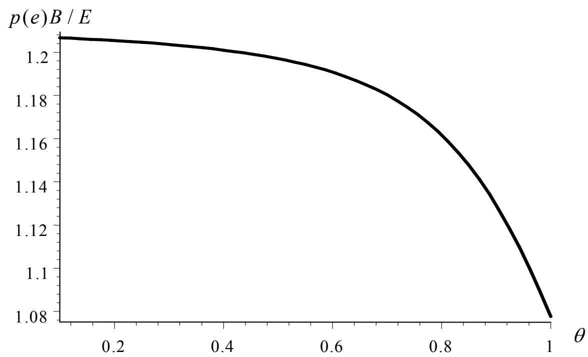

Figure 6: Real wage per efficiency units

values. In our framework the "real wage per efficiency unit" is decreasing in the quality of monitoring. The worker's rent drops while he becomes more "efficient", as the significance of the moral hazard problem diminishes. In the limit, with $\theta = 1$, the worker's rent drops to zero, and labor compensation equals the marginal effort cost.[32]

Finally, we depict the equivalent of the third row of Figure 2 in our model. Applying the definition of efficiency unit and using the firm's capital choice (equation (12)) yields for the Cobb-Douglas case:

$$\frac{E}{k} = \left(\frac{r}{\gamma(1-\alpha)}\right)^{\frac{1}{1-\gamma}} \tag{31}$$

Applying the above parameters to (31), we obtain:

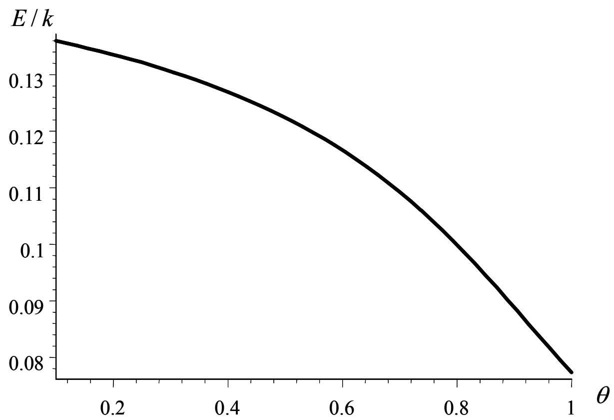

Figure 7: Labor efficiency units to capital

To understand the above figure, it is useful to start with the standard framework of a growth model. There, in the steady state, E/k is independent of Harrod-neutral productivity gains. In our model too the direct impact of the improved monitoring on productivity is perfectly offset by changes in capital as can be seen from equation (31), where E/k does not depend on λ despite the fact that both E and k are increasing in λ. There is, however, an additional effect due to the holdup problem. Since an improvement in monitoring implies an increase in the optimal bargaining power of capital, $1-\alpha$, the ratio E/k must decrease.

[32] In Figure 6 the wage/efficiency ratio becomes 1 when $\theta = 1$ because in the numerical example we have set the marginal effort cost, c, to 1.

To conclude the section, we consider the operating surplus.[33] In our model improved monitoring cannot do anything but increase operating surplus, as seen in Figure 8 below (drawn for the above functional forms and parameter values).

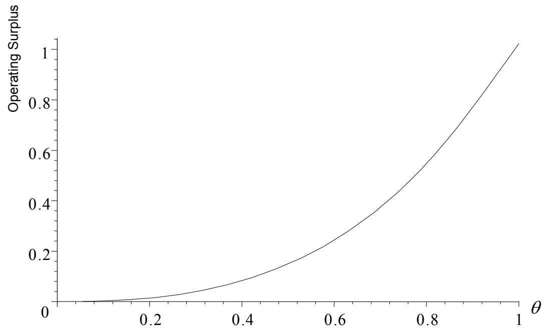

Figure 8: Operating surplus per unit of labor

In Figure 9, we depict the evolution of the real operating surplus per efficiency unit in France.[34] From the point of view of the model, the appropriate

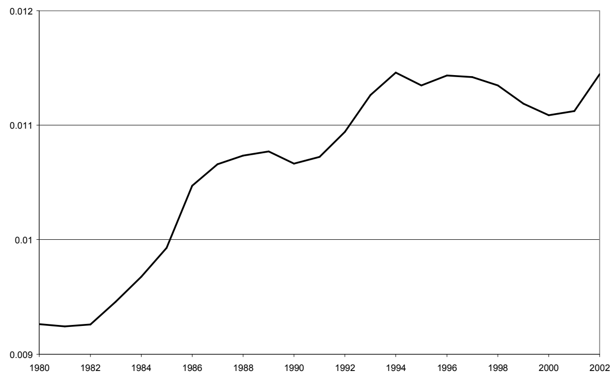

Figure 9: Operating Surplus per efficiency unit in France

measure would have been operating surplus per physical unit of labor. How-

[33]We follow the OECD definition of "operating surplus", that is - profits plus interest payments. The data is taken from OECD STAN-industry. It is deflated by the price index computed according to Blanchard's algorithm.

[34]In this version of the paper we are still missing the corresponding data for Australia and Germany.

ever, this would overlook the fact that, unlike in the model, productivity in France may have increased exogenously. The normalization by the efficiency units is done to correct for this. However, since the measured productivity gain includes also effects due to variations in the quality of monitoring, Figure 9 underestimates the "correct" trend.

6 Discussion and Concluding Remarks

This paper introduces two frictions that hinder a smooth functioning of the economy. There is a moral hazard problem that forces firms to leave rents to their workers in order to induce effort. On the other hand, there is a holdup problem that causes investment to decrease as workers' share in output increases. The bargaining power of labor determines the relative importance of either friction. When labor is given significant power, the moral hazard problem is reduced while the holdup problem increases. When capital has great bargaining power the reverse holds.

At the optimum the social planner balances these two effects. The optimal allocation of bargaining power is affected by the economy's underlying parameters, and in particular by the effectiveness of the monitoring technology. As this technology improves, the moral hazard problem becomes less significant and the social planner reduces the bargaining power of labor.

There are many indications that the emergence of IC technologies have improved the quality of monitoring. In line with the prediction of our model, we observe that many countries have enacted policies affecting labor relations. Beside the well documented examples of the Netherlands and Denmark, other countries have also moved in the same direction through the reduction of unemployment benefits and tougher eligibility criteria, stricter rulings of labor courts, etc.. We interpret these measures as an indication of a reduction in the bargaining power of labor in the respective countries.

Using our model, such adjustments can explain declining trends in labor shares observed in OECD countries over the last two decades. Furthermore, the model predicts a decreasing ratio of labor in efficiency units and capital, and falling wages per efficiency unit. These trends are present in several important economies. Moreover, in the model these changes in the institutional environment imply that per-worker profits increase, as they do in the data.

Not surprisingly, the institutional changes described above have been opposed by labor representatives. In terms of our model, the diverging interests between the workers and society as a whole can be captured by the difference between the bargaining power workers would prefer on their own, α_L, and the social optimal α^*. The former maximizes the worker's rent (equation

(16)) with respect to α, and yields:

$$\alpha_L = \frac{1-\gamma-\nu}{1-\nu}. \tag{32}$$

The difference $\Delta = \alpha_L - \alpha^*$ may be regarded as a measure capturing the strength of the potential opposition to institutional reforms in the labor market. Figure 10 plots the case for the parameter values chosen above. The figure reflects the impact of the moral hazard problem. As its significance grows (θ decreases), the efficient level of bargaining power converges to the workers' preferred choice. Intuitively, for $\theta = 0$, the moral hazard problem is infinite, and the social planner in effect lets the workers choose their preferred bargaining power.

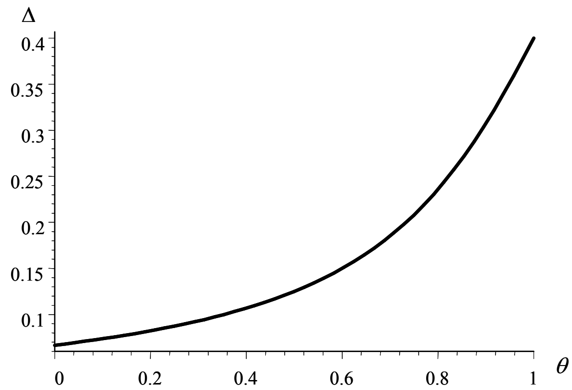

Figure 10: Divergence of α choices

In this context, labor's opposition has often been phrased in terms of equity issues. In particular, while profits have been increasing (as seen in Figure 9 for the French case), the falling labor shares imply that labor compensation has not grown at the same rate. As argued above, these observations are consistent with our model. In fact, our framework predicts an even stronger result. For high quality of monitoring, further improvements reduce the worker's rent while increasing effort. This obtains because large values of θ imply the disappearance of the moral hazard problem and thus rents.

While our model has been successful in explaining puzzling facts observed in a significant group of countries, at this stage it cannot match the trends observed in other countries. Specifically, in most other large economies (including the U.S. and the U.K.) while labor shares and wages per efficiency units have been decreasing, the ratio between labor in efficiency units and capital has been increasing. Since the latter trend corresponds to the neoclassical predictions given the former trends, it seems that a competitive element is missing in our current framework. This suggests that introducing into our model a sector not subject to the frictions we have emphasized, may provide an additional degree of freedom, thereby, explaining the differences between the two groups of countries.

The way institutions are introduced and justified in our paper is clearly rudimentary and should be elaborated upon. For example, in the current framework institutions were designed to resolve inefficiencies stemming from transactions costs emerging from holdup in capital investments and moral hazard on the side of labor. Of course, there are many other imperfections leading to transactions costs. One may consider human capital investments, and in particular relationship-specific ones. Multi-tasking and incomplete contracts may be other important sources of transactions costs.[35] Another natural line of extension is to directly analyze policy variables underlying the abstract "bargaining power" which we have used in this paper.

Empirically, the model may be taken beyond the stylized facts listed above. For example, it draws a very clear distinction between productivity gains that are due to technological changes in the underlying production function, and productivity gains that are due to improved monitoring and the resulting changes in the allocation of bargaining power. In principle, the model allows a decomposition of TFP into a direct "technology effect" and an indirect effect due to the improvement in monitoring and institutional responses. Alternatively, cross-country variations in institutions (as listed by e.g. Botero *et al.*(2004)) may be exploited to identify the model's parameters.

[35] A similar contracting friction has been recently used by Acemoglu, Antras and Helpman (2005).

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