

Declining Labor Shares and Bargaining Power: An Institutional Explanation

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Abstract

We model the design of labor market institutions in an economy characterized by moral hazard and irreversible investment. In this setting, the institutional setting affects the bargaining power of labor. At the optimum the allocation of bargaining power balances the aforementioned frictions. We examine the impact of improved monitoring and investigate the implication upon labor share, effort and investment. The model's predictions are consistent with recent decreasing labor shares and wages per effective labor units observed in most OECD countries. It is also consistent with rising labor productivity and declining ratio between effective labor and capital found in many of these countries.

KEYWORDS: institutions, moral hazard, irreversible investment, bargaining, labor share, productivity

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1 Introduction

During the last quarter of a century, most OECD countries have undertaken substantial institutional reforms affecting their labor markets (see e.g. Nickell and Nunziata (2001)). At the same time, while output in the industrial world has been growing significantly, labor shares in national income have been decreasing in most of these countries (see, e.g., Blanchard (1997) and Jones (2003), Figure 1).¹ Moreover, there is a general impression that labor compensation is lagging behind productivity gains. Despite the latter fact, in many countries the ratio between capital and labor measured in efficiency units has increased. We propose a setup in which changes in the economy's institutional design may generate the aforementioned phenomena.

In the standard neoclassical framework any labor market institution that hinders competition reduces efficiency (see, e.g., Botero et al. (2004), Caballero et al. (2004)). Accordingly, such institutions are commonly perceived as resulting from capture (see, e.g. Caballero and Hammour (1998)). In contrast, in the presence of frictions, labor market institutions as manifested in employment laws (regulating dismissal procedures and employment conditions), collective labor relation laws (co-determination, conflict resolution mechanisms, contract extension laws) and social security laws are essential, and may potentially increase efficiency. This is the case presented in the current paper.

Specifically, we analyze the institutional design in an economy characterized by two contractual frictions. First, labor relations are affected by moral hazard requiring firms to offer incentive contracts. Second, investment is irreversible and precedes contracting with labor. This contract incompleteness creates a form of holdup on investment and enables labor to extract part of the quasi-rent.

In this environment, institutions influence the relative strength of the bargaining power of labor. Accordingly, contracts and the respective impact of these frictions are affected by the institutional design. For example, allocating high bargaining power to labor induces high-powered incentive contracts and high effort. This mitigates the inefficiencies stemming from the moral hazard problem. At the same time the appropriation of a large part of the quasi rent by labor is detrimental to investment. Consequently, the institutional setup generates a trade-off between induced effort and investment. Optimally designed institutions recognize this trade-off and balance the inefficiencies associated with the aforementioned frictions. When the technological environment associated with any of these frictions changes, the optimal institutional arrangement needs to respond.

We concentrate below on the effect of technological changes related to monitoring and their impact on the moral hazard problem. In our framework firms and workers cannot directly contract on effort and need to rely on proxy vari-

¹While Figure 1 in Jones (2003) does not include the U.S., the increasing capital shares reported by Jones in Table 1 point in the same direction. See also the IMF's World Economic Outlook, 2007, Figure 5.7.

ables. We argue that in the recent past monitoring has become more efficient due to improvements in *ICT* (information and communication technologies). As a result the association between effort and the proxy variables has grown and the informational content of the proxy variables has increased. This development makes it easier for the firms to align incentives, and reduces the benefit of high powered incentive contracts. From the normative point of view, the optimally designed institutions should have responded by reducing the bargaining power of labor in order to increase the investment incentives. Such a reduction leads to a lower labor share, improved labor productivity and reduced wages per efficiency units of labor. Despite the last effect, capital per efficiency units of labor is likely to increase as a result of the higher quasi-rent accruing to capital.²

The role of institutions in explaining the recent evolution of the labor share has been recognized by others. Bentolli and Saint-Paul (2003) associate movements in the labor share to deviations from competitive wage setting induced by collective bargaining. Giammarrioli et al. (2002) explain the dynamics of European labor shares since the 1980s by modifications in labor market institutions manifested by changes in dismissal restrictions and union power. Berthold et al. (2002) analyze the connection between the decreasing labor shares and rising unemployment rates in France and Germany. They ascribe the performance of these economies to labor market institutions which allow labor to appropriate some of the rents generated by capital. Unlike our approach, labor market institutions in the above papers are exogenous to the underlying structure of the economy. In particular, institutions do not provide remedies to market failures, and therefore do not respond to changes in the economic environment.

Abstracting from the institutional setting, the evolution of labor share has also been explained as resulting from changes in the underlying production technologies that occur along the growth process. For example, Peretto and Seater (2006) as well as Zuleta (2008) propose models in which the elasticity of output with respect to reproducible inputs (i.e. capital) can be increased through R&D. Increases in the cost of the non-reproducible factor (i.e. labor) induce such investments in R&D, thereby lowering the labor share. Another approach which leads to increased capital intensity in the production function is due to Zeira (2005). In that paper, capital-intensive machines replace labor input as the latter becomes more expensive, leading to a reduction in the labor share.³

Finally, some researchers have associated recent declining labor shares in industrialized economies with globalization (see, e.g. Guscina (2006) and Jaumotte

²Our model remains consistent with the facts listed above as long as labor bargaining power declines. This could also be due to other factors discussed below and not necessarily reflect an *optimal* institutional response to improved monitoring.

³The idea is also used in Alesina and Zeira (2006) to explain the differential performance of the economy between Europe and the United States. According to that explanation, since in Europe institutions drive wage distribution to become more egalitarian, low-skilled-labor intensive industries there replace relatively expensive workers by machines.

and Tytell (2007)). Specifically, through increased capital mobility, pressure increases on the less mobile factor (labor) thereby reducing the labor share. The impact of all of the above explanations is empirically investigated in the IMF World Economic Outlook (2007). Appropriately decomposing the decline in labor shares, this study assesses the contributions of technological change, globalization and labor market policies to that decline and shows how the impact of these factors varies across groups of countries.

The current paper belongs to a growing literature linking organization theory and aggregate phenomena. Much of the work is associated with the impact of productivity, monitoring technologies and contracting environments on sourcing decisions and on foreign direct investment (e.g. Grossman and Helpman (2002), (2004), (2005), Antràs (2003), Antràs and Helpman (2004), Acemoglu, Antràs and Helpman (2005)). These papers use a variety of organizational frictions, such as multitasking agency problems, and property right issues à la Grossman and Hart (1986). Where productivity is relevant, it is assumed to vary exogenously, providing an explanation to the choice of integration versus outsourcing and location. Compared to that approach, the current paper uses a standard moral hazard framework varying the precision of monitoring. In that respect, the current analysis is closely related to our earlier work that associates productivity gains with endogenous changes in incentive contracts (Bental and Demougin (2006)). In that paper, the contracting environment was embedded in a competitive setting. Adding bargaining into the contracting environment introduces an additional feature that allows us to focus on the design of institutions, their impact on labor share and other aggregate variables. The current analysis is also related to Bental and Demougin (2008) which suggests a simple way to extract bargaining power out of aggregate data, but does not deal with moral hazard and institutional design.

The remainder of the paper is organized as follows. Next section provides some evidence on trends of macroeconomic indicators, evolution of labor market institutions and changes in incentive contracting. Section 3 introduces the model. Section 4 examines the microeconomic decisions of firms and workers. Section 5 analyzes the allocation of bargaining power. The sections 6 and 7 parameterize the case of a Cobb-Douglas technology to derive the trends of macroeconomic indicators predicted by the model. Finally, the last section offers some concluding remarks.

2 Some Evidence

2.1 Macroeconomic Indicators

The main data characteristics in which we are interested are summarized in Figure 1. The figure updates Blanchard's (2006) Figure 14 for France, adding the

U.S. and Germany and including labor productivity measures. The figures are derived from OECD data on 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 (see the appendix for a short discussion of data issues). The starting point is chosen to be 1980, reflecting the general impression that some major changes took place in labor markets around that time.⁴ Furthermore, the date coincides with the widespread introduction of microcomputers and information processing that, from our point of view, had an important impact on monitoring technologies.

The figure shows that contrary to conventional wisdom, labor shares in these countries (as well as in almost all other OECD countries) have been decreasing since the 1980s (see also Blanchard (1997), Jones (2003) and Figure 3.7 of the IMF World Economic Outlook (2007)). The figure also shows that the wage per efficiency units tends to be decreasing, which corresponds to informal assessments that can be found in the popular press. This feature characterizes also most other OECD countries. Next, it can be seen that for France and Germany the ratio between employment in efficiency units and capital is decreasing. This feature can be found in a number of other countries, with the notable exception of the U.S. Finally, we see that in all these countries labor productivity (as inferred from TFP) has significantly increased.

Blanchard (2006) focuses on France and associates the behavior of these measures with an "adverse shift in labor demand". He suggests that the shift may have been caused by decreased labor hoarding. This would explain why the labor share decreased relative to its level in the early 1970s. Blanchard points out that this line of reasoning creates a puzzle as to why employment in efficiency units relative to capital stayed well below its 1970 level. Our model suggests a potential answer to this puzzle by interpreting the observed phenomena as an institutional response to improvement in monitoring.

⁴Ljungqvist and Sargent (1998) explain some key features of the U.S. and European unemployment data by arguing that the labor markets underwent a structural change in the 1980s.

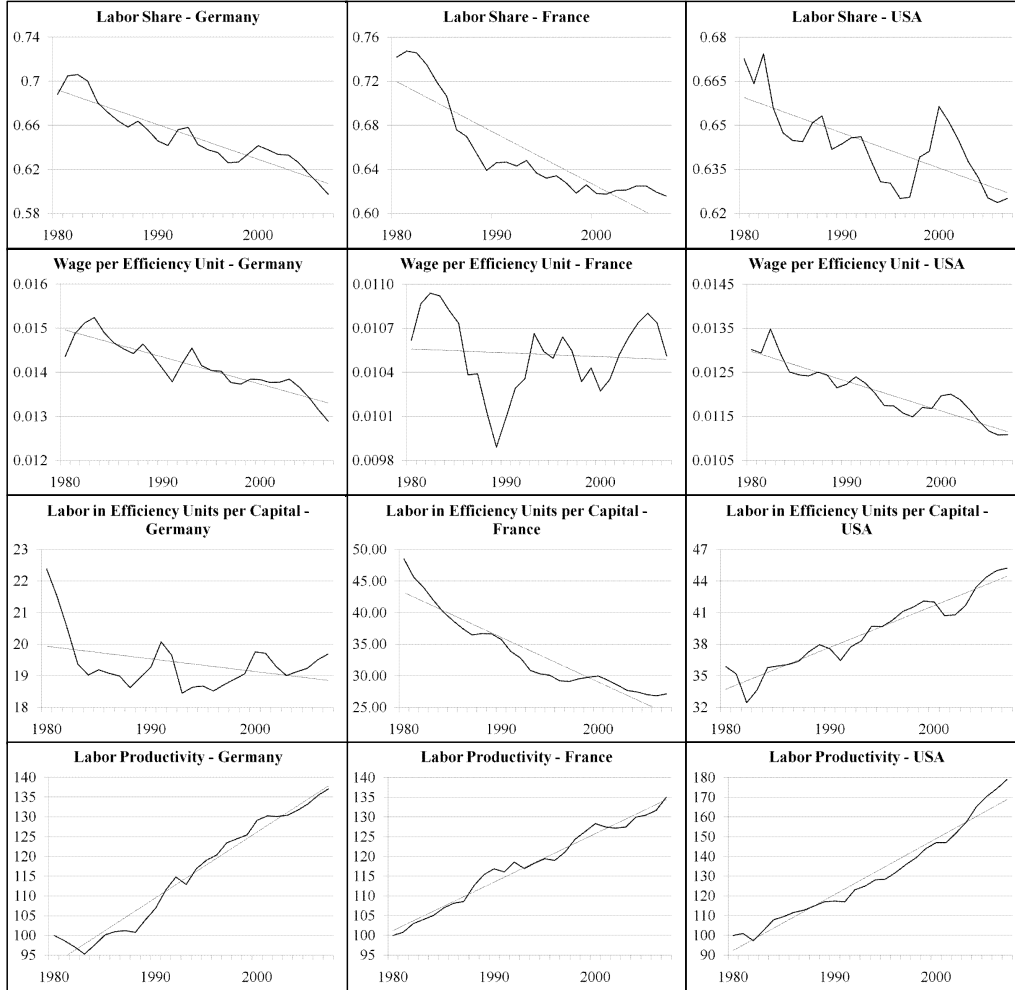


Figure 1: Trends for Germany, France and the USA

2.2 Labor Market Institutions

There are many ways in which the institutional framework shapes the abilities of parties to appropriate fractions of the quasi-rents, especially where labor markets are concerned. Some obvious candidates are direct regulations of the labor market, but also the courts' implementation of these. In addition, the openness of the market environment in particular the mobility of goods and services, capital and persons affects the ability of parties to appropriate quasi-rents.

With respect to the last point, it is clear that the ever increasing integration of the European Community has increased mobility of all the above factors within Europe. More generally, globalization has generated the same processes worldwide. Specifically, the high mobility of capital should reduce the fraction of quasi-rents which labor can appropriate. Moreover, a number of countries have undergone series of reforms of their labor market institutions and in the

way regulations are implemented. For example, in 1985 Germany allowed the use of fixed term contracts in labor relations without specifying an objective reason for its necessity. In 1994, the legislation governing temporary work agencies was loosened. Similarly, in 1986 France abolished prior administrative authorization for dismissals based on economic reasons (OECD Employment Outlook (2004)). Furthermore, jurisprudence has evolved. Before 1992, a dismissal for economic reasons was justified if the firm's competitiveness was threatened. After the judgement of the Cour de Cassation of 1st April 1992, the economic reason is recognized as soon as the firm's interest requires it.⁵

In the remainder, we do not provide a model mapping the complexity of the institutional setup into the ability of labor to appropriate a fraction of the quasi-rents. We do however capture that ability by a parameter representing labor's bargaining power.

2.3 Monitoring and Incentives

There are indications that monitoring has in fact been improving for quite some time and that the process has accelerated during the last two decades due to the rapid development of ICT. For example, Hubbard analyzes in a series of papers the impact of the installation of on board computers on the structure of the trucking industry and its productivity (e.g. Hubbard (2000) and Hubbard (2003)).⁶ In the same vein, Miozzo and Ramirez (2003) argue that the new information technology was used to monitor tasks of field engineers in the U.K. telecommunication industry, thereby improving their productivity.

Furthermore, the increased use of incentive schemes provides additional indirect indication that monitoring has improved or become cheaper. Intuitively, the willingness of profit maximizing firms to adopt incentive contracts increases if the association between the employee's effort and the proxy variables used to align incentives, tightens. In that respect, there is convincing evidence that the

⁵Nickell and Nunziata (2001) provide a regulation based employment protection index for various OECD countries. While their index indicates a reduction of protection for Germany over the relevant period, it finds that protection in France has slightly increased. From the point of view of our analysis, the index does not fully capture the extent of changes in the institutional environment. Specifically, it ignores issues associated with implementation. Furthermore, in some cases the increase in regulation may well have reduced labor's bargaining power as suggested by Blanchard and Landier (2002).

⁶In this context, the following advertisement of a typical producer of computerized monitoring technology may be 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." See also the American Management Association surveys on monitoring and surveillance at www.amanet.org/press/amanews/ems05.htm.

use of incentive schemes is, in fact, on the rise. For example, the European Industrial Relations Observatory (EIRO) reports in a 2001 study that "overall, the incidence of variable pay is increasing throughout the EU".⁷ Kurldelbusch (2002) examines in detail the case of major corporations in Germany. She reports in Table 2 a sequence of DAX companies introducing or extending variable pay schemes since the mid 1990s showing a significant increase in that form of pay. For Great Britain, Green (2004) exploits 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.

3 Model

We analyze a static economy with a given capital stock which is populated by a representative risk neutral individual. There are two sectors in the economy producing the same output. One sector requires only capital as input and yields r units of output per unit of capital. In the other sector firms operate a technology that requires both capital and labor. A representative firm employs a worker who provides a unit of physical labor. However, the effectiveness of capital and labor employed by the firm depends on the worker's effort, which is assumed to be non-contractible. Specifically, we assume that a firm's output takes the form

$$F(e, k) = e^\nu f(k) , \quad (1)$$

where k denotes capital employed and e is the worker's effort, $e, \nu \in [0, 1]$. We assume that $f(\cdot)$ is an increasing concave function, with $f(0) = 0$. We further assume that output is also not contractible. 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 (see Milgrom (1981)). 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. We assume that the probability of detecting a favorable signal is

$$p(e) = e^\theta , \quad (2)$$

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.

⁷See <http://www.eurofound.europa.eu/eiro/2001/04/study/tn0104201s.htm> for the report on "Variable Pay in Europe".

In this kind of environment the optimal contract consists of a fixed payment A and a bonus B that is paid 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 worker, specifically requiring that payments be 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.⁸

Exerting effort is costly to the worker in terms of utility. This cost, specified in monetary equivalent, is assumed to be linear, taking the form⁹

$$c(e) = c \cdot e . \quad (3)$$

We model the interaction between the representative firm and its worker in the following way. In the first stage of the game, the firm invests in k units of capital at the rental rate, r , induced by the alternative production technology, i.e. implicitly assuming that the supplied capital is sufficiently large. This investment is irreversible. In the second stage the representative worker is matched with the firm. The worker bargains with the firm 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 the worker, which is taken as given by the parties.¹⁰ At the bargaining stage, we assume that the outside option of both parties is zero. Finally, the contract is executed, the worker exerts effort, s is observed and payments are made. The interaction between the firm and the worker is embedded in a social context. In that context, α becomes a 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. For a small α , the moral hazard problem implies that effort is inefficiently low. Due to the risk neutrality of the parties, and in order to raise incentives as much as possible, they agree on a contract where all payments to the worker take the form of a bonus. Moreover, with $\alpha > 0$, the allocation of capital across the two sectors turns out to be inefficient. Given an amount of capital employed by the firm, increasing the worker's bargaining power induces higher effort. However, at the same time the allocation of capital across sectors worsens. Accordingly, for

⁸Clearly, the zero boundary is purely arbitrary. Other conditions would work just as well as long as the constraint prevents the outright sale of the production technology to the worker. For an example of this, see Demougin and Helm (2008).

⁹The 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.

¹⁰The Nash bargaining paradigm is extensively used for wage setting in the labor search literature, see Pissarides (2000). Demougin and Helm (2006) extend the non cooperative game theoretical foundation of Nash bargaining to contract negotiation in a moral hazard environment.

sufficiently small α there is a trade-off between the worker's incentivized effort level and the allocation of capital across sectors.

In contrast, when α becomes large, the worker's effort becomes efficient for a given level of capital employed by the firm. At that point a further increase in α raises the fixed payment of the optimal contract to $A > 0$, instead of increasing the bonus. As a result, choosing such a "large" α cannot be socially optimal. Specifically, marginally reducing α would not affect effort efficiency, while capital efficiency would increase. Therefore, below we initially impose $A = 0$ and assuming that α is set optimally, we verify that the above intuition holds.

Before turning to the analysis of the model, we briefly discuss some of the foregoing assumptions. With respect to the timing of the game, our static environment mimics standard treatments of investment and labor market transactions in dynamic models, where the former usually precede the latter. The non-negativity requirement on A and $A + B$ are imposed purely for convenience. As we have just discussed, this implies $A = 0$. Obviously, introducing a positive subsistence level would guarantee $A > 0$. In addition, we also assumed for convenience that the parties' outside option in case of a failed negotiation was zero. Alternatively, one could consider positive outside options; for example unemployment payment to the worker (see Demougin and Helm (2008)). From the point of view of our analysis, these variations would not affect our main conclusion, but significantly complicate the presentation.

4 Effort and Capital Choices

Applying backward induction, we start with the worker's effort choice. That choice solely depends on the structure of the contract which, at this stage, is already specified. Accordingly, the worker selects his effort level to maximize rent:

$$R = \max_{\hat{e}} Bp(\hat{e}) - c(\hat{e}) . \quad (4)$$

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:

$$e = \lambda^{\frac{1}{1-\theta}} B^{\frac{1}{1-\theta}}, \text{ where } \lambda = \frac{\theta}{c} . \quad (5)$$

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, improved monitoring (i.e. higher θ) also increases effort.

Moving to the bargaining stage, the parties negotiate the labor contract anticipating its impact on effort. At this stage of the game, capital is already determined. By assumption, the resulting labor contract maximizes the Nash

product. Thus, it solves:

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

Substituting the functional forms and the incentive compatibility condition, (5), we reformulate the Nash-bargaining problem solely in terms of B :

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

From the first-order condition, we obtain:

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

which also satisfies the second order requirement. The bonus is clearly positively affected by the bargaining power of labor.¹¹ Intuitively, raising the worker's bargaining power increases his share of the quasi-rent. As a result, the parties find it optimal to also induce more effort. Capital also affects the bonus positively due the complementarity between effort and capital. Finally, the quality of monitoring affects the bonus in two opposite ways. For a given level of effort, from (5), raising θ reduces the bonus. Accordingly, at the initial effort level, the marginal cost of inducing effort decreases. This implies that the firm would like to increase effort, which in turn implies that the bonus should increase. The combined effect on B is, therefore, ambiguous.

Substituting effort and bonus into (1), we obtain output:

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

Notice that for output the impact of improved monitoring becomes 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.

Next, we turn to the firm's decision concerning capital. Assuming that the firm anticipates the outcome of the contract negotiation and its impact of the worker's effort, we obtain:¹²

¹¹We ignore the fixed payment A . If it is included, the Lagrangian resulting from the maximization of the Nash product becomes

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

where $C^P(e) = \frac{p(e)}{p'(e)} c'(e)$ is the firm's cost to induce effort e , and ξ is the multiplier 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 . In that case, the bargaining power of labor no longer affects the bonus.

¹²In the sequel we omit the dependence of the various expressions on α and θ , except where that dependence is essential for comprehension.

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

where

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

The resulting first order condition is:

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

This implicitly defines $k(\alpha, \theta)$ under the assumption that the second-order condition is satisfied. Intuitively this requires that the production function, $f(k)$, be "sufficiently" concave (see below the condition for the Cobb-Douglas case).

5 Choice of Bargaining Power

To highlight the conflicting interests of the two parties, we first examine how firms and workers would individually want to allocate bargaining power. Next, we compare the respective preferred allocation to the societal optimum.

5.1 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. On the other hand, as shown above it also allows for higher incentives. It turns out that the former effect dominates, as summed up in the following proposition:

Proposition 1 *The firm's choice is to set $\alpha = \alpha_F = 0$.*

To see this result, we apply the envelope theorem to the firm's optimization problem and compute:

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

where:

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

Clearly, this implies that the firm would like to drive the bargaining power of workers to zero. This corner solution is quite general and not due to the specific interaction between effort and capital given by (1). Intuitively, if the firm chooses to give bargaining power to the worker, it binds itself to raise incentives. The firm could induce the same effort even if it maintained all the bargaining power.

However, it chooses not to because it would raise the worker's rent. Therefore, yielding bargaining power does not provide any advantage to the firm.

Notice that increasing α induces the firm to reduce investment;

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

where the denominator of (15) is negative due to the second order conditions.

5.2 Bargaining Power from the Point of View of Labor

From the point of view of the representative worker, an increase in the bargaining power of labor can be decomposed into three separate effects. First, it raises worker's share in output. Second, the worker is induced to exert more effort. Third, capital investment decreases. To assess the overall impact of these effects on the worker's utility, we use the optimal effort and bonus conditions in (4):

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

where

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

Proposition 2 *The worker's choice is to set α_L such that $0 < \alpha_L < 1$.*

To verify the claim, note that at $\alpha = 1$ the worker's rent is zero since there is no output (as $\Phi(1, \theta) = 0$). At the other extreme, with $\alpha = 0$, the rent is still positive due to the remaining information problem. It is increasing since $\Omega_\alpha(0, \theta) > 0$ and $k_\alpha(0) = 0$. Intuitively, the worker prefers to trade off some of his "share of the pie" in order to increase the "size of the pie".

5.3 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:

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

Observe that the regulator needs to subtract rk from output because capital can be used in an alternative technology that yields r per unit. From (18), it can be seen that a benevolent regulator balances the conflicting interests of the two parties. Thus we obtain the following result:

Proposition 3 *The social planner choose α^* such that $\alpha_F < \alpha^* < \alpha_L$.*

Proof. The second inequality follows immediately from the fact that at α_L , $\Omega_\alpha(\alpha_L, \theta) = 0$ while $\Phi_\alpha(\alpha_L, \theta) < 0$. To verify the first inequality, we take the derivative of (18) with respect to α :

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

where

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

From the second order condition of the firm's optimization problem, we know that X must be negative. Notice that at $\alpha = 0$, (19) simplifies:

$$W_\alpha(0) = \lambda^{\frac{\nu}{1-\nu}} \nu^{\frac{\nu}{1-\nu}} (1-\theta) f(k)^{\frac{1}{1-\nu}} > 0 \quad (21)$$

Furthermore, since $X < 0$ at an interior solution, α^* , the optimal level of the bargaining power must satisfy the following inequality:

$$\frac{1-\nu}{(1-\theta) [(1-\alpha^*)\nu + \alpha^*]} - \frac{1}{\alpha^*} < 0 \quad (22)$$

Or equivalently:

$$\alpha^* < \frac{(1-\theta)}{\theta} \frac{\nu}{(1-\nu)} . \quad (23)$$

Therefore, α^* is not constrained by zero, and accordingly $0 = \alpha_F < \alpha^*$. ■

Note from the inequality (23) that the set of admissible α shrinks as θ increases. Moreover, as $\theta \rightarrow 1$, i.e. when the moral hazard problem disappears, α^* must converge to zero. Intuitively, in the absence of moral hazard, providing the worker with bargaining power only worsens the allocation of capital between the two sectors.

6 The Cobb-Douglas Technology

To gain further insights, we consider for the rest of the paper the Cobb-Douglas production technology. This specification considerably simplifies the numerical experiments presented below. Accordingly, we replace (1) by:

$$F(e, k) = e^\nu k^\gamma . \quad (24)$$

With this specification, the optimal allocation of bargaining power is independent of investments. Specifically, (20) simplifies to:

$$X = \frac{\gamma}{\gamma + \nu - 1} \quad (25)$$

which is independent of k . The specification requires $\gamma + \nu - 1 < 0$ in order to satisfy the second-order condition.

From here we obtain a relationship between the optimal α^* and the precision of the monitoring device, θ . This relationship follows from (19) and is implicitly defined by:

$$\left(\frac{1 - \nu}{(1 - \theta) [(1 - \alpha^*)\nu + \alpha^*]} - \frac{1}{\alpha^*} \right) - \left(\frac{1}{1 - \alpha^*} \right) \frac{\gamma}{\gamma + \nu - 1} = 0 \quad (26)$$

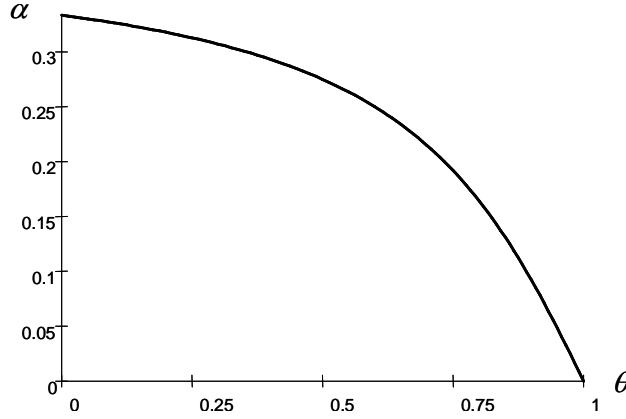


Figure 2: The optimal bargaining power

Figure 2 depicts the above relationship for ν and γ fixed at arbitrarily chosen values of 0.5 and 0.3, respectively.¹³ As can be seen, the emerging relationship is decreasing in θ . Intuitively, as monitoring improves, the moral hazard problem becomes less significant. As a result, at the social optimum the balance between the moral hazard problem and the investment irreversibility friction tilts towards the latter. 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, $\alpha^* = 0$.

¹³Clearly, (26) has two roots. It is easily verified that only one of them is relevant. The shape of the corresponding curve is independent of the particular choices of ν and γ , as long as $\gamma + \nu - 1 < 0$.

7 Interpreting the Stylized Facts

For the purpose of this section, we assume that monitoring is improving over time and that it is the only technological advancement.¹⁴ In other words, we think of a dynamic process $\theta(t)$ where as of some moment in time θ is monotonically increasing. Furthermore, as a working hypothesis, we treat $\alpha(t)$ as if it is generated by optimal and immediately adjustment to these improvement in monitoring. Likewise, we assume that the private sector takes optimal decisions as described above at every moment in time. In particular, we ignore any intertemporal interactions.

Clearly, these simplifications are done purely for convenience in an attempt to focus on the core relationship between monitoring and labor market institutions. For example, the optimal $\alpha^*(t)$ path will certainly depend on intertemporal saving and investment decisions. Moreover, the $\alpha^*(t)$ path should also reflect institutional adjustment costs. Nevertheless, we believe that the underlying argument remains robust. Since improvements in monitoring attenuate the moral hazard problem, the benefit of raising incentives through high bargaining power must become weaker over time, even if intertemporal decisions or adjustment costs were taken into account.

In reality institutions adjust slowly and erratically to changes in the environment. Furthermore, the evolution of labor institutions over the last decades have likely been influenced by many other factors like globalization or unemployment considerations. Moreover, institutional response to these pressures in the respective countries and the speed of adjustment depend on the structure of the political system, its internal functioning, the specifics of the legal system and the like. Therefore, while the exact nature of the comovement between improved monitoring and adjustment in labor market institutions is likely to vary across countries what matters are the overall trends.

7.1 The Model's Performance

In order to study the impact of changes in the monitoring technology, we first derive the relationship between the institutional setup (as represented by α) and the macroeconomic indicators mentioned above; labor share, wage per efficiency units, labor in efficiency units per capital and labor productivity. We use these expressions to represent the impact of variations in the monitoring technology on the respective indicators through the optimal adjustment of the institutional setup as depicted in figure 2.

¹⁴In fact, introducing in the model a Harrod-neutral technological change does not affect any of the conclusions (see footnote 16).

7.1.1 Labor share

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 find:

$$LS = [(1 - \alpha)\nu + \alpha] \quad (27)$$

Observe that this result is independent of the Cobb-Douglas specification of the production function. Since ν is smaller than 1, LS is increasing in α . Notice that while the labor share is independent of production technology parameters in any direct way (such as γ in the Cobb-Douglas case) or the monitoring precision θ , these parameters enter indirectly through the optimization process leading to the choice of α .

Under the assumption that α is optimally adjusted to changes in the environment and since α^* is decreasing in θ , we obtain a negative relationship between the quality of monitoring and the labor share, as drawn in Figure 3.

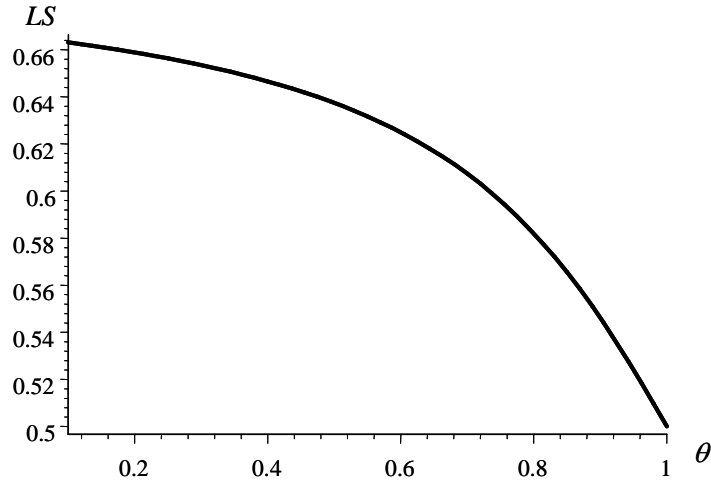


Figure 3: Labor share

Intuitively, with improved monitoring the social planner finds it optimal to shift the allocation of bargaining power away from labor, thereby reducing the portion of the quasi rent appropriated by labor.

7.1.2 Wage per efficiency units

We introduce labor “efficiency units”, E as emerging from a Harrod-neutral productivity change. Specifically, for the Cobb-Douglas technology this implies:

$$e^\nu k^\gamma = k^\gamma E^{1-\gamma}. \quad (28)$$

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

$$E = e^{\frac{\nu}{1-\gamma}} \quad (29)$$

Applying the definitions of labor compensation and efficiency units, the wage per efficiency units becomes:

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

Figure 4 depicts the wage per efficiency units for the above parameter values.

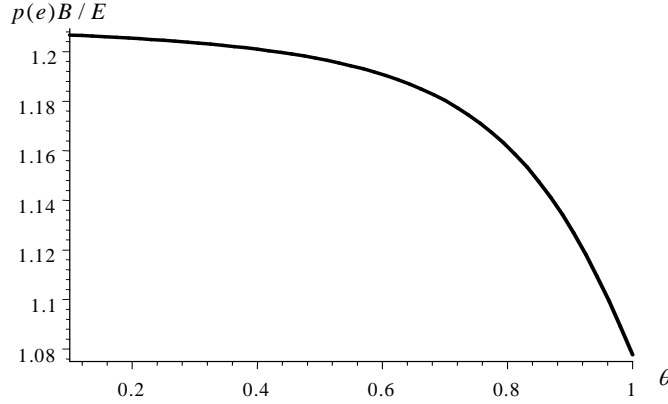


Figure 4: Wage per efficiency units

The figure reflects the fact that the worker's rent drops while he becomes more "efficient". The intuition is as follows: The significance of the moral hazard problem diminishes with increase in θ . This induces an effort level which is closer to the first-best solution. Consequently, society finds it also optimal to adjust the allocation of bargaining power, thereby, reducing the worker's informational rents. In the limit, with $\theta = 1$, the worker's rent drops to zero while labor compensation equals the marginal effort cost, thus, inducing the first-best effort level.¹⁵

7.1.3 Labor in efficiency units per capital

Applying the definition of efficiency units and using the firm's capital choice (equation (12)) yields for the Cobb-Douglas case the ratio between labor in efficiency units and capital:

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

¹⁵In Figure 7.1.2 the wage/efficiency unit ratio becomes 1 when $\theta = 1$ because in the numerical example we have set the marginal effort cost, c , to 1.

The RHS of equation (31) is increasing in α and therefore the ratio between efficiency units and capital must be decreasing in θ (Figure 5). To understand this result, 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.¹⁶ In our model, the direct impact of the improved monitoring on productivity is also perfectly offset by changes in capital. This 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 investment irreversibility problem. Since an improvement in monitoring implies an increase in the optimal bargaining power of capital, $1 - \alpha$, the ratio E/k must decrease.

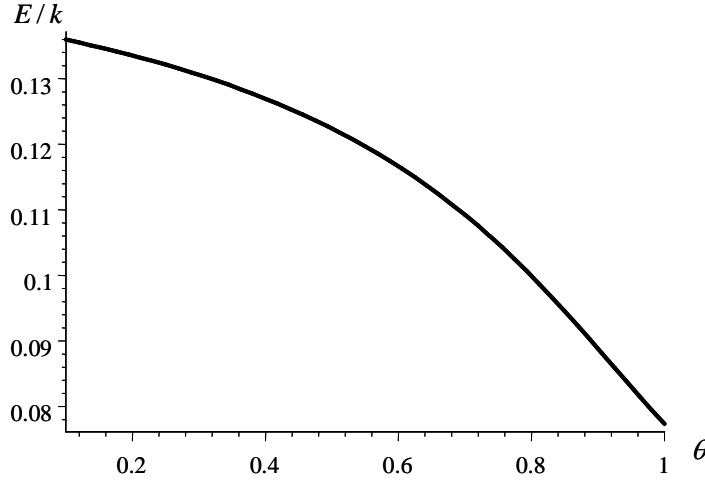


Figure 5: Labor in efficiency units to capital

7.1.4 Labor productivity

Labor productivity is simply captured by the "efficiency units", E . At the equilibrium, from (5), (8), (12) and (29) we obtain:

$$E = \left[\lambda [(1 - \alpha)\nu + \alpha] \left[(1 - \alpha) \left(\frac{\gamma}{r} \right)^{\frac{\gamma}{1-\gamma}} \right]^{\frac{\nu}{1-\gamma-\nu}} \right] \quad (32)$$

Intuitively, two opposite forces affect the equilibrium level of effort. On the one hand, increasing the quality of monitoring reduces the importance of the moral hazard problem, thereby raising effort. On the other hand, the adjustment of the institutional environment reduces the bargaining power of labor and weakens incentives. Overall, the first effect dominates as seen in the following figure.

¹⁶Consequently, including such a Harrod-neutral technological advancement would not affect any of the foregoing results.

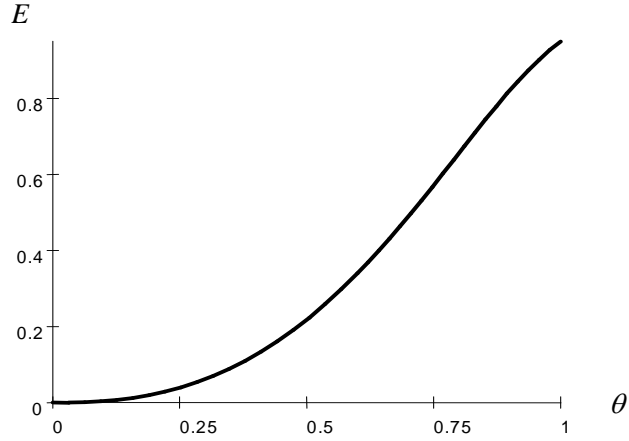


Figure 6: Labor productivity

7.2 The stylized Facts

Despite the parsimonious nature of the model, qualitatively the trends of the macroeconomic indicators which it generates are consistent with most of the actual data depicted in Figure 1. Specifically, assuming improvements in *ICT* have weakened the moral hazard problem, according to our model, the bargaining power of labor should be reduced (Figure 2). Consequently, labor share declines (Figure 3) which fits the upper panel of Figure 1. Furthermore, the wage per efficiency unit is reduced as effort comes closer to the first-best while informational rents are reduced (Figure 4 and Figure 6). This is consistent with the actual evolution of wage per efficiency units and the gain in labor productivity in OECD countries (panels 2 and 4 in Figure 1). Finally, the ratio between labor measured in efficiency units and capital is decreasing because the relaxation of the holdup in capital over compensates the reduction in wages per efficiency units (Figure 5). This conclusion is consistent with the data for France and Germany, but not for the U.S., where the labor in efficiency units grows faster than capital. However, with proper amendments to the model this inconsistency could be removed.

For example, in the foregoing derivations we took the user cost of capital, r , to be constant. Suppose instead that the user cost is increasing. According to (27), this would leave the labor share unaffected and from (30) enhance the negative trend of the wage per efficiency units. However, from the equations (31) and (32) it would respectively moderate the trends of the labor in efficiency units per capital and labor productivity. With respect to the latter, as the model predicts large productivity gains, realistic increases in the user cost of capital are unlikely to change the direction of the productivity trend. On the other hand, the ratio between labor in efficiency units and capital is not directly affected by changes in the monitoring technology. In particular, if the institutional environment measured by α is not changing much, an increasing trend in r would actually generate

an increasing trend in E/k . In fact, there is some evidence pertaining to the USA that the user cost of capital has been increasing during the relevant period (see Mead, 2001). Furthermore, the institutional framework in the USA has undergone much smaller changes than that of Germany or France. This is reflected by the small change in labor share in USA.¹⁷

At this point, the level effects generated by the model require further research. Schneider (2008) provides some initial simulation results that are quantitatively consistent with actual data. Specifically, her analysis modifies the current model along the lines discussed above, in particular, with respect to user costs of capital and the institutional adjustment process.

8 Conclusion

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 an investment irreversibility 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 investment 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 clear indications that the emergence of *IC* technologies during the past two or three decades has improved the quality of monitoring. During the same period many countries have reformed labor markets, for example, by reducing unemployment benefits and introducing tougher eligibility criteria, encouraging stricter rulings of labor courts, etc. All these measures indicate a reduction in the bargaining power of labor in the respective countries.

Using our model, such adjustments can explain the declining trends in labor shares observed in all OECD countries over the last two decades. Furthermore, the model predicts a decreasing ratio between labor in efficiency units and capital, falling wages per efficiency units and an increase in labor productivity. Such trends are also present in many OECD countries with the notable exception of the USA, where labor in efficiency units has grown faster than capital. We have shown that by considering the evolution of the user cost of capital this effect can also be accounted for.

¹⁷Gomme and Ruppert (2004) argue that the falling labor share in the U.S. is just an artifact of mismeasurement by the BLS. See also Feldstein (2008).

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APPENDIX

Blanchard's (2006) analysis of the French economy is based on data obtained from the OECD's Economic Outlook CD-ROM of August 2003. We have updated Blanchard's data using the OECD publication "Economic Outlook N° 78 - December 2005 - Annual Projections for OECD Countries" (see http://stats.oecd.org/wbos/Index.aspx?DataSetCode=EO23_VINTAGE).

In addition to some relatively minor modifications, there are two major differences between the two data sets:

1) The time series of the variable "capital stock of the business sector, volume" (called KBV) for France is significantly different across the two sets, in particular for the period prior to the mid 1990s. As indicated through a correspondence with the OECD, both series originate in INSEE and the difference may be due to chain indexing. Most importantly, the growth rate of the more recent series is higher than that used by Blanchard for his computation of the Solow residual. As a result, the growth rate of labor in efficiency units used by Blanchard exceeds the one obtained using the updated time series, and consequently the wage per efficiency unit in Blanchard (2006) is decreasing, while we find that it is more-or-less trendless.

2) For Germany the data base used in Blanchard (2006) contains time series which start in 1962 and go continuously through unification till 2002. The new OECD data do not contain information prior to 1991. We have decided to combine the data sets as we found that at least for the relevant variables, the overlapping data points of both data sources display, to a large extent, very close growth patterns. In order to smooth out level differences we used the 1991 data of the new data set, and extrapolated it backwards using the growth rates of the older set.