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Incentive Contracts and Efficient Unemployment Benefits in a Globalized World*

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Abstract

Several European countries have reformed their labor market institutions. Incentive effects of unemployment benefits have been an important aspect of these reforms. We analyze this issue in a principal-agent model, focusing on unemployment levels and labor productivity. In our model, a higher level of unemployment benefits improves the workers' position in wage bargaining, leading to stronger effort incentives and higher output. However, it also reduces incentives for labor market participation. Accordingly, there is a trade-off. We analyze how changes in the economic environment such as globalization and better educated workers affect this trade-off.

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1 Introduction

In recent years, most industrialized countries have undergone substantial reforms of their labor market institutions. Often, these reforms involved reductions in the level and duration of unemployment benefits, and have been justified by reference to the process of globalization. An additional development of labor markets has been the increasing use of performance pay as a wage component. In this paper, we develop a stylized framework that provides a justification for the use of unemployment benefits and accounts for these evolutions.

A prominent example for labor market reforms is the so-called Hartz IV legislation in Germany. Prior to the reforms, unemployment benefits amounted to 67% of the last net income and were paid for up to 32 months. Thereafter, the unemployed received an unlimited assistance of 57% of their last net income.[1] As of 2005, the duration of unemployment benefits was reduced to 12 months. Thereafter, the unemployed receive a fixed support which equals the payment to those people who have never worked.[2] This lead to a substantial reduction of workers' expected unemployment benefits. Other countries have implemented similar reforms that reduced unemployment benefits (see Saint-Paul (2004), Nickell et al. (2005)).

Regarding the development of performance pay, Lemieux et al. (2009) report for the US that by the end of the 1990s the fraction of labor contracts with incentive components ranged from 30% for craftsmen to 78% for sales workers, with an average of 45% across all jobs. In Europe these figures are a bit lower, ranging from 10-15% in some Mediterranean countries to more than 30% for Nordic countries (Bryson et al., 2012).[3] An often cited explanation is the presence of informational asymmetries on the job and improvements of monitoring due to advances in ICT.

Reflecting this development, Demougin and Helm (2011) developed a model that integrates performance pay due to moral hazard at the workplace into a dynamic job matching environment. The paper argues that unemployment benefits affect the design of incentive contracts and, thereby, labor productivity and unemployment. In particular, a higher level of unemployment benefits improves the workers' position in contract negotiations, leading to stronger effort incentives and higher output. However, it also reduces incentives for labor market participation. Notwithstanding other justifications for unemployment benefits, the model provides an efficiency argument for them that had so far not been addressed in

[1] Without children the respective levels were 60% and 53%.

[2] See Jacobi and Kluve (2007) for a description and first assessment of the Hartz legislation.

[3] Figures for the importance of performance pay in individual European countries are reported, e.g., by Gielen et al. (2010) for the Netherlands, Green (2004) for Great Britain, Kurdelbusch (2002) for major corporations in Germany.

the literature (see Holmlund (1998) and Fredriksson and Holmlund (2006) for surveys).

In this paper, we build a simplified version of Demougin and Helm (2011) that captures the salient features of their analysis. In particular, we abstract from the dynamics of the matching process and choose a linear specification of the model. These simplifications allow us to investigate in a tractable way how the trade-off between the productivity and the participation effect of unemployment benefits reacts to changes in the underlying economic environment such as globalization and changes in workers' skills.

For the analysis, we consider an environment with a continuum of workers and firms. Workers differ in their productivity, which may reflect differences in their inherent skills and/or their education level. Firms differ in their opportunity to relocate their business abroad, which determines their outside options. Workers and firms are randomly matched and each pair negotiates a labor contract. Bargaining over contracts is hampered by the workers' moral hazard problem and their financial constraints. This results in incentive contracts that implement inefficiently low effort levels.

Obviously, negotiations are influenced by the outside options of the parties. In particular, higher unemployment benefits and a worsening of firms' opportunity to relocate abroad improve the worker's relative bargaining position. In either case the workers' share of the total surplus in an employment relationship rises. This induces an adjustment of the incentive contract, which leads to a higher effort and increases the overall surplus. However, higher unemployment benefits also have a negative effect on labor market participation. From the perspective of the regulator this generates a trade-off which affects the choice of unemployment benefits.

In the analysis, we interpret globalization as an improvement in the ability of domestic firms to relocate abroad. By contrast, we do not consider the location decision of foreign firms. Intuitively, what we have in mind is the situation of a developed country that is confronted with potential delocalization as a result of globalization. In the model, globalization improves the outside option of firms, thereby weakening the effort enhancing effect of unemployment benefits. Moreover, more matches fail, which leads to higher unemployment. We find that an optimal response of the regulator is to reduce the benefit level.

We also consider improvements in the productivity of matches that occur independently of the respective workers' effort choice. Such changes may arise from advances in education or in technologies. The optimal policy response of the regulator is to boost the workers' bargaining position by raising the level of unemployment benefits.

Our paper is related to different strands of literature. The first investigates the incentive effects of unemployment benefits in an environment with moral hazard.

Usually, this literature focuses on the job search effort of unemployed workers. On the negative side, higher unemployment benefits reduce workers' incentive to search for a job. On the positive side, it allows workers to reject relatively unproductive matches and to continue searching for a more suitable job (e.g., Diamond (1981), Marimon and Zilibotti (1999), Acemoglu and Shimer (1999)). By contrast, we analyze the effects of moral hazard during an employment relationship, i.e. after a worker is matched with a firm. We share this focus on endogenous work effort with the literature on efficiency wages (e.g., Shapiro and Stiglitz (1984)). In that literature, if shirking is detected the worker is laid off. Hence, higher unemployment benefits reduce the costs of loosing the job, lowering effort incentives. By contrast, in our model if shirking is detected a worker only looses his bonus. Since the bonus is increasing in the level of unemployment benefits, these have a positive effect on effort.

A second strand of related literature analysis the effects of globalization for labor market institutions. For example, with Gaston and Nelson (2004) and Boulhol (2009) we share the idea that globalization has a transformative impact on the labor market structure. Similar to our set-up, in Boulhol (2009) the threat of relocations improves the relative bargaining power of firms. In that model, the choice of labor market regulation follows from social preferences over the allocation of rents and efficiency. In our contribution, the positive welfare effect of unemployment benefits follows from their effort enhancing impact in the moral hazard set-up. While the underlying mechanism leading to changes in labor market institutions differ, the relationship to the existing empirical literature is similar. For instance, Rodrik (1997) and Dumont et al. (2006) find some empirical support for the idea that capital mobility weakened the bargaining position of workers.

Finally, our paper is related to studies that examine the interaction between unemployment insurance schemes and education. Typically, that literature has emphasized the effect of unemployment benefits on workers' incentives to accumulate human capital (e.g., Brown and Kaufold (1988); Dellas (1997)). By contrast, we focus on the reverse direction. Specifically, we analyze the effect of changes in the workers' skill distribution on the government's trade-offs underlying the choice of unemployment benefits.

The remainder of the text is structured as follows. After introducing the basic model (section 2), we analyze contract negotiations for mutually beneficial firm/worker matches (section 3). In section 4, we examine participation decisions. These two aspects are brought together in section 5 to determine the welfare effects of unemployment benefits. Sections 6 and 7 derive how these welfare effects are affected by globalization and improvements in the distribution of skills. Finally, section 8 offers some concluding remarks.

2 The model

We consider an environment populated by a continuum of risk neutral firms and risk neutral workers, respectively of measure 1. Workers differ in their skills, $\gamma \in \mathbb{R}^+$, which determines the quality of the firm/worker match. All firms have the same production technology, but differ in their outside option $\theta \in \mathbb{R}^+$. The respective cumulative distribution and density functions are denoted by $G(\gamma \mid \xi)$ and $g(\gamma \mid \xi)$ as well as $H(\theta \mid \lambda)$ and $h(\theta \mid \lambda)$. The variables ξ and λ are parameters that affect the associated distribution of workers' skills and firms' outside options. Their specific interpretation in terms of globalization and improvements in skills will be discussed in the sections 6 and 7 where we derive the comparative static analysis.

All workers have the same outside option, which is given by the level of unemployment benefits s.[4] These are financed by a distortionary mechanism, for instance an excise tax or an unemployment insurance scheme (see, e.g., Caillaud et al. (1988)). For parsimony, we do not explicitly model the distortionary mechanism. Instead, we directly assume that financing benefit payments s for one unemployed individual generates a cost of $s + \tau(s)$. Consequently, $\tau(s)$ can be interpreted as the shadow price of the distortionary mechanism. It is assumed to be non-decreasing in s.

The value of a specific firm/worker match is jointly determined by the worker's skill and his effort on the job. We assume that workers carry out two different tasks. Effort in the first task is verifiable, generating a non-verifiable value of output, γ. For parsimony, we set the associated effort cost to $c_1 = 0$. For the second task, the worker's effort and the value of output are both non-verifiable leading to a moral hazard problem. We denote the worker's effort in that task by $a \in [0, 1]$. It produces a value of output, γa, and costs $c_2(a) = a$. Accordingly, the overall net benefit from the two tasks is $\gamma(1 + a) - a$.

Effort in the second task generates a contractible signal which the firm can use to align incentives. Due to the risk-neutrality of the parties, we can restrict attention to a binary signal $\sigma \in \{0, 1\}$, where $\sigma = 1$ is the favorable signal (see Milgrom (1981)).[5] We denote with $p(a) = a^{1/\mu}$ the probability of observing the favorable signal given the worker's effort. Such a specification has been suggested by Demougin and Fluet (2001) in an environment where agents can make mistakes in the process of their work which are Poisson-distributed. In that case, $1/\mu$ denotes the fraction of time which the principal spends monitoring the agent.

[4] That all workers have the same outside option is an artifact of the static set-up. In a dynamic environment, the expected stream of future payments of an unemployed worker would be type-dependent (see Demougin and Helm (2011)).

[5] Specifically, in a risk-neutral agency problem all relevant information from a mechanism design point of view can be summarized by a binary statistic (see, e.g., Kim (1997)).

Due to the structure of the problem, contracts will be binary. Accordingly, the worker receives a fixed payment A and, in addition, a bonus b when $\sigma = 1$. In addition, we assume that workers are financially constrained. Specifically, we require wage payments to be non-negative, i.e. $A, A + b \geq 0$.[6]

A priori, the optimal wage contract negotiated by a specific firm/worker pair will depend on the characteristics (γ, θ) of that particular match. However, in order to keep notation to a minimum, we suppress this dependence whenever possible without confusion. Consider now a specific firm/worker match. If negotiations are successful and the worker undertakes effort a, it leads to payoffs

$$u \equiv A + ba^{1/\mu} - a, \tag{1}$$

$$\pi \equiv \gamma(1 + a) - A - ba^{1/\mu} \tag{2}$$

for the worker and the firm respectively. Alternatively, if negotiations fail, the worker becomes unemployed, obtaining benefit payments $s \geq 0$, while the firm moves abroad, realizing the outside option $\theta \geq 0$. We call contracts "mutually beneficial" if $u \geq s$ and $\pi \geq \theta$, and "strictly mutually beneficial" if one of the inequalities is strict. Due to the linear specification, we impose the following restriction on the distribution of skills.

Assumption 1: $\gamma \in \left(1, \frac{1}{2}\mu\right]$, where $g(\gamma \mid \xi) > 0$ over the support.

The assumption can be motivated as follows. First, for $\gamma < 1$ the marginal costs of effort exceed marginal benefits. Hence the Pareto efficient solution would lead to the uninteresting case where effort is minimal, i.e. $a = 0$. For the second requirement, $2\gamma < \mu$, we later show that it insures second-best contracts where parties negotiate effort below the Pareto efficient level, $a^* = 1$. Such an outcome would arise endogenously if we explicitly modeled the quality of monitoring as a choice variable. In such a model the parties should never agree to expand monitoring to the point where it implements the first-best effort. Intuitively, at that point the marginal benefit of monitoring drops to zero while the marginal cost of monitoring remains positive (Demougin and Fluet, 2001). Assumption 1 implies $\mu \geq 2$. Intuitively, this means that the principal cannot spend more than half of his time monitoring the worker.

The timing of the game is as follows. First, the regulator chooses an unemployment benefit level s. Second, firms and workers are randomly matched in pairs and observe their respective outside options. Third, each pair negotiates an incentive wage contract. If negotiations fail, the parties receive their respective outside options. Otherwise, the worker undertakes effort, the signal is realized and payments are made.

[6] If one wants to drop the simplification $c_1 = 0$, while keeping the results from the ensuing analysis, a simple possibility is to change the non-negativity constraint to $A, A + b \geq c_1$. This would mean that the worker recovers at least the costs associated with the verifiable task.

Before solving the game by backwards induction, we briefly elaborate on some of the critical assumptions. The linear specification of payoff functions insures that the bargaining frontiers for negotiations are also linear. Introducing standard curvature assumptions would yield a frontier that is decreasing concave ((Demougin and Helm, 2006)). Hence, an interpretation of the linear specification is that we focus on first-order effects. Furthermore, despite our focus on globalization we do not introduce capital as a factor of production. However, doing so would not affect the paper's main conclusions, provided that firms can adjust investments at the time of bargaining. Intuitively, in that case the parties would always negotiate the quantity of capital that is Pareto efficient *conditional* on the effort level implemented by the contract. Finally, the model abstracts from the dynamics of the matching process. These dynamics have been a key focus in Demougin and Helm (2011). We discuss their implications for our analysis informally in the concluding remarks.

3 Negotiations of incentive contracts

In this section, we consider firm/worker matches for which a mutually beneficial, incentive-compatible contract exists. If negotiations for a specific (γ, θ)-match have been successful, the worker faces a wage contract $\{A, b\}$. Given that contract, he selects effort to maximize his payoff as given by (1). Accordingly, effort follows from the first-order condition

$$\frac{b}{\mu} a^{\mu^{-1}-1} = 1. \tag{3}$$

Multiplying by μa yields the principal's expected bonus cost of implementing effort level a, which we denote by

$$B(a) \equiv b a^{1/\mu} = \mu a. \tag{4}$$

3.1 The constrained Pareto frontier

In the preceding stage of the game, parties negotiate the contract. For the moment, we abstract from the specific bargaining process, but follow the widespread assumption that bargaining is efficient. Examples for which this is the case include the alternating offer game, the egalitarian solution and the Nash bargaining solution (Muthoo, 1999, 12). However, in contrast to the standard literature we have to impose additional requirements resulting from the incentive compatibility condition and financial constraints for the worker. The ensuing set of *constrained* efficient bargaining outcomes, hereafter the constrained Pareto frontier (CPF), is defined as the set of payoff pairs (π, u) that arise if we maximize the firm's profits subject to $A \geq 0$ and (4), while varying the constraint on the worker's payoff $\bar{u} \geq 0$. Observe that payoffs for the firm and the worker follow straightforwardly from the values for A and a. Accordingly, upon substituting the incentive constraint (4) into the payoff functions, the CPF follows from solving the problem

$$\max_{a \in [0,1], A} \gamma + \gamma a - (A + \mu a) \quad \text{s.t.} \tag{I}$$

$$A \geq 0, \tag{FC}$$

$$A + \mu a - a \geq \bar{u} \tag{PC}$$

Observe that (I) is equivalent to the standard optimization problem of a principal that has all the bargaining power and can make take-it-or-leave-it offers to agents. First, consider the situation $\bar{u} = 0$. In that case, optimization problem (I) yields $A^{**} = a^{**} = 0$. The result follows since the firm's profit is decreasing A and, by assumption 1, also in a. The latter is a consequence of the moral hazard environment and the linear specification of the model. Specifically, the marginal costs of inducing effort include the marginal informational costs. Due to our assumption $\gamma - \mu < 0$, they outweigh the marginal benefits. In contrast, the Pareto efficient solution requires $a^* = 1$ since $\gamma - 1 > 0$.

Raising the constraint on the worker's payoff, $\bar{u}$, requires to increase the worker's compensation. This can be done by either increasing a or A. From (I), raising A yields $d\pi/d\bar{u} = -1$. In contrast, increasing a yields

$$\frac{d\pi}{d\bar{u}} = \frac{\gamma - \mu}{\mu - 1} > -1, \tag{5}$$

since the assumption $\gamma > 1$ implies $\gamma - \mu > 1 - \mu$. Accordingly, for any increase in $\bar{u}$, the payoff of the firm falls by less if it raises a rather than A. Hence, increasing effort is the better option. However, once firm's profit drops below zero, mutually beneficial contracts no longer exist. We denote the resulting critical level of the agent's outside option by $\bar{u}^{crit}$, hence

$$\gamma + \frac{\gamma - \mu}{\mu - 1}\bar{u}^{crit} = 0 \implies \bar{u}^{crit} = \gamma\frac{\mu - 1}{\mu - \gamma}. \tag{6}$$

Observe that at $\bar{u}^{crit}$ effort is inefficiently low since from the binding participation constraint (PC) and (6),

$$a^{**}\left(\bar{u}^{crit}, \gamma\right) = \frac{\bar{u}^{crit}}{\mu - 1} = \frac{\gamma}{\mu - \gamma} < 1,$$

where the inequality follows by assumption 1. Accordingly, we obtain the following lemma.

Lemma 1 *The CPF*(γ) *is given by* $\pi^{**}(u,\gamma) = \gamma - \frac{\mu-\gamma}{\mu-1}u$, *whereby* $0 \leq u \leq \gamma\frac{\mu-1}{\mu-\gamma}$. *Along the CPF*($\gamma$), *contracts are always second-best with* $A^{**}(u,\gamma) = 0$ *and* $a^{**}(u,\gamma) = \frac{u}{\mu-1} < 1$.

The results of the lemma are depicted in figure 1. The dashed line represents the Pareto frontier which would be obtained for $a = 1$. The continuous line depicts the *constrained* Pareto frontier. Observe that the distance between these two lines decreases in u. This reflects that effort and, therefore, the overall surplus are increasing in u.

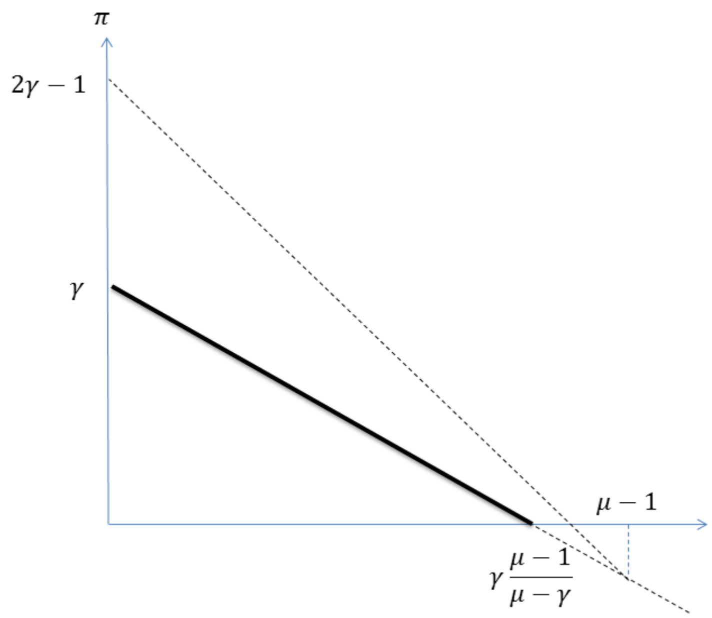

Figure 1: The Constrained Pareto Frontier CPF(γ)

3.2 The Nash bargaining solution

In this subsection, we analyze the effects of unemployment benefits and the firm's outside option on the negotiated contract. To do so, we follow standard practice and assume that the outcome of negotiations results from maximizing the Nash product for equal bargaining power. Specifically, a (γ, θ)-firm/worker match maximizes

$$\mathcal{N} \equiv (u-s)(\pi-\theta), \tag{7}$$

with respect to feasible contracts. Given that Nash bargaining is efficient, the resulting contracts lead to payoffs on the CPF(γ), i.e. $(u,\pi) = (u, \pi^{**}(u,\gamma))$. Accordingly, the outcome of negotiations solves

$$\max_u \quad (u-s)\left(\pi^{**}(u,\gamma)-\theta\right). \tag{II}$$

Hence the Nash bargaining solution, denoted (π^N, u^N), follows from the first-order condition

$$\left(\pi^N-\theta\right)-\left(u^N-s\right)\frac{\mu-\gamma}{\mu-1}=0. \tag{8}$$

Geometrically, the result can be obtained from the iso-Nash curves that are characterized by a constant $\mathcal{N}$ in (7). In the (π, u)-space, holding s and θ constant, it is easily verified that the iso-Nash curves are decreasing convex with slope

$$\left.\frac{d\pi}{du}\right|_{\mathcal{N}=\text{constant}}=-\frac{\pi-\theta}{u-s}. \tag{9}$$

Moreover, $\mathcal{N}$ increases in the North-East direction. Altogether, the constrained Nash bargaining solution is characterized by a tangency of the iso-Nash curve with the CPF(γ) (see figure 2).[7] Analytically, equating the slopes immediately yields (8).

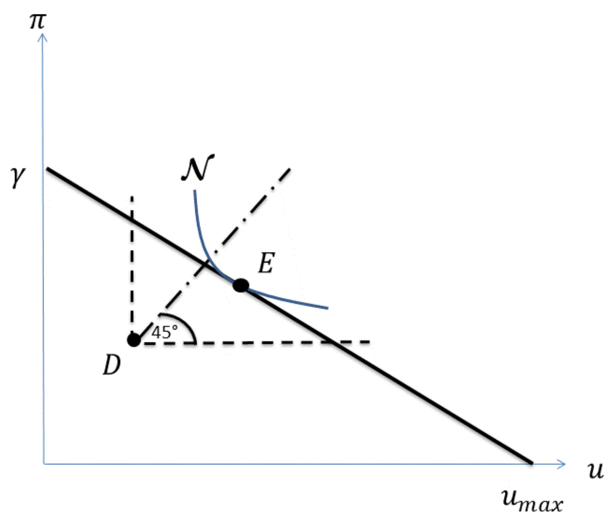

Figure 2: Maximizing the Nash product

In the ensuing lemma, we summarize the results that will be central for the remaining analysis.

[7] See Muthoo (1999, 12) for a similar approach.

Lemma 2 *Consider firm/worker matches for which a mutually beneficial contract exists.*

- *The Nash bargaining solution leads to $A^N = 0$ and inefficient effort,*

$$a^N(\theta, \gamma, s) = \frac{1}{2}\frac{s}{\mu - 1} + \frac{1}{2}\frac{\gamma - \theta}{\mu - \gamma}. \tag{10}$$

- *Payoffs are*

$$u^N(\theta, \gamma, s) = \frac{1}{2}\left[s + \frac{(\gamma - \theta)(\mu - 1)}{\mu - \gamma}\right], \tag{11}$$

$$\pi^N(\theta, \gamma, s) = \frac{1}{2}\left[\gamma - s\frac{\mu - \gamma}{\mu - 1} + \theta\right]. \tag{12}$$

- *For any strictly mutually beneficial contract the worker extracts more rent than the firm; $\pi^N - \theta < u^N - s$.*

Proof. From lemma 1, we know that along any CPF(γ) we have $A^{**} = 0$. Given that the Nash bargaining solution lies on the CPF(γ), it follows that $A^N = 0$. Turning to effort, substituting $\pi^{**}(u, \gamma)$ from lemma 1 and $u = (\mu - 1)a$ (which follows from (PC) being binding) into the first-order condition (8) yields

$$\left[\gamma - \frac{\mu - \gamma}{\mu - 1}(\mu - 1)a - \theta\right] - [(\mu - 1)a - s]\frac{\mu - \gamma}{\mu - 1} = 0, \tag{13}$$

which can be solved for a^N. The payoffs follow from (8) and appropriate substitution. Finally, the inequality follows from (8) and $\frac{\mu-\gamma}{\mu-1} < 1$ by (5). ■

The lemma has also a straightforward intuition. Ceteris paribus, either raising s or reducing θ lowers the rent of the worker relative to that of the firm. This is best compensated by raising effort according to a^N. The result can also be seen geometrically from figure 2. For instance, raising s shifts D to the right so that the tangency point E moves downwards along the CPF(γ), implying higher effort. Similarly, raising θ shifts D upwards so that E moves up along the CPF(γ), implying lower effort. Finally, the unequal rent follows from the tension between raising the Nash product, which requires equalizing the rents, and increasing efficiency, which requires a movement down the CPF(γ).

The lemma emphasizes some of the distributional concerns that a regulator would face. As long as contracts remain mutually beneficial, from society's perspective an increase in s is surplus augmenting because it induces a higher effort (see 10). However, the effects on the negotiating parties go in opposite directions. The workers' payoff increases for two reasons (see 11). First, a higher s means a better outside option. Second, the associated increase in effort raises the workers' informational rent. By contrast, the firms' payoff is reduced (see 12).

To conclude this section, we briefly re-examine the assumptions with respect to linearity and the parameter range, $\gamma \in \left[1, \frac{1}{2}\mu\right]$. First, observe that at $(\theta, \gamma, s) = \left(0, \frac{1}{2}\mu, s\right)$, equation (10) would yield a value of $1 + \frac{1}{2}\frac{s}{\mu - 1}$, which is outside the range of feasible effort levels for any $s > 0$. Accordingly, the resulting effort would be Pareto efficient at $a^* = 1$. Hence raising s would not impact effort, but induce an adjustment in the distribution of economic rents via an increase in the fixed payment A. More generally, allowing $\gamma > 0.5\mu$ would necessitate a case distinction at the boundary where effort reaches its maximal value. Nevertheless, the intuition of lemma 2, which was discussed above, would extend, but effort would now be weakly increasing in s.

Second, a more general specification of payoff functions as in Demougin and Helm (2011) would lead to a CPF(γ) that is decreasing concave. From figure 2 it can be seen immediately that the basic mechanism which follows from the tangency between the CPF(γ) and the iso-Nash curve directly extends. Obviously, in that case closed form solutions would be substantially more complicated.

4 Successful matches

In the previous section, we have identified the outcome of contract negotiations for mutually beneficial matches. We now determine the set of mutually beneficial matches and analyze how it is affected by variations in the level of unemployment benefits.

We define a critical firm/worker match as a (γ, θ)-pair for which the disagreement point (s, θ) is located on the CPF(γ). Accordingly, it satisfies $u^N = s$ and $\pi^N = \theta$ so that both parties are just indifferent between participation and non-participation. Consider a γ-worker that is matched in an environment with unemployment level s. Let $\widehat{\theta}(\gamma, s)$ denote the outside option of the firm that would receive a rent of zero at the ensuing optimal contract. Accordingly, $\left(\gamma, \widehat{\theta}(\gamma, s)\right)$ is a critical firm/worker match so that negotiations are successful if and only if $\theta \leq \widehat{\theta}(\gamma, s)$. From the definition, $\widehat{\theta}(\gamma, s)$ implicitly solves $\pi^N(\theta, \gamma, s) - \theta = 0$. Substituting from (12) and solving for θ yields

$$\widehat{\theta}(\gamma, s) = \gamma - s\frac{\mu - \gamma}{\mu - 1}. \tag{14}$$

Accordingly, $\widehat{\theta}$ is increasing in γ and decreasing in s. Intuitively, an increase in the productivity parameter γ raises the benefits of the match. Moreover, for the critical match raising s shifts the disagreement point outside of the region that characterizes mutually beneficial contracts (see figure 2). Hence contract negotiations can only remain successful if the firm's outside option falls.

Figure 3 depicts all matches in the (θ, γ) space. The $\widehat{\theta}(\gamma, s)$-function divides this space into two regions such that a match is successful if and only if it lies on or above the $\widehat{\theta}(\gamma, s)$-function.

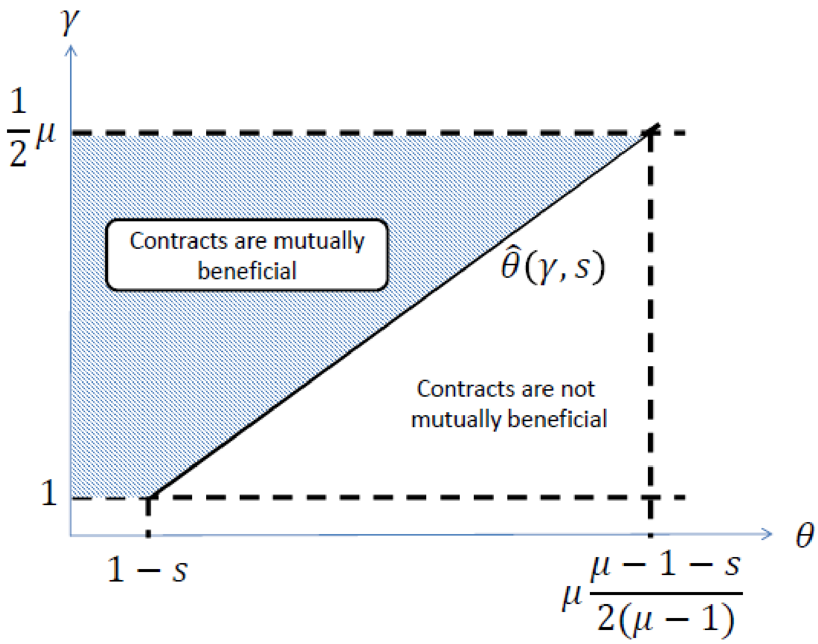

Figure 3: Successful matches

The figure has been drawn for the case $1 - s > 0$, which requires that unemployment benefits are not too large. This ensures that even for the least productive worker there exist some θ-firms for which the match is mutually beneficial. In the remaining, we only consider this case. It results endogenously from the following assumption (see Proposition 1 below).

Assumption 2: $\lim_{s\to 1} \tau(s) = \infty$.

In the current environment, the assumption has a straightforward interpretation. Keeping in mind that a measures effort costs with $0 \leq a \leq 1$, the assumption requires that unemployment benefits are less than the costs associated with maximal effort. Intuitively, benefit payments above this level would trigger substantial political opposition by the working part of the labor force that finances these payments. Hence, if $\tau(s)$ also includes such political costs, the assumption appears very reasonable.

In conclusion, raising s has a negative and a positive effect. On the negative side, it shifts the $\widehat{\theta}$-curve to the left, reducing the number of mutually beneficial matches. On the positive side, the efficiency of contracts that remain mutually beneficial is improved as shown in lemma 2. In the following section we analyze the associated welfare effects.

5 Welfare effects of unemployment benefits

We now consider a benevolent social planner who determines the optimal level of unemployment benefits. Notwithstanding other justifications for such benefits, we focus on the trade-off between the incentive effects for effort and labor market participation decisions that have been derived above.[8] At the optimum, the social planner balances the positive impact of s on mutually beneficial contracts against higher unemployment and the associated distortionary costs necessary to finance benefit payments.

For a given s, a mutually beneficial (γ, θ)-match generates an overall surplus, $S^N(\theta, \gamma, s) \equiv \pi^N(\theta, \gamma, s) + u^N(\theta, \gamma, s)$, i.e.

$$S^N(\theta, \gamma, s) = \gamma + (\gamma - 1)\, a^N(\theta, \gamma, s). \tag{15}$$

In contrast, for a (γ, θ)-match for which negotiations fail, the firm obtains its outside option θ, while the worker receives s. The latter requires a redistribution which is financed by an unemployment scheme that generates a cost $s + \tau(s)$. Altogether, society's net costs resulting from an unemployed worker is $\tau(s)$ so that an unsuccessful (γ, θ)-match generates an overall surplus of $\theta - \tau(s)$. Summing up, expected welfare can be written as:

$$\begin{aligned} W(s \mid \lambda, \xi) \;\equiv\; & \int_1^{\frac{1}{2}\mu} \left(\int_0^{\widehat{\theta}(\gamma,s)} S^N(\theta, \gamma, s)\, h(\theta|\lambda) d\theta \right. \\ & \left. + \int_{\widehat{\theta}(\gamma,s)}^{+\infty} [\theta - \tau(s)]\, h(\theta|\lambda) d\theta \right) dG(\gamma|\xi). \end{aligned} \tag{16}$$

Accordingly, the optimal level of unemployment benefit, s^*, is implicitly defined by the first-order condition $W_s(s \mid \lambda, \xi) = 0$. By definition, at the point $\widehat{\theta}$ we have $S^N = \widehat{\theta} + s$. Moreover, $\widehat{\theta}_s = -\frac{\mu - \gamma}{\mu - 1}$ follows from (14). Using these equalities and (10) yields:

[8] For instance, a positive level of unemployment benefits has been justified by appealing to consumption smoothing or standard search frictions. In a more comprehensive framework which would include these additional justifications for unemployment benefits, our results could be interpreted as deriving the marginal effects arising from the trade-off that is at the heart of the current analysis.

$$W_s(s \mid \lambda,\xi) = \int_1^{\frac{1}{2}\mu} \left(\int_0^{\widehat{\theta}(\gamma,s)} \frac{1}{2}\frac{\gamma-1}{\mu-1} h(\theta|\lambda) d\theta - \tau'(s)\left[1 - H(\widehat{\theta}|\lambda)\right] \right. \\ \left. - \left[\tau(s)+s\right] \frac{\mu-\gamma}{\mu-1} h(\widehat{\theta}|\lambda) \right) dG(\gamma|\xi) = 0 \tag{17}$$

The first term on the RHS represents the benefits that result from the positive effects of s on effort for employed workers. The second term on the RHS represents the marginal increase in the shadow price in financing unemployment benefits weighted by the mass of unemployed workers. The terms in the second line capture the effect of the change in the unemployment level. $\widehat{\theta}_s = -\frac{\mu-\gamma}{\mu-1} h(\widehat{\theta}|\lambda)$ represents the marginal effect of raising s on the mass of firms that are induced to move abroad. For each such firm, domestic production falls by $\widehat{\theta} + s$. Moreover, the worker that was matched with this firm becomes unemployed, leading to additional costs $\tau(s)+s$. However, there is a countervailing positive effect coming from the firm and the worker obtaining their respective outside options $\widehat{\theta}$ and s. Accordingly, for each firm moving abroad the net welfare loss is $\tau(s)+s$.

The first term is positive, and at $s=0$ we have $\tau(s)+s=0$. Hence, the LHS of (17) is positive for $\tau'(0)$ sufficiently small. Moreover, by assumption 2 we have $\lim_{s\to 1} \tau(s) = \infty$ so that as $s \to 1$ the second line converges towards $-\infty$. Hence we obtain the following result.

Proposition 1 *For $\tau'(0)$ sufficiently small, we have $0 < s^* < 1$.*

It is difficult to make a general statement about the value of $\tau'(0)$. For instance, if a country must set up an entirely new administration even for small values of s, then $\tau'(0)$ would be large. In contrast, if a country uses its existing social welfare system to administer small levels of unemployment benefit payments, $\tau'(0)$ may be very small.

In the remaining, we assume $\tau'(0)$ is sufficiently small to yield $s^* > 0$ and consider the effect of globalization and of an improvement in technology or education on the optimal level of unemployment benefits.

6 Globalization

In this section, we interpret the parameter λ as a measure of firms' transaction costs associated with moving abroad. We discuss the impact of changes in λ on the distribution of firms' outside options. Based on this interpretation, globalization is thought of as a reduction λ. In the real economy, such a reduction may have resulted from advances in ICT, the lowering of trade barriers and cheaper transportation costs (for instance, due to large scale container shipments).

Specifically, we assume that a firm's outside option, θ, depends on what that firm could gain abroad, denoted $\widetilde{\theta} \in \mathbb{R}^{+}$, net of the transaction costs λ. A priori, this allows for the possibility that a firm makes a loss when moving abroad. However, since a firm can always leave the market, the resulting outside options may be written as $\theta = \max\left\{\widetilde{\theta} - \lambda, 0\right\}$. This specification affects how the distribution of outside options $H(\theta \mid \lambda)$ depends on the transaction cost parameter.

In particular, let $F\left(\widetilde{\theta}\right)$ denote the cumulative distribution function of $\widetilde{\theta}$ and assume that it is differentiable everywhere with density $F'\left(\widetilde{\theta}\right) = f\left(\widetilde{\theta}\right)$. Without loss of generality, we can define f over the entire real line with $f(x) = 0$ outside of the support. The above definition of outside options implies that $H(\theta \mid \lambda)$ has a mass point at $\theta = 0$. Intuitively, it results from the mass of firms which would make losses when moving abroad and, hence, have an outside option of 0. Mathematically, the result obtains because we have $H(0 \mid \lambda) = \Pr[\theta \leq 0] = \Pr\left[\widetilde{\theta} \leq \lambda\right] = F(\lambda)$.

Similarly, for any $z > 0$, we have $H(z \mid \lambda) = \Pr[\theta \leq z] = \Pr\left[\widetilde{\theta} \leq z + \lambda\right] = F(z + \lambda)$. Moreover, lowering transaction costs reduces the share of firms that would loose from moving abroad. Hence, a reduction in λ shifts the distribution $H(\theta \mid \lambda)$ according to first-order stochastic dominance.

In summary, globalization – interpreted as a reduction in the transaction costs of moving – improves the distribution of firms' outside option. Based on this interpretation, we now analyze how globalization affects the justification for unemployment benefits that is at the core of our analysis. Specifically, applying the implicit function theorem to (17), we have $\frac{ds^*}{d\lambda} = -\frac{W_{s\lambda}}{W_{ss}}$. Moreover, from the second-order condition we know that at the optimum $W_{ss} \leq 0$. Accordingly, the sign of $\frac{ds^*}{d\lambda}$ is identical to the sign of the cross derivative $W_{s\lambda}$.

Due to the mass point at $\theta = 0$, the distribution of outside options involves both a continuous and a discrete part. Accordingly, solving for the density $h(\theta \mid \lambda)$ requires the use of a so-called *generalized probability density function*

$$h(\theta \mid \lambda) = \delta(\theta)F(\lambda) + f(\theta + \lambda), \tag{18}$$

where $\delta(\cdot)$ denotes the Dirac delta function. This specification implies that

$$\int_{-\infty}^{\widehat{\theta}(\gamma,s)} h(\theta \mid \lambda)d\theta = \left[F(\lambda)\int_{-\infty}^{\widehat{\theta}(\gamma,s)} \delta(\theta)d\theta + \int_{0}^{\widehat{\theta}(\gamma,s)} f(\theta + \lambda)d\theta\right] = F(\widehat{\theta} + \lambda),$$

where $\int_{-\infty}^{\widehat{\theta}(\gamma,s)} \delta(\theta)d\theta = 1$ by definition of the Dirac delta function and $\widehat{\theta} > 0$. Moreover, the inequality also implies $\delta\left(\widehat{\theta}\right) = 0$, yielding $h(\widehat{\theta} \mid \lambda) = f(\widehat{\theta} + \lambda)$. Upon substituting the generalized pdf into (17) we obtain

$$\begin{aligned} W_s(s \mid \lambda, \xi) \;&= \int_1^{\frac{1}{2}\mu} \left(\frac{1}{2}\frac{\gamma - 1}{\mu - 1} F(\widehat{\theta} + \lambda) - \tau'(s)\left[1 - F(\widehat{\theta} + \lambda)\right] \right. \\ &\qquad \left. - \left[\tau(s) + s\right] \frac{\mu - \gamma}{\mu - 1} f(\widehat{\theta} + \lambda) \right) dG(\gamma|\xi). \end{aligned} \tag{19}$$

Hence, taking the derivative with respect to λ yields:

$$\begin{aligned} W_{s\lambda}(s \mid \lambda, \xi) \;&= \int_1^{\frac{1}{2}\mu} \left(\frac{1}{2}\frac{\gamma - 1}{\mu - 1} f(\widehat{\theta} + \lambda) + \tau'(s) f(\widehat{\theta} + \lambda) \right. \\ &\qquad \left. - \left[\tau(s) + s\right] \frac{\mu - \gamma}{\mu - 1} f'(\widehat{\theta} + \lambda) \right) dG(\gamma|\xi). \end{aligned} \tag{20}$$

The first two terms under the integral are unambiguously positive. Accordingly, we find the following result.

Proposition 2 *Globalization leads to a reduction of the optimal level of unemployment benefits if $f'(\widehat{\theta}(\gamma, s) + \lambda)$ is sufficiently small over the range of γ.*

An obvious case where globalization leads to a reduction of s^* is $f'(\widehat{\theta}(\gamma, s) + \lambda) \leq 0$ for all γ. In particular, this holds if $f(\cdot)$ is decreasing everywhere (for instance, this is the case for the exponential distribution). Intuitively, such a condition requires that the relative frequency of gains abroad is decreasing in the size of the gains. While we do not have empirical evidence for such a hypothesis, this (sufficient) requirement appears quite reasonable.

7 Improvements in the distribution of skills

In this section, we consider the impact of variations in the distribution of the skill parameter on the welfare effects of unemployment benefits. Just as in the analysis on globalization, we do not model the process leading to such a variation. Rather we take the latter as exogenously given and derive the optimal response of the benevolent regulator. In the real economy, the distribution of skills may shift due to technological advances and improvements in the general level of education.

In our analysis, the skill distribution depends on the parameter ξ. Specifically, we assume that an increase in ξ shifts the distribution $G(\gamma \mid \xi)$ according to first-order stochastic dominance. Just as in the previous section, applying the implicit function theorem yields $\frac{ds^*}{d\xi} = -\frac{W_{s\xi}}{W_{ss}}$. Accordingly, the effect of skill improvements depends on the sign of the cross derivative $W_{s\xi}$. Let

$$z(\gamma,\lambda) \equiv \frac{1}{2}\frac{\gamma-1}{\mu-1}F(\widehat{\theta}+\lambda)-\tau'(s)\left[1-F(\widehat{\theta}+\lambda)\right]-[\tau(s)+s]\frac{\mu-\gamma}{\mu-1}f(\widehat{\theta}+\lambda) \quad (21)$$

so that equation (19) can be rewritten as:

$$W_s(s,\lambda,\xi) = \int_1^{\frac{1}{2}\mu} z(\gamma,\lambda)dG(\gamma \mid \xi) = 0 \quad (22)$$

Accordingly, if $z(\cdot)$ is increasing in γ, directly applying the defining characteristic of first-order stochastic dominance implies for the cross partial derivative that $W_{s\xi} \geq 0$ (see Rothschild and Stiglitz (1970)). From (21), we obtain:

$$\begin{aligned}\frac{\partial z}{\partial \gamma} = \;& \frac{F(\widehat{\theta}+\lambda)}{2(\mu-1)} + \left[\frac{\tau(s)+s}{\mu-1} + \left(\frac{\gamma-1}{2(\mu-1)}+\tau'(s)\right)\frac{\partial\widehat{\theta}}{\partial\gamma}\right]f(\widehat{\theta}+\lambda) \\ & - [\tau(s)+s]\frac{\mu-\gamma}{\mu-1}f'(\widehat{\theta}+\lambda)\frac{\partial\widehat{\theta}}{\partial\gamma}\end{aligned} \quad (23)$$

From the definition (14), we have $\frac{\partial\widehat{\theta}}{\partial\gamma} = 1 + \frac{s}{\mu-1} > 0$. Accordingly, all terms in the first line are positive which yields the ensuing result.

Proposition 3 *Improvements in the distribution of skills lead to an increase of the optimal level of unemployment benefits if $f'(\widehat{\theta}(\gamma,s)+\lambda)$ is sufficiently small over the range of γ.*

Similarly to proposition 2 regarding globalization, a sufficient condition for the current result is that $f'(\widehat{\theta}(\gamma,s)+\lambda) \leq 0$ for all γ. This condition has already been discussed above.

8 Concluding remarks

The main contribution of this paper is to provide a stylized framework that suggests a key mechanism through which improvements in the distribution of skills and globalization affects a central argument for unemployment payments. Specifically, we developed a simple model of bargaining over labor contracts where parties are risk neutral, contracts are subject to effort moral hazard, and workers are financially constrained. In this context, unemployment benefits improve workers' outside option. On the hand, this reduces the number of mutually beneficial contracts, thereby raising unemployment. On the other hand, the workers' bargaining position improves, resulting in larger bonuses, stronger work incentives and higher production efficiency.

Welfare maximization leads to a level of unemployment benefits that balances these two effects. The trade-off depends on the respective distributions of workers' skills and firms' outside options from moving abroad. Specifically, we show that the optimal benefit level increases with skill improvements and decreases in firms' relocation opportunities. The first result appears consistent with the observation that states with high education levels often afford relatively generous unemployment benefits, as for example the Nordic countries. The second prediction is compatible with the observation that globalization is often used as a justification for reducing the "welfare state".

For parsimony, we derived the results using some simplifying assumptions. We now informally discuss the generality of our findings in the light of these simplifications. As mentioned in the introduction, replacing the linearity of production and effort cost functions with more general curvature assumptions would induce a bargaining frontier that is decreasing concave. Adjusting figure 2 appropriately, raising the worker's outside option would still move the outcome of contract negotiations downward along the CPF, thereby increasing efficiency. Hence, the key trade-off remains according to which higher unemployment benefits raises the efficiency of mutually beneficial contracts while increasing unemployment.

This trade-off would also remain valid in a dynamic matching framework, but additional effects would arise (see Demougin and Helm (2011)). In particular, in dynamic matching models successful matches are dissolved with a certain probability after each period. Moreover, firms and workers for which contract negotiations fail can continue to search a profitable match. If globalization induces the regulator to lower the level of unemployment benefits, this reduces the unemployment level and less firms decide to exit the domestic labor market. Therefore, it takes less time for an unemployed worker to find a profitable match. This constitutes a positive effect of lowering unemployment benefits on a worker's outside option that does not arise in our static framework. Moreover, the forgone wage during such spells of unemployment is larger for high-skill workers. Hence the positive effect on a worker's outside option – and, therefore, on its bargaining power and negotiated wage – is particularly strong for such high-skilled workers. As a consequence, one would expect that the wage spread between high-skilled and low-skilled workers increases in the course of globalization. In line with this prediction, there does indeed exist substantial evidence that wage spreads have increased. Moreover, this development is often associated with the process of globalization (see Haskel et al. (2012) for a recent discussion).

A final simplifying assumption that we want to discuss is our focus on a single country. Intuitively, if in the process of globalization it has become less costly for domestic firms to relocate abroad, this should also be the case for foreign firms that enter the domestic market. Given that lower unemployment benefits improve firms' bargaining power, this would make relocations into the domestic country more attractive. As a consequence, governments would have an further incentive to reduce benefit payments so as to attract a larger number of firms. Such "race to the bottom" effects that arise from regulatory competition have been discussed extensively in the literature (e.g., Sinn (2003)). Nevertheless, expanding the above analysis by a more explicit modeling of international trade and foreign direct investment would certainly constitute a worthwhile area for future research.

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