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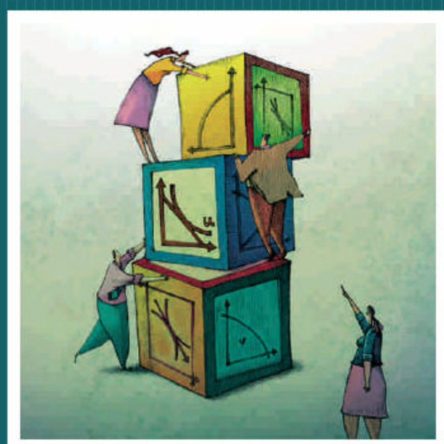

Nº 252 FIRM-PROVIDED TRAINING AND LABOR MARKET POLICIES

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Firm-Provided Training and Labor Market Policies

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Abstract

This paper studies firm-provided training in the presence of the following labor market policies: minimum wages, unemployment benefits, firing costs, and severance payments. I show that in high minimum wage economies, a more intense use of labor market policies reduces firm-provide training, while in low minimum wage economies, this may result in more training. The results of the paper are used to shed light on the relationship between the skill-premium and labor-market policies. In particular, I show that the skill premium is non-decreasing in the strictness of employment-protection legislation and non-increasing with the minimum wage and unemployment benefits.

1 Introduction

This paper studies how labor-market policies (LMP hereafter) influence firms' incentives to provide training in an otherwise competitive labor market. The paper develops in detail the intuition that LMP distort the wage structure and hence the employment rents firms earn from workers with different levels of human capital.[1] Because training augments productivity and therefore wages, the results here are used to shed light on the effect of LMP on the skill-premium. The main contribution of the paper is that it provides a unified treatment of the relationship between firm-provided training and LMP that is capable of explaining the differences between the different theories and sheds light on mixed evidence regarding this relationship.

In the standard human capital theory as developed by Becker (1964), the analysis of firm's investment in general training in a competitive labor market is straightforward; due to perfect competition, workers capture the full return to their general human capital and thus firms should not pay for this type of training. The empirical evidence, however, is difficult to reconcile with Becker's model. When information about training investments is available, most of the reported job-related training appears to be firm sponsored (at least partially), even when it is viewed by respondents as general (Barron, Berger and Black, 1997; Loewenstein and Spletzer,1999; Booth and Bryan, 2002).[2]

More recent theories of firm-provided human capital can explain this evidence. In particular, Acemoglu and Pischke (1998, 1999) show that when labor market imperfections distort the wage structure within the firm, pushing it away from the competitive benchmark and favoring skilled workers, it will be profitable for firms to provide workers with general human capital. This is because labor market imperfections make general abilities into de-facto specific in the sense that trained workers do not get their full marginal product when they switch to another job.[3] Balmaceda (2005) considers a Becker's type of model in which bargaining and employment on the spot market are mutually exclusive. In this case, taking a job outside the firm or hiring a replacement worker terminates the bargaining process. Therefore, the no-trade payoff would be an outside, rather than

[1] I use the word training and human capital as interchangeable.

[2] For instance, for 16 OECD countries, the IALS data shows that, on average, 80% of vocational training courses are paid for or provided by employers. Although cross-country variation is large, in all countries at least 50% of vocational training courses are employer-sponsored. A similar pattern emerges in the ECHP data, where on average 72% of the training courses on which there is information on the source of financing is employer-sponsored

[3] Chang and Wang (1996) and Katz and Siderman (1990) make a very similar point in a slightly different context. Assuming that investment in general training is unobserved by potential employers and non-contractible so potential employers do not know trained workers' marginal productivity; they show that trained workers' outside offers do not fully reflect their productivity. Thus, there is underinvestment in human capital but, in equilibrium, investment in general training is positive and positively related to the probability of a worker staying with the same employer in the second period.

an inside option in bargaining terminology.[4] In this setting, Balmaceda shows that when there is uncertainty about the worker's productivity at the time investments are undertaking there is a positive probability of the worker and firm sharing the returns to training. This encourages firms to pay for general training while creating incentives to invest in specific capital at an inefficient level.[5]

The effect of any labor market policy such as the minimum wage on a firm's incentive to provide human capital in a competitive labor market is likely to be different from that in a market with imperfections such as incomplete information and investment unobservability. For instance, Becker's human capital theory predicts that if the labor market for the low paid is competitive and workers are not credit constrained, a minimum wage will reduce training (see, Rosen, 1972). In the absence of binding training contracts for workers, a minimum wage provides a floor below which wages cannot fall. Thus lower wages cannot be used as a mean to finance general training. In contrast, wage compression theories based on imperfect labor markets such as Stevens (1994), Acemoglu and Pischke (2003), Chang and Wang (1996) and Booth and Zoega (2003) predict that a minimum wage can increase investment in general human capital. Minimum wages make less profitable to employ unskilled workers. When there are no rents to the employment relationship, as in a competitive labor market, the firm has no option but to lay-off workers who were previously paid below the new minimum wage. In contrast, in the presence of labor market rents, it may be more profitable to increase the productivity of workers through training, who are already receiving high wages, rather than laying them off.

In this paper I adopt a slightly modified version of the model developed in Balmaceda (2005) to study the relationship between minimum wages, unemployment assistance benefits, firing costs, and mandated severance payments and firm-provided general training. The paper considers a simple two-period competitive labor market model between a risk neutral firm and a risk neutral worker. The crucial assumptions are: (i) the worker's second-period productivity is uncertain and its distribution depends positively on training and skills in the sense of first-order stochastic dominance; (ii) the worker acquires on-the-job specific training, which is neither complement nor substitute with general

[4] Becker's result is consistent with several wage determination processes that are in agreement with plausible bargaining games like Rubinstein's alternating-offer game. To visualize this, suppose that the worker and the firm receive a per-period payoff while bargaining continues (what is known as the inside option) equal to what they can get outside the relationship, which is forfeited once agreement is reached. Then, as discounting goes to zero, the perfect equilibrium outcome gives each party the inside option plus half the surplus generated within the relationship, which in this case is the total output minus the sum of the inside options. Becker's solution considers the no-trade payoffs as the inside options, which can be interpreted as a wage bargaining model in which during the negotiations the worker can work in another job and the firm can hire an equivalent worker, until they reach a wage settlement. In this case, investment in general training shifts the inside option, but does not shift the surplus within the relationship since total output and the inside option increase by the same amount with general training. Consequently, the firm never shares the returns to general training and therefore it should not invest in general training. See, Balmaceda (2005) for a more detail discussion of this.

[5] As shown in Balmaceda (2005) this result holds despite the fact that general and specific human capital are neither substitutes nor complements in the production technology.

training; and (iii) wages are determined by Rubinstein's alternating-offer bargaining game with outside options. In other words, assuming that bargaining and employment on the spot market are mutually exclusive. Thus, in contrast to most model in the literature, here the no-trade payoffs for the firm and worker enter the bargaining process as outside options instead of as inside options.

The timing of the model is as follows. In the first period the firm offers the worker a one period wage contract and if the worker accepts, the firm decides whether to provide the worker with one unit of costly human capital. This is observable, yet non-verifiable and non-contractible. Before the second period begins, the worker's productivity is publicly realized and, then the firm and worker negotiate the second-period wage and decide whether to continue or to terminate the relationship.

Using this framework, I show that in the absence of LMP, firms employ all workers, but train only those who have an skill level greater than or equal to a given threshold, there is less training than first-best efficiency requires, and firms pay for training. The key to this insight stems from two facts. First, bargaining and employment on the spot market are mutually exclusive and therefore the parties' outside options may not affect the bargaining outcome, and the worker's productivity is uncertain at the time the training decision is made. These two things together imply that the worker and the firm will share the return to training with positive probability, and thereby it is in the interest of the firm to pay for training. In contrast, in the presence of LMP, firms hire only those workers whose skills exceed a given threshold and train only those with sufficiently large skills, there is less training than efficiency requires, and also firms pay for training. Wage floors make general training to behave as if it were specific and employment protection legislation (hereafter EPL) makes separations less likely to occur, but decreases the probability that the worker and firm share the return to training.

In order to study the effect of marginal change of any given policy on training I denote by a high minimum wage economy as one in which all hired workers receive training and by a low minimum wage economy as one in which not all hired workers receive training (only those with the highest skills among hired workers receive training). The main results can be summarized as follows:

1. In a high minimum wage economy, a marginal increase in any LMP considered here results in less training.

2. In a low minimum wage economy, a marginal increase in firing costs increases training, while a marginal increase in either minimum wages, or unemployment benefits or severance payments may either increase or decrease training. This depends on the distribution of the worker's productivity and the intensity of each policy.

3. The skill premium is non-decreasing in the strictness of EPL and non-increasing with the

minimum wage and unemployment benefits.

The rest of the paper is structured as follows. The next section, Section 2, discusses the related empirical and theoretical literature. In section 3, the model is presented. In Section 4, I derive the first-best efficient amount of training and the optimal training incidence when there are no LMP. In Section 5, I derive the optimal training incidence in the presence of LMP and how marginal changes in LMP influence the firm's training decision. In the following section, effect of LMP on the skill premium is considered. And finally, Section 7 offers some concluding remarks.

2 A Literature Review

The related literature is vast, yet no paper that I am aware off considers several policies at once, emphasizes the different effects that LMP can have on firm-provided training, and provides a market equilibrium in which firms pay for training as a benchmark against to which the effects of LMP on firm-provided training could be compared. In addition, the model here comprises the main ideas of Becker's human capital theory and Acemogleu and Piscke's wage-compression theory. Thus, the model here proposes a unified treatment of the relationship between firm-provided training and LMP that is capable of explaining both at the theoretical and empirical level the differences between the different theories. For instance, as mentioned before, Becker's human capital theory predicts that a hike in the minimum wage decreases training incidence and Acemoglu and Piscke's wage compression theory predicts the opposite. The model here shows that the reason for this is that Becker's model ignores the possibility that the firm and worker share the return to training with positive probability, and Acemoglu and Pischke assume exogenous separations.

Belot, Boone and van Ours (2007), presents a one shot matching model to formalize the idea that firing costs may stimulate workers to invest in training. Fella (2005) studies the effect of conditional and privately negotiated separation payments on the firm's incentives to provide general training. He shows that large enough conditional separation payments may induce the firm to undertake investment in general training. Booth and Zoega (2003) show that employment protection increases welfare when the worker's human capital embodies more than match-specific abilities. Teulings and Hartog (1998) argue that when workers can invest in non-contractible firm-specific training, employment protection could help to stimulate this type of investment, which would otherwise be suboptimal due to the hold-up problem. Wasmer (2004) propose a job-matching model in which workers in more flexible labor markets (that is, markets with little employment protection and low unemployment benefits) tend to invest in general human capital, while in more rigid markets with generous benefits and higher duration of jobs workers are more inclined to invest in specific training. Acemoglu and Pischke (1999a,b, 2003) show that firms invest more in general training in the presence of minimum wages, and that by compressing the wage structure, unions may encourage firms to sponsor training programs that provide general abilities. Lechthaler and Snower (2006), using a model where outside options are treated as inside payoffs, show that minimum wages may either increase or decrease training intensity.

The evidence with regard to the relationship between minimum wages and training is comprehensive. Earlier studies that focus on the effect of minimum wages on wage growth found a negative impact of minimum wages on wage growth (Leighton and Mincer,1981; and Hashimoto (1982)).[6] However, more recent studies using US micro-data have performed more direct tests of the effect of minimum wages on training that have resulted in mixed evidence Grossberg and Sicilian (1999) and Schiller (1994) find a negative effect, while Neumark and Wascher (2001) and Acemoglu and Pischke (2003) find no evidence that minimum wages reduce training. Booth and Zoega (2005) report empirical results indicating that the introduction in 1999 of a national minimum wage in Britain had a small but statistically significant positive effect on subsequent training incidence for affected workers. Lastly, Arulampalam, Booth and Bryan (2004) look at the training experiences of a representative sample of men and women from the UK and find that each year, low-paid workers were only about half as likely to receive training as higher paid workers, but find no evidence that the introduction of the national minimum wage reduced training in the affected groups. In fact, the results suggest that it may even have enhanced their training prospects by up to 10 percentage points. In conclusion, the evidence is mixed, yet the evidence seems to indicate more strongly that on average there is no effect and that it is important to study the effect of minimum wages on training controlling for group characteristics.

The evidence with regard to the link between EPL and training is mainly presented in Bassanini et al. (2005), Pierre and Scarpeta (2004) and Bishop (1991). The first find that training incidence is lower when the degree of employment protection of both regular and temporary workers increases, Pierre and Scarpeta find that in countries where employment protection is relatively more strict,[7] firms make greater use of training to accommodate the workforce to the needs of new technologies, but also use more temporary contracts to enhance labor flexibility, and Bishop reports that the likelihood and amount of formal training are higher at firms where firing a worker is more difficult.

[6] Card and Krueger (1995) compared cross sectional wage profiles in California before and after the 1988 minimum wage increase with a number of comparison states. They also found flatter profiles in California after the minimum wage increase. However, they point out that the Californian profile also shifts up and does not cross the previous age-wage profile. This pattern contradicts the standard theory, but is consistent with the predictions of our model.

[7] They draw from harmonized surveys of 17,000 firms around the world and compare employers' responses with actual labor legislation.

3 The Model

3.1 Set-Up

I consider a two-period model between a firm (f) and a worker (l), both of whom are risk neutral. Each worker has a publicly known schooling or skill level $a \in [0, A]$, with $A > 0$. At the beginning of period 1, which is viewed as the early stage of a worker's career, the firm and the worker negotiate a one period contract for the supply of one unit of labor and then the firm decides whether or not to provide non-contractible training to the worker. To simplify the discussion I assume that training is indivisible, so only $\tau = 0$ (no training) and $\tau = 1$ (training) are possible. The cost of training, which is independent of skills, is incurred in terms of lower output in the first period and is equal to $C > 0$. There is free-entry at zero cost and all firms have access to the same constant-return to scale technology; i.e. the total productivity of a firm is equal to the sum of each worker's productivity.

At the beginning of period 2, after the investment in training has been undertaking, the worker's productivity, denoted by y, is publicly realized. After productivity becomes known, the parties either negotiate a one period contract for the supply of one unit of labor, or alternatively, they may either refuse to trade, or agree to trade with a third party instead. The wage determination procedure, which I discuss in detail below, is based on the outside option principle found, for example, in Sutton (1986).

- Assumption 1: Productivity y has density $f(\cdot \mid \tau, a)$ with fixed support $Y \equiv [y_L, y_H]$, with $y_L < 0 < y_H$, positive mean $E(y \mid \tau, a)$ and constant variance. Furthermore, f is twice-continuously differentiable and the cumulative distribution function satisfies the following conditions: $F(y \mid 1, a) < F(y \mid 0, a)$ for all $y \in Y$, $F_a(y \mid \tau, a) < 0$ and $F_a(y \mid 1, a) \leq F_a(y \mid 0, a)$ for all $y \in Y$.

This assumption says that training and skills improve the output distribution in the sense of first-order stochastic dominance (hereafter FOSD). This in turn implies that for any given skill level, average productivity is higher when the worker receives training and, for any given training level, average productivity is higher the higher the worker's skill level. The last part of assumption 1 imposes that training and skills are complements.

A worker's with a skill level a produces $E(y \mid 0, a) - \tau C$ in period 1; that is, the average output minus training costs. In period 2, when he stays with the first-period employer, he produces $y + \eta$ while when he leaves the first-period employer, he produces y, where η is the productivity gain due to on-the-job specific human capital. Thus, the technology is such that τ is general in Becker's sense; that is, the marginal product of general training inside the firm is the same as that with any alternative employer and skills and training are complements.

The worker in no state can be paid less than the minimum wage set by the authority at $\underline{w} > 0$, and when unemployed he or she receives unemployment assistance benefits in an amount μ,[8] with $\mu \leq \underline{w}$. This is financed by the government through general taxes. An employment protection legislation (EPL) that considers firing costs and severance payments is also in placed. Severance payments are cash transfers within the match and firing costs are real resource costs which include the costs associated with following whatever procedure is necessary in order to terminate a relationship. These costs represent transfers to a party outside the match and thus they are a pure waste from the match's viewpoint. Severance payments and firing costs are fixed amounts given by P and T respectively.

Let define $D = (\underline{w}, T, \mu, P)$, where D stands for policies or distortions and the wage floor $\theta \equiv max\{\mu + P, \underline{w}\}$. From here onwards, I will denote a labor market without policies as $D = \mathbf{0}$ and a labor market with policies as $D > \mathbf{0}$.[9] In this setting, a worker's outside option is $y + P$ if upon a separation he is able to find a job and $\mu + P$ if upon a separation he is not able to find a job. Thus, a worker's outside option at the time he or she negotiates with the first-period employer is $max\{y + P, \mu + P\}$ and the first-period employer can never paid him or her less than the minimum wage. This implies that the negotiated wage must be as least as large as the maximum between the minimum wage and the worker's outside option; that is, $\underline{w}(D) = \max\{y + P, \theta\}$. The firm's outside option is given by $\pi - T - P$, and for the sake of simplicity, it is assumed that $\pi = 0$.[10]

Because the firm and the worker are risk neutral, the potential surplus from continuing the relationship after productivity is realized is well-defined and given by:

$$S(y, D) = max\{y + \eta, max\{y + P, \mu + P\} - P - T\} \ . \tag{1}$$

3.2 Wage Determination

Here, I turn to the issue of how the worker's compensation is determined after y is realized. The key is that the no-trade payoffs enter the bargaining process as outside options instead of as inside options.

The bargaining between the firm and worker adopted here is Rubinstein's alternating-offer game with the addition of outside options for both, the firm and worker. Bargaining takes place over a

[8] Most countries that have unemployment assistance benefits programs opt for a fixed amount schedule. For instance, among OECD countries, only Germany (53% of net earnings) and Austria (92% of UI benefits) have a variable system. In addition, some countries have a unlimited duration for these benefits and some have finite durations.

[9] Bolds denote vectors.

[10] This assumption is consistent with a competitive labor market since in the absence of specific training the firm has to pay a worker his productivity.

number of periods. At the beginning of each period, the worker is chosen to be a proposer with probability $\frac{1}{2}$–the worker's bargaining power–and the firm with probability $\frac{1}{2}$–the firm's bargaining power. If the proposer is the worker, he proposes a wage w. The firm can either accept or reject this offer, if it accepts, then the firm gets $y+\eta-w$, while if it rejects, then the firm and the worker get zero and bargaining either goes to the next round where the firm makes a proposal or chooses to terminate the bargaining process taking its outside option. If bargaining is terminated because the responder takes his or her outside option, the worker gets his outside option which is equal to $max\left\{y+P,\mu+P\right\}$. Note that only the responder is allowed to choose to terminate bargaining. This ensures a unique solution for the bargaining game. Furthermore, because complete information is assumed, the bargaining process ensures that trade is ex-post efficient conditional on that the worker cannot be paid less than $\underline{w}$ and there are positive firing costs and severance payments; that is, the firm-worker relationship continues whenever continuing the relationship generates more than separating; *i.e.*, $y+\eta \geq max\left\{y+P,\theta\right\}-P-T$. It follows from this and the outside option principle that when neither the outside option nor the minimum wage binds, the surplus from continuing the relationship is divided according to each party's bargaining power (hereafter, the surplus-sharing outcome);[11] that is, the worker gets $\frac{1}{2}\left(y+\eta\right)$ and the firm gets $\frac{1}{2}\left(y+\eta\right)$; when only the worker's outside option binds and it is optimal to continue the relationship, the worker gets the maximum between his outside option and the minimum wage, and the firm gets the total surplus minus the worker's wage; that is, $y+\eta-max\left\{y+P,\theta\right\}$; and when only the firm's outside option binds, the worker gets the total surplus from continuing the relationship and the firm gets its outside option $-P-T$. Finally, when the worker and the firm's outside options are both binding, they are better-off terminating the relationship and each getting his or her outside option because what is generated by continuing the relationship is less than what can be generated if the firm and worker terminate their relationship.

I shall made the following assumption that guarantees that all possible outcomes discussed above are possible.

- Assumption 2: $\eta > \theta + P$ and $y_H > \theta - P$.

Thus, the firm's period-2's expected payoff is given by:

$$U_f\left(\tau \mid a, D\right) \equiv \int_{\eta-2P}\left(y+\eta-\left(y+P\right)\right)dF\left(y \mid \tau, a\right) + \int_{2\theta-\eta}^{\eta-2P}\frac{1}{2}\left(y+\eta\right)dF\left(y \mid \tau, a\right) + \tag{2}$$
$$\int_{\theta-P-T-\eta}^{2\theta-\eta}(y+\eta-\theta)dF\left(y \mid \tau, a\right) - \int^{\theta-P-T-\eta}(P+T)dF\left(y \mid \tau, a\right)$$

[11] See, Muthoo (1999) pages 135-145.

and the worker's period-2 expected payoff is given by:

$$U_l(\tau \mid a, D) \equiv \int_{\eta-2P} (y+P)\, dF(y \mid \tau, a) + \int_{2\theta-\eta}^{\eta-2P} \frac{1}{2}(y+\eta)\, dF(y \mid \tau, a) \tag{3}$$
$$+ \int_{\theta-P-T-\eta}^{2\theta-\eta} \theta dF(y \mid \tau, a) + \int^{\theta-P-T-\eta} (\mu+P) dF(y \mid \tau, a)$$

It follows from equations (2) and (3) that total second-period expected surplus is given by:

$$S(\tau, a, D) = \int_{\theta-P-T-\eta} (y+\eta)\, dF(y \mid \tau, a) + \int^{\theta-P-T-\eta} (\mu - T) dF(y \mid \tau, a). \tag{4}$$

4 Training Level in the Absence of LMP

4.1 The First-Best Efficient Training Level

In this sub-section I determine the first-best efficient training level in the absence of LMP (i.e., when $D = \mathbf{0}$). In this case for any training level τ and productivity y, trade must be at the efficient level; that is, separations take place if and only if what is generated by staying together is lower than what can be created by severing the match. That is, a match is severed if and only if $y + \eta \leq y$. Thus, a separation never occurs since the worker acquires on-the-job specific training η, which makes him or her more productive with the first-period employer for any realized productivity level y. In period 1, the worker has no training and thus his productivity is the $E(y \mid 0, a)$.

Given efficient trading, the efficient investment further requires that τ maximizes the total expected gains from the employment relationship regardless of whether a separation occurs. That is, τ maximizes total second-period surplus minus total costs; that is,

$$\max_{\tau \in \{0,1\}} \{S(\tau, a, \mathbf{0}) - \tau C\}$$

Let denote by τ_a^* the efficient investment in training. Then $\tau_a^* = 1$ if and only if

$$S(1, a, \mathbf{0}) - C \geq S(0, a, \mathbf{0}). \tag{5}$$

Integrating-by-parts once, equation (5) reduces to the following condition

$$\int (F(y \mid 0, a) - F(y \mid 1, a))\, dy - C \geq 0 \tag{6}$$

Observe that this inequality is satisfied when there are no training costs since the output distribution when the worker receives training FOSD that when the worker does not receive training and therefore the average productivity is greater when the worker receives training. Because of assumption 1, the LHS rises with skills, and thus I shall define $a^*(C)$ as the lowest skill level under which equation (6) is satisfied. This threshold rises with C.

Then the next result summarizes the discussion so far.

Proposition 1 *(i) It is first-best efficient to train a worker with skill level a if and only if $a \geq a^*(C)$; and (ii) $a^*(C)$ rises with training costs C.*

From here onwards I shall assume that $A \geq a^*(C)$. That is, it is efficient to provide training to a number of workers $1 - G(a^*(C))$.

4.2 The Optimal Training Level in the Spot Market

Consider now the case of spot contracting when there are no LMP–that is, $D = \mathbf{0}$. The firm then chooses τ to maximize its total expected profits $E(y \mid 0, a) - w_1 + U_f(\tau \mid a, \mathbf{0}) - \tau C$ instead of expected total surplus.

Let denote by τ_a^s the optimal investment in training, where s stands for spot market. Then provided that the firm hires a worker with a skill level a, the firm provides him with training if and only if the sum of the first- and second-period profits are greater when training is provided; that is,

$$E(y \mid 0, a) - w_1 + U_f(1 \mid a, \mathbf{0}) - C \geq E(y \mid 0, a) - w_1 + U_f(0 \mid a, \mathbf{0}), \tag{7}$$

Thus, a worker with a skill level a receives training if and only if

$$\int_\eta \eta dF(y \mid 1, a) + \int^\eta \frac{1}{2}(y + \eta)\, dF(y \mid 1, a) - C \geq \int_\eta \eta dF(y \mid 0, a) + \int^\eta \frac{1}{2}(y + \eta)\, dF(y \mid 0, a) \tag{8}$$

Equation (8) reveals that the firm gets a share $\frac{1}{2}$ of the return to worker's productivity from general training when the surplus-sharing outcome occurs, and gets no return to it when the worker's outside option binds. This is due to the fact that training rises the worker's productivity by the same amount as it increases the output within the relationship. Thus, in no state the firm is the full residual claimant.

Integrating-by-parts once and rearranging, equation (8) reduces to the following condition

$$\frac{1}{2}\int^\eta \left[F(y \mid 0, a) - F(y \mid 1, a)\right] dy - C \geq 0. \tag{9}$$

First, observe that at $C = 0$, the inequality in equation (9) is satisfied since the term in square brackets is positive for all skill levels. In addition, because training and skills are complements, this rises with skills.[12] Thus, I can define $a^s(C)$ as the lowest skill level at which the inequality in equation (9) is satisfied. In the case in which the inequality in equation (9) does not hold for any $a \leq A$, I adopt the convention that $a^s(C) = A$.

Next, I turn to the hiring decision. Because in the first period, firms compete for workers in a Bertrand-like fashion with the well-known result that in equilibrium firms have zero expected profits, $E(y \mid 0, a) - w_1 + U_f(\tau_a^s \mid a, \mathbf{0}) - \tau_a^s C$ must be equal to zero, where $E(y \mid 0, a) - w_1 - \tau_a^s C$ is the first-period profit and $U_f(\tau_a^s \mid a, \mathbf{0})$ is the second-period expected profit. Hence, the first-period wage is given by $w_1 = E(y \mid 0, a) + U_f(\tau_a^s \mid a, \mathbf{0}) - \tau_a^s C$, which is the sum of the worker's productivity in the first period and the firm's second-period expected profit. Notice that $U_f(\tau_a^s \mid a, \mathbf{0}) \geq 0$, since the firm can always ensure a payoff of at least zero by investing zero and hiring an untrained worker or closing down.[13] Thus, the firm always hires a worker with skill level a for all a and when the firm trains the worker, it cannot recoup investment costs by paying the worker less than his marginal product as an untrained worker. Thus, the condition in equation (9) is necessary and sufficient for training to take place.

Observe that equation (9) when evaluated at $a = a^*(C)$ simplifies to the following

$$-\frac{1}{2}\int^{\eta} \left[F(y \mid 0, a^*(C)) - F(y \mid 1, a^*(C))\right] dy < 0. \tag{10}$$

This implies that there are workers that should receive training, but firms have no incentives to train them. Thus, in contrast to Becker (1964) there is firm-provided training, yett there is underinvestment in training. The reason is that the firm gets a share of the return to training when the surplus-sharing outcome occurs, but no return to general training and the full return to specific training when the worker's outside option binds. In other words, there are states in which the firm is not the full residual claimant of the return to training and this holds even when training is fully specific.

Then I am ready to state the main results of this section.

Proposition 2 *Suppose that $\eta > 0$. Then (i) it is optimal to employ all workers and to train those with a skill level $a \geq a^s(C)$; (ii) there is under-investment in training; and (iii) $a^s(C)$ rises with training costs (C) and falls with the productivity of specific training (η).*

As in the standard neoclassical model all workers find a job but, in contrast to Becker's Human Capital theory and consistent with the evidence, there is firm-sponsored general training whenever

[12] The partial derivative of the term in square brackets with respect to skills is $\int^{\eta} \left[F_a(y \mid 0, a) - F_a(y \mid 1, a)\right] dy$.

[13] Note that compensation is front-loaded since firms anticipate the rent that they will receive in the second period, and thus they are willing to bid higher than the worker's current productivity.

training costs are not too large. Observe that in the absence of specific training, Becker's result is obtained; that is, there is no firm-sponsored training since the worker must be paid his total productivity in every state and therefore the firm never gets a positive return to training. In contrast, in the presence of specific training, the surplus-sharing outcome occurs and thus the firm invests in training. The number of workers receiving training is $T^s(C) = 1 - G(a^s(C))$; that is, the more skillful workers receive training. Observe also that as the productivity of specific training rises more workers receive training. Thus, general and specific training are complements.

The evidence on firm-provided training is eloquent with respect to who is more likely to receive training. Bassanini et al. (2005) shows that the average training incidence is higher in European countries where the percentage of the active population with at least upper secondary education is higher. Arulampalam, Booth and Brian (2004) find, estimating separate models for each European country, for both men and women, that there are seven out of ten countries in which highly educated individuals are significantly more likely to get training than the base group of less than upper secondary level.[14] Existing evidence also shows strong complementarities between education and training (see, Booth, 1991; Arulampalam and Booth, 1998; Brunello, 2001). In addition, Ariga and Brunello (2002) find that there is evidence that the strength of this complementarity depends on whether training is provided on-the-job or off-the-job. Thus, the fact that the model predicts that only workers with a skill or schooling level exceeding a given threshold receive training is consistent with this evidence.

Bassanini et al. (2005) also find, after controlling for a relatively large set of time varying individual, job and firm characteristics, that cross-country variation in training incidence remains large. For example, a Danish employee has still a 20 percentage point greater probability of taking training than a Portuguese. The estimated range of variation among country effects is far greater than that estimated for educational levels (7.6 percentage points), age classes (6.2), firm size classes (7.7), occupations (13) and industries (12.4). Indeed, the analysis of variance reveals that country effects alone explain 45.9 per cent of the fraction of total variance explained by their covariates. This suggests that LMP could play an important role on the explanation for the behavior of training incidence.

[14] For both sexes, the common set of countries comprises Britain, Denmark, Finland, Italy and Spain. However highly educated women in France and the Netherlands, and men in Austria and Ireland, are more likely to experience training starts than the base. Only in Belgium does education have no significant effect, ceteris paribus.

5 Training in the Presence of Labor Market Policies

5.1 The Optimal Training Level

In this section I study the firm's incentive to invest in training in the presence of LMP. As when there are no LMP, the firm chooses τ to maximize its expected profits $E(y \mid 0, a) - w_1 + U(\tau \mid a, D) - \tau C$ rather than total expected surplus.

Let denoted by τ_a^D the optimal investment in training. Then provided that the firm hires a worker with skill a, the firm provides him with training (i.e., $\tau_a^D = 1$) if and only if the sum of the first- and second-period profits are greater when training is provided; that is,

$$E(y \mid 0, a) - w_1 + U_f(1 \mid a, D) - C \geq E(y \mid 0, a) - w_1 + U_f(0 \mid a, D). \tag{11}$$

Thus, provided the worker is hired, he receives training if and only if

$$\begin{gathered}\int_{\eta-2P} (\eta - P)\, dF(y \mid 1, a) + \int_{2\theta-\eta}^{\eta-2P} \frac{1}{2}(y + \eta)\, dF(y \mid 1, a) + \\ \int_{\theta-P-T-\eta}^{2\theta-\eta} (y + \eta - \theta) dF(y \mid 1, a) - \int^{\theta-P-T-\eta} (P + T) dF(y \mid 1, a) - C \geq \\ \int_{\eta-2P} (\eta - P)\, dF(y \mid 0, a) + \int_{2\theta-\eta}^{\eta-2P} \frac{1}{2}(y + \eta)\, dF(y \mid 0, a) + \\ \int_{\theta-P-T-\eta}^{2\theta-\eta} (y + \eta - \theta) dF(y \mid 0, a) - \int^{\theta-P-T-\eta} (P + T) dF(y \mid 0, a).\end{gathered} \tag{12}$$

Equation (12) reveals the following. When productivity y is greater than $2\theta - \eta$, equation (12) reveals that the firm gets a share $\frac{1}{2}$ of the return to worker's productivity from general training when the surplus-sharing outcome occurs, and gets no return to it when the worker's outside option binds. When productivity y is smaller than or equal to $2\theta - \eta$ and greater than $\theta - P - T - \eta$, in order to retain the worker, the firm must paid the worker the wage floor θ, while when productivity is smaller than or equal to $\theta - P - T - \eta$, the relationship is severed and the firm must paid the firing costs $T + P$.

Integrating-by-parts once and rearranging, the necessary condition in equation (12) reduces to the following

$$\frac{1}{2}\int_{2\theta-\eta}^{\eta-2P} [F(y \mid 0, a) - F(y \mid 1, a)]\, dy + \int_{\theta-P-T-\eta}^{2\theta-\eta} [F(y \mid 0, a) - F(y \mid 1, a)]\, dy - C \geq 0. \tag{13}$$

Observe that the first term captures the firm's return to training when the surplus-sharing outcome occurs while the second term captures the firm's return to general training when the worker is paid the the wage floor. Note that in those states the firm gets the full return to training and thus LMP transform general human capital into *de facto* specific. In the absence of LMP only the first term arises though more frequently than in the presence of LMP, while the second term is due exclusively to the presence of LMP. Observe also that in contrast to the case in which there are no LMP, firms may still have an incentive to provide workers with training when there are no on-the-job specific training acquisition; i.e., when $\eta = 0$. This is due to the fact LMP changes the nature of general training in the sense that it makes this to behave as if it were specific.

Nevertheless, condition (13) is not sufficient to provide training. Firms also need to make non-negative profits in order to be willing to hire the worker. In period one, firms compete for workers in a Bertrand-like fashion and therefore total firm's expected profits should be zero. This results in that the first-period wage should be set to $w_{1a}^D = E(y \mid 0, a) + U_f\left(\tau_a^D \mid a, D\right) - \tau_a^D C$. However, the minimum wage legislation prevents the firm from paying w_{1a}^D when this is lower than the minimum wage. Thus, a worker with skill level a will be able to find a job in period 1 only when $w_{1a}^D \geq \underline{w}$ (that is, when the firm does not make negative profits). Integrating-by-parts once, the necessary condition for a worker with skill level a and training τ to be hired is

$$E(y \mid 0, a) + \eta - P - \frac{1}{2}\int_{2\theta-\eta}^{\eta-2P} F(y \mid \tau, a)\, dy - \int_{\theta-P-T-\eta}^{2\theta-\eta} F(y \mid \tau, a)\, dy - \tau C \geq \underline{w}. \tag{14}$$

All workers for whom conditions (13) and (14) are satisfied will be hired and trained, while those for whom condition(13) is violated, but condition (14) is satisfied when $\tau = 0$ will be hired but will not receive training.

Given this, it is possible now to determine the equilibrium level of employment and training.

Because an increase in skills improves the output in the FOSD sense, the LHS of equation (14) rises with skills. Thus, I can define $a(\tau, \underline{w})$ as the lowest skill level at which the inequality in equation (14) is satisfied. It follows from this that any worker with training τ and skills greater than or equal to $a(\tau, \underline{w})$ will be hired.

Because skills and training are complements in the sense that skills improve the output distribution more in the sense of FOSD when the worker receives training that when he does not. The LHS of equation (13) rises with skills. Then, I can define $a^D(C)$ as the lowest skill level at which the inequality in equation (13) is satisfied. In the case in which the inequality in equation (13) does not hold for any $a \leq A$, I adopt the convention that $a^D(C) = A$.

Observe that equation (13) evaluated at $a = a^* (C)$ is

$$-\frac{1}{2}\int_{2\theta-\eta}^{\eta-2P} \left[F(y \mid 0, a^*) - F(y \mid 1, a^*)\right] dy - \int^{\theta-P-T-\eta} \left[F(y \mid 0, a^*) - F(y \mid 1, a^*)\right] dy - \int_{\eta-2P} \left[F(y \mid 0, a^*) - F(y \mid 1, a^*)\right] dy < 0 \tag{15}$$

This implies that firms invest in training, but as with spot contracting in the absence of LMP, firms do not invest at the first-best efficient level. The reason is that there are states in which the firm is not the full residual claimant of the return to training.

I can now state the main result of this section:

Proposition 3 *(i) If $a^D (C) > a(0, \underline{w})$,*[15] *then it is optimal to employ all workers with a skill level $a \geq a(0, \underline{w})$ and train only those with a skill level $a > a^D (C)$, while if $a^D (C) \leq a(0, \underline{w})$, then it is optimal to employ and train all workers with a skill level $a \geq a(1, \underline{w})$; (ii) there is under-investment in training; and (iii) $a^D (C)$ and $a(0, \underline{w})$ rise with training costs (C) and falls with the productivity of specific training (η).*

As in the standard neoclassical model, minimum wages reduce employment since there are workers who will not be able to find a job. It is easy to see that the number of unemployed workers in period one is

$$U^D (C) \equiv G\left(min\left\{a(1, \underline{w}), a(0, \underline{w})\right\}\right) > 0, \tag{16}$$

and the number of trained workers is equal to

$$T^D (C) \equiv 1 - G\left(max\left\{a^D (C), a(1, \underline{w})\right\}\right). \tag{17}$$

Thus the number of workers who are hired but will not receive training is equal to

$$1 - T^D (C) - U^D (C) \geq 0. \tag{18}$$

In the next sub-section, I will discuss how LMP change the number of workers who are hired and trained relative to the case in which there are no LMP. In short, whether $T^s (C)$ is greater or smaller than $T^D (C)$. It is useful to have in mind that $T^D (C) = T^s (C)$ when $D = \mathbf{0}$.

[15] Observe that if $\underline{w}$ is such that $a(0, \underline{w}) = a^D (C)$, then $a(0, \underline{w}) = a(0, \underline{w})$ since at $a = a^D (C)$, $E(y \mid 0, a) + U_f (1 \mid a, D) - C = E(y \mid 0, a) + U_f (0 \mid a, D)$. This together with the fact that the worker's utility rises with skills implies that if $a(0, \underline{w}) \leq a^D (C)$, then $a(0, \underline{w}) < a(1, \underline{w}) < a^D (C)$, otherwise $a(1, \underline{w}) > a(1, \underline{w}) > a^D (C)$.

5.2 The Effect of Labor Market Policies on Training

5.2.1 The Effect of Minimum Wages on Training

In this section I study the effect of a marginal increase in the minimum wage on training when the other policies remain constant. The effect of minimum wages on training stems from two effects. First, a minimum wage may preclude the firm from hiring a worker despite the fact that if the firm were to hire the worker it will train him, and second, the minimum wage may transform ex-post general training into the facto specific since the firm will become the full residual claimant to the return to training when the worker is paid the minimum wage.

In order to study the effect of a marginal increase in the minimum wage on training, I partially differentiate $T^D(C)$ with respect to the minimum wage. It readily follows from equations (13) and (14) that the sign of the cross-partial differentiation of $T^D(C)$ with respect to $\underline{w}$ is as follows:

$$\frac{\partial T^D(C)}{\partial \underline{w}} = \begin{cases} -g\left(a\left(1,\underline{w}\right)\right)\frac{\partial a(1,\underline{w})}{\partial \underline{w}} & if\, a\left(0,\underline{w}\right) > a^D\left(C\right), \\ -g\left(a^D\left(C\right)\right)\frac{\partial a^D(C)}{\partial \underline{w}} & if\, a\left(0,\underline{w}\right) \leq a^D\left(C\right), \end{cases} \tag{19}$$

where:

$$sign\left\{\frac{\partial a(1,\underline{w})}{\partial \underline{w}}\right\} = -sign\left\{-1 - F\left(2\theta-\eta \mid 1, a\left(1,\underline{w}\right)\right)\frac{\partial \theta}{\partial \underline{w}} + F\left(\theta - P - T - \eta \mid 1, a\left(1,\underline{w}\right)\right)\frac{\partial \theta}{\partial \underline{w}}\right\} > 0 \tag{20}$$

and

$$sign\left\{\frac{\partial a^D(C)}{\partial \underline{w}}\right\} = -sign\left\{\begin{array}{c} F\left(2\theta-\eta \mid 0, a^D\right) - F\left(\theta-P-T-\eta \mid 0, a^D\right) - \\ \left[F\left(2\theta-\eta \mid 1, a^D\right) - F\left(\theta-P-T-\eta \mid 1, a^D\right)\right] \end{array}\right\}\frac{\partial \theta}{\partial \underline{w}}\ . \tag{21}$$

From here onwards I will denote by a high minimum wage economy as one in which $a^D(C) \leq a(0,\underline{w})$ and by a low minimum wage economy as one in in which the opposite holds. In a high minimum wage economy, all workers who are hired receive training. Then an increase in the minimum wage decreases, ceteris-paribus, the number of workers who receive training since the cost of hiring a worker rises and therefore less workers are hired. In a low minimum wage economy; that is, one where not all workers who are hired receive training, a hike in the minimum wage may either increase or decrease the number of workers who receive training. For all productivity levels between $2\theta - \eta$ and $\theta - P - T - \eta$, the worker is paid the minimum wage which is independent of the worker's productivity. In those states, a minimum wage hike reduces firm's profits by the same amount regardless of the worker's level of training. Thus, if by providing training, firms pay the minimum wage less often, a marginal increase in the minimum wage increases the number of workers who receive training and vice-versa. This leads to the following result.

Proposition 4 *In a high minimum wage economy, as the minimum wage rises less workers are trained, while in a low-minimum wage economy, as the minimum wage rises more workers are trained when trained workers are paid the minimum wage less often than untrained workers and less workers are trained when the opposite occurs.*

This proposition shows that a marginal increase in the minimum wage may either increase or decrease the level of training and when the minimum wage is sufficiently large, training falls. Becker's human capital predicts that the imposition of a minimum wage induces firm's to provide less general training since it prevents workers from taking a wage cut in the first period to compensate the firm for its training costs, while Acemoglu and Pischke's wage compression theory predicts the opposite. That is, in the presence of a minimum wage firms are induced to provide general training provided that firms make non-negative profits, which in turn entails an upper bound in the minimum wage.

The difference between the prediction of the model here and that of Acemoglu and Pischke is that they use as a benchmark Becker's Human Capital Theory, which predicts no firm-sponsored training. Since minimum wages compress the wage structure, Acemoglu and Pischke predict that minimum wages result in firm-sponsored training. Using Becker's theory as as benchmark seems less appropiate than the benchmark used here since the empirical evidence shows that there is firm-sponsored training for workers who are likely to be paid the minimum wage as well as for those who are highly unlikely to be paid the minimum wage, and this holds true across different countries and different LMP. In contrast, here I provide conditions under which a minimum wage increase may result in more or less training relative to a benchmark (that is, the competitive case without LMP) in which there is firm-sponsored training. Against this benchmark, minimum wages result in less training in high minimum wage economies and in more or less training in low minimum wage economies. Thus, the prediction that minimum wages result in more training when Becker's theory is used as a benchmark could be misleading. However, at the end this is an empirical issue.

The empirical literature on the impact of minimum wages on training provides mixed evidence. The earliest efforts focused primarily on wage growth as a proxy for training, producing mixed results. Two studies found age-earnings profiles to be significantly flatter for workers whose wages were bound to the minimum (Leighton and Mincer 1981; Hashimoto 1982), while a third study (Lazear and Miller 1981) found no statistically significant relationship between minimum wages and the slope of age-earnings profiles.[16] Recent evidence has cast serious doubt on the validity of this

[16] Card and Krueger (1995) compared cross sectional wage profiles in California before and after the 1988 minimum wage increase with a number of comparison states. They also found flatter profiles in California after the minimum wage increase. However, they point out that the Californian profile also shifts up and does not cross the previous age-wage profile. This pattern contradicts the standard theory, but is consistent with the predictions of our model.

entire approach.

Grossberg and Sicilian (1999) find that while minimum wages are indeed associated with reduced wage growth, they appear to have no significant impact on job training. Acemoglu and Pischke (1999) claim that minimum wages eliminate part of the lower tail of the wage distribution, bunching workers around the minimum wage and thereby lowering the age-earnings profile, and that this will be true independent of their impact on training. Thus, it seems clear that a correct test of the relationship between minimum wages and training must be conducted with information on worker training. Acemoglu and Pischke (1999), taking into account their own criticism and using within state variation in minimum wages for an a homogeneous group of workers, find no evidence of a reduction in training for workers with wages near to the minimum wage. Fairris and Pedace (2004), using establishment-level data, find no evidence indicating that minimum wages reduce the average hours of training of trained employees and little to suggest that minimum wages reduce the percentage of workers receiving training. Arulampalam, Booth and Bryan (2004) estimate the impact of the new national minimum wage in the UK on low-wage workers using two 'treatment groups': those workers whose derived 1998 wages were below the minimum and those workers explicitly stating they were affected by the new minimum. Using information on training incidence and intensity, they find no evidence that the minimum wage introduction reduced the training intensity of affected workers and some evidence that it increases the number of workers receiving training. In particular, the training probability increased by 8 to 11 percentage points for affected workers. It follows from this that the model's predictions are consistent with the evidence coming from studies that have information on training when the economies are considered low minimum wage economies, which they are, and the condition in proposition (4) holds.

The model here also suggests that it is indispensable to control for workers' skills, the size of the minimum wage as well as labor turnover in order to be able to predict the correct effect of minimum wages on training. If turnover is related both to training and to the degree to which the wage exceeds the mandated minimum wage, then failing to control for turnover may bias the estimated impact of minimum wages. Indeed, there is empirical evidence to suggest that the extent of training is both dependent upon and an important determinant of the rate of labor turnover. For instance, Royalty (1996) examines the effect of the predicted probability of job turnover on the probability of receiving training and finds that predicted turnover is significantly related to receiving training.

5.2.2 The Effect of Unemployment Benefits on Training.

In this section I study the effect of a marginal increase in unemployment benefits on training when the other policies remain constant.

In order to study the effect of a marginal increase in unemployment benefits on training, I need to partially differentiate $T^D(C)$ with respect to μ. It readily follows from equations (13) and (14) that the sign of the cross-partial differentiation of $T^D(C)$ with respect to μ is as follows:

$$\frac{\partial T^D(C)}{\partial \mu} = \begin{cases} -g\left(a\left(1,\underline{w}\right)\right) \frac{\partial a(1,\underline{w})}{\partial \mu} & if\, a\left(0,\underline{w}\right) > a^D(C), \\ -g\left(a^D(C)\right) \frac{\partial a^D(C)}{\partial \mu} & if\, a\left(0,\underline{w}\right) \leq a^D(C), \end{cases} \tag{22}$$

where:

$$sign\left\{\frac{\partial a(1,\underline{w})}{\partial \mu}\right\} = -sign\left\{-F\left(2\theta - \eta \mid 1, a\right) + F\left(\theta - P - T - \eta \mid 1, a\right)\right\} \frac{\partial \theta}{\partial \mu} > 0 \tag{23}$$

and

$$sign\left\{\frac{\partial a^D(C)}{\partial \mu}\right\} = -sign\left\{\begin{array}{c} F\left(2\theta - \eta \mid 0, a\right) - F\left(\theta - P - T - \eta \mid 0, a\right) - \\ \left[F\left(2\theta - \eta \mid 0, a\right) - F\left(\theta - P - T - \eta \mid 1, a\right)\right] \end{array}\right\} \frac{\partial \theta}{\partial \mu}. \tag{24}$$

In a high minimum wage economy, an marginal increase in unemployment benefits result in less training since the worker must be paid a higher wage relative to benchmark in which there are no unemployment benefits. This reduces firm's profits and thus less workers are hired, and since all hired workers receive training, less workers are trained. In a low minimum wage economy, the same two forces that arise in the case of a marginal increase in the minimum wage are present and the intuition is exactly the same as the one provided for that case. Thus, the next result readily follows from equation (22) and the discussion in the minimum wage section.

Proposition 5 *In a high minimum wage economy, as unemployment benefits rise less workers are trained, while in a low-minimum wage economy, as unemployment benefits rise more workers are trained when trained workers are paid a wage equal to unemployment benefits plus severance pay less often than untrained workers and less workers are trained when the opposite occurs.*

5.2.3 The Effect of Firing Costs on Training

In this section I study the effect of a marginal increase in firing costs on training when the other policies remain constant. In order to do so, I need to partially differentiate $T^D(C)$ with respect to T. It readily follows from equations (13) and (14) that the sign of the cross-partial differentiation of $T^D(C)$ with respect to T is as follows:

$$\frac{\partial T^D(C)}{\partial T} = \begin{cases} -g\left(a\left(1,\underline{w}\right)\right) \frac{\partial a(1,\underline{w})}{\partial T} & if\, a\left(0,\underline{w}\right) > a^D(C), \\ -g\left(a^D(C)\right) \frac{\partial a^D(C)}{\partial T} & if\, a\left(0,\underline{w}\right) \leq a^D(C), \end{cases} \tag{25}$$

where:

$$sign\left\{\frac{\partial a(1,\underline{w})}{\partial T}\right\} = -sign\left\{-F\left(\theta - P - T - \eta \mid 1, a\right)\right\} > 0 \tag{26}$$

and

$$sign\left\{\frac{\partial a^D(C)}{\partial T}\right\} = -sign\left\{F\left(\theta - P - T - \eta \mid 0, a\right) - F\left(\theta - P - T - \eta \mid 1, a\right)\right\} < 0. \tag{27}$$

In a high minimum wage economy, all workers who are hired receive training. Then an increase in firing cost decreases, ceteris-paribus, the number of workers who receive training since the cost of hiring a worker rises and therefore less workers are hired. In contrast in a low minimum wage economy not all hired workers receive training and an increase in firing costs, increases the number of workers who receive training. The reason is that a marginal increase in firing costs decreases the firm's outside option and thus the relationship is less likely to be severed. Because the firm gets the full return to training in states close to the separation threshold, the firm has a higher incentive to train the worker. This leads the following result.

Proposition 6 *In a high minimum wage economy, as firing cost rises less workers are trained, while in a low minimum wage economy, as firing costs rise more workers are trained.*

With regard to employment protection policies the evidence is somewhat scarce. Bishop (1991) reports that the likelihood and amount of formal training are higher at firms where firing a worker is more difficult. Acemoglu and Pischke (2000) argue that there are complementarities between regulation regimes and training systems, and that reducing firing costs and increasing employment flexibility could reduce the incentives to train. Their evidence, however, is casual and focuses mainly on Germany. As an counterexample take for instance Italy and Japan. The former country has one of the strictest systems of employment protection and very little training, and the latter country is often mentioned as a leading example of a high training equilibrium (see, Lynch, 1994) in spite of its having a much lower index of employment protection than Italy. For European countries, Bassanini et al. (2005) finds that training incidence is lower when the degree of employment protection of both regular and temporary workers increases, although this effect is statistically different from zero only for the former. In particular, they find that a unit increase in the employment protection index reduces training incidence by 0.034 in the case of regular workers and by 0.004 in the case of temporary workers. Given that average training incidence in their sample is close to 0.2, these effects are not negligible.

5.2.4 The Effect of Severance Pay on Training

In this section I study the effect of a marginal increase in severance pay on training. It readily follows from equations (13) and (14) that the sign of the cross-partial differentiation of $T^D(C)$ with respect to P is as follows:

$$\frac{\partial T^D(C)}{\partial P} = \begin{cases} -g\left(a\left(1,\underline{w}\right)\right)\frac{\partial a(1,\underline{w})}{\partial P} & if\, a\left(0,\underline{w}\right) > a^D\left(C\right), \\ -g\left(a^D\left(C\right)\right)\frac{\partial a^D(C)}{\partial P} & if\, a\left(0,\underline{w}\right) \leq a^D\left(C\right), \end{cases} \tag{28}$$

where:

$$sign\left\{\frac{\partial a(1,\underline{w})}{\partial P}\right\} = -sign\left\{\begin{array}{c} -1 + F\left(\eta - 2P \mid 1, a\right) - F\left(2\theta - \eta \mid 1, a\right)\frac{\partial \theta}{\partial P} + \\ F\left(\theta - P - T - \eta \mid 1, a\right)\left(\frac{\partial \theta}{\partial P} - 1\right) \end{array}\right\} > 0, \tag{29}$$

and

$$sign\left\{\frac{\partial a^D(C)}{\partial P}\right\} = -sign\left\{\begin{array}{c} -\left[F\left(\eta - 2P \mid 0, a\right) - F\left(\eta - 2P \mid 1, a\right)\right] + \\ \left[F\left(2\theta - \eta \mid 0, a\right) - F\left(2\theta - \eta \mid 1, a\right)\right]\frac{\partial \theta}{\partial P} - \\ \left[F\left(\theta - P - T - \eta \mid 0, a\right) - F\left(\theta - P - T - \eta \mid 1, a\right)\right]\left(\frac{\partial \theta}{\partial P} - 1\right) \end{array}\right\} \tag{30}$$

In a high minimum wage economy, all workers who are hired receive training. Then an increase in firing cost decreases, ceteris-paribus, the number of workers who receive training since the cost of hiring a worker rises and therefore less workers are hired. In contrast in a low minimum wage economy the effect of a marginal increase in P is less straightforward since not all hired workers receive training. When $\underline{w} > \mu + P$, the workers' wage when the outside option does not bind is independent of P and therefore an increase in P rises the worker's outside option and decreases the separation threshold. The former effect reduces the firm's incentive to train the worker since the firm is less likely to get a positive return to training, while the latter effect induces the firm to invest more in training since at the separation threshold, the firm gets the full return to training because the wage is independent of the worker's productivity. In contrast when $\underline{w} \leq \mu + P$, the workers' wage rises with P in a one-by-one relationship and therefore the separation threshold is independent of P since in this case this is just a transfer from the firm to the worker.[17] On the one hand, as severance pay rises, the firm's incentive to train falls since the workers' outside option is more likely to bind and, on the other hand, the worker is more likely to be paid a wage that is independent of his productivity and therefore the firm's incentive to train rises in those states in

[17] This is in line with Cahuc and Zylberberg (1999) who argue that in the presence of minimum wages, inside wages cannot be adjusted to the severance pay.

which the worker is paid $\mu + P$. Thus, whether an increase in P rises or falls training depends on which effect dominates. This leads to the following result.

Proposition 7 *In a high minimum wage economy, as severance pay rises less workers are trained, while in a low minimum wage economy, as severance pay rises training may either rise or fall.*

There is no evidence that speaks directly to this prediction different from the one already provided in the case of a marginal increase in firing costs.

6 The Skill Premium and LMP

There are important differences in LMP and labor market outcomes between continental European countries and Anglo-Saxon economies such as the U.S. and the U.K. In fact, the existence of European-like LMP that attempt against labor market flexibility have led to higher unemployment rates and lower turnover, while the flexibility of the U.S. labor market and to some extent that in the U.K. has resulted in a higher wage inequality or skill premium. Freeman (2007) documents the existence of a large cross-country difference in LMP, and concludes that they reduce the dispersion of earnings and income inequality, which alters incentives, but finds equivocal effects on other aggregate outcomes, such as employment, unemployment and turnover.

In this section, I discuss the Europe-US differences in LMP with an eye into the nature of firms' incentives to train workers. I argue that the European type of LMP may help to alleviate the under-provision of training due to the hold-up problems for some type of workers and contribute to keep average as well as residual wage inequality at a lower level, yet they may contribute to reduce turnover and increase unemployment.

The evidence show that wage inequality has increased sharply in the US during the last two decades. This increase was concentrated in the 1980s, while wage inequality in the 1990s remained relatively stable (see Card and DiNardo 2002; Lemieux 2003). During the same period wage inequality remained stable or fell in continental European countries. The standard explanation for increasing wage inequality is the faster increase in the relative demand for skills than the relative supply due to a skill-biased technical change (see Acemoglu 2002 for a recent survey, and Card and DiNardo 2002 for a critical view).[18] According to this hypothesis, technological developments lead to investments which were complementary with more skilled workers. This raised the wage of more skilled workers, while depressing the wage of less skilled workers. A challenge for this hypothesis is to explain why trends in wage inequality were so different in Europe, when technological developments should be fairly similar across most OECD countries. There are two types of answer for

[18]This is perhaps also due to an increase in international trade (Acemoglu, 2002a).

this: (i) either the relative supply of skills increased faster in Europe than in the US or the relative demand increased less in Europe than in the US or a combination of both; and (ii) European-style LMP prevent wage inequality from raising. In fact there is evidence in favor of this last hypothesis.

Koeniger, Leonardi and Nunziata (2004) investigate how LMP such as unemployment insurance, unions, firing regulations, and minimum wages have affected the evolution of wage inequality among male workers for eleven OECD countries. They find that changes in LMP can account for much of the change in wage inequality between 1973 and 1998. Factors found to have been negatively associated with male wage inequality are union density, the strictness of employment protection law, unemployment benefit duration, unemployment benefit generosity, and the size of the minimum wage. Over the 26-year period, institutional changes were associated with a 15% reduction in male wage inequality in France, where minimum wages have increased and employment protection has became stricter, but with an increase of up to 13% in the United States and United Kingdom, where unions became less powerful and (in the United States) minimum wages fell.

Lee (1999), Card and DiNardo (2002) and Lemieux (2005), have emphasized the central role of the minimum wage in explaining the rise of U.S. earnings inequality. Card and DiNardo (2002) and Lemieux (2005) argue that much of the rise in overall and residual inequality over the last two decades may be attributed to the minimum wage. Using a cross state analysis of minimum wage levels and earnings inequality, Lee (1999) also concludes that were it not for the falling U.S. minimum wage, there would have been no rise in inequality during the 1980s. Gosling and Lemieux (2002) compare trends in male and female hourly wage inequality in the United Kingdom and the United States between 1979 and 1998. They find that the extent and pattern of wage inequality became increasingly similar in the two countries during this period and attribute this convergence to US-style reforms in the U.K. labor market. In particular, they argue that the much steeper decline in unionization in the United Kingdom explains why inequality increased faster than in the United States. For women, they conclude that the fall and subsequent recovery in the real value of the U.S. minimum wage explains why wage inequality increased faster in the United States than in the United Kingdom during the 1980s, while the opposite happened during the 1990s.

Let define the skill-premium as the difference in average wages for any pair of workers $a', a \in [0, A]$ with $a' > a$ as

$$\triangle w\left(D\right) \equiv w^{D}\left(\tau_{a'}^{D}, a'\right) - w^{D}\left(\tau_{a}^{D}, a\right),$$

where the average wage for workers with training τ_a^D and skill a is, after integrating by parts once, given by:[19]

$$
\begin{aligned}
w^D\left(\tau_a^D, a\right) \equiv y_H + P - (\theta - \mu - P)\, F\left(\theta - P - T - \eta \mid \tau_a^D, a\right) - \\
\int_{\eta - 2P} F\left(y \mid \tau_a^D, a\right) dy - \tfrac{1}{2} \int_{2\theta-\eta}^{\eta-2P} F\left(y \mid \tau_a^D, a\right) dy.
\end{aligned}
\tag{31}
$$

Let define $H(x)$ as $-\frac{x \triangle f(x)}{\triangle F(x)}$ for any $x \in [y_L, y_H]$. Then the following is proved below.

Proposition 8 *(i) If $\underline{w} \leq \mu + P$, then the skill-premium rises with severance payments, falls with uneployment benefits, and it is independent of the the minimum wage and firing costs; and (ii) if $\underline{w} > \mu + P$ and $H(\theta - P - T - \eta) \geq 1$, then the skill-premium rises with severance payments and firing costs, falls with the minimum wage, and it is independent of uneployment benefits.*

Proof:

Let define $\triangle F(\cdot)$ as $F\left(\cdot \mid \tau_{a'}^D, a'\right) - F\left(\cdot \mid \tau_a^D, a\right)$ for any $a', a \in [0, A]$ with $a' > a$. Observe that $\tau_{a'}^D \geq \tau_a^D$ for all $a', a \in [0, A]$ with $a' > a$ implies that $\triangle F(\cdot) \leq 0$ for all $y \in [y_L, y_H]$.

The change in the skill premium with respect to the minimum wage is given by:

$$
\begin{aligned}
\frac{\partial \triangle w(D)}{\partial \underline{w}} = \left[-\triangle F(\theta - P - T - \eta) - (\theta - \mu - P)\, \triangle f(\theta - P - T - \eta)\right] \frac{\partial \theta}{\partial \underline{w}} + \\
\triangle F(2\theta - \eta) \frac{\partial \theta}{\partial \underline{w}}.
\end{aligned}
\tag{32}
$$

The change in the skill premium with respect to unemployment benefits is given by:

$$
\begin{aligned}
\frac{\partial \triangle w(D)}{\partial \mu} = \left[-\triangle F(\theta - P - T - \eta) - (\theta - \mu - P)\, \triangle f(\theta - P - T - \eta)\right] \frac{\partial \theta}{\partial \mu} + \\
\triangle F(2\theta - \eta) \frac{\partial \theta}{\partial \mu} < 0.
\end{aligned}
\tag{33}
$$

The analysis above implies that the marginal change in the expected wage of a worker with skill a and training τ_a^D is greater, the greater the worker's skill.

The change in the skill premium with respect to firing costs is given by:

$$
\frac{\partial \triangle w(D)}{\partial T} = (\theta - \mu - P)\, \triangle f(\theta - P - T - \eta). \tag{34}
$$

Because $\triangle f(\cdot)$ could be either positive or negative, the sign is undetermined.

[19]This assumes that outputs are independently and identically distributed across workers.

The change in the skill premium with respect to severance pay is given by:

$$\frac{\partial \triangle w\left(D\right)}{\partial P} \equiv \left[-\triangle F\left(\theta-P-T-\eta\right)-\left(\theta-\mu-P\right)\triangle f\left(\theta-P-T-\eta\right)\right]\frac{\partial\left(\theta-P\right)}{\partial P}+ \\ -\triangle F\left(\eta-2P\right)+\triangle F\left(2\theta-\eta\right)\frac{\partial\theta}{\partial P}>0. \tag{35}$$

■

This proposition shows that the general model of firm-provided training proposed here provides a rationale for the evidence showing that higher minimum wages and unemployment benefits reduce the skill premium. It might also explain the evidence of the effect of unionization on this if I assume that the minimum wage is not a legally binding minimum wage, but the wage set by the union in a given industry or sector.[20]

However, I am not the first to provide a plausible model that explains the evidence relating the skill-premium and LMP. Acemoglu (2003) argues that European-style LMP that result in wage compression in Europe, also encourage more investment in technologies, which in turn, raises the productivity of less skilled workers, implying less skilled-biased technical change in Europe than in the US. This argument however is based on the idea that LMP only result in a wage-compression effect, which ignores another margins on which LMP act, which are the affect the duration of a match as well as the outside option.

7 Conclusions

In this paper I have studied the effect that LMP may have on firms' incentives to provide training and have studied the relationship between the skill-premium and LMP. At the theoretical level the main contribution of the paper is that it comprises the main ideas of Becker's human capital theory and Acemogleu and Piscke's wage-compression theory in a way that is more akin to the mixed empirical evidence. Thus, the model here proposes a unified treatment of the relationship between firm-provided training and LMP that is capable of explaining both at the theoretical and empirical level the differences between the different theories. Furthermore, the paper is general in the sense it considers several policies at once, emphasizes the different effects that LMP can have on firm-provided training, and provides a market equilibrium in which firms pay for training as a benchmark against to which the effects of LMP on firm-provided training could be compared.

The results suggests that the effects of LMP on training depends mainly on the intensity in which this policies are applied. For instance in high-minimum wage economies a more intense use

[20] See, Acemoglu and Piscke (1999) for a similar interpretation of wage floors.

of the policies considered here are detrimental for employment as well as training, while in low-minimum wage economies, some policies can have a positive effect on training, yet a negative effect on employment.

The theoretical results also shed light on the relationship between the skill-premium and LMP. In particular, under certain conditions a more intense use of some LMP may result in a lower skill-premium, yet in higher unemployment. This is consistent with the evidence suggesting that the European-type LMP that impair labor-market flexibility are good for wage inequality, but bad for employment.

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