Firm-Provided Training and Labor Market Policies\textsuperscript{1}

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Abstract

This paper studies firm-provided training in the presence of the following labor market distortions: minimum wages, unemployment benefits firing costs, and severance payments. I show that labor-market policies have an effect on training incidence and training intensity understood as the time invested in general versus specific training. In addition I show that these effects are different for skilled and unskilled workers and that the predictions of the model are consistent with the evidence regarding LMP and training. The results of the paper are used to shed some light on the different evolutions of Anglo Saxon and continental European countries’ labor markets outcomes.
1 Introduction

During the last three decades or so we have witnessed a sharp increase in wage inequality in U.S. and U.K. in contrast to a roughly flat development in continental Europe, whereas we have seen a sharp increase in European unemployment and no trend in U.S. unemployment. Together with this, the evidence shows that the organization of labor markets and workplace have changed. For example, unions are less prevalent today than 30 years ago, and to the extent that unions still exists, centralized bargaining has been replaced by decentralized bargaining. Minimum wages and employment protection laws have decreases in the U.S., whereas they have increased or remain unchanged in Europe, the workplace has become more flexible and has favored workers with general skills who are more qualified for multi-tasking activities. These trends along with or induced by recent technological changes have had a non-negligible impact on the way wages are determined and thus on firm’s incentives to provide workers with different types of human capital. An issue that is not fully understood in the literature yet.

This paper is intended to contribute to improve our understating of these trends by studying how changes in labor market policies (hereafter LMP) such as minimum wages, unemployment benefits, and employment protections laws (hereafter EPL) influence firms’ incentives to provide general and specific human capital and thus workers’ productivity and employment prospects.\footnote{In a companion paper (Balmaceda, 2008), I study how workplace organization, technology and firm provided training are intertwined and explain the rise in wage inequality.} Specifically, it develops in detail the intuition that LMP distort the wage structure and hence the amount of employment rents firms earn from workers with different productivity and different types and levels of training. Furthermore, because LMP, and as a result wage structures, are different in Anglo Saxon and European economies, the paper also contributes to our understanding of the differences in labor market outcomes between countries with different LMP.

In this paper I study the link between firing costs, mandated severance payments, minimum wages, and unemployment assistance benefits and firm-provided general and specific human capital.\footnote{General training is general in Becker’s sense; that is, it is equally productive with the current as well as alternative employer.} 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 productivity with the current employer is determined by an idiosyncratic productivity shock, his or her general and specific training, and his or her skill level; and (ii) 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 (that is, taking a job outside the firm or
hiring a replacement worker terminates the bargaining process). The model distinguishes between unskilled and skilled workers, where the former are those whose productivity outside of the firm is lower than the minimum wage and skilled workers are those whose productivity outside of the firm is above the minimum wage. Thus, in equilibrium skilled workers are never paid the minimum wage. 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 firms decides whether to provide the worker with one unit of training or not. A worker who receives training produces nothing in the first-period and a worker who does not receive training has a productivity equal to his skill level in the first-period. Thus, the opportunity cost of training is the first-period output. If the firm chooses to provide training, then it decides how much of that goes to general and how much to specific training. Training is observable, yet non-verifiable and non-contractible. Before the second period starts, an idiosyncratic productivity shock that determines the productivity with the first-period employer 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 train workers with a skill level lower than or equal to certain threshold, pay for general and specific training, and over-invest in specific training and under-invest in general training relative to the first-best. In the presence of LMP, firms also train workers with a skill level lower than or equal to certain threshold, pay for general and specific training, but in contrast to the case in there are no LMP, for unskilled workers firms under-invest in specific training and overinvest in general training, while for skilled workers the opposite occurs. The key to this insight stems from two things: First, the fact that bargaining and employment on the spot market are mutually exclusive and therefore the parties’ outside options may not affect the bargaining outcome. This, together with the fact that the second-period worker’s productivity is uncertain at the time the training decision is made, implies that the worker and the firm will share the return to training with positive probability (regardless of whether this is general or specific), and thereby it is in the interest of the firm to invest in general and specific training; second, LMP policies makes general training to behave as if they were specific training since when the negotiated is equal to the maximum between the minimum wage and the worker’s outside option, it is independent of the level general training. This implies that the firm gets the full return to both general and specific training.

The main results of the model with regard to the effect of marginal change of any given policy

\[^3\]The standard human capital theory, as developed by Becker (1964), predicts that in a competitive labor market workers capture the full return to general training which in turn results in that firms should not pay for general training, and share the returns to specific training (there is one caveat here: workers must have free access to the credit markets).
on how many workers are trained (hereafter training incidence) and how training is divided between general and specific training (hereafter specific-training intensity) are as follows:\textsuperscript{4}

1. For skilled workers, the investment decision as well as the intensity of general and specific training are independent of the minimum wage and unemployment benefits; and (ii) for unskilled workers, the intensity of general and specific training is independent of the minimum wage and unemployment benefits, and more workers receive training as the minimum wage and unemployment benefits rise if the cumulative distribution function of the productivity shock is convex, less workers receive training if that is strictly concave, and the effect is ambiguous otherwise.

2. (i) As firing costs rise, skilled and unskilled workers are more likely to receive training; and (ii) for skilled workers, the investment in specific training rises and that in general training falls as firing costs increase, while for unskilled workers the specific-training intensity is independent of firing costs.

3. (i) As severance pay rises, skilled and unskilled workers are more likely to receive training; and (ii) For skilled and unskilled workers, the optimal investment in general and specific training rise with firing costs; and (ii) for skilled workers, the investment in specific training rises and that in general training falls as severance pay increase, while for unskilled workers the specific-training intensity is independent of severance payments.

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 considers general and specific training. Thus, in my view the model here proposes a more complete model of the complexities that a firm faces when deciding whether to provide training or not and what type of training to provide to a worker when it faces several labor market policies that are intertwined. This help us to understand the current evidence between training and LMP and also highlights the importance of certain issues that has been ignored when studying the empirical relationship between firm-provided training and LMP. For instance, the prediction of the model with respect to the relationship between minimum wages and training incidence is different from Becker’s human capital theory and Acemoglu and Pische’s wage compression theory. The former predicts that a marginal increase in the 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.

\textsuperscript{4}Some of this results were derived first in Balmaceda (2001), albeit in a simpler form. Specially, those related to the relationship between training and wage floors.
costs, while the latter predicts the opposite. That is, in the presence of a minimum wage firms are
induced to provide general training to more workers. 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. In fact, I show
that these two theories can be seen as special cases of the more complete theory provided here.
Similarly for the other policies. Thus, the model here has the added advantage of encompassing
the two most commons rationales provided to explain the link between LMP and firm-provided
training.

Boone, Belot 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. Zoega and Booth (2003) show that employment protection increases
welfare when the worker’s human capital embodies more than match-specific skills. Teulings and
Hartog 1998 argue that when workers can invest in non-contractible firm-specific skills, 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 on specific training. Acemoglu and
Pischke (1999a,b, 2002, 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 skills.

Rosen (1972) points out that a binding minimum wage prevents low-wage workers from accept-
ning the necessary wage cuts to contribute to finance their training costs or to facilitate worker-firm
sharing in specific training investments. If, instead, the labor market for low paid workers is non-
competitive and workers are credit constrained, then a minimum wage should increase the invest-
ment in the general component of training. The rationale for this result is provided in several papers
(Stevens, 1994; Acemoglu and Pischke, 2003; Chang and Wang, 1996; Booth and Zoega, 2003). The
reason is that firm-sponsored training exists when market imperfections compress the structure of
wages. 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, who are
already receiving high wages, rather than laying them off. Thus, the early papers in this literature predict that minimum wages decrease incentives to provide training, while the more recent papers predict the opposite.

With regard to employment protection policies the only studies that I am aware of that empirically study the link between these and training is Pierre and Scarpeta (2004) and Bishop (1991). Mainly, the former find that in countries where employment protection is relatively more strict, 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, while the latter reports that the likelihood and amount of formal training are higher at firms where firing a worker is more difficult. The evidence with regard to the relationship between minimum wages and training is more 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)). However, more recent studies using US microdata 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 rest of the paper is structured as follows. The next section, Section 2 presents the model. In Section 3, I derive the first-best efficient training level, the optimal training level in the spot market when there is no LMP, and the optimal training level in the presence of LMP. Section 4.1

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5 They draw from harmonized surveys of 17,000 firms around the world and compare employers’ responses with actual labor legislation.

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.
studies how changes in the LMP affect the firm’s training decision. In the following section, I study the effect of LMP on labor market outcomes. And finally, Section 6 offers some concluding remarks.

2 The Model

I consider a two-period model between a firm \((f)\) and a worker \((l)\), both of whom are risk neutral. Each worker has a schooling or skill level \(a \in \{a_s, a_u\}\), with \(a_s > a_u\) and where \(s\) stands for skilled and \(u\) for unskilled. At the beginning of period 1, which is viewed as the early stage of the 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 train the worker and the composition of training. In particular, if the firm decides to train the worker it provides him or her with one unit of non-contractible training, which is divided between \(s\) units of non-contractible specific human capital and \(g\) units of non-contractible general human capital. Thus, \(s + g = 1\). A natural interpretation for this is that 1 is the total time available when the worker is trained and \(s\) represents the time spent on specific training and \(g\) the remaining time. If the firm trains the worker, he or she produces nothing in period one while if the firm does not train the worker, he or she produces \(a\). Thus, an untrained skilled-worker is more productive than an untrained unskilled-worker. In addition, I assume that all firms have the same technology.

At the beginning of period 2, after the investment in training has been undertaking, an idiosyncratic productivity shock that determines the productivity inside the relationship, denoted by \(\eta\), is publicly realized. After the productivity shock 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).

I shall made the following assumption regarding the idiosyncratic shock.

- Assumption 1: The idiosyncratic productivity shock \(\eta\) has density \(f(\cdot)\) with fixed support, mean equal to 0 and constant variance. Furthermore, \(f\) is twice-continuously differentiable and log-concave; that is, the hazard function \(h_f (\cdot) \equiv \frac{f(\cdot)}{1-F(\cdot)}\) is non-decreasing \(\eta\).

Output (joint surplus) in period 2 when the worker stays with the first-period employer is \(a + h(s) + g + \eta\) and that for trade with third parties is \(a + g\), where \(h(\bullet)\) is a strictly concave and continuously differentiable function satisfying the following Inada’s conditions: \(\lim_{x \to 0} h'(x) = \infty\) and \(\lim_{x \to 1} h'(x) = 0\). In addition, \(h(0) = 0\) and \(h(1) = 1\). It is worthwhile to notice that the production function in the second period is such that \(g\) 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.

The following institutional setting is assumed. The worker can never receive less than the minimum wage set by the authority at $w > 0$ and when unemployed he or she receives unemployment assistance benefits in an amount $\mu$.\[^7\] This is financed by the government through general taxes. There is also employment protection legislation (EPL) that considers firing costs and severance pay. Here severance payments are a cash transfers within a match and firing costs are real resource costs which include the costs associated with following whatever procedures are necessary in order to dismiss a worker. These costs represent transfers to a party outside the match and thus they are a pure waste from a match’s viewpoint. Severance payments are a fixed amount $P$ and firing costs are given by the fixed amount $T$.\[^8\]

Let define $D = (w, T, \mu, P)$, where $D$ stands for policies or distortions. From here onwards, I will denote a labor market without policies as one in which $D = 0$ and a labor market with policies as one in which $D > 0$.\[^9\] Given these policies, the worker’s outside option is $a + g + P$ 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. Then, I will make the following simplifying assumption: for skilled workers $a_s > w$ and for unskilled workers $a_u + 1 < w$. Thus, skilled workers are never paid the minimum wage, while unskilled workers are paid that with positive probability. Thus, a skilled worker’s outside option at the time he or she negotiates with the first-period employer is $w_s(D) = a + g + P$ and an unskilled worker’s outside option is $w_u(D) = \mu + P$. The firm’s outside option is given by $\pi - T - P$, and for the sake of simplicity, it is assumed that $\pi = 0$.\[^{10}\]

In addition, were the worker to remain with the current employer in the second period, he would have to be paid at least the minimum wage. Thus, the negotiated wage must be as least as large as the maximum between the minimum wage and the worker’s outside option; that is, $w_n(D) = \max \{w_a(D), w\}$.

Because the firm and the worker are risk neutral, the potential surplus from continuing the

\[^7\] 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.

\[^8\] Note that firing costs and severance payments are independent of the the worker’s skill level. It is easy to assume that these differ across skill levels, yet in the static setting considered here there is no benefit from doing so.

\[^9\] Bolds denote vectors unless otherwise noticed.

\[^{10}\] This assumption is consistent with a competitive labor market since in the absence of specific training the firm has to pay a worker his expected marginal product.
relationship after the idiosyncratic productivity shock is realized is well-defined and given by:

\[ S(s, a, D) = \max \{a + h(s) + g + \eta, w_a(D) - P - T\}. \]  (1)

I now turn to the issue of how the worker’s compensation is determined after the productivity shock \( \eta \) 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 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 \( a + h(s) + g + \eta - w \), 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 \( w_a(D) \). 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 \( w \) 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., \( a + h(s) + g + \eta \geq w_a(D) - p - T \). 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 \( \frac{1}{2} (a + h(s) + g + \eta) \) and the firm gets \( \frac{1}{2} (a + h(s) + g + \eta) \); 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, \( a + h(s) + g + \eta - w_m(D) \); 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.

\(^{11}\)See, Muthoo (1999) pages 135-145.
Let define $\eta^s(a,D)$ as the productivity shock that equates the output inside the relationship with $w_a(D) - P - T$ (i.e., $\eta^s(a,D) = w_a(D) - P - T - h(s) - g - a$) and $\eta^b(a,D)$ as the productivity shock that equates the negotiated wage when the outside option does not bind with $w_a(D)$ (i.e., $\eta^b(a,D) = 2w_a(D) - h(s) - g - a$). Observe that $\eta^b(a,D) > \eta^s(a,D)$.

I shall define $\tau \equiv (z,s)$, where $z = 1$ when the worker receives training and $z = 0$ otherwise.

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

$$U_f(\tau | a,D) \equiv \int_{\eta^b(a,D)} \frac{1}{2} (a + z(h(s) + g) + \eta) dF + \int_{\eta^b(a,D)} (a + z(h(s) + g) + \eta - w_a(D)) dF$$

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

$$U_l(\tau | a,D) \equiv \int_{\eta^b(a,D)} \frac{1}{2} (a + z(h(s) + g) + \eta) dF + \int_{\eta^b(a,D)} w_a(D) dF + \int_{\eta^b(a,D)} w_m(D) dF$$

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

$$S(\tau,a,D) = \int_{\eta^b(a,D)} (a + z(h(s) + g + \eta) dF + \int_{\eta^b(a,D)} (\max\{a + zg, \mu\} - T) dF. \quad (4)$$

3 The Optimal Training Level

3.1 The First-Best Efficient Training Level

In this section I determine the first-best efficient training level in the absence of LMP (i.e., when $D = 0$). In this case for any training level $\tau$ and state $\eta$, 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 $\eta \leq \eta^s(a,0) = -h(s)$.

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

$$\max_{\tau \in \{0,1\} \times [0,1]} S(\tau,a,0)$$

$^{12}$Because the firm’s outside option is $-P - T$ and $w_a(D) - P - T \geq -P - T$ for all $\tau = (s,g)$, whenever the firm’s outside option is binding it is optimal to terminate the relationship.

To visualize this, notice that the firm’s outside option is binding when $\frac{1}{2} (a + h(s) + g + \eta - w_a(D)) < -P - T$. This implies that the surplus within the relationship $a + h(s) + g + \eta$ is negative, which means that
Assuming that total surplus is strictly concave and that the firm trains the worker, this results in a unique maximizer, denoted by $s^*$, which is determined as the solution to the following first-order condition

$$[1 - F(\eta^s(a,0))] [h'(s^*) - 1] - F(\eta^s(a,0)) = 0, \quad (5)$$

With probability $1 - F(\eta^s(a,0))$ a separation does not take place and thus the marginal return to specific training is $h'(s)$ and that to general training is one since both types of training determine the worker’s productivity inside the relationship, while with probability $F(\eta^s(a,0))$ a separation occurs and the marginal return to general training is one and that to specific training is zero because only general training determines the worker’s productivity outside of the relationship.

Observe also that the efficient amount of specific training and thus of general training is independent of the worker’s skill level since skills are general in Becker’s sense; that is, they rise the worker’s productivity inside the relationship by the same amount as they do it outside of it.

Finally, I assume that it is efficient to provide the worker with training; that is, total career productivity is greater when the worker receives training than when it does not. Thus,

$$a + h(a) + g + \eta < w_1(D). \quad (6)$$

It follows then from the envelope theorem that there exists a skill level, denoted by $a^*$, such that only workers with a skill level lower than $a^*$ receive training. This leads to the following result.

**Proposition 1** Workers with a skill level greater than $a^*$ do not receive training and those with a skill level smaller than or equal to $a^*$ receive training.

While this result may seem counter intuitive is not since the opportunity cost of providing training is the forgone productivity of the worker in the first-period. For an untrained worker with a large productivity, the forgone output is large and thus training is not profitable.

### 3.2 The Optimal Training Level in the Absence of Labor Market Policies

Consider now the case of spot contracting when there are no LMP—that is, $D = 0$. The firm then chooses the training level $\tau$ to maximize its total expected profits $(1 - z) a - w_1 + U_f(\tau | a, 0)$ instead of expected total surplus.

Assuming that the objective function is strictly concave and the firm provides training, the optimal investment under spot-contracting, denoted by $s^*_{a}$, is uniquely determined by the following

$$a + h(s) + g + \eta < w_1(D).$$

That is, the surplus inside the relationship is lower than the minimum between the worker’s outside option and the minimum wage.
first-order condition,

\[
\left[1 - F\left(\eta^b(a,0)\right)\right] \frac{1}{2} \left(h'(s^*_{a}) - 1\right) + \left[F\left(\eta^b(a,0)\right) - F\left(\eta^s(a,0)\right)\right] h'(s^*_{a}) = 0,
\]

(7)

This shows that the firm gets a share \( \frac{1}{2} \) of the return to general and specific training when the surplus-sharing outcome occurs, and gets no return to general training and the full return to specific training when the worker’s outside option binds, since the worker’s outside option rises with general training by the same amount as the output within the relationship does and is independent of the level of specific training. It follows from the Inada’s conditions and the fact that the firm gets a positive return to general training with positive probability that the firm has an incentive to invest in general training. Nevertheless spot contracting never provides with enough incentives to induce the firm to undertake the first-best efficient investment in general training since the firm gets a return to general training only when the outside option is non-binding, which occurs with probability \( 1 - F\left(\eta^b(a,0)\right) \).

The fact that the firm invests in training does not mean that there is firm-sponsored training because the firm may recoup training costs in the first period by lowering the first-period wage. However, 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. This implies that \((1 - z^s_{a})a - w_1 + U_f(\tau^s|a,0)\) must be equal to zero, where \((1 - z^s_{a})a - w_1\) is the first-period profit and \(U_f(\tau^s|a,0)\) is the second-period expected profit. Hence, the first-period wage is given by \(w_1 = (1 - z^s_{a})a + U_f(\tau^s|a,0)\), which is the sum of the worker’s productivity as an untrained worker and the firm’s expected profit from its investment in training.

Notice that \(U_f(\tau^s|a,0) \geq 0\), since the firm can always ensure a payoff of at least zero by investing zero and hiring an untrained worker or closing down. Thus, the firm cannot recoup investment costs by paying the worker less than his marginal product as an untrained worker. This result is in contrast to Becker’s Human Capital theory and is consistent with the stylized fact that there is firm-sponsored general training.

Further, observe that the investment in specific training rises and that in general training falls as the skill level increases if and only if

\[
\frac{\partial U_f(\tau^s|a,0)}{\partial s^s_{a}} = (1 + h'(s^*_{a})) f\left(\eta^b(a,0)\right) > 0.
\]

An increase in the skill level does not affect the probability of separation since skills are general in Becker’s sense, but it increases the probability that the outside option binds. These two things together imply that the surplus-sharing outcome is less likely to take place or that the outside option
is more likely to bind. This rises the return to specific training since the firm gets the full return to it more often, but it decreases the return to general training since the firm gets no return to it more frequently. As consequence of this, the marginal return to specific training increases with the skill level, while the marginal return to general training falls with it.

The discussion so far is summarized in the following proposition.

**Proposition 2** (i) Firms pay for training; (ii) there is underinvestment in general training and over investment in specific training; i.e., \( g^s < g^* \) and \( s^s > s^* \); and (iii) the investment in specific training rises with the worker’s skill level and that in general training falls with it.

**Proof:**

\[
\frac{\partial s^s}{\partial a} = -\frac{1}{|U_{ss}|} \frac{\partial U_f(\tau^s|a,D)}{\partial s \partial a},
\]

where \(|U_{ss}| > 0\) is the determinant of the Hessian.

Thus, specific training rises with the worker’s skill level and since \( g = 1 - s \), general training falls with it.

Lastly, I study firms’ incentives to provide training. Because in this case there are no LMP, all workers are able to find a job. Then a firm provides a worker with training if and only if the sum of the first- and second-period profits are greater when training is provided; that is, when the following holds

\[
-w_1 + \frac{1}{2} \int_{\eta^s(a,0)}^{\eta^h(a,0)} (a + h(s^a) + 1 - s^a + \eta) dF + \int_{\eta^s(a,0)}^{\eta^h(a,0)} (h(s^a) + \eta) dF \geq a - w_1 + \frac{1}{2} \int_{0}^{a} (a + \eta) dF + \int_{0}^{a} \eta dF
\]

Then the next results follows from the envelope theorem and equation (8).

**Proposition 3** There exists a skill level, denoted by \( a(0) \), such that workers with a skill level lower than or equal to \( a(0) \) receive training and those with a skill level greater than \( a(0) \) do not receive training.

While this result may seem counter intuitive is not since the opportunity cost of providing training is the forgone productivity of the worker in the first-period. For an untrained worker with a large productivity, the forgone output is large and thus training is not profitable.

### 3.3 The Optimal Training Level in the Presence of Labor Market Policies

In this section I study the firm’s incentives to invest in training in the presence of LMP. As when there are no LMP, the firm chooses \( \tau \) to maximize its expected profits \( (1 - z) a - w_1 + U(\tau | a, D) \) rather than total expected surplus.
Thus, assuming that the objective function is strictly concave and that the firm provides training, the firm’s investment in specific training, denoted by $s^D_a$, is given by the solution to the following first-order condition

$$\left[1 - F(\eta^b(a, D))\right] \frac{1}{2} \left(h'(s^D_a) - 1\right) + \left[F(\eta^b(a, D)) - F(\eta^s(a, D))\right] \left(h'(s^D_a) - 1 - \frac{\partial w_a(D)}{\partial s}\right) = 0,$$

(9)

where $\frac{\partial w_a(D)}{\partial s} = 0$ for unskilled workers and $\frac{\partial w_a(D)}{\partial s} = -1$ for skilled workers.

First, I analyze the first-order condition for skilled workers. In this case the first-order condition looks identical to that in the absence of labor-market policies (equation 7) since the firm shares the return to specific and general training when the surplus-sharing outcome occurs and gets the full return to specific training and no return to general training when the worker’s outside option binds. The latter is due to the fact that the worker’s outside option is independent of the level of specific training. However, the first-order condition differs from that in equation (7) because the cutoffs for each of these outcomes to occur are different from those in the absence of LMP.

The first-order condition for skilled workers is quite different from that in equation (7), since the firm and worker share the return to general and specific training not only when the surplus-sharing outcome occurs but also when the outside option binds. The reason is that unskilled workers must be paid the maximum between the minimum wage and $\mu + P$, both of which are independent of the level of general training.

In period one, firms compete for workers in a Bertrand-like fashion with the well-known result that in equilibrium firms have zero expected profits. This implies that $(1 - z^D_a)a - w_1 + U_f(\tau^D_a|a, D)$ should be zero, which implies that the first-period wage should be set to $w^D_1 = (1 - z^D_a)a + U_f(\tau^D_a|a, D)$.\(^{13}\) However, the minimum wage will prevent the firm from paying $w^D_1$ when this is lower than the minimum wage. This implies that a worker is able to find a job in period one if and only if $w^D_1 \geq \underline{w}$. Because the firm’s second-period expected profits fall as the minimum wage rises, the second-period wage $w^D_1$ is less likely to be greater than $\underline{w}$ as this rises. Thus, low-ability workers may not be able to find a job if the minimum wage is sufficiently large.

Notice that for unskilled workers the investment is determined by the following condition: $h'(s^a) = 1$, and thus the investment in specific training is independent of the skill level, while for skilled workers specific training rises and general training falls as the skill level increases if and only if

$$\frac{\partial U_f(\tau^D_a|a, D)}{\partial s|a} = \frac{1}{2} \left(h'(s^D_a) + 1\right) f(\eta^b(a, D)) > 0.$$

\(^{13}\)Notice that $U_f(\tau^D_a|a, D) \geq 0$, since the firm can always ensure a payoff of at least zero by investing zero and hiring an untrained worker or closing down.
Proposition 4 (i) Firms pay for training; (ii) for unskilled workers there is underinvestment in specific training; i.e., \( s_D^u < s_u^* < s_u^* \), and over investment in general training; i.e., \( g_D^u > g_u^* > g_u^* \); (iii) for skilled workers there is over investment in specific training; i.e., \( s_D^s > s_s^* \), and underinvestment in general training; i.e., \( g_D^s < g_s^* \); (iv) for skilled workers the investment in specific training rises and that in general training falls with the worker’s skill level and for unskilled workers they are independent of the skill level.

Next, I study firms’ decision to train. Provided that a worker with skill level \( a \) is hired, he will be trained if and only if

\[
-w_1 + \frac{1}{2} \int_{\eta^h(a,D)(a)} \left( a + h(s_D^a) + 1 - s_D^a + \eta \right) dF + \int_{\eta^h(a,D)} (a + h(s_D^a) + 1 - s_D^a + \eta - w_a(D)) dF + \int_{\eta^s(a,D)} (-P - T) dF \geq \frac{1}{2} \int_{a} (a + \eta) dF + \int_{0}^{a} (a + \eta - w_a(D)) dF + \int_{0}^{a} (-P - T) dF
\]

Then the next result follows from the envelope theorem and equation (10), denoted by \( a(D) \), such that only workers with a skill level lower than \( a(D) \) receives training. This leads to the following result.

Proposition 5 There exists a skill level, denoted by \( a(D) \), such that workers with a skill level greater than \( a(D) \) do not receive training and those with a skill-level lower than or equal to \( a(D) \) receive training.

Again this follows from the fact that the opportunity cost of providing training to a worker is the forgone productivity in the first-period. For an untrained worker with a large productivity, the forgone output is too large and thus training is not profitable.

Before ending it is interesting to note that the fact that training is chosen in order to maximize second-period expected profits implies that training increases the change of being hired. To see this note that worker who receives training is hired if and only if

\[
\frac{1}{2} \int_{\eta^h(a,D)} \left( a + h(s_D^a) + 1 - s_D^a + \eta \right) dF + \int_{\eta^h(a,D)} (h(s_D^a) + \eta) dF \geq \frac{w}{2}.
\]

It follows then from equations (10) and (12) that for all worker with an skill level lower than or equal to \( a(D) \), the fact that they receive training implies that they are more likely to find a job.
4 The Effect of Labor Market Policies on Training

4.1 The Effect of Minimum Wages on Training

In this section I study the effect of an increase in the minimum wage on training incidence and training intensity in each type of training when the other policies remain constant. Because the minimum wage is binding only for unskilled workers when \( w > \mu + P \), here I assume that this condition holds. For all other workers, minimum wages have no impact on training.

The first to notice is that training intensity is independent of the minimum wage level. Thus, a marginal increase in the minimum wage has no effect on how much time is spent on being trained in general versus specific training, but it does have an impact on the decision of whether to provide training or not. In order to study the effect of a marginal increase in the minimum wage on the training decision, I need to partially differentiate \( a(D) \) with respect to the minimum wage. It readily follows from equation (10) that

\[
\frac{\partial a(D)}{\partial w} = \frac{2[F(\eta^b(a(D),D)) - F(\eta^s(a(D),D))] - 2[F(2w - a(D) - T - P) - F(a(D) - T - P) - 2F(a(D) - T - P)]}{F(\eta^b(a(D),D)) - 2F(\eta^s(a(D),D)) - [F(2w - a(D)) - 2F(w - a(D) - T - P)] - 2}
\]

(13)

Observe that denominator is negative. Thus if the numerator is negative more workers receive training. On the one hand, an increase in the minimum wage decreases, ceteris-paribus, firm’s second-period expected profits from the marginal worker when he or she receives training and is paid the minimum wage. This occurs with probability \( F(\eta^b(a(D),D)) - F(\eta^s(a(D),D)) \). On the other hand, an increase in the minimum wage also decreases, ceteris-paribus, firm’s second-period expected profits from this marginal worker when he or she does not receive training and is paid the minimum wage. This occurs with probability \( F(2w - a(D)) - F(w - a(D) - T - Pu) \). Because with and without training, firm’s profits decrease by the same amount as the minimum wage rises when the worker is paid the minimum wage, the numerator is negative when the marginal worker is paid the minimum wage more often when he or she does not receive training than when he or she receives training. Thus, if by providing training firms have to pay the minimum wage less often, a marginal increase in the minimum wage increases the number of workers who receive training and vice-versa.

Because \( \eta^b(a(D),D) - \eta^s(a(D),D) \) is independent of the worker’s total skill level defined as \( A^D_u \equiv a_u + h(s^D_u) + g^D_u \) and \( F(\cdot) \) is non-decreasing, one can find sufficient conditions under which the numerator in equation (13) is negative. In fact, it is easy to show that if \( F(\cdot) \) is convex, this holds since \( \eta^b(a(D),D) < 2w - a(D) \) and \( \eta^s(a(D),D) < w - a(D) - T - P \), while the opposite
occurs if $F(\cdot)$ is strictly concave. For all other cases, the effect is ambiguous and depends on the magnitude of the corresponding cutoffs. For instance when $\eta$ is normally distributed this depends on whether the cutoffs are in the concave or convex part of the cumulative distribution function.

This leads to the following result.

**Proposition 6** (i) For skilled workers, the investment decision as well as the intensity of general and specific training are independent of the minimum wage; and (ii) for unskilled workers, the intensity of general and specific training is independent of the minimum wage, and more workers receive training as the minimum wage rises if $F(\cdot)$ is convex, less workers receive training if $F(\cdot)$ is strictly concave, and the effect is ambiguous otherwise.

In general terms this proposition shows that a marginal increase in the minimum wage may result in either more or less workers receiving training. This prediction is different from Becker’s human capital theory and Acemoglu and Pischke’s wage compression theories. The former predicts that a marginal increase in the 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 the latter predicts the opposite. That is, in the presence of a minimum wage firms are induced to provide general training to more workers. The reason 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.

In fact, it is easy to see that these two theories are a special case of the one provided here. First consider Becker’s theory. Then, lets assume that $F(\eta^b(a(D),D))$ is zero for all minimum wages; that is, the probability that the surplus-sharing outcome occurs is zero. Then the inequality in equation (??) can be written as follows

$$F(\eta^s(a(D),D)) < F(w - a(D)),$$

which never holds since $\eta^s(a(D),D) < 2w - a(D)$ and $F(\cdot)$ increasing. Thus, as predicted by Becker’s human capital theory less workers get trained as the minimum wage rises.

Next, consider Acemoglu and Pischke’s theories. Then, let assume that $F(\eta^b(a(D),D))$ is constant for all skill levels and minimum wages. In this case the inequality in equation (??) can be written as follows

$$F\left(\eta^b(a(D),D)\right) < F\left(2w - a(D)\right),$$

which holds true always since $\eta^s(a(D),D) < 2w - a(D)$ and $F(\cdot)$ increasing. Thus, as predicted

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14Observe also that all concave functions are log-concave.
by Acemoglu and Pischke’s theory more workers get trained as the minimum wage rises.

The results here show that the simplifying assumptions made by the authors in each case are not innocuous. It seems more natural to assume that the probability of separation and the probability that the surplus-sharing outcome occurs depend on the minimum wage and the worker skill level as done here. Thus, the model here has the added advantage of encompassing the two most commons rationales provided to explain the link between minimum wages and firm-provided training.

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. Recent evidence has cast serious doubt on the validity of this 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 cumulative distribution function is assumed to convex.
The model here also suggests that it is indispensable to control for workers’ skills, type of training 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, 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. 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.

4.2 The Effect of Unemployment Benefits on Training.

In this section I study the effect of an increase in unemployment benefits on training incidence and training intensity in each type of training when the other policies remain constant. Because only unskilled worker are paid unemployment benefits when \( \mu + P_u > w \), here I focus on workers for whom this verifies. For all the rest, unemployment benefits have no effect on training.

The first to notice is that training intensity is independent of the minimum wage level. Thus, a marginal increase in the minimum wage has no effect on how much time is spent on being trained in general versus specific training, but it does have an impact on the decision of whether to provide training or not. In order to study the effect of a marginal increase in unemployment benefits on the training incidence, I need to partially differentiate \( a(D) \) with respect to \( \mu \). It readily follows from equation (10) that this is as follows:

\[
\frac{\partial a(D)}{\partial \mu} = \frac{2[F(\eta^s(a(D),D)) - F(\eta^s(a(D),D))] - 2[F(2w-a(D)) - F(2w-a(D)-T-P)]}{F(\eta^s(a(D),D)) - 2F(2w-a(D)) - 2F(2w-a(D)-T-P)}
\]

When unemployment benefits are large enough so that in order to retain the worker he or she must be paid at least \( \mu + P_u \), a marginal increase in unemployment benefits results in the same two counter weighting forces that arise in the case of a marginal increase in the minimum wage. The intuition is exactly the same as that given in the case of a minimum wage. Thus, the next result readily follows from equation (14) and the discussion in the minimum wage section.

**Proposition 7** (i) For skilled workers, the investment decision as well as the intensity of general and specific training are independent of unemployment benefits; and (ii) for unskilled workers, the intensity of general and specific training is independent of unemployment benefits, and more workers receive training as unemployment benefits rise if \( F(\cdot) \) is convex, less workers receive training if \( F(\cdot) \) is strictly concave, and the effect is ambiguous otherwise.

However, there is no evidence
4.3 The Effect of Firing Costs on Training.

In this section I study the effect of an increase in firing costs on training incidence and training intensity in each type of training when the other policies remain constant. Because firms must pay firing costs to both unskilled and skilled workers when they leave the firm, here I focus on both types of workers. In contrast to the last two cases, a marginal increase in firing costs have an impact on training intensity in each type of training, and thus in this section first I study the impact of that in the training incidence and then on training intensity.

It readily follows from equation (10) that the cross-partial differentiation of $a(D)$ with respect to $T$ for unskilled worker is as follows:

$$\frac{\partial a(D)}{\partial T} = \frac{2[F(\eta_s (a(D), D)) - F(w - a(D) - T - P)]}{F(\eta_s (a(D), D)) - 2[F(2w - a(D)) - 2F(w - a(D) - T - P)]} > 0,$$

and that for skilled workers is

$$\frac{\partial a (D)}{\partial T} = \frac{2 [F (\eta_s (a (D), D)) - F (w - a (D) - T - P)]}{F (2w - a (D)) - F (\eta_b (a (D), D)) - 2} > 0.$$

The effect of firing costs on training incidence is straightforward. A marginal increase in firing costs decrease the firm’s outside option and thus it decreases the firm’s expected-second period profits. This fall in profits when the worker receives training relative to that when the worker does not receive training depends on the probability of separation. Because trained workers receive specific training, they are less likely to separate from the first-period employer and thus the firm is less likely to pay firing costs to a trained worker than to an untrained worker. Thus a marginal increase in firing costs reduces firm’s profits more when the worker does not receive training. This leads the following result.

**Proposition 8** As firing costs rise, skilled and unskilled workers are more likely to receive training.

Next I study how the intensity of training varies with firing cost. This depends on how the firm’s marginal return to specific training changes with firing costs. For unskilled workers, this is independent of firing cost since since specific training is determined by the following condition: $h'(s^U_a) = 1$. In contrast, for skilled workers is given by cross-partial derivative of equation (9) with respect to $T$; that is,

$$\frac{\partial U_f (s^D_a, s^U_a, D)}{\partial s a_D} = f (\eta^s (a_s, D)) h'(s^D_a) > 0,$$

A marginal increase in firing costs decreases the probability of separation since the firm’s outside option falls and the worker’s outside option remains constant. Because an increase in firing costs
does not affect the probability that the surplus-sharing outcome occurs, this implies that the firm is more likely to get the full return to specific training and no return to general training since in the states in which the worker is now retained he is paid his productivity outside of the firm which rises with general training by the same amount as the productivity inside the firm. This leads the following result.

**Proposition 9** For skilled workers, the investment in specific training rises and that in general training falls as firing costs increase, while for unskilled workers the specific-training intensity (and thus general-training intensity) is independent of firing costs.

With regard to employment protection policies the only studies that empirically study the link between these and training that I am aware-off are Pierre and Scarpetta (2004) and Bishop (1991). Mainly, the former find that in countries where employment protection is relatively more strict, 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, while the latter reports that the likelihood and amount of formal training are higher at firms where firing a worker is more difficult. Both findings consistent with the model’s predictions.

I will finish this section by comparing the predictions here with those arising from this model but under the assumption implicitly made by Becker and explicitly made Acemoglu and Piske. Under the assumption that the surplus-sharing outcome never occurs, which is Becker’s assumption, the model’s predictions are the same as the one without this assumption. While under the Acemoglu and Piske’s assumption that the probability of separation is constant, the model here predicts that firing costs have no effect on training incidence. Thus, again this simplifying assumption is not without harm.

The results here show that the simplifying assumptions made by the authors in each case are not innocuous. It seems more natural to assume that the probability of separation and the probability that the surplus-sharing outcome occurs depend on the minimum wage and the worker skill level as done here. Thus, the model here has the added advantage of encompassing the two most commons rationales provided to explain the link between minimum wages and firm-provided training.

### 4.4 The Effect of Severance Pay on Training

In this section I study the effect of an increase in severance pay on training incidence and training intensity in each type of training when the other policies remain constant. Because firms must pay

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15 They draw from harmonized surveys of 17,000 firms around the world and compare employers’ responses with actual labor legislation.
firing costs to both unskilled and skilled workers when they leave the firm, here I focus on both types of workers. Because a marginal increase in severance pay changes training intensity, first I study the impact of that in training incidence and then on training intensity.

For unskilled workers for whom \( w > \mu + P \), it readily follows from equation (10) that the marginal change in \( a(D) \) due to a marginal increase in severance payments is given by:

\[
\frac{\partial a(D)}{\partial P} = \frac{2\left[F\left(\eta^b(a(D),D)\right) - F\left(w-a(D)-T-P\right)\right]}{F\left(\eta^b(a(D),D)\right) - 2F\left(w-a(D)-T-P\right)} > 0 \tag{18}
\]

for unskilled workers for whom \( w \leq \mu + P \), this is given by:

\[
\frac{\partial a(D)}{\partial P} = \frac{2\left[F\left(\eta^b(a(D),D)\right) - F\left(w-a(D)\right)\right]}{F\left(\eta^b(a(D),D)\right) - 2F\left(w-a(D)-T-P\right)} > 0, \tag{19}
\]

and for skilled workers the marginal change in \( a(D) \) with respect to \( P \) is as follows

\[
\frac{\partial a(D)}{\partial P} = \frac{2\left[F\left(\eta^b(a(D),D)\right) - F\left(w-a(D)\right)\right]}{F\left(2w-a(D)-F\left(\eta^b(a(D),D)\right)\right)} > 0 \tag{20}
\]

The effect of severance payments on training is less straightforward than the effect of firing costs. For unskilled workers who are paid the minimum wage with positive probability, severance payments behave as if they were firing costs. The reason is that their wage when retained is independent of severance pay and greater than the worker’s outside option since the wage cannot be adjusted to the severance pay.\(^{16}\) This implies that \( P \) does not affect firm’s profits when the worker’s outside option binds. In contrast for skilled workers and unskilled workers who must be paid \( \mu + P \) in order to be retained, the effect is different from that of firing costs. A marginal increase in firing costs decrease the firm’s outside option and increases the worker’s outside option and therefore it decreases firm’s expected-second period profits. Because firm’s profits fall by the same amount with an increase in severance pay when the outside option binds as well as when the match is severed, the final effect depends on the probability that either of these two events occur, which is given by \( F \left(\eta^b(a_s,D)\right) \). Because the probability that the surplus-sharing outcome occurs (that is, \( 1 - F \left(\eta^b(a_s,D)\right) \)) is greater for a trained worker since he or she receives general training, a marginal increase in severance pay decreases firm’s profits more when the worker does not receive training. This leads to the following result.

**Proposition 10** As severance pay rises, skilled and unskilled workers are more likely to receive training.

Next I study how the intensity of training varies with firing cost. For unskilled, a marginal

\(^{16}\)This is in line with Cahuc and Zylberberg (1999) who argue that in the presence of minimum wages, inside wages
increase in severance pay does not affect the intensity of specific training for the same reasons given
in the case of firing costs. For skilled workers this depends on how the firm’s marginal return to
specific training changes with severance pay, which is given by the following cross-partial derivative
of equation (9) with respect to $P$:

$$\frac{\partial U_f(r^D_{s, D})}{\partial s \partial P} = \frac{1}{2} \left( h'(s^D_s) + 1 \right) f(\eta^0(a_s, D)) > 0. \quad (21)$$

In contrast to a marginal increase in firing costs, a marginal increase in severance pay does not
change the probability of separation since a severance pay is a transfer within the match, but it
decreases the probability that the surplus-sharing outcome occurs. This implies that the worker’s
outside option is more likely to bind and therefore the firm is more likely to get the full return to
specific training and no return to general training since in the states in which the worker is now
paid his outside option he used to be paid a share of the return to training. This leads the following
result.

**Proposition 11** *For skilled workers, the investment in specific training rises and that in general
training falls as severance pay increase, while for unskilled workers the specific-training intensity is
independent of severance payments.*

Once again, I will finish this section by comparing the predictions here with those arising from
this model but under the assumption implicitly made by Becker and explicitly made Acemoglu and
Piske. Under the assumption that the surplus-sharing outcome never occurs, the model’s predictions
for for unskilled workers for whom $w \leq \mu + P$ and skilled workers are that severance payments have
no effect on training, while for for unskilled workers for whom $w > \mu + P$, the prediction is unchanged.
While under the Acemoglu and Piscke’s assumption that the probability of separation is constant,
the model’s predictions for unskilled workers for whom $w \leq \mu + P$ and skilled workers is unchanged.
while for for unskilled workers for whom $w > \mu + P$, the model predicts no effect. Thus, for both
models the simplyfing assumption made are not without loss of generality.

5 Turnover, Wage Inequality and LMP

There are important differences in LMP and labor market outcomes between continental Euro-
pean 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 has been widely criticized because
they have led to poor labor market outcomes, while the flexibility of the U.S. labor market and to
cannot be adjusted to the severance pay.
some extent that in the U.K. has resulted in better labor market outcomes. In this section, I discuss
an alternative way of thinking about the Europe-US differences in the labor market that is linked
to the nature of firms’ incentives to train workers. The bottom line is 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 wage inequality at a lower level and reduce turnover.

First I turn to the question of how LMP affect wage inequality. The evidence show that wage in-
equality 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).17 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 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
that much of the rise in overall and residual inequality over the last two decades may be attributed

17This is perhaps also due to an increase international trade (Acemoglu, 2002a).
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.

In order to study the effect of LMP on wage inequality, I will focus on the difference between the average wage of skilled workers and that for unskilled workers. For this exercise it is useful to think of the unskilled workers as those with a high-school diploma, and the skilled workers as those with a college degree, so the terms skill and education can be used interchangeably. In practice, however, education and skills are imperfectly correlated, so it is useful to have in mind that since there are skilled and unskilled workers within the same education group, an increase in the returns skills will also lead to an increase in within-group wage inequality.

Note that the average wage for unskilled workers is given by:

\[ w(\tau^D u | a_u, D) \equiv 1 - F(\eta^b(a, D)) \frac{1}{2(1-F(\eta^b(a, D)))} (a + h(s^D_u) + 1 - s^D_u - \max\{w, \mu + P\}) + \frac{1}{2(1-F(\eta^s(a, D)))} \int_{\eta^b(a, D)}^{\eta^b(a, D)} (\eta - \max\{w, \mu + P\}) dF + \max\{w, \mu + P\} \]

while that for skilled workers is given by:

\[ w(\tau^D s | a_s, D) \equiv \int_{\eta^b(a, D)}^{\eta^b(a, D)} \frac{1}{2} (a + h(s^D_s) + 1 - s^D_s + \eta) dF + \int_{\eta^b(a, D)}^{\eta^b(a, D)} (a_s + 1 - s^D_s + P_s) dF \quad (22) \]

Then I can define the wage inequality or skill premium—the wage of skilled workers divided by the wage of unskilled workers— as

\[ \Delta w(D) \equiv \frac{w(\tau^D s | a_s, D)}{w(\tau^D u | a_u, D)} \quad (23) \]

The next result studies how \( \Delta w(D) \) change with the different policies.

**Proposition 12** (i) Suppose that \( w \leq \mu + P \). Then wage inequality falls with unemployment.
benefits, is independent of the minimum wage, rises with firing costs and may either rise or fall with severance pay; and (ii) suppose that \( w > \mu + P \). Then wage inequality falls with the minimum wage, is independent of unemployment benefits, and rises as the strictness of EPL increases.

**Proof:**

First note that for skilled workers the wage is independent of the minimum wage and unemployment benefits and for unskilled workers, the marginal change in the wage with respect to the minimum wage when \( w > \mu + P \) is given by:

\[
\frac{\partial w (\tau_u^D | a_u, D)}{\partial w} = \frac{F (\eta^b(a, D)) - F (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))} + \frac{f (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))^{\frac{3}{2}}} \left[ \int_{\eta^h(a,D)} (a + h (s_u^D) + 1 - s_u^D + \eta - 2 \max \{w, \mu + P\}) dF \right] (24)
\]

and that with respect to the unemployment benefits when \( w \leq \mu + P \) is given by:

\[
\frac{\partial w (\tau_u^D | a_u, D)}{\partial \mu} = \frac{F (\eta^b(a, D)) - F (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))} + \frac{f (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))^{\frac{3}{2}}} \left[ \int_{\eta^h(a,D)} (a + h (s_u^D) + 1 - s_u^D + \eta - 2 \max \{w, \mu + P\}) dF \right] (26)
\]

Next consider the effect of EPL on wage inequality. For unskilled workers

\[
\frac{\partial w (\tau_u^D | a_u, D)}{\partial T} = -\frac{f (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))^{\frac{3}{2}}} \left[ \int_{\eta^h(a,D)} (a + h (s_u^D) + 1 - s_u^D + \eta - 2 \max \{w, \mu + P\}) dF \right] (28)
\]

and

\[
\frac{\partial w (\tau_u^D | a_u, D)}{\partial P} = \frac{F (\eta^b(a, D)) - F (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))} \frac{\partial \max \{w, \mu + P\}}{\partial P} + \frac{f (\eta^s(a, D))}{2 (1 - F (\eta^s(a, D)))^{\frac{3}{2}}} \left[ \int_{\eta^h(a,D)} (a + h (s_u^D) + 1 - s_u^D + \eta - 2 \max \{w, \mu + P\}) dF \right] * \left( \frac{\partial \max \{w, \mu + P\}}{\partial P} - 1 \right) (29)
\]

Thus, unskilled workers’ wage rises as EPL becomes stricter.

Now consider the wage of skilled workers. Then

\[
\frac{\partial w (\tau_s^D | a_s, D)}{\partial T} \equiv \frac{1}{2} \left( h' (s_s^D) - 1 \right) \frac{\partial s_s^D}{\partial T} \int_{\eta^h(a,D)} dF - h' (s_s^D) \frac{\partial s_s^D}{\partial T} \int_{\eta^h(a,D)}^{\eta^b(a,D)} dF (31)
\]
and
\[
\frac{\partial w (\tau^D_s | a_s, D)}{\partial P} = \frac{1}{2} \left( h' \left( s^D_s \right) - 1 \right) \frac{\partial s^D_s}{\partial P} \int_{\eta^P(a_s, D)} dF - h' \left( s^D_s \right) \frac{\partial s^D_s}{\partial P} \int_{\eta^P(a_s, D)} dF + \int_{\eta^P(a_s, D)} dF. \tag{32}
\]

The positive effect is due to that \( \frac{\partial s^P_s}{\partial T} < 0 \) and \( \frac{\partial s^P_s}{\partial P} < 0 \) and \( h' \left( s^D_s \right) - 1 < 0 \).\)

This proposition shows that the general model of firm-provided human capital proposed here provides a rationale for the evidence showing that a higher minimum wage and unemployment benefit reduces wage inequality between skilled and unskilled workers. It might also explain the evidence of the effect of unionization on wage inequality if we 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.\(^{18}\)

While the results concerning minimum wages and unemployment benefits at first glance seem obvious there are not. The reason is that minimum wages and unemployment benefits not only affect the wage in certain states, but also how many workers are employed and how many receive training. If as the minimum wage or unemployment benefits or both rise, more workers get trained and these workers are more skillful. Thus, increases in these policies not only affect wages directly but also the composition of workers who keep a job in the second period.

However, I am not the first to provide a plausible model that explains the evidence relating wage inequality and EPL. 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 I have shown already is a highly simplified abstraction of the role of LMP since they also affect the duration of a match.

Now I turn to the question of how EPL affect wage inequality. The effect EPL on labor outcomes is an unsettled issue. Some economists adhere to the view that LMP impair economic performance, while others maintain that they can improve workers’ welfare without harming economic efficiency.\(^{19}\)

The empirical evidence has not helped to settle the debate. A large body of literature assessing the impact of EPL on labor market outcomes, mostly based on the analysis of data for industrial countries, has lead to ambiguous results. While some studies find that employment protection regulations have important effects on employment adjustment, worker turnover, employment, or unemployment, others find no evidence of such effects. Recent evidence however finds that more stringent EPL impaired turnover. For instance, [?] find that more stringent legislation slows down

\(^{18}\)(see, Acemoglu and Piscke (for a similar interpretation of wage floors).

\(^{19}\)See for example, Freeman (2005) for a description of the state of this debate.
job turnover, and that this effect is more pronounced in sectors that are intrinsically more volatile. Moreover, employment and value added in the most affected sectors decline. \[?\] find that EPL slows the creative-destruction process, especially in countries where regulations are likely to be enforced. They report that moving from the 20th to the 80th percentile in job security, in countries with strong rule of law, cuts the annual speed of adjustment to shocks by a third while shaving off about one percent from annual productivity growth. The same movement has negligible effects in countries with weak rule of law.²⁰

For any given worker, I will define the probability of turnover as the probability that the match is severed regardless of whether the worker goes to the unemployment pool or finds a new job. For skilled workers, this is the probability that they change employer and for unskilled workers is the probability that they become unemployed. Thus the turnover rate for a worker with a skill level \(a\) is given by:

\[ T(a, D) \equiv F(\eta^s(a, D)) \]  

Let \(d \in D\). Then, it is straightforward to show that

\[
\frac{\partial T(a_s, D)}{\partial d} \equiv f(\eta^s(a_s, D)) \left[ \frac{\partial \eta^s(a_s, D)}{\partial d} + \frac{\partial \eta^s(a_s, D)}{\partial s^D_s} \frac{\partial s^D_s}{\partial d} \right],
\]

and

\[
\frac{\partial T(a_u, D)}{\partial d} = f(\eta^s(a_u, D)) \left[ \frac{\partial \eta^s(a_u, D)}{\partial d} + \frac{\partial \eta^s(a_u, D)}{\partial s^D_u} \frac{\partial s^D_u}{\partial d} \right].
\]

In what follows I will refer to firing costs plus severance pay as EPL. There are two ways in which EPL can affect turnover: by mean of a change in specific training intensity and by mean of a change in training incidence. For unskilled workers intensity is independent of EPL, while as shown in propositions (8) and (10) respectively, more workers get trained as firing costs and severance pay raises. Because trained workers receive specific training, they are more likely to remain with the first-period employer in the second-period than untrained workers. Thus, for unskilled workers EPL impaired turnover.

For skilled workers both the intensity of specific training as well as the incidence of training are affected. In particular, as EPL becomes stricter, ceteris-paribus, the separation threshold falls and as shown in propositions (9) and (11), specific-training intensity rises. These two effects go in the same direction, which is to decrease the probability of separation and thus turnover. With regard to training incidence, propositions (8) and (10) respectively show that more skilled workers get trained as firing costs and severance pay raises. Because trained workers receive specific training, they

²⁰See, also Ljungqvist and Sargent (2007).
are less likely to separate than an untrained workers. Thus, for skilled workers EPL also impaired turnover.

For unskilled workers things are bit different since not only firing costs but also severance payments may affect the firing threshold and the effect of EPL on the sum of general and specific training matters. Because the sum of general and specific training rises as the EPL becomes more stringent and, ceteris-paribus, a match is less likely to be severed as EPL is tougher, an increase in EPL reduces turnover for unskilled workers. This leads to the following result.

Proposition 13 For skilled and unskilled workers, their turnover rate falls as EPL becomes stricter.

This result show that a stricter EPL leads to less turnover not only because it makes firms' outside option worse but also because it induces firms to invest more in specific training and to train more workers. This however does not mean that a stricter EPL is welfare enhancing. In fact, one can show that tougher EPL decrease job creation in the presence of minimum wages and unemployment benefits. To see this notice that as firing costs or severance pay rise, the first-period wage \( w^D_1 = a + U_f (\tau^D | a, D) \) falls. This implies that for any given minimum wage and unemployment benefit, an increase in firing costs or severance pay decrease the probability that any given worker finds or accepts a job. Thus, stricter EPL in the presence of minimum wages and unemployment benefits contributes to have unemployment. In short, stricter EPL makes a relationship more robust to shocks and therefore it decreases the inflows into unemployment, but at the same time it decreases the probability to find an employment of untrained workers in the short and the long-run. This together with the fact that European countries have had generous unemployment benefits with long durations, while they were stingy with short duration in the US, and EPL is stronger in Europe than in the US help us to explain the fact that turnover is lower in Europe than in the US but unemployment is higher.\(^{22}\)

6 Conclusions

In this paper I have studied the effect that LMP may have on firms' incentives to provide training and on the composition of training; that is, how much is general and how much is specific training. I have in the presence of LMP, for unskilled workers firms overinvest in general training and under-

\(^{21}\)For workers who are paid the minimum wage, severance payments behave as if they were firing costs. The reason is that the worker is paid the minimum wage in those states close to the separation threshold and thus severance payments cannot be considered a transfer within the relationship at the time the match is severed.

\(^{22}\)If we add to this that the minimum wage has been declining in the US, but has remained relatively constant across Europe during the last two decades, then we have a better reason to have longer unemployment durations in Europe.
invest in specific training, while for skilled worker the opposite occurs. In addition, EPL rises the number of workers who receive training while minimum wages and unemployment assistance benefits could either rise or fall that. I have also shown that the predictions concerning LMP and training from Becker’s human capital model and Acemoglu and Pischke’s wage compression models are special cases of the more general model proposed here.

This results are applied to study wage inequality and labor turnover. I show that they contribute to our understanding about the costs and benefits of the recent trend of several European countries toward adopting US-type labor market policies, in particular, those that increase flexibility at the margin. The paper suggests that this trend might result in an increase in wage inequality and turnover and probably in less firm-provided training.
References


