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## Market Conditions and Worker Training: How Does it Affect and Whom?

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# Market Conditions and Worker Training: How Does it Affect and Whom?

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# Market Conditions and Worker Training: How does it Affect and Whom?

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## Abstract

This paper analyses the impact of labor market conditions on a firm's incentive to train its workers. In an equilibrium model of the labor market in which firms use both untrained and in-house-trained workers, we show that the incidence of training increases with the tightness of the labor market. In a multi-sector framework, the usual threat of hold-up by a trained worker is more severe for workers who change their sector of work; during downturns, this serves to bias firms' incentives in imparting training away from such workers and towards workers already in the firm and those new workers coming from the same sector. Evidence from the NLSY confirms both predictions — the incidence and duration of company-sponsored training is adversely affected by higher unemployment rates; furthermore, this negative effect is much stronger for workers who change industries as compared to those who do not.

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# 1 Introduction

Firms can enhance the productivity of their workforce through training. As has been long recognized, firms face the problem that on completion of training, the worker may threaten to leave the firm for opportunities in the outside market. This fear of getting “held up” ex-post limits the ex-ante incentives of firms in imparting training. The degree to which a trained worker can hold up the firm will of course depend both on the ease with which the firm can replace the worker as well as on the value of the trained worker to other firms. Thus the training decisions of all other firms in the market play an important role in this hold-up problem and makes the decisions of different firms interdependent. In this paper, we build an equilibrium model that focuses on the interactions between different firms in a set up where each firm faces the problem of getting held up by its in-house trained workers. We use this model to ask what factors affect the intensity of worker training, and how these effects differ across workers. In exploring this question both theoretically as well as empirically (using data from the National Longitudinal Survey of Youth (NLSY)), the paper takes a first step towards studying the effect of market conditions on investments by firms in human capital, an issue which has seen relatively little systematic analysis.

In our model, training allows a firm to use fewer untrained workers. When outside opportunities are low, it reduces the extent to which a worker can credibly hold up the firm on completion of training. But at the same time, there is a countervailing effect on the ex-ante training incentives for the firm: in such situations, the benefit from training is also lower, since a trained worker can be replaced at lower cost by a suitable number of untrained workers from the competitive market. In equilibrium, the latter of the above two effects is shown to dominate, so that overall the level of training turns out to be *positively* related to the degree of tightness of the labor market.

In the basic model, all workers are assumed to be ex-ante identical. In a multisector framework however, a worker may decide to change her sector of work either due to a permanent adverse shock to her productivity in that sector or temporarily due to her inability at finding a suitable job in the sector. For a firm facing a worker coming from a different sector, the threat of hold-up differs depending on whether or not the worker has quit her previous sector permanently. If the worker is a “passing bird” (i.e. has made a temporary move), the possibility of returning to

her original sector makes her ability to hold-up the firm greater. In downturns the workers who change sectors are more likely to be “passing birds” rather than permanent shifters; thus in the absence of perfect information about the reason for change, at such times firms would prefer to train continuing workers rather than the sector-changers.

Both implications of the model are tested using data from the NLSY. Using the unemployment rate in the labor market of the respondent’s current residence as a proxy for her outside opportunities, we find that both the incidence and the duration of training are lower when the unemployment rate is high. While this effect of outside opportunities on training is found to be negligible for workers who have been with the firm for some time, it is much stronger for new hires. Even among new workers, the effect is significant only for those with no prior experience of working in the same sector; for older workers and for those new workers who have worked in the same sector before, the adverse effect of the local unemployment rate on the probability (and duration) of receiving company-sponsored training is much less. Thus the evidence supports a compositional bias on the part of firms against training “passing birds” during downturns. Of course, there may be other possible explanations for the procyclical nature of worker-training and we attempt to deal with several of them in our estimation.

Ever since being raised by Becker (1964), the issue of worker-training has been widely studied. From a theoretical perspective, Acemoglu and Pischke (1999) provide a general condition on the structure of the labor market that needs to hold in order for firms to sponsor their workers’ training. Other recent contributions include papers by Chang and Wang (1996), Acemoglu (1997), Acemoglu and Pischke (1998). Most of these papers explore the effects of institutional structure on determining the division of surplus (from training) between the worker and the firm, and consequent effects on the incentives of either party to invest in costly training. Their focus is thus on differences in training caused by institutional differences. Our model instead takes the institutional structure as given, and focuses on the effect of the market in determining the surplus itself. The symmetric equilibrium in our model is unique, which makes it possible to identify conditions that may lead to differences in the levels of training even within a given institutional structure. The empirical literature on training has tended to largely focus on the effect of worker and firm characteristics on the incidence of training and on the effects of training on observed outcomes such as wages and

productivity (e.g., Barron, Black and Lowenstein (1987), Lynch (1992), Black and Lynch (1996), to cite a few). However the question of whether a more or less tight labor market tends to favor worker-training, as we do in this paper, has been little explored.

The rest of the paper is organized as follows. Section 2 presents the basic model, derives the solution to the bargaining game between a worker and her parent firm and characterizes the market equilibrium. Section 3 extends the basic model by incorporating it in a multi-sector framework. Section 4 presents evidence for predictions of the model using data from the NLSY, while section 5 concludes.

## 2 The Basic Model

In this section we outline a simple model of worker-training. Before analyzing the formal model, it maybe useful to consider intuitively the basic argument the theoretical model is intended to capture. Training increases the productivity of a worker (relative to that of untrained workers), and if this increase is greater than the expenses for training, it results in a surplus. In a tighter labor market, the cost of an unit of labor is higher. Therefore in such a situation, the marginal value from an increase in the efficiency units of a worker is also greater, and hence the value of total surplus from training is more. Thus, from an efficiency viewpoint, the incentives for training in a tighter labor market environment should be higher.

Since training involves the creation of human capital which is firstly, embodied in the worker and secondly, may be of use elsewhere, it imparts to the worker some bargaining power over split of the surplus from training. In making decisions about whether or not to sponsor costly training for workers, a firm's calculus involves only its share of the total surplus. Thus an additional issue of consideration is the split of this surplus from training between the worker and the firm. In a tighter labor market, outside opportunities for trained workers are higher and their bargaining position is stronger. However, unless this increase in outside opportunities is enough to overshadow the increase in joint surplus from training, a tighter labor market would see more firm-sponsored training. This intuitive idea is formalized in Corollary 1 of the basic model given below.

Consider an economy with a measure  $N$  of potential workers<sup>1</sup> and  $F$  firms. All the firms are identical and have access to a production technology  $f(e)$  in which the only input is labor;  $e$  is the total effective units of labor used in production. Untrained workers can inherently provide 1 unit of labor which they supply inelastically; however, a worker's productivity can be enhanced through training. The focus of our study here is on company-sponsored training i.e. training which either due to technological or cost reasons is imparted only by firms.

Training, however, need not be completely firm-specific; it could raise the productivity of the worker in other firms as well. A worker who successfully completes training can supply  $\phi$  units of labor to her parent firm i.e. the firm where she was trained, or  $\delta\phi$  units in any other firm.<sup>2</sup>

**Assumption 1:**  $\phi > \phi\delta > 1$ .

This assumption implies that training is productivity-enhancing both in the parent firm as well as outside it.  $1 - \delta$  represents the firm-specific component and  $\delta$  the general content of the training program.  $\delta$  is assumed to be less than one, so that training is not completely general. Although we have taken  $\delta$  here as a technological parameter of the training program, it can also be treated as representing an underlying institutional feature. As Acemoglu and Pischke (1999) show, such a gap between the value of training inside and outside the firm (which may occur due to asymmetric information between the parent firm and any other firm, unionism, minimum wages etc.) is required to generate any positive incentive for firms to impart costly training to their workers.

Training is costly: the cost of training  $m$  workers is given by  $c(m)$ . In the present section, let us assume that training does not detract from production. Thus, here the only cost of training is  $c(m)$ , which is incurred by the firm prior to production. Later we extend the model to include the possibility that the worker is off-line during training; so, in addition to  $c(m)$ , foregone production must also be included in the training costs. As we show below, the results are quite similar in the extended model where a part of the cost is in the form of lost production.

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<sup>1</sup>We assume that the workers form a continuum mainly for expositional simplicity; throughout the analysis, we shall use the phrase "number of workers" to refer to the corresponding measure of workers.

<sup>2</sup>For simplicity, we have assumed here that there is only a single level of training; for concreteness one can think of it as a training course. The model however can be relatively easily extended to incorporate the level of training (or time spent in training) as a decision variable too.

We make the following assumptions on the production function and the costs of training.

**Assumption 2:**  $f(\cdot)$  is differentiable, strictly increasing, concave and satisfies the Inada conditions i.e.  $\lim_{e \rightarrow 0} f'(e) = \infty$  and  $\lim_{e \rightarrow \infty} f'(e) = 0$ .  $c(\cdot)$  is differentiable, strictly increasing, convex,  $c(0) = 0$  and  $\lim_{m \rightarrow \infty} c'(m) = \infty$ .

Furthermore, we assume that the industry faces a perfectly elastic demand curve with the price of the product  $p$  given exogenously. Firms maximize their profits, while workers maximize their incomes. We assume that each firm is small in the sense that it believes that its actions will not have any effect on the market.

For simplicity, we assume that the economy lasts for two periods, and the timing of events is as follows. There is no production in the first period. If the firm wishes to train any worker, it must do so in this period only. A market for trainees opens at the beginning of period 1. Firms can choose to hire trainees from this market paying them a signing-up amount, if necessary. During the course of training, there is an exogenous probability  $s$  of the worker having to quit the firm without completing the training program. It could alternately be interpreted as the chance of the worker failing the course. Those who successfully complete training then bargain with their parent firm over their future employment contract. If this bargaining fails, the trained worker then goes to the outside market, where its services are bid for by all the other firms. In period 2, there is also a market for untrained workers from which the firm can hire additional units of labor at the going rate. Production takes place at the end of period 2. There is no discounting between periods and workers consume only at the end of the second period.

Regarding the costs of training, we assume that workers are credit-constrained and cannot be asked to bear any part of the training expenses. Hence, the cost of training workers, if any, will have to be borne by the firms themselves.<sup>3</sup>

Investment by the firm in human capital, however, is quite different from any physical capital

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<sup>3</sup>Even if the workers are not credit-constrained, there maybe several other reasons why they may not be inclined to bear all the costs of training. One, since there's always a chance of failing the training course, if workers happen to be extremely risk-averse, they may not be willing to pay the entire cost of training. Secondly, the efficacy of training programs may vary and if firms cannot credibly commit to the level and quality of training that it will impart, workers may not be willing to pay up-front these training-costs.



investment in the sense that the enhanced productivity due to training is embodied in the worker, who is mobile. So, unless the worker can be made to commit to remaining with the firm at a prespecified wage after getting trained or can be made to pay a severance-fine on leaving the firm, the firm will be subject to an employee hold-up problem. Forcing a worker to commit to staying with the firm is akin to a clause of bondedness, which may be legally problematic; contracts with severance-fine clauses also have the possibility of tying the labor in involuntary servitude, especially in the presence of liquidity constraints on the part of the worker.

In the absence of such contracts however, once a worker gets trained, the worker and the firm find themselves in a situation of bilateral monopoly: the firm owns the production process while the worker “owns” the enhanced productivity. Hence, as is common in the literature, (e.g., Grout (1984), Acemoglu (1997)), we assume that a trained worker and the firm bargain over the split of their “surplus” at the beginning of period 2. After the firm has bargained with all its trained workers, it can hire more effective units of labor, if necessary, from the market at the going rate. When all its units of labor are in place, production takes place.

The bargaining game here is complicated by the fact that firms have to bargain simultaneously with multiple in-house trained workers. Furthermore, given the concave production function  $f(e)$ , each (trained) worker’s marginal product depends on how many other workers there are in the firm. The above interdependency means that a particular worker’s value depends not only on the outcomes of the firm’s bargaining with other workers preceding him, but also on the expectations about the bargaining to follow. In general, this turns out to be a rather complicated problem (see Stole and Zwiebel (1996) for an elegant analysis of this issue). However, as we shall show below, in the market equilibrium here, each worker’s marginal product can be evaluated independently of how many other workers there are in the firm. Hence, the above complications do not arise in equilibrium, and we can thus assume that in any bargaining between an in-house trained worker and the firm, they split the surplus evenly.<sup>4</sup>

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<sup>4</sup>The results remain unchanged if instead one assumed that the split is according to some exogenously given (for example, by the institutional set-up) bargaining power of the two parties.

## 2.1 Equilibrium

Let us first characterize the decision problem of an individual firm and then use it to derive the equilibrium for the entire economy. All through the subsequent analysis, we shall focus on a symmetric pure-strategy equilibrium.

Following successful bargaining with  $m$  trained workers, each firm decides whether or not to hire any additional units of labor from the market. Denote by  $w_u$ , the market rate for one unit of effective labor in period 2, which the firm takes as given. Then the firm's demand for units of (untrained) labor is given by:

$$\arg \max_{e \geq 0} pf(\phi m + e) - w_u e$$

Define the function  $e(w)$  by  $pf'[e(w)] = w$ ; thus  $e(w_u)$  is the marginal unit of production at a wage of  $w_u$  and denotes the choice of labor by a firm with no trained workers. A firm will hire extra units of labor only if that provided by its in-house trained workers is less than  $e(w_u)$ . Let us denote  $n(w_u) = e(w_u)/\phi$ ; this then is the critical number of trained workers which determines whether or not a firm will hire extra untrained workers from the market in period 2.

Then revenues for the firm, *gross* of payments to its  $m$  trained workers is given by:

$$\begin{aligned} R(m) &= pf(e(w_u)) - w_u[e(w_u) - \phi m] && \text{if } m \leq n(w_u) \\ &= pf(\phi m) && \text{otherwise} \end{aligned}$$

In the case where  $m \leq n(w_u)$ , the revenue function can be written as  $[pf(e(w_u)) - w_u e(w_u)] + m\phi w_u$ . The first part of this expression is the profit for a firm with no trained workers, and the second part is the surplus from having  $m$  trained workers. It thus indicates that the worth of having a trained worker in this case is  $\phi w_u$ . This occurs because if a trained worker were to quit, the firm would find it profitable to replace her with  $\phi$  units of effective labor from the market, at a cost of  $\phi w_u$ . This will be important in the solution of the bargaining game, which we characterize below. In the case of  $m > n(w_u)$ , the marginal product of any worker depends on the number of other workers there are in the firm. This latter case (as explained below) does not arise in equilibrium, and thus much simplifies the overall analysis.

At the beginning of period 1, firms hire potential trainees, paying them a non-negative sign-up

amount  $K$ . During the course of training, the firm will lose a fraction  $s$  of its hires during the first period. The workers who are forced to quit in period 1 join the market of untrained workers in period 2. Since  $s > 0$ , it ensures that there is always a positive supply of untrained workers in the labor market of period 2. If there is no demand for them, then the wage in this market,  $w_u$ , will be zero. However if  $w_u = 0$ , a firm would prefer not to train any worker and would meet all its labor requirements by hiring untrained workers from the market in period 2; this of course contradicts the initial surmise that  $w_u = 0$  and that there is no demand for untrained workers.

Thus in equilibrium, there will always be *positive demand* for untrained workers in period 2. In a symmetric equilibrium, this must be true of all firms. Therefore the equilibrium wage-rate  $w_u$  must be such that firms will not have an incentive to hire more than  $\frac{1}{q}n(w_u)$  trainees in the first period (so that the number of units of labor provided by in-house trained workers in period 2,  $\phi m$ , is less than  $e(w_u)$ , and there is positive market demand for untrained workers), where  $q = 1 - s$  is the probability of a trainee completing training.

Now  $w_u$  is the wage for each effective unit of labor in period 2. Since a trained worker can supply  $\delta\phi$  units of effective labor in any outside firm, her value to firms other than her parent firm is  $\delta\phi w_u$ . If she goes to the outside market, the other firms will bid her wage up to this level, and this then is the outside option for such a trained worker in bargaining with her parent firm. Splitting of the surplus between the firm and the trained worker implies that the wage of a trained worker in her parent firm,  $w_T$ , will be given by:

$$\phi w_u - w_T = w_T - \delta\phi w_u \quad \text{i.e. } w_T = \frac{1}{2}\phi(1 + \delta)w_u$$

Incorporating the firm's share of the surplus into its profit function, the firm's problem of choosing its optimal number of workers to train can now be written as

$$\max_m \frac{qm}{2}\phi(1 - \delta)w_u - [Km + c(m)] \tag{1}$$

and the resulting first-order condition

$$\frac{1}{2}q\phi w_u(1 - \delta) = K + c'(m) \tag{2}$$

gives  $m(w_u, K)$ , the number of workers trained by a firm in the first period. Condition (2) implies that higher is the equilibrium wage  $w_u$  for untrained workers, greater will be the incentive for firms

to train workers. Of course, if most of a firm's demand for effective units of labor is satisfied by its in-house trained workers, then the demand for untrained workers would be low and so would be  $w_u$ . But a lower wage-rate  $w_u$  serves to diminish the firm's incentives in training workers. We thus need to determine the wage-rate  $w_u$  in equilibrium. This is done next.

For  $w_u$  and  $K$  to determine an equilibrium, the following two conditions need to be satisfied:

(i) [Labor market clearing in period 2]:  $F[e(w_u) - \phi qm(w_u, K)] = N - Fqm(w_u, K)$

(ii) [Trainee market clearing in period 1]:

if  $Fm(w_u, 0) < N$ , then  $K = 0$ ; if not, then  $K$  is given by:  $Fm(w_u, K) = N$ .

Condition (i), the period 2 labor market clearing condition, stems from the fact that the total number of untrained workers in period 2, viz.  $N - Fqm(w_u, K)$  must equal the firms' demand for such workers, viz.  $F[e(w_u) - \phi qm(w_u, K)]$ .

Condition (ii) determines the equilibrium in the market for hires in period 1. Since a trained worker always earns at least as much as an untrained worker, all potential workers would want to be hired as trainees (even if  $K = 0$ ) in period 1. Hence if the firms' demand for hires,  $Fm(w_u, K)$  is less than the size of the potential workforce  $N$ , the firm does not need to pay any sign-up amount to attract trainees and in this case  $K = 0$ . If however, the demand for trainees exceeds the size of the potential workforce, this sets up competition among firms for trainees; hence  $K$  will be positive in this case and all workers will receive training. Since this is hardly the case in the data, we will assume that  $N$  is large enough so that not all workers get hired as trainees.

The following proposition summarizes the above discussion and characterizes the unique symmetric equilibrium of the model.

**Proposition 1** *Given any  $n = N/F$ , there exists a unique pure strategy symmetric equilibrium. There exists  $n^*$  such that for  $n \geq n^*$ , the equilibrium comprises of each firm hiring  $m(n)$  trainees with a zero sign-up amount, a wage-rate  $w_u(n)$  for untrained workers and  $\frac{1}{2}\phi w_u(n)(1+\delta)$  for trained workers (in the parent firm), where  $m(n)$  and  $w_u(n)$  are given by:*

$$\begin{aligned} \frac{1}{2}q\phi(1-\delta)pf'[n + (\phi - 1)qm(n)] &= c'[m(n)] \\ w_u(n) &= pf'[n + (\phi - 1)qm(n)] \end{aligned} \tag{3}$$

**Proof.** Incorporating the labor-market clearing condition (i) above and the definition of  $e(w_u(n))$  into the firm's first-order condition for determining the number of trainees, (2), gives (3). The left-hand side of (3) is decreasing in  $m$ , while the right-hand side is increasing in the same. Hence, for every  $n$ , there is a unique value  $m(n)$  that satisfies the above equation. ■

Although in our model the wage  $w_u$  is determined endogenously, to better understand the intuition, let us for a moment consider it as exogenously given. As  $w_u$  rises, a trained worker's replacement value rises, and thus the surplus from training rises; this increases a firm's incentive to impart training. At the same time, it also raises a trained worker's attractiveness to all other firms and the worker's outside option increases. This serves to diminish the firm's training incentives. However, since a gap between the worker's value to the parent firm and to all other firms was required to have any training at all in the first place, a rise in  $w_u$  does not translate into an equal rise in the worker's outside option; hence, the former of the above two effects dominate, and an increase in  $w_u$  implies an increase in the firm's incentives to sponsor training.

Now with  $w_u$  being endogenously determined, an excess supply of untrained workers relative to the number of firms brings down their wage-rate, and consequently diminishes the surplus from training more than the decrease in the workers' outside option. Therefore, any increase in the relative supply of labor,  $N/F$ , will result in a lower fraction of the workforce getting trained.

Any increase in the firm-specific component of training, i.e. a decrease in  $\delta$ , increases incentives for firms to impart training to their workers. Similarly, for a given wage  $w_u$ , an increase in the price  $p$  or a rise in the effectiveness of training i.e. an increase in  $\phi$  or a decrease in the probability  $s$  of failing the training course raises incentives for firms to train their workers. However, a rise in  $\phi$  or a decrease in  $s$  also raises the overall efficiency of the workforce, thereby reducing the marginal product of an untrained worker. Under relatively mild conditions on the production function (satisfied, for example, by the Cobb-Douglas and most other common production functions), we can show that the first effect dominates. Thus, if education raises the effectiveness of training or at least diminishes the chance of failing a training course, this would imply that in an economy with a more educated workforce, firms would tend to train more of their workers and therefore such an economy would exhibit higher labor productivity even if education were not directly productivity-enhancing.

The following corollary summarizes the above discussion.

**Corollary 1** *Suppose the density of workers per firm  $n$ , is greater than  $n^*$ . Then as  $n$  increases, the percentage of the workforce that gets trained decreases. If the production function satisfies the condition  $\frac{d}{dx}[xf'(x)] > 0$ , then the probability of receiving training increases with an increase in the effectiveness of training  $\phi$ , or a decrease in the probability of failure  $s$ .*

**Proof.** The left-hand side of (3) is decreasing in  $m$ . It is also decreasing in  $n$ , while the right-hand side is independent of  $n$ . Thus, as  $n$  increases,  $m(n)$  will decrease, and consequently, the proportion of workers who get trained,  $Fm/N$ , falls.

Under the condition that  $xf'(x)$  is increasing in  $x$ , an increase in  $\phi$  or  $q$  raises the left-hand side of (3), leading to an increase in the number of workers getting trained,  $m(n)$ . ■

In the basic model, there was no production in the first period, and thus the only cost of training was the direct training expenses  $c(m)$ . Next, we explore the consequences of including production in the first period so that training costs include not only the expenses  $c(m)$ , but also the value of foregone production.

Consider a modification of the basic model in which production can occur in the first period as well. At the beginning of the first period, firms hire workers, who can each supply 1 unit of labor in that period. The production function for the first period is the same viz.  $f(e)$ . After workers join the firm, the training potential of some of the workers are realized<sup>5</sup>, and the firm decides whether or not to impart training to the workers with potential. Training is assumed to be off-line in the sense that workers cannot be involved in production at the same time. Thus from a firm's perspective, training now involves not only direct expenses  $c(m)$ , but also the indirect cost of foregone production.

The price in the product market too can vary from period to period, thereby affecting the opportunity cost of training. To capture this, we denote by  $p$  the price of the product in the first period, and by  $p^e$  the expected price in the second period. The rest of the game is as before, with trained workers bargaining with their parent firms at the successful completion of their training.

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<sup>5</sup>This assumption is made to keep the wages of all workers the same in the first period; making workers ex ante heterogeneous in training potential would add complications into the model without much added insight.

The analysis is similar to that in the basic model above, except that the firm's problem for determining its optimal number of trainees is now given by:

$$\max_m pf(n - m) + \frac{qm}{2}\phi(1 - \delta)w_u^e - c(m)$$

where  $w_u^e$  is the expected wage in the second period. The additional element here is that in deciding to train  $m$  workers, the firm's production workforce is reduced by that amount in the first period.<sup>6</sup>

The resulting first-order condition is:

$$\frac{1}{2}q\phi(1 - \delta)w_u^e = pf'(n - m) + c'(m)$$

Incorporating the second-period market-clearing condition (for any given realization of the second-period product price  $\tilde{p}$ )  $w_u = \tilde{p}f'[n + (\phi - 1)qm]$  into the above equation now gives the equilibrium condition as:

$$\frac{1}{2}q\phi(1 - \delta)p^e f'[n + (\phi - 1)qm] = pf'(n - m) + c'(m)$$

Along with the marginal cost of training  $c'(m)$ , the firm here trades-off the marginal productive value of the worker in the first-period,  $pf'(n - m)$ , against the increase in value from having a trained worker in the second-period. How does this affect the overall proportion of the workforce  $t = m/n$  that receives training? Let us re-arrange the above equation as:

$$\frac{1}{2}q\phi(1 - \delta) = \frac{pf'[n(1 - t)]}{p^e f'[n(1 + (\phi - 1)qt)]} + \frac{c'(nt)}{p^e f'[n(1 + (\phi - 1)qt)]}$$

From this equation, it is clear that for a Cobb-Douglas production function of the form  $f(x) = x^\alpha$ , here too the overall proportion of the workforce that gets trained diminishes as  $n$  increases. An increase in  $n$  lowers the marginal product in both the first and second periods; thus there is a decrease in the effective cost of training, but also a fall in the value of training. However, the total effective units of labor is larger in the second period, as part of the workforce is trained now. So, if the elasticity of the marginal product i.e.  $-xf''(x)/f'(x)$ , is (weakly) increasing in  $x$ , the (negative) impact of an increase in  $n$  on the first-period opportunity cost of training is bigger than that on

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<sup>6</sup>The results are very similar if instead we assumed that only a fraction of production is lost during training instead of all production.

the value of training in the second period. Consequently, under this condition (which is satisfied by most common production functions), an increase in  $n$  leads to a lower fraction receiving training.

Thus, even in this modified model, the basic result holds that as the labor market becomes tighter, either due to an increase in the number of firms, or a shrinking labor-force, the overall incidence of training will increase.

In terms of the value of lost production, note that as the first-period product price  $p$  increases (relative to  $p^e$ ), the opportunity cost of training increases, and from the above equation,  $t$  decreases i.e. a lower fraction receive training.

So far, all workers have been assumed to be ex-ante identical. In a multisector framework however, workers may differ in terms of their inherent productivity or experience in the different sectors. Next, we provide the sketch of a model to show how market conditions may affect the decision of firms in selecting whom to train.

### **3 Deciding whom to train: Composition effects**

This section outlines a model incorporating the basic model in a multi-sector framework. It illustrates how the state of the overall market may affect the preferences of firms between training those workers who change sectors and those who do not. Among other factors, the surplus from any training is dependent on the probability of breaking up of the match between the worker and the firm. Matches that have a higher inherent probability of breaking up have lower expected surplus and therefore generate less incentives for training. Thus, as outlined in the model below, workers who are perceived by firms to be more likely “birds of passage” receive less training.

Let us assume that the productivity of a worker in her current sector (which we call the parent sector  $P$ ) is  $v$ . In any period, she may have to seek employment in some other sector  $S$  either due to an inability to find a job in her parent sector or due to suffering an adverse but permanent shock to her productivity in sector  $P$ . For example, her skills may have become obsolete in that sector, forcing her to make a permanent switch. During downturns in a sector, a worker is more likely to seek employment elsewhere due to her inability to find a job, while in good times the likely reason for a change is due to an adverse but permanent shock.



Facing a worker coming from a different sector, in deciding whether or not to impart training to such a worker, it is important from a firm's point of view to know the reason for the worker's change of sector because this has implications for the worker's ability to hold up the firm in the future. If the worker moved due to a permanent shock to her productive ability in her parent sector, her outside opportunity in bargaining with the firm ex-post is determined only by her ability to find a trained-worker job with another firm in sector  $S$ , i.e. it is  $\delta w_u$ . On the other hand, if the worker has shifted temporarily due to her inability in finding a job in her parent sector, her threat of hold-up in the future is given by the maximum of her opportunities in the present sector  $S$  as well as her opportunity of finding a job in her parent sector  $P$ . Let us call those workers who have migrated to a different sector only to avoid the bad times in their parent sector as "passing birds". For such workers, their outside option in bargaining is given by  $\max\{\delta w_u, p(\theta)v\}$  where  $p(\theta)$  is the probability of finding a job in their parent sector when the state of the world is  $\theta$ . Thus the threat of hold-up is greater for "passing birds" than the more permanent shifters and therefore firms would be more averse to training the former.

Now, suppose firms are unable to determine the exact reason for the worker changing her sector of work. In the presence of such asymmetric information, during downturns the firm is more likely to ascribe a worker coming from a different sector as being a "passing bird" rather than one who has shifted due to a permanent productivity shock. Since firms are more averse to imparting training to the "passing birds", this implies that in downturns firms are more likely to take training decisions in favor of workers from the same sector or workers already in the firm rather than workers moving from a different sector.

In the context of our model, incorporating the increased flow of migrants from another sector during downturns would make the labor market less tight and the overall incidence of training is likely to be lower. However, at such times, the bias in training towards continuing workers means that they will be less affected, and depending on the magnitude of the two effects, overall it may even be positive for them. It is the training of new workers, especially those who shift sectors, which is mostly likely to see a pronounced reduction during downturns.

Of course the ultimate test for any theory is in the data, which we turn to next, using data from the NLSY.

## 4 Empirical Evidence

In the basic model for worker-training presented in section 2, a part of the workforce receives company-sponsored training. When the outside opportunity for workers is low, the possibility of hold-up is less, but at the same time, the value of total surplus from training is also lower. Overall, it serves to reduce the incentive of firms to impart training to their workforce and consequently, a smaller fraction of workers get trained.

To test this implication of the model, we thus need to determine a proxy for the outside labor market opportunities of workers. Here we will use the unemployment rate in the labor market of the worker's current residence as a measure of her outside opportunity. Although there is no unemployment in our model, the basic model could be extended to incorporate unemployment and the main prediction would still hold: when unemployment is higher, a lower fraction of the workforce receives company-sponsored training. More generally, we feel that the unemployment rate is a natural proxy for the labor market opportunities of workers and if the implications of the model do not show up by considering the local unemployment rate, they are unlikely to be confirmed by the use of other measures.

We empirically test the basic implication of our worker-training model by examining the relation between the unemployment rate in the local labor market and the probability and duration of company-sponsored training. Studying the extent of this relationship among workers with different employment histories enables us to examine any composition bias in training for the different groups of workers. Of course, there may be other possible explanations for the predicted negative correlation between the two and we attempt to deal with some of these explanations in our estimation below. In using the local unemployment rate, an issue of likely concern is that the unemployment rate in the local labor market maybe influenced not only by local changes, but possibly also by cyclical economy-wide factors (e.g. macroeconomic shocks). Thus, in some of our estimation below we also incorporate time effects to capture any other secular trends in the state of the overall labor market.

## 4.1 The Data

We use data from the main file and the geographic code file of the 1988-96 National Longitudinal Survey of Youth (NLSY) ages 14-21 in 1979 (see Appendix for details)<sup>7</sup>. The main file provides detailed information on various personal characteristics such as age, education, main activity etc. For each respondent, it also contains employment information for a maximum of five jobs in each survey year. One of these is designated as a “CPS job”; this is the current or most recent job at the time of the interview and is also typically the main job. As in most work using the NLSY data (e.g. Bartel and Sicherman (1998)), we restrict our analysis to CPS jobs as the survey contains employee/employer information on the CPS job in much greater detail than non-CPS jobs. It also enables one to link the CPS employer with previous employers of the respondent and thus create the respondent’s work-history and identify if her current job is a new one.

The NLSY also collects a large amount of data on formal company training. Data on a maximum of six different training programs since the time of the last interview are recorded. During the 1979-86 interviews, information was limited only to training programs which lasted for at least a month; in 1987, only one question on training was asked. Since 1988 however, data on formal training is especially detailed; hence we use data for the time period 1988-1996. Respondents are not only asked about the incidence of training programs since the last survey, but also about the type of training, the time spent and the sponsor of the training program. Thus, it is possible to identify the instances and the duration of company-sponsored training.

Table 1 reports the incidence and duration of training that was sponsored by the firm. Overall, about 14% of workers received training from their firms with the mean duration of such training being 83 hours or approximately two working weeks. Workers in larger firms reported more training, both in terms of incidence as well as in training time; workers in firms with more than 1000 employees received on average 30 hours more training than those in smaller firms. Instances of training increased with education, with 22% of college graduates reporting some company-sponsored

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<sup>7</sup>The geographic code file can be obtained from the Bureau of Labor Statistics upon satisfactory completion of an agreement procedure to ensure confidentiality of the survey respondents. The data for 1988-96 was made available to the author while he was at an US university. In the subsequent period, being a non-US citizen in a non-US university prevented his access to the data beyond 1996.

training, as compared to less than 5% for high-school dropouts. Conditional on receiving training however, the duration of training is not necessarily higher for more educated workers. Male and female workers do not differ much in the probability of receiving company-sponsored training; however, among male workers who do receive training, the duration of such training programs is about 60% longer than for females.

The geographic code file of the NLSY contains additional information on the area of residence of the individual. It merges information from other sources to provide information on the demographic composition and labor force statistics for the labor market of current residence. Among other variables, it provides the unemployment rate for the labor market of the individual's current residence. Table 1 also reports the incidence and duration of training across the distribution of the local unemployment rate. As an aggregate, we find that instances of company-sponsored training are lower for high unemployment rates. Thus, for unemployment rates lower than the tenth percentile, 16% of the workers report having received company-sponsored training; the corresponding figure for unemployment rates greater than the 90-th percentile is 11.4%. Similarly, the mean duration of training too shows a decrease with an increase in the unemployment rate.

We then categorized workers into "new" i.e. those who had joined their present job since the time of the last interview, and "older" i.e. those who have continued working in the same firm since the prior interview. Although the incidence of training is higher for older workers, the training programs for new workers last longer. On average, new workers are put through as much as 3-4 working weeks of training. This difference in the incidence of training between the two types of workers is less in larger firms than in smaller ones. In both kinds of firms however, the length of training programs for new workers are almost double that for older workers.

Both types of workers show a decrease in the incidence of training with a rise in the local unemployment rate; however, the drop is sharper for new workers than it is for older workers. Between the 10-th and 90-th percentiles of the local unemployment rate, the drop in the incidence of training is 6 percentage points for new workers as compared to a drop of 4.3 percentage points for older workers. Thus it appears that training decisions for new workers are more affected by changes in the local rate of unemployment than that for older workers. As for duration of training, conditional on being trained, while it is lowest in areas where the unemployment rate is above the

90th percentile, the movement is not clear from this simple exercise.

## 4.2 Results

Consider first the probability of company-sponsored training. Column 1 of Table 2 presents the results of a probit regression of the incidence of training for all workers on the local unemployment rate, controlling for several personal, firm and industry characteristics. A one standard deviation increase in the unemployment rate leads to a 0.4 percentage point decline<sup>8</sup> in the probability of receiving company-sponsored training. This decline however, is not statistically significant.

### *New versus Older Workers:*

The basic theoretical model is a stylized two-period model with workers joining the firm in the first period and receiving training. Though the model does not distinguish between new and older workers, it seems more appropriate as a model for new workers for several reasons. Firstly, for workers already in the firm (i.e. older workers), taking a wage cut to pay for productivity-enhancing training is more likely to be a feasible option, thereby mitigating the hold-up problem inherent in training. Secondly, in the theoretical model, the productive value of a trained worker is determined by the replacement value in terms of untrained workers. Again, this appears a more appropriate assumption for new workers. Thirdly, the accumulation of firm-specific capital by older workers is likely to complicate the bargaining over surplus from additional training between a older worker and the firm. Thus the focus of our model is on new workers and according to the model, the incidence of training should be lower for them when the unemployment rate is high. Column 3 shows the results for workers who have joined the firm since the time of their last interview. We see that the effect of the local unemployment rate for new workers is negative and statistically significant: now, a one standard deviation rise in the unemployment rate is associated with a 1.3 percentage point decline in the probability of receiving company-sponsored training.<sup>9</sup>

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<sup>8</sup>The standard deviation for the local unemployment rate is 2.44. Multiplying the derivative of the probit equation (i.e. 0.0017) by 2.44 thus gives the (extrapolated) effect of a one standard deviation change in the unemployment rate on the probability of receiving company-sponsored training.

<sup>9</sup>A logit-specification of the model also yielded similar results; these are reported in the next section which also incorporates fixed effects into the regression specification.

Column 5 presents the results for older workers i.e. workers who had been working for the same firm at the time of their last interview. In contrast to new workers, we find that the effect of the unemployment rate on the training of older workers is much smaller and is virtually zero.

Columns 2, 4 and 6 reports maximum-likelihood tobit regressions of the effect of the local unemployment rate on the duration of company-sponsored training. Effects similar to those for the incidence of company-sponsored training also show up for the duration of training. For the overall sample, a one standard deviation increase in the local unemployment rate is associated with a decline in the mean duration of training by about 8 hours.<sup>10</sup> For newly-hired workers however, this effect is substantially larger: for them, the decline is by 23.7 hours compared to about 4 hours for older workers. Thus, while training of new workers is affected significantly by changes in the unemployment rate of the local labor market, the effect for older workers is very small.

Most of the other independent variables in the above series of regressions have effects which are consistent with those found elsewhere on company-training (e.g. Bartel and Sicherman 1998, Lynch 1992). Education has a positive and significant effect both on the incidence as well as on the duration of training.<sup>11</sup> Females and non-whites have a lower probability of receiving training as well as a shorter training duration. Larger firms train more, both in terms of incidence as well as duration of training. White-collar workers tend to have a greater incidence of training as well as longer training programs. Tenure has a very small and insignificant effect on the probability of receiving training, which is similar to that found by Lynch (1992). However, its effect on training time is positive and significant meaning that workers who remain longer with a firm receive training of longer duration. Although not included in the theoretical model, the effect of tenure on training has two possible countervailing effects. Firstly, as a worker spends more time with a particular firm, she is likely to accumulate more firm-specific human capital, thereby reducing her likelihood of leaving the firm and hence mitigating the hold-up problem. On the other hand, experience and

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<sup>10</sup>Note that the duration of training is a latent variable that is observed only when it is positive.

<sup>11</sup>Including an interaction effect between education (whether the worker is a high-school graduate or not) and the local unemployment rate in the regressions (both incidence and duration), we find that the interaction term is positive thereby suggesting that training for more educated workers is less likely to be affected by changes in the unemployment rate. However, even for high school graduates, the negative effect of the unemployment rate is not overshadowed by the positive effect of their education so that the overall effect on their training is still negative.

accumulation of knowledge may obviate the need for training.

*Passing Birds versus Others: Composition Effects*

As the above results show, although the effect of the local unemployment on training is negative, it is pronounced for new workers and negligible for older workers. This is in line with the hypothesis that given asymmetric information about the outside opportunities of workers, during downturns firms would prefer to train workers who are less likely to be “passing birds”; firms likely possess more information about their older workers rather than any new hires and therefore during downturns are expected to be biased towards the former in making training decisions. To further examine this issue, we consider the employment history of each worker and note whether the worker had ever been employed in the present industry before. (We distinguish industries according to the 1970 Census 3-digit classification) A worker with a history of previous employment in the industry is less likely to be a “passing bird” as compared with one who has never worked in the industry before; according to the hypothesis, during downturns (i.e. during periods of high unemployment) firms would favor their training decisions towards the former rather than the latter.

To test for this effect among the new hires, we included a dummy variable to indicate whether the worker has any history of previous employment in the industry and also an interaction effect between the unemployment rate and this indicator variable. The results are reported in columns 1 and 2 of Table 3. The impact of the local unemployment rate on the probability of receiving company-sponsored training is significantly different for the two types of workers. Those with prior experience in the sector are much less affected by a higher unemployment rate as compared to those with no history of previous employment in the sector. In fact, the effect of the local unemployment rate (a drop of 0.056 in the probability of receiving training) is more than offset by the interaction term (an increase of 0.0628 in the probability of receiving training); a statistical test fails to reject the hypothesis that the overall effect of the unemployment rate on the likelihood of receiving company-sponsored training for new hires with previous experience in the current sector is significantly different from zero. In other words, it is the training decisions of workers changing their sector of work that is the hardest hit by increases in the local rate of unemployment. A similar result is also found for the duration of company-sponsored training; as reported in column

2, the effect of the local unemployment rate on the length of training for new workers with previous experience in the industry is largely offset by the positive effect of the interaction.

Thus, overall the results seem consistent with the joint hypothesis that less competition in the labor market reduces training, but in such situations the training decisions of firms are biased against workers with no prior experience of working in the industry, i.e. those who are more likely to be “passing birds”. Next we consider several possible alternative explanations for this association between the unemployment rate and worker-training and attempt to deal with some of them using the available data.

### 4.3 Alternative explanations?

While we have used changes in the local unemployment rate to proxy for tightness of the local labor market, economy-wide factors (e.g. productivity and/or product-demand shocks) can also have an impact on demand in any labor market. At the same time, such macroeconomic shocks could also affect firms’ decisions to impart training. For example, tighter resource constraints during bad economic times could reduce the incidence of firm-sponsored training. Changes in governmental policy on worker-training could also affect the same. To address such cyclical issues, we include year fixed effects in our probit regressions for the incidence of company-sponsored training. The results are reported in columns 3 and 4 (for new and older workers respectively) of Table 3. They are very similar to those obtained without the time effects: the local unemployment rate has a negative effect on the probability (and also on duration, not reported here) of training for all types of workers, and the effect is of much larger magnitude (and significant) for new workers. The time effects (relative to 1996) themselves (not reported here) are all positive and significant<sup>12</sup>. Overall, even accounting for aggregate shocks, the effect of a tighter labor market is increased training.

An alternative explanation for the negative correlation between unemployment and training could be based on productivity shocks and the introduction of new technology. If firms made a greater investment in new technologies during times of expansion (characterized by low unemploy-

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<sup>12</sup>An issue of concern may be the relatively low number of "time" observations here (the data is for 8 years). As pointed out by Donald and Lang (2004), standard asymptotics for the t-statistics may not be appropriate if the number of groups is small; thus, statistical significance of the results here should be treated with caution.



ment rates) and new technologies require a greater amount of training for the workforce (some evidence for it is found in Bartel and Sicherman (1998)), this could also lead to a negative relationship between the unemployment rate and the incidence of training. However, we would expect this effect to be present in the training of older workers too. As reported in columns 5-6 of Table 2, although the effect of the unemployment rate on their training is negative, it is much smaller than that for new workers and is statistically insignificant. If lower training and higher unemployment were both the result of a common shock, one would expect the same negative relationship for both new and older workers; the data does not seem to find a strong support for this explanation.

It is also possible that the unemployment rate could have an effect on the incentives of firms in imparting training by affecting the quality of new hires. Solon, Barsky and Parker (1994) have suggested that more low-skill workers get hired during expansions than during recessions. The effect of this change in composition of the workforce may serve to increase or decrease the incidence of training. One argument is that less skilled workers require more training and therefore when the fraction of such workers in the workforce is high, one would see a higher incidence of training.<sup>13</sup> To check for this, we introduce individual-specific fixed effects. Unfortunately, the probit model with fixed-effects does not lend itself to consistent estimation. Hence we introduce the individual-specific fixed effects into a logit specification of the incidence of company-sponsored training.<sup>14</sup> For comparison with the earlier probit-specification, Column 5 reports the results (for new workers) for the logit-specification without the fixed effects; most of the coefficients have the same sign as in Table 2 or are insignificant in both. Introducing individual-specific fixed effects in column 6, the effect of the local unemployment rate on training is still negative and significant. In fact, comparing with the results without individual-specific fixed effects, we find that the negative effect of the unemployment rate on the probability of receiving training is even stronger after controlling

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<sup>13</sup>An alternate argument may be made based on the assumption of a skill-training complementarity: if training is more effective for workers of higher skill, then we would tend to see lower training in expansions as the average skill level of a new hire is lower at such times. This argument of course introduces a bias in our favor and the above estimates are thus conservative with respect to the importance of our explanation.

<sup>14</sup>In the data, there are a significant number of respondents with more than one new job during the data-period. For example, 2073 respondents have changed jobs twice over the period 1988-96 and over 2000 respondents reported changing jobs thrice or more; thus, there are ample observations to permit estimation of the fixed-effect specification.

for observable (to the firm) quality differences among workers. Thus there is little evidence in the data to support the explanation of higher training for a workforce of lower average skill-level during expansions.

Another possibility could be that unemployment is lower in regions with more training-intensive industries. For example, region-specific characteristics could lead to differences in the concentration of training-intensive industries and to differences in the natural rate of unemployment. We use geographic data on individuals' county of residence to examine this possibility. Less than 10% of the respondents report a change in counties during the data period 1988-96. Further, we have a large number of counties with more than one respondent. On average, there are 35 observations per county, which allows us to control for county-specific effects in our estimation. We introduce county-specific fixed-effects into a logit specification of the incidence of company-sponsored training for new workers (column 7 of Table 3). Comparing the coefficient on the unemployment rate with and without county-specific fixed-effects, we find that it is virtually unchanged. Any deviation from the mean unemployment rate for the county still has a negative and significant effect on the probability of receiving training. Thus, the data does not seem consistent with a region-based explanation for variability in worker-training with unemployment.

## 5 Conclusion

In this paper, we have presented a simple model to study the incentives for firms to impart costly non-firm-specific training to their workers. Incompleteness of contracts leads to an employee hold-up problem ex-post, which the firm takes into account ex-ante in deciding whether or not to bear the training expenses of a worker. When all firms do this, it has important consequences for the overall proportion of workers that get trained, and since training is productivity-enhancing, the average labor productivity also gets affected.

A higher opportunity cost of hiring untrained workers increases the replacement value of trained workers, thus increasing the surplus from training. At the same time, a trained worker's share of the surplus does not rise by as much. Hence, in a tighter labor market environment (where the outside opportunity of workers is high), a higher fraction of the workforce is likely to receive company-

sponsored training. In a multi-sector framework, workers who change sectors during downturns are deemed more likely to have done so because of their inability to find a job in their parent sector rather than due to any permanent adverse shock to their productivity in that sector. From a firm’s point of view, the possibility of being held-up is higher for such workers; consequently, during downturns its training decisions will be biased in favor of older workers and those new workers with prior experience in the same sector.

We find evidence in support of both hypotheses using data from the NLSY. Using the unemployment rate in the local labor market as a proxy for the outside opportunities of workers, we find that the probability and duration of company-sponsored training is negatively affected by an increase in local unemployment. This relation is found to hold even after controlling for various individual, firm and region-specific effects. The overall relationship however hides important compositional effects: it is the training of new hires with no prior experience of working in the sector i.e. the “passing birds”, which is most adversely affected by a higher unemployment rate; this appears to reflect the bias in the training decisions of firms against such workers during downturns. For older workers, there is very little effect.

The model we have developed here is a static two-period model. However, the productivity-enhancing effects of training a worker typically extend over a longer time-frame. Nevertheless, if this time-horizon is finite and certain, then the basic model can be easily extended. However, if instead of the training being one-shot, the firm had the option of training workers not only in the initial period but also later on in the worker’s career, it raises the question of what is the optimal time-path for imparting training; two issues then become important – one is the future gains from training, and secondly, if the worker builds more firm-specific human capital over time, it may reduce the worker’s incentives to leave the firm. We hope to address these and other issues in future work.

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## 7 Appendix: Data Description

### 7.1 Dependent Variables

Since the 1988 survey, data on formal training in the NLSY has become particularly detailed. Respondents are asked to report any instances of attendance at a vocational/technical program or on the job training since the previous interview. For all such programs (up to a maximum of 4), the sponsor is also reported; we construct the dummy variable COPAIDTR which designates whether the worker received any company-sponsored training since the prior interview. This is the dependent variable that is used in our probit and logit regressions. All throughout, the sample is restricted to workers in for-profit firms only.

The survey also contains data on the type of training received; the following categories are reported: (i) business school, (ii) apprenticeship program, (iii) vocational or technical institute, (iv) correspondence course, (v) formal company training run by employer or military training, (vi) seminars or training programs at work not run by employer, (vii) seminars or training programs outside of work, (viii) vocational rehabilitation center, (ix) other. Bartel and Sicherman (1998) aggregate instances of (v), (vi) and (vii) as company training and use the dummy variable TRATCO to designate it. The correlation between it and COPAIDTR (the variable that we used, which is based on who paid for the training) is 0.87, and all of the results are unchanged if we use TRATCO instead.

The NLSY also records the length of the training programs that the respondent attended. Specifically, it asks questions about the number of weeks and the average hours per week spent at each of the programs. In the instances of company-sponsored training, we multiply the hours per week in each such program by the number of weeks in the program to get the total hours of training which we denote by the variable TOTTRTIM; this is the variable used in the time-regressions. If the answer on the number of weeks was zero (i.e. less than one week), we recoded it to half a week. Similarly for the hours per week variable.

## 7.2 Explanatory Variables

The NLSY contains a host of data on the individual's personal characteristics like age, race, sex and education (the highest grade completed as of the survey year). Employment information on jobs (up to a maximum of five) since the last interview are also recorded. One of these (typically, the current or most recent job) is designated the "CPS job". The survey contains detailed information on the CPS job including the industry, firm-size, tenure and wage-rate. The size of the firm is distinguished by whether the number of employees at the respondent's firm exceeds or is less than 1000. We use the 3-digit Industrial Classification Code to designate the type of industry as Manufacturing, Services, Trade, Agriculture, and Construction, Mining and Transportation. The survey also asks the respondent whether she had previously worked for her present employer, thus enabling us to identify new jobs from old ones.

The geographic code file of the NLSY draws on data from other sources to supplement information provided by the respondents. It provides county codes based on the Federal Information Processing Standards. Unemployment rate for the labor market of the respondent's current residence is obtained from the May issue of the Bureau of Labor Statistics' *Employment and Earnings*. Respondents residing within one of the selected metropolitan statistical areas within each state are assigned the appropriate unemployment rate. For those living outside of these areas, a "balance of state" unemployment figure is computed and assigned based upon state of residence.

**Table 1. Incidence and Duration of Company-sponsored Training: Summary Statistics**

	<u>All workers</u>		<u>New workers</u>		<u>Older workers</u>	
	% trained	Mean Hours Trained	% trained	Mean Hours	% trained	Mean Hours
<u>Firms</u>						
All firms	13.9 [37,764]	83.4 [4,545]	12.8 [9,324]	137.1 [1,022]	15 [26,514]	68 [3,455]
Large firms	16.4 [21,300]	92.6 [3,052]	16.38 [4,578]	158.4 [649]	17.1 [15,766]	75 [2,361]
Small firms	10.9 [15,274]	62.1 [1,425]	9.6 [4,207]	98 [339]	12.2 [10,162]	51.2 [1,062]
<u>Education</u>						
HS Dropout	4.7 [4,010]	70.9 [157]	5.2 [1,354]	89.8 [59]	4.6 [2,407]	59.6 [98]
HS Graduate	10.9 [16,431]	90.9 [1,536]	10.34 [4,129]	147.5 [367]	11.72 [11,351]	73.6 [1,138]
College dropout	15.9 [8,768]	81 [1,201]	15.4 [2,052]	145.5 [261]	16.8 [6,311]	63.6 [926]
College Graduate	21.9 [8,555]	79.3 [1,651]	21.2 [1,789]	127.6 [335]	22.8 [6,445]	67 [1,293]
<u>Sex</u>						
Male	14.3 [18,812]	102.1 [2,291]	13 [4,673]	178.5 [514]	15.3 [13,521]	80.4 [1,783]
Female	13.6 [18,285]	64.8 [2,188]	12.5 [4,651]	96.3 [508]	14.7 [12,993]	54.9 [1,672]
<u>Unemployment rate</u>						
< 10-th percentile	16.1 [3,799]	85.8 [545]	16.1 [1,012]	154.5 [140]	16.8 [2,665]	60.8 [404]
10 to 50-th percentile	14.1 [15,322]	84 [1,939]	13.4 [3,981]	125.6 [460]	15.4 [10,854]	71.1 [1478]
50 to 90-th percentile	13.4 [14,538]	83.8 [1,670]	11.8 [3,538]	152.3 [354]	14.6 [10,497]	66.7 [1316]
> 90-th percentile	11.4 [4,105]	72.4 [391]	10 [935]	99.8 [75]	12.5 [2,968]	65.2 [312]

Note: Number of observations are in square brackets. Mean Training Hours are calculated for positive hours only. "New" ("Older") workers are those who have joined (remained with, respectively) their present firm since the time of the last interview.

**Table 2. The Likelihood and Duration of Company-sponsored Training:  
Maximum Likelihood Probit and Tobit Models**

Variable	All workers		New workers		Older workers	
	Probability Coefficient [Std. Error] {Derivative}	Duration	Probability Coefficient [Std. Error] {Derivative}	Duration	Probability Coefficient [Std. Error] {Derivative}	Duration
	[1]	[2]	[3]	[4]	[5]	[6]
Local. unemp. rate	-0.0084 [0.0062] {-0.0017}	-3.4 [1.59]	-0.0274 [0.0112] {-0.0055}	-9.72 [3.88]	-0.0022 [0.0072] {-0.0005}	-1.7 [1.72]
age	-0.0273 [0.0047] {-0.0058}	-9.82 [1.18]	0.0033 [0.0080] {0.0006}	2.49 [2.77]	-0.0235 [0.0059] {-0.0052}	-8.66 [1.36]
sex = female	-0.1093 [0.0317] {-0.0219}	-44.5 [7.27]	-0.1676 [0.0529] {-0.0339}	-63.16 [17.51]	-0.0861 [0.0366] {-0.0189}	-38.39 [7.89]
race = non-white	-0.2115 [0.0288] {-0.0415}	-49.27 [7.19]	-0.2272 [0.0477] {-0.0429}	-68.92 [17.14]	-0.205 [0.0337] {-0.042}	-42.41 [7.84]
education	0.0477 [0.0070] {0.0101}	16.9 [1.71]	0.0422 [0.0115] {0.0086}	18.64 [4.01]	0.0478 [0.0084] {0.0105}	15.74 [1.88]
urban	0.1269 [0.0497] {0.0255}	31.57 [11.63]	-0.0489 [0.0821] {-0.0101}	-18.7 [28.03]	0.1562 [0.0596] {0.0327}	38.1 [12.75]
white-collar	0.2921 [0.0355] {0.0599}	98.26 [8.64]	0.3522 [0.0588] {0.7047}	143.04 [20.47]	0.2687 [0.0420] {0.0572}	84.39 [9.43]
firmsize = large	0.2935 [0.0291] {0.061}	83.38 [7.18]	0.3716 [0.0483] {0.0763}	124.17 [16.98]	0.26 [0.0345] {0.056}	69.72 [7.86]
tenure	0.0003 [0.0001] {0.0001}	0.08 [0.02]			0.0001 [0.0001] {0.0000}	0.05 [0.02]
N	27,036	27,019	7,356	7,350	18,668	18,620

Note: Standard error of coefficients are in square brackets. The derivatives or differentials of the probability with respect to the explanatory variable are in braces. N is the number of observations. Other variables included in the regressions, but not reported here are a dummy for whether or not the worker resides in a SMSA, and dummies for the sector of work: manufacturing, services, transport-mining-and-construction, trade.



**Table 3. Company-sponsored Training for Workers: Controlling for Prior Experience, Time Effects, and Individual and Regional Fixed Effects**

Variable	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Local unemp. rate	-0.056 [0.0158]	-13.505 [5.3142]	-0.022 [0.0104]	-0.006 [0.008]	-0.0481 [0.0213]	-0.1163 [0.0456]	-0.0444 [0.0216]
Any prior exp. in the industry	-0.4312 [0.1463]	-44.179 [49.9866]					
Any prior exp. in the ind. X unemp. rate	0.0628 [0.0215]	8.563 [7.4600]					
age	0.003 [0.0084]	1.639 [2.9385]			0.0039 [0.0147]	0.0443 [0.0362]	0.0047 [0.0146]
sex = female	-0.1674 [0.0531]	-63.027 [17.7122]	-0.17 [0.0531]	-0.09 [0.0372]	-0.3227 [0.0994]		-0.295 [0.0942]
race = non-white	-0.235 [0.0482]	-69.895 [17.3276]	-0.233 [0.0481]	-0.209 [0.0343]	-0.4394 [0.0921]		-0.4764 [0.1005]
education	0.0416 [0.0116]	18.28 [4.0442]	0.042 [0.0115]	0.047 [0.0084]	0.071 [0.0211]	0.3213 [0.1896]	0.1004 [0.021]
urban	-0.0522 [0.083]	-19.1225 [28.3981]	-0.052 [0.0827]	0.137 [0.0615]	-0.0902 [0.157]	0.8102 [0.4283]	
white-collar	0.3415 [0.0596]	145.298 [20.7162]	0.342 [0.0594]	0.276 [0.0423]	0.6484 [0.115]	0.8225 [0.2182]	0.6506 [0.1102]
firmsize = large	0.3818 [0.0487]	127.552 [17.2064]	0.387 [0.0486]	0.279 [0.0346]	0.7083 [0.0928]	0.7597 [0.1549]	0.691 [0.0905]
N	7,356	7,350	7,356	18,668	7,356	1,062	5,249

Note: Standard errors are in square brackets. N is the number of observations.

[1] and [3] are probit specifications and [5], [6] and [7] are logit specifications for the incidence of training of new workers. [4] is a probit specification for the incidence of training of older workers. Reported here are the coefficients of these regressions. [3] and [4] include time-effects, [6] includes individual-specific fixed-effects, while [7] includes county-specific fixed effects. [2] is a tobit specification for the duration of training of new workers. Other variables included in the regressions, but not reported here are tenure, a dummy for whether or not the worker resides in a SMSA, and dummies for the sector of work: manufacturing, services, transport-mining-and-construction, trade.